



NEW U.S. LEADERSHIP, NEXT STEPS ON CLIMATE CHANGE

Cross-Sector Insights and Recommendations to Guide a New Administration
from The Climate Implementation Project at Stanford University

October 2016 | Convened by David J. Hayes





About the Climate Change Implementation Project Conference Series

Through a series of workshops and conferences, an interdisciplinary and cross-sector group of experts have identified policy tools that the next President might employ to reduce greenhouse gas emissions and accelerate the United States' pivot to a clean energy economy. Participants in the talks have also examined how the new President might structure the White House, the Cabinet and the new government's relationships with state and local officials, the business community and other stakeholders, to effectively implement complex climate change mitigation and adaptation initiatives that cut across jurisdictional lines. Events held at Stanford and in Washington, D.C., from November 2015 through September 2016 have generated a diverse collection of perspectives pertinent to the challenging task of identifying potential climate change priorities for our next President.

Convener David J. Hayes is a Distinguished Visiting Lecturer in Law at Stanford Law School and a Consulting Professor at the Stanford Woods Institute for the Environment. He also is a Senior Fellow at the Center for American Progress. Hayes was the Deputy Secretary and Chief Operating Officer at the U.S. Department of the Interior for Presidents Clinton and Obama from 1999-2001 and 2007-2013.

Contact

Stanford Woods Institute for the Environment
Jerry Yang & Akiko Yamazaki Environment & Energy Building – MC 4205
473 Via Ortega
Stanford, CA 94305



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I. INTRODUCTION

Over the past year, the Stanford community has been engaged in a special project that has focused on the next President's climate agenda, with the support of the Hewlett Foundation. Stanford's Climate Implementation Project has focused on substantive policy ideas for addressing climate change at the federal level, as well as organizational and governance questions – a particularly challenging subject for climate change, which cuts vertically across many affected federal agencies and, horizontally, through all levels of government.

Our thesis has been that regardless of whether Secretary Hillary Clinton or Donald Trump is elected President, climate change is a pressing reality that cannot be ignored. And while President Barack Obama has made significant strides forward, and laid important groundwork, the next eight years will be a critical time period on the climate front.

We held workshops in November 2015 at Stanford and in January 2016 in Washington, and followed up with a major event on the Stanford campus on May 6, 2016. Finally, on September 15, 2016, we presented papers at the National Press Club with specific climate change recommendations for the two transition teams. Throughout this exercise, we encouraged participants to move beyond conventional thinking and offer creative suggestions for how the next President might build out his or her climate agenda. As a result, the body of work produced through the Climate Implementation Project does not attempt to cover the many relevant topics associated with climate change. Instead of seeking to develop a comprehensive laundry list of recommendations, it emphasizes thoughtful – and even bold – thinking on what is perhaps the most important challenges of our time.

In this document, we have compiled key materials from the Stanford Climate Implementation Project, including the detailed papers that were presented at the National Press Club event, and outlines describing key take-aways from the November and January workshops, and the May 6th conference that was held on Stanford's campus.

We appreciate your interest in this important subject. Additional information, including access to videos of presentations made on May 6 and September 15, is available on the conference website: stanford.io/1S7iRSd

David J. Hayes

II. PRELIMINARY WORKSHOPS

Climate Change Implementation Project Workshop I

November 19, 2015

In Fall 2015 Stanford scholars launched the Climate Change Implementation Project to gather policy and governance ideas for how the next President of the United States might address climate change at the outset of his or her Presidency.

Participants in the November workshop shared ideas for executive actions in the energy, housing, transportation, land use and other sectors that might help reduce greenhouse gas emissions and respond to climate impacts. Conferees considered a range of regulatory, disclosure and information-based tools, as well as partnership opportunities with state, local, tribal, business and NGO leaders.

Summary

Approximately 25 climate change experts gathered at Stanford on November 19, 2015 to brainstorm on the potential opportunities that our next President might prioritize to reduce GHG emissions under his/her Administration. The discussion was conducted under Chatham House rules. This outline captures some of the points raised during the course of the workshop.

Emissions Sources

- Central focus on emissions from the **power sector** is necessary: that's where 42% of GHGs are generated.
 - Validates Administration's prioritization on the Clean Power Plan (CPP) & the need to decarbonize the electricity sector.
 - CPP may usher in some form of trading, potentially offering market-based flexibility into compliance strategies.
 - Strong support for considering carbon tax as an efficient mechanism to reduce GHG emissions.
 - Note: some recommend avoiding characterizing a carbon tax as "putting a price on carbon."
- **HFCs + methane** (e.g. from natural gas systems, landfills, coal mines) + **black carbon** emissions must be a top priority given outsized impact of these GHGs vis-à-vis CO₂. (Also see discussion below under Land Use, below.)
- **Real estate/building** sector needs to be a top priority, based on its GHG footprint (approximately 1/3 of total energy use).
 - **Energy efficiency** gains within buildings – how/where can the feds play?
 - Federal role in building sector is limited to tax policy; market making and infrastructure; limited subsidies. Consider adjusting Fannie/Freddie policies to support energy savings investments or certification.
 - PACE program should be expanded; need Fannie Mae's help.
 - Consider broadening the mission of Fannie/Freddie to consider locational efficiency and requiring EE audits for Fannie/Freddie mortgage qualification.
 - Acute need for better data on building efficiency (draw lessons from California's implementation of Prop 39; AB 802). Can feds help, working with state/local programs?
 - Federal buildings – leadership and "proof of concept" opportunities.
 - Review current scoring rules for federal real estate investments.
 - Support deep retrofit of owned assets.

- Accelerate consolidation and colocation.
 - Government should focus on sending energy efficiency demand signal to the marketplace with coordinated purchasing power from its large building stock.
- DOE equipment standards program has been successful; how “gear it up”? Consider feebate model? (May require statutory change.)
- Leverage existing HUD, DOT, and EPA Sustainability Communities effort; add in GSA’s new efforts on “Economic Impact.”
- Extend access to federal procurement schedules to state and locals.
 - Give access to USG’s sustainable procurement.
 - Extend ESPC contracts to state and local facilities.
- How influence real estate industry, which is atomized, non-tech, and largely non-federal? Real estate incentives tend to be perverse (e.g., triple net leases).
- Focus on **real estate/transportation nexus**; facilitate civic infrastructure development.
 - Acknowledge and capitalize on development/transit nexus to maximize lower-GHG-impact growth.
 - Expand Build America Bonds with location and energy efficiency focus.
 - Establish Infrastructure Bank to support financing for urban and institutional district heat and power facilities, micro-grid investments, and transportation assets that support location efficiency.
 - Develop Retail Investment Funds that support investment around mass transit.
- Building codes look backwards. How leapfrog forward with new energy efficient building approaches that are not held back by immediately obsolete building codes?
- How scale up “District Energy” innovations – such as exhibited in the Stanford Energy System Innovations (SESI) project – for similar, aging energy infrastructure projects around the U.S.?
- **Transportation sector** needs to be a top priority, based on its GHG footprint (approximately 1/3 of total energy use).
 - US leadership needed to address aviation emissions.
 - Focus on biofuel-based jet fuels (with the help of DOD via DARPA – potential 50% biofuels usage goal by DOD aircraft).
 - Need active U.S. engagement in ICAO (Int’l Civil Aviation Organ.)
 - Increase NASA aeronautics R&D.
 - Accelerate elimination of lead from general aviation.
 - US leadership needed to address maritime transportation emissions; the maritime industry consumes large volumes of the world’s dirtiest fuels (e.g., bunker fuel).
 - Aggressive engagement in international forum (the IMO).
 - Consider restructuring federal Title XI loan guarantees for shipbuilding to require LNG/CNG.
 - Consider reserving loan guarantee capacity for repowering of existing Great Lakes and inland waterways fleets.
 - Recommit to US Navy’s “Great Green Fleet.”
 - Establish tax incentives and begin EPA regulatory process for shore power of vessels at dock.
 - **Surface transportation** opportunities in the US.
 - Need to electrify cars/trucks. There will be a huge investment in fleet turnover in the coming years– \$15T dollars. How take advantage of that level of investment to address climate concerns?

- Consider developing a new iteration of CAFE standards (e.g., an incentive-based approach)?
- Get inefficient cars/trucks off the road (being attentive to serious equity issues).
- Establish by regulation a joint EPA/DOT methodology for measuring cradle-to-grave carbon footprint of individual motor vehicles (help consumers make informed choices).
- X-prize for the best wearable app that measures the carbon footprint in real time of transportation choices.
- Self-driving cars and shared transport models:
 - How maximize lower GHG opportunities that they potentially present (and avoid the longer commutes that they potentially could promote)?
 - Federal insurance in support of transportation asset-sharing ventures (Uber, Zip, Split, etc.)?
- Level the federal funding playing field for more efficient, safer movement of people. (e.g., formula funding dominates federal funding for airports, interstates and highways; less than 50% competitive grant money is available for transit; 0% federal formula or competitive funding is available for inter-city passenger rail.)
 - Feds should influence “loss of service” criteria used by state/local transportation projects that tilt the funding scale in favor of greenfield projects.
 - Need a “modally agnostic” surface transportation program that incentivizes and encourages city pairs 50-400 miles apart to be served by intercity passenger rail.
- Inefficiencies in transportation networks are major contributor to GHG emissions. Adopt a National Freight Policy that incentivizes goods movement on water as long as possible, then on rail as long as possible, then truck the last mile – a goods movement hierarchy.
- Recruit transit organizations to support revenue potential associated with carbon tax or cap and trade program.
- Seek to incentivize LNG for trucks, railroads.
- Need mapping of transit systems.
- Maximize government fleet leadership opportunities.

Crosscutting Issues

Fostering Innovation

- Need to increase clean energy investment. Currently, federal energy RD&D is 1/3 of what is needed.
 - Without legislation, energy R&D will remain fragmented. (In one year, 23 federal agencies implemented 700 renewable energy initiatives – GAO 2012.)
- What’s the vision for federal R&D investments? Need to make R&D more effective and efficient:
 - Need to better link up upstream R&D with scale-up financing opportunities; need more communication/coordination between R&D and finance.
 - E.g., find ways to get information developed through ARPA-E and other federal research out to the private sector. (Note: DOE’s recently has established a Clean Energy Information Center.)
 - Increase collaboration between DOE and 17 national labs. Consider developing a shared strategic vision for national labs developed with DOE, while seeking to avoid micromanagement.
 - Identify lessons learned from DOE Innovation Hubs since 2010.

- Innovation hubs potentially can provide important regional synergies.
- Focus on lashing together gov't, academy, and industry via seed money. Need more focus on optimal organizational approach.
- Apply race-to-the-top funding approach.
- Consider “hub” on specific topics (already occurring, on de facto basis). Potential priorities could include CCS, land use (with Interior, USDA). (See Center for American Progress report on hubs.)
- Need more disciplined R&D exit criteria. (e.g., arguably, DOE's Sun Shot program has run its course, given private sector investment in solar technology.)
- How best address soft costs?
- Apply lessons learned from successful ARPA-E program.
 - Restructure other DOE programs to ARPA-E model to spur innovation?
- Evaluate how best to coordinate with, and leverage, private sector R&D investment initiatives (PRIME + Gates, et al.). Focus on fostering bold opportunities to promote innovation by opening up new opportunities for competition, taking a page from communications revolution.

Financing Innovation and Clean Energy Deployment

- Phasing out tax credits and other outright subsidies will likely be necessary (due to limited tax credit market; political challenges, etc.); look for a soft landing.
 - Old dogs, new tricks: develop MLPs (MLP Parity Act); REITs (via IRS ruling); Private Activity Bonds (outside disaster zones!) for clean energy projects.
 - Consider creative uses of existing loan authorities.
- Given the availability of cheap money, how much gov't financing \$\$ is needed? What are appropriate criteria for federal financing help? (e.g., outside validation via private \$\$ commitments?)
 - Need to distinguish among early stage, scale-up and deployment needs.
 - Huge \$\$ needed for deployment – post-R&D (RD&D); getting through the scale up phase. \$310B spent on clean energy in 2014; need to get to \$1T/year, largely via private investment (not VC, more asset/project finance).
 - CCS is good example – need to find profit in carbon product.
- Should encourage the use of more patient private capital.
 - “Aligned Intermediary” initiative.
 - Divestment movement provides opportunity.
 - Push for requirements to consider climate risk in investment world.
- How deal with “crony capitalism” charge?
- Financing and soft costs are too high. How reduce?

Utilities

- Key is opening the door to competition in the utility sector, a la the communications revolution. Need disruptive thinking, a la Google X. Trend is inevitable; how best to speed it up?
 - Challenge “restraint in interstate trade in electrons” as stifling energy consumer choices; lawsuit led by large energy consumers? DOJ Antitrust division, a la AT&T breakup?
 - Open up “behind the meter” innovations; limit monopoly to the wires; incentivize wires companies to provide “smart” grid services; invest R&D \$\$ in the academy for behind-the-meter and smart grid innovations.
 - Offer stranded asset incentives for utilities?
 - States still are “laboratories of democracy” but liberate captured state regulators to facilitate competition.
 - Promote competition “at the grid edge.” PUCs should be required to consider competitive impacts of their actions (e.g., injury to solar industry); compel consideration of antitrust concerns in rate cases involving rate structure charges.
 - Data generated/analyzed by smart grid should be recoverable cost, available broadly. Consider amendments to PURPA re grid data?
- Huge investments will be made to modernize the grid (\$2T in next 10 years): how make the most of these large capital infusions?
 - Consider lifting cap on utilities’ capital spending constraints. E.g., consider allowing utilities to increase capital spending at more than the inflation rate.
 - Storage will be key. California experience shows big market response to limited policy push.
 - Accelerate investments by providing generous opportunities for utilities to write off “stranded assets”?
- Need clarity regarding appropriate federal role. Gov’t can assist with early innovation; fill gaps that the market won’t/can’t; play role of the objective validator. In addition:
 - DOJ brings commerce clause challenges to discriminatory state utility statutes.
 - TVA; BPA – push on them to support competition.
 - Implement Clean Power Plan to favor competition.
 - Other potential tools to promote wholesale competition:
 - Order 1000 implementation.
 - Utility mergers.
 - CAISO regionalization.

Building Clean Energy Generation/Infrastructure

- Need to make big moves to substantially increase renewable generation from 7%. Huge capital flows will be required.
 - Effort to replace oil consumption in transportation sector with clean electricity increases the stakes.
- State Renewable Portfolio Standards will continue to be important drivers.
- Role for federal government?
 - Evaluate strategies for improving the process by which federal agencies and private parties can make bulk renewable energy purchases.

- Legislative push for clean energy standard?
- Facilitate permitting of renewable energy and transmission projects on public lands. (See land use, below.)
- Nuclear: need to develop clear policy direction. Concern about pending losses of nuclear capacity in the U.S.

Land Use/Emissions Sources and Sinks

- Land Use-Related Emissions Sources:
 - Ag-related emissions.
 - Livestock – methane (1/3 of all ag emissions).
 - Liquid manure management.
 - NOx from fertilizers.
 - Methane emissions from oil/gas production/distribution.
 - Deforestation.
 - Wildfires.
 - Permafrost melt.
- Potential land use-related mitigation opportunities
 - Ag industry
 - Biogas anaerobic digesters – USDA has an initiative; opportunity to expand? Need incentive-based approach.
 - Methane emissions from oil/gas production/distribution.
 - EPA/BLM regulatory actions.
 - Leak detection technologies.
 - Infrastructure inspections, etc.
 - Potential disclosure requirements.
 - Forest management in the U.S.
 - Use thinning, prescribed fires, successional forest harvesting practices to promote forest health and reduce incidence of catastrophic fires.
 - Evaluate federal fossil fuels extraction policies on public lands (coal; oil and gas).
 - Consider key areas of potential biofuels development:
 - Biogas from manure, landfills, etc.
 - Wood pellets and wood wastes from forest thinning activities (wood is renewable resource with 50% stored carbon). (Need full life-cycle evaluation of potential climate benefits.)
 - Cellulosic ethanol.
- Sequestration opportunities – natural landscapes (forests, rangelands, wetlands) sequester a significant portion of global carbon (15%). Some concern that sinks could become sources without good stewardship. Potential policy opportunities include:
 - Need to educate policymakers and the general public about the public benefits of natural landscapes. Establish easily accessible database of information regarding carbon uptake from ag and forest lands, wetlands, parks, etc.
 - Enhance carbon uptake in soils.

- Spreading composted manure and bio char can significantly enhance rangelands' carbon sequestration opportunities; invest in additional research; develop more pilots. (Note: State of California interest in issue; Marin Carbon Project).
- Develop “natural capital,” market-based concepts to better value natural carbon- absorbing assets.
- Consider categorizing carbon-assisting watershed improvements as “infrastructure” for funding/policy purposes.
- Conserve agricultural and forest lands via conservation land banking; work with states and local entities to develop mitigation strategies if ag and forest lands are taken out of production.
- Assist in siting clean energy and transmission projects.
 - Improve appropriate access and permitting processes for siting new clean energy projects on public lands, where federal gov't can provide direct policy direction.
- Developing Adaptation/Resilience Strategies to Address Climate Impacts on Resources.
 - The federal government is in a unique position to be an information source and clearinghouse regarding potential climate impacts and resilience and adaptation strategies that are being utilized around the U.S.
 - Feds should develop easily accessible and user-friendly GIS mapping capabilities to understand and project potential climate impacts on resources.
 - Better use of GIS mapping techniques needed – identify data gaps; identify inefficient, duplicative systems/programs across competing federal agencies; consider partnering with leading states and syncing up software and data approaches (e.g., California).

International Considerations

The domestic/international interplay will become more and more important, post-Paris.

- Paris success provides new opportunities for key sectors. International approaches may emerge via climate “clubs,” bilateral initiatives, public/private partnerships.
 - Consider formalizing sectoral collaborations (e.g., extractive industries; materials- related industries)(taking a page from Bali).
 - Explore public private partnerships (e.g., tropical forest alliance; alliance for climate smart agriculture).
- As noted above, tackling aviation and maritime emissions will require collaboration with international nations/organizations.
- The Montreal Protocol provides a promising international mechanism to address HFC emissions.
- The Paris agreement's focus on deforestation provides and opportunity for (1) cost- effective, market-based investments in avoided deforestation in other nations; and (2) more focus on US forest and rangeland stewardship (per land use section, above).
 - Need more attention on measurement, reporting, verification (you can't manage what you don't measure).
- Likewise, international black carbon reductions provide potential trading opportunities.
- How can federal gov't use subnational efforts (e.g., Calif + other subnationals) as leverage for national policies?

Important Miscellaneous Issues

- Governance questions (addressed in January workshop)
 - Need a “Carbon Cabinet” to coordinate inter-agency initiatives?
 - First wave of Executive Orders from the new President will set the stage for climate-related policy directions – what should they address?
- Consider developing a federal legislative proposal from the Administration to help define/focus the Administration’s priorities.
- How deal with carbon leakage issue? (i.e., shifting of U.S. manufacturing-related emissions overseas).
- Need to address equity issues – e.g., community-based v. rooftop solar.
- Avoid excess buildout of natural gas infrastructure.
- How can feds help on promoting attention to, and investment in, resilience issues?

List of Participants

Ken Alex	Dian Grueneich	Andy Karsner	Erin Rogers
Joel Bluestein	Karl Hausker	Nat Keohane	Tom Steinbach
Mike Boots	David Hayes	Dan Lashof	Dave Stewart
Kate Brandt	Trevor Houser	Jan Mazurek	Daniel Tangherlini
Jim Connaughton	Reed Hundt	John Porcari	Buzz Thompson
Kate Gordon	Bob Inglis	Dan Reicher	Michael Wara

Climate Change Implementation Project Workshop II

January 11, 2016

Recognizing that there is no more important time than at the start of a new Administration to clearly lay out roles and responsibilities, participants in the January workshop focused on how to effectively balance policy and implementation functions that cut across the full breadth of the government, involving multiple White House offices and cabinet-level departments.

Summary

Approximately 25 climate change experts gathered at Resources for the Future in Washington, D.C. on January 11, 2016 to brainstorm on how to improve federal competence in coordinating the implementation of climate change-related policies across the many White House offices and federal agencies involved. The discussion was conducted under Chatham House rules. This outline captures some of the points raised during the course of the workshop.

Overview/Intro to Workshop

Broadest frame

How to improve the Executive Branch's performance in efficiently implementing major, cross-cutting policy imperatives?

- What are key ingredients to effective, coordinated execution within the Executive Branch?
 - Role of White House? Cabinet agencies?
 - What architectures work in different contexts to optimize efficient, coordinated implementation efforts?
- How to incorporate these learnings into an effective game plan to promote the effective delivery of governmental services?

Workshop's frame

- How to improve the Executive Branch's performance in effectively addressing climate change implementation challenges?
- What's our advice for the next President? How make the most of his or her fresh start?

Examples of Types of Climate Change Implementation Issues:

- Reducing GHG emissions from existing sources.
 - Coordinating regulatory programs; coordinating voluntary programs.
- Promoting clean energy.
 - Coordinating R&D efforts; coordinating deployment efforts – permitting, financing, voluntary programs.
- Promoting energy efficiency.
- Addressing climate impacts.
 - Coordinating resilience-related programs/activities; coordinating information aggregation/dissemination.
 - Matching up domestic implementation with int'l commitments/opportunities.

Potential Methodology for Evaluating these Issues:

1. Share relevant organizational experiences.
2. Identify ingredients for (failure and) potential success.
3. Consider application to climate change context.
4. Identify recommendations for our next President.

Identify Ingredients for Potential Success

- White House; Cabinet Agencies.
 - Inherent organizational strengths/weaknesses.
 - Convening power; expertise/bandwidth/budget/jurisdiction.
 - Accountability; metrics.
 - Talent/personalities.
 - One size doesn't fit all: need to match implementation issues with appropriate architecture.
- Congress; other key stakeholders.

Develop Recommendations

- White House: How organize climate change effort; who should be in charge?
 - Role of CEQ, OMB, DPC, NSC, NEC, OSTP?
- Cabinet agencies: "Green/Carbon Cabinet"?
 - Consider any cabinet agency reorgs (internal or external)?
 - How/where should Cabinet leaders interact with WH?
 - How create effective inter-agency implementation teams?
- WH/Cabinet relationship
 - Develop organizational guidelines/criteria/templates for implementing cross-cutting climate change issues.
 - Repurpose Presidential Management Council's mission/responsibilities?
- Potential Options Might Include:
 - Accountability placed with high level official(s) that have the capacity & stroke to get the job done; bias toward agencies for implementation issues.
 - Confirm/clarify support responsibilities (e.g., WH budget, coordination assistance, etc.)
 - Identify metrics, deliverables at outset.
 - Adopt proven management techniques (e.g., McKinsey & Co.).
 - Avoid default E.O. formula (e.g., multiple WH offices "in charge of" implementation Task Forces, Working Groups, etc.).
 - Imbue professionalism, respect for chain of command, deference.

- Be ready on “Day 1”
 - Provide early clarity on existing WH/interagency climate change initiatives & WH/Cabinet approach, more generally.
 - Consider congressional strategy/proposals.

Key Discussion Points Raised During the Workshop

Who should have the lead in the WH to effectively help to manage the climate change agenda?

- Visible interest/involvement/ prioritization by POTUS/VP is necessary to marshal the WH and cabinet horses needed for success.
- Climate change issue is large enough, cross-cutting enough, and with enough impact on the economy that:
 - Many WH offices have a significant stake in the issue; and
 - It will be important that one of the WH “top dogs” has overall responsibility for it, providing air cover for the head of whatever WH office is given the lead. (e.g., John Podesta model; de facto czar, but not labeled as such).
- In terms of which WH office should have the lead for climate change, opinions varied:
 - The Council on Environmental Quality (CEQ) and the Domestic Policy Council (DPC) have been co-managing the issue in the Obama Administration. In the Bush Administration, the National Economic Council (NEC) was the lead for the issue.
 - Some participants were uneasy about CEQ as the lead, due to questions about CEQ’s heft and the concern about pigeon-holing climate change issues as environmental (only).
 - Others were skeptical about the DPC as the lead, due to questions about its heft and because the issue is not traditionally in its corner.
 - Some favored having the NEC as the lead, given the importance of clean energy/climate change to the overall economy.
 - There was significant discussion regarding the appropriate role for OMB. Most viewed OMB has the wrong place for policy development. It is well-situated, however, to address financial support needs and performance reviews.
- General consensus was that it was less important where the “home” is for climate change among the WH offices, than that the POTUS identify it as a priority – aided by one of his/her top dogs to provide air cover– and that whichever WH office has the lead, it be led by an individual who is a strong leader and collaborator – and who will, and is empowered to, make decisions. **“We just need someone in charge and who will make decisions,” was a common refrain.**
 - Can’t have implementation initiatives that are “led by” multiple WH offices. E.g., initiatives with led by multiple WH offices dilutes responsibility and accountability.
 - In terms of connecting with outside stakeholders, it is important to have clear point of engagement, clear purpose of dialogue, and accountability. Unfocused, ad hoc efforts will not work with companies and other outside constituencies.
 - Major problem in WH structure: endless meetings because too many staffers are involved in too many issues in too many ways. Need to avoid the WH “free for all.” If offices are told what to do clearly by higher-ups, they will behave.
 - The “czar” term is not helpful, although leadership and accountability are needed. There should be sensitivity to Congressional (and other) concerns about the apparent “power” invested in “czars.”
- Whoever is in charge of the climate change policy in the WH, it is important that the WH communications and outreach functions are integrated into the process from the outset. Comms and outreach have very important roles to play, given the broad scope of climate change issues.

What is the mission of the WH office that is put in charge of climate change?

- What do we want the WH office to accomplish?
 - Should it be primarily a policy development shop?
 - What is its role in terms of ensuring appropriate implementation of policy decisions throughout the federal bureaucracy?
 - Should oversight of *mitigation* (reduced emissions) be split from *climate impacts* (adaptation/resilience) because different players/interests are involved? Note: adaptation has been a stepchild; no one appears to have overall responsibility over this important issue area.
- What is the breadth of the WH office's mission?
 - Should the WH office be charged with fostering “disruptive innovation” that goes beyond the boundaries of legal obligations? For example, will the WH focus be constrained by legal/jurisdictional lines, or will it dial in the corporate community and other private sector interests that fall outside the scope of governmental authority? (Workshop participants voiced a strong, broadly held view that the Administration’s climate change approach should not be tied to jurisdictional boundaries.)
 - WH insularity is a major concern. In clean energy, important developments are occurring in the private sector. The Administration needs to be working with corporate and NGO leaders to identify paths forward.
 - WH leader needs to lean into the issue and be pro-active and resist the WH’s reactive mindset.
 - Crises will distract leaders from larger priorities. (e.g., Deepwater Horizon oil spill). Some suggested that different WH teams be involved in handling crises versus addressing longer-term policy priorities. Others questioned the practicality of such line drawing.

How mesh the international and domestic sides of climate change?

- This will be a challenge that needs to be addressed up front. The National Security Council (NSC) traditionally does not have much expertise on (or, arguably, sensitivity to) environmental issues and it will be important to have a key cross-walk between the WH lead on climate change and the NSC, given the connectivity between the international and domestic climate change agendas.

How deal with “people” issues in terms of leadership, cooperation, competence, in the WH, and in the agencies?

- Recruitment of the “right” people in key jobs in the WH and in the cabinet agencies is critically important. Need people who can work together well and have good “horizontal” connectivity. Also need folks who can effectively deploy career employees.
 - Note: Recruitment is not something that the transition process historically does well. Transitions often are dominated by political considerations, without appropriate attention given to governance needs, leading to relatively random appointments and predictably mixed results.

Cabinet agencies are needed to implement climate-related policy. Many implementation efforts cut across agency lines. How can the WH/Cabinet relationship be structured to maximize coordination and accountability across affected agencies?

Step 1: Improve the WH/Cabinet relationship.

- Cabinet heads should have more regular strategy sessions with top WH leadership. (Example of VP Gore and env/energy cabinet secretaries' weekly breakfast.)
- WH failure to draw in top level cabinet and sub-cabinet in key climate meetings promotes a major disconnect between WH and agencies. Pathological concern about leaks, FOIA exposure, etc., needs to be dealt with, but not at the expense of robust cabinet engagement in climate policy development and execution.
- National security decision-making model provides more input from affected cabinet agencies. Should that model be considered for domestic climate change issues? Visibility and input by cabinet secretaries into decision-making process is important.
- Consolidation of power in WH has accelerated, post Reagan and Bush I. Now, messy issues are routinely taken into WH. Previously, cabinet secretaries were asked to help manage them. Some of that was because key cabinet secretaries were recognized as being adept at managing difficult issues and being fair to all concerned ("respecting the box"), such as Bill Reilly, Lee Thomas. Also, prior WH Chiefs of Staff, like Jim Baker, pushed issues out to agencies. Additional advantage of having issues managed at the cabinet level: cabinet secretaries have more staff capability than the WH.
 - o Note: Quality of individuals willing to serve in the cabinet arguably has been eroded by perception (and, perhaps, reality) that cabinet secretaries' responsibilities/accountability are limited vis-a-vis WH staff.
- Should be more "transactional" discussions between WH and cabinet: "This is what we want you to do" and "why aren't you doing x, y, or z?" Surprisingly little of that has been occurring in recent years.
- Develop clear policy blueprints through WH policy process and use them as guides for agency implementation. (e.g., Obama Energy Blueprints; Climate Action Plan).
- Consider appointing someone other than the WH lead to handle disasters to reduce distracting from the full agenda (e.g., Shawn Donovan for Hurricane Sandy; Ron Klain for Ebola).

Step 2: Look to Cabinet for accountability in implementation of policies, with WH support.

- Broad consensus that cabinet agencies are often appropriate leads to push forward with the implementation of WH policy decisions.
- More investment in the agencies is merited because their work must go on, regardless of who is elected President and given the swirling politics around climate change. Agencies also have the staff, expertise, budget and bandwidth to follow through on challenging implementation priorities, particularly as compared with WH staff.
 - Note: The framing of issues and chain-of-command as being driven by climate change may alienate some in Congress and impact funding and oversight support.
- Agencies might consider having key individual in charge and accountable for climate change matters in each department. Important that information flow is both ways, with agencies keeping WH up-to-date on developments.
 - Recovery Act model of VP-led effort, with single point of contact in agencies and lots of communication, worked well.
- Bush CAFE rulemaking structure required 3 agencies to work together. Each was given veto power as a way to ensure cooperation.

Miscellaneous Additional Points Raised During the Workshop

- The federal contracting community is huge, and needs to be considered with regard to the execution of an Administration's climate policies. Feds may enhance their impactfulness, for example, if they expect climate-related performance from contractors (e.g., lower carbon footprint).
- Major challenge: how to tap into younger people in the agencies and harness their enthusiasm. Also, need to give attention to serious "burnout" issues affecting among many senior career employees.
- Executive Orders are important. They can/should identify Presidential priorities, provide explicit direction, and establish clear accountability.
- How deal with the "white spaces" and with areas in which federal jurisdiction is limited (e.g., utility sector)?
- Transition process is critical, particularly vis-à-vis early messaging to political hires in agencies. Hiring is random and slow.
 - To assist the transition, the first step is to put together an inventory of all of the activity underway in the WH and the agencies.
- OMB is the place for accountability, metrics; OMB not good at interagency coordination. Bush-era performance standards, including scorecards, are important, needed.
 - Need to rethink OIRA role; should rotate senior OMB career officials.
- Use outside resources better, including universities, think tanks, for issue development, avoiding FACAs, etc.
 - Look outside the gov't for management ideas.

List of Participants

David Anderson	Laura Davis	Elgie Holstein	John Porcari
Kai Anderson	Linda Fisher	Brandon Hurlbut	Jeff Rosen
Vicki Arroyo	Paul Glastris	Melissa Lavinson	Tom Steinbach
Roger Ballentine	Jason Grumet	Jim Lyons	Daniel Stid
Joel Bluestein	Karl Hausker	Michelle Moore	Max Stier
Mike Boots	David Hayes	Pete Ogden	Renee Stone
Sharon Burke	Alice Hill	Bob Perciasepe	Beth Viola

III. CONFERENCE: SETTING THE CLIMATE AGENDA FOR THE NEXT U.S. PRESIDENT

May 6, 2016, Stanford University

A conference was held at Stanford University to highlight strategies the next President might employ to reduce greenhouse gas emissions and accelerate the United States' pivot to a clean energy economy. The conference also addressed difficult "governance" issues, including how the new President might structure the White House and Cabinet to implement climate change programs that cut across jurisdictional lines, and how to effectively partner with private sector innovators and investors.

The conference was sponsored by the Stanford Law School, the Stanford Woods Institute for the Environment, the Precourt Institute for Energy, and the Stanford School of Earth, Energy & Environmental Sciences, with the support of the Hewlett Foundation.

Conference: Setting the Climate Agenda for the Next U.S. President

Resources

Visit the conference website:

http://bit.ly/CCIP_Conf_May-6

Watch major highlights from the event:

Full Conference:

http://bit.ly/CCIP_May-6_Video

Panels:

http://bit.ly/CCIP_May-6_Panels

Speakers:

http://bit.ly/CCIP_May-6_Speakers

Moderator Takeaways:

http://bit.ly/CCIP_May-6_Moderators

Follow the Twitter conversation at the hashtag [#ClimatePOTUS45](#).

In advance of the conference, David J. Hayes of Stanford University wrote the discussion paper "Optimizing White House and Cabinet Agencies' Roles in Implementing Federal Climate Change Initiatives".



May 6, 2016, 8 a.m. to 5 p.m. Paul Brest Hall, Stanford University

Setting the Climate Agenda for the next U.S. President

8:00 a.m. **Registration and continental breakfast**

8:45 a.m. **Welcome**

Steve Denning—Chairman, Stanford University Board of Trustees

Setting a National Agenda for Addressing Climate Change

Former Governor of Michigan **Jennifer Granholm**

Former U.S. Secretary of State **George Shultz**

Moderator—**David J. Hayes**, Stanford Law School and Stanford Woods Institute for the Environment

Expanding the Clean Energy Economy—Powering the Research Agenda

Arun Majumdar—Co-Director, Stanford Precourt Institute on Energy; former Acting Undersecretary for Science and Energy, U.S. Department of Energy; former Director, ARPA-E, DOE

Jagdeep Bachher—Chief Investment Officer, University of California system; representing the UC system in Bill Gates' Breakthrough Energy Coalition

Moderator—**Sally Benson**, Stanford School of Earth, Energy & Environmental Sciences & Precourt Institute for Energy

Break

Expanding the Clean Energy Economy—Unleashing Competition in a Regulated Environment

Reed Hundt—Former Chairman, Federal Communications Commission; CEO, Coalition for Green Capital



Andy Karsner—Managing Partner, Emerson Collective; Senior Strategist, Google X; Stanford Precourt Energy Scholar & Former Assistant Secretary for Efficiency and Renewable Energy, DOE

Michael Picker—Chair, California Public Utilities Commission; former Senior Advisor for Renewable Energy for Governor Jerry Brown

Moderator—**Michael Wara**, Stanford Law School

12:30 p.m. Lunch

1:30 p.m. Financing Clean Energy Deployment

Nancy Pfund—Founder and Managing Partner, DBL Partners

Dan Reicher—Executive Director, Stanford Steyer-Taylor Center for Energy Policy and Finance; former Assistant Secretary of Energy; former Director, Climate Change and Energy Initiatives, Google.

Moderator—**Buzz Thompson**, Stanford Law School & Stanford Woods Institute for the Environment

Filling in the Gaps: Additional Climate Change Challenges/Opportunities

David J. Hayes—Visiting Lecturer in Law, Stanford Law School; former Deputy Secretary, Department of the Interior

Kate Gordon—Vice Chair for Climate and Sustainable Urbanization, Paulson Institute; former VP for Energy Policy, Center for American Progress

Jim Connaughton—President and CEO, Nautilus Data Technologies; Board, former Chairman, White House Council on Environmental Quality

Organizing the Federal Government for Success

John Podesta—former Chief of Staff for President Clinton; former Counselor to President Obama, in a discussion moderated by **Larry Kramer**, President, the Hewlett Foundation

William K. Reilly—Senior Advisor, TPG Capital; former Administrator, Environmental Protection Agency

Steven Chu—Professor of Physics and Molecular & Cellular Physiology, Stanford University; former Secretary of the Department of Energy

Moderator—**Bruce Cain**, Bill Lane Center for the American West & Department of Political Science

5 p.m. Adjourn

The conference is sponsored by the Stanford Woods Institute for the Environment, Stanford Law School, Precourt Institute for Energy, and the Stanford School of Earth, Energy and Environmental Sciences, with the support of the Hewlett Foundation.

For background papers, video recordings and updates related to the Climate Implementation Project Series, visit: <http://stanford.io/1S7iRSd>

Join the conversation on Twitter at: #ClimatePOTUS45
[@StanfordWoods](#) [@StanfordLaw](#) [@StanfordEnergy](#) [@StanfordEarth](#)

Summary from May 6 Stanford Climate Conference

Thanks for helping make Stanford's May 6th conference on "Setting the Climate Agenda for the Next U.S. President" such a success. We had a full house at Stanford, and hundreds more watching online.

The terrific line-up of speakers advanced important observations and recommendations about how our next President might approach climate change-related issues and advance a successful agenda. All of the speakers agreed that, regardless of who wins the election, he or she will need to forthrightly address the impact that climate change already is having on our environment and our economy. He or she should advance a thoughtful agenda that engages key stakeholders in energy, infrastructure, land use, and many other sectors, as well as impacted state and local governments and, importantly, the international community.

Availability of Conference Presentations

All of the presentations made at the conference are now available online, including both the speakers' individual presentations (which averaged about 15 minutes in length and are well worth your time) and in the provocative, moderated discussions that followed all of the individual presentations (also worth your time!). Here is the link: <https://www.youtube.com/playlist?list=PLVC5RXohm34X63Z0Pzsin7zplyzpNXIhF>

By way of reminder, the presentations that you can find online include all of the speakers involved in the conference, along with moderated discussions, listed here in the order of their presentations:

Former Governor **Jennifer Granholm**

Former Secretary **George Shultz**

Arun Majumdar – Co-Director, Stanford Precourt Institute for Energy; former Acting Undersecretary for Science and Energy, U.S. Department of Energy; former Director, ARPA-E, DOE

Jagdeep Bachher – Chief Investment Officer, University of California system; representing the UC system in Bill Gates' Breakthrough Energy Coalition

Reed Hundt – Former Chairman, Federal Communications Commission; CEO, Coalition for Green Capital

Andy Karsner – Managing Partner, Emerson Collective; Senior Strategist, Google X; Stanford Precourt Energy Scholar & Former Assistant Secretary for Efficiency and Renewable Energy, DOE

Michael Picker – Chair, California Public Utilities Commission; former Senior Advisory for Renewable Energy for Governor Jerry Brown

Nancy Pfund – Founder and Managing Partner, DBL Partners

Dan Reicher— Executive Director, Steyer-Taylor Center for Energy Policy and Finance; former Assistant Secretary of Energy; former Director, Climate Change and Energy Initiatives, Google

David J. Hayes – Visiting Lecturer in Law, Stanford Law School; former Deputy Secretary, Department of the Interior

Kate Gordon – Vice Chair for Climate and Sustainable Urbanization, Paulson Institute; former VP for Energy Policy, Center for American Progress

Jim Connaughton – President and CEO, Nautilus Data Technologies; Board, former Chairman, White House Council on Environmental Quality

John Podesta, former Chief of Staff for President Clinton and former Counselor to President Obama

William K. Reilly – Senior Advisor, TPG Capital; former Administrator, Environmental Protection Agency

Steven Chu – Professor of Physics and Molecular & Cellular Physiology, Stanford University; former Secretary of the Department of Energy

[Discussion moderators included **David J. Hayes** (Stanford Law School); **Michael Wara** (Stanford Law School), **Sally Benson** (Co-Director of the Precourt Institute for Energy), **Buzz Thompson** (Co-Director of the Woods Institute for the Environment), and **Bruce Cain** (Director of the Bill Lane Center for the American West).]

Key Conference Take Aways

I have summarized below some of the key take aways from the conference. There was some divergence about how the next President might most effectively approach the climate issue (which is not surprising, given that experienced hands from both sides of the aisle participated in the conference), but there was a remarkable degree of coalescence around a number of key themes.

Caveat: The conference was not designed to provide a comprehensive list of recommendations for the next President. Indeed, speakers were encouraged to lean into creative ideas, and give less attention to proposals that are commonly identified for consideration.

The key observations and recommendations highlighted by speakers in the conference fall into two buckets:

- Substantive Observations/Recommendations for the next President; and
- A Potential Organizational/Governance Agenda for the next President.

I. SUBSTANTIVE OBSERVATIONS/RECOMMENDATIONS FOR THE NEXT PRESIDENT

General Themes

Innovation and Job Creation

- Several speakers made a strong, optimistic and non-partisan case for viewing the climate change challenge through the positive lens of unleashing U.S. competition, innovation, and job creation.
- The President should rally the U.S. innovation economy – the U.S.'s “bread and butter” – as being particularly well suited to take on the climate challenge.
- The demand side of the equation, and the economic opportunity that it provides to the U.S., is enormous.
 - Climate change puts the need for innovation in a global market context, providing global opportunities for U.S. innovators, financiers, and job-creators.
 - In addition to tackling the carbon-heavy existing energy infrastructure in the U.S. and around the world, the global need to provide electricity to the 1.3 billion people who currently are without it will provide significant new demand for U.S. products.
- Here in the U.S., several states already have seen substantial job growth in the energy sector due to the implementation of clean energy.
- The next President can accelerate job growth by providing financial incentives for states that exceed clean energy goals, and by facilitating the siting of new ventures and industries that match the states' needs and existing industrial eco-systems. States might be measured for awards based on advances in workforce development, permit streamlining, access to capital, and the like.

(See generally Granholm; Shultz; Majumdar; Connaughton)(note: speakers identified under subject areas in this outline were among the speakers who addressed some aspects of the area during the conference.)

Establishing an Effective R&D and Deployment “Ecosystem”

- Mission Innovation, the Breakthrough Energy Coalition, and other initiatives to increase R&D in the energy area were applauded. Speakers emphasized, however, the importance of closely tying government-sponsored R&D activities with private industry research investments, potentially through a new Presidential initiative that would establish joint research collaboratives that are supported by both private and public entities and that have, from the outset, the goal of bringing promising clean energy innovations to scale.
- A deployment-oriented ecosystem will need strong private sector support, both from sponsoring companies, and from institutional investors who have the wherewithal to invest the billions of dollars needed to bring clean energy to scale. The President has an opportunity to promote partnerships and bring together a strong community of interests from across the private and public sectors to create a successful ecosystem that can scale up clean energy. The traditional approach of “handing off” R&D for private sector up- take will not meet the clean energy challenge on an acceptable timeframe.
- Adopting an R&D focus that emphasizes scalability and deployment will require “innovation” in more than technology. Innovation also will be needed in finance, institutional structures and regulatory systems so that barriers to bringing clean energy solutions to market can be removed.
- The next President should work with the R&D community to promote the development of small, modular systems that can be deployed and improved in an iterative basis. This will accelerate innovation and lead to quicker scale-up of new systems.
- The President should turn to the “A” list of government players, including the Department of Defense, to serve as “early adopters” and facilitate the deployment of new technologies.

(See generally Majumdar, Bachher; Connaughton; Shultz.)

Incentives and Tax Reform

- Several speakers from both sides of the aisle expressed support for a revenue neutral carbon tax as a means of enabling the market to more accurately reflect the true costs of fossil fuels and facilitate increased competition and innovation. Because a carbon tax is unlikely to be adopted in the near term, several speakers recommended that the next President focus on providing support for clean energy tax incentives – including for storage – and the removal of legacy fossil fuel incentives.
- One speaker recommended that the next President revise the corporate tax rate, repatriate the trillions of dollars that corporations have parked overseas, and reinvest proceeds in clean energy. Bringing dollars back to the U.S. for reinvestment here also should reduce the “export” of carbon emissions that are generated overseas, and financed by U.S. companies.
- Another speaker recommended that the new President advocate for the application of long-standing grant and incentive programs to emerging clean energy applications (e.g., the Community Reinvestment Act’s applicability to low-income solar installations).

(See generally Shultz; Majumdar; Chu; Podesta; Connaughton; Pfund; Reilly)

Addressing Economic Dislocation

- The next President should forthrightly address economic dislocation caused by changing energy markets with focused retraining programs and providing assistance in locating new, clean energy jobs in stressed communities.

(See generally Shultz; Reilly; Pfund.)

Sector-Based Observations/Recommendations

Electricity/Utilities

In some areas of the country, the electricity/utility sector has been facilitating the pivot to a cleaner energy economy through renewable portfolio standards, net metering, etc. However, the record is decidedly mixed and many incumbent utilities are pushing back against market trends and opportunities (e.g., distributed energy; customer choice, etc.). The regulatory structure is not keeping up with the pace of innovation and change.

Several speakers emphasized that the utility monopoly's reach beyond the transmission system (the "wires") into generation (before the wires) and an exclusive customer relationship that can limit consumer choice (behind the meter) is inhibiting competition and innovation, and is ripe for disruption.

- Strong parallels were drawn to the successful, government-led antitrust litigation strategies that led to the break-up of "Ma Bell." Three speakers argued that the next President should consider pursuing a similar path and initiating antitrust litigation against utilities that may be engaged in restraint of trade on the generation or end-user sides of the business as a means of opening up more fair competition and innovation in the electricity sector.
- Reference was made to moderator Michael Wara's recent publication relating to this subject: "Competition at the Grid Edge – Innovation and Antitrust Law in the Electricity Sector." http://papers.ssm.com/sol3/papers.cfm?abstract_id=2765502
- Several speakers emphasized that the President has an opportunity to lay out a vision for increasing competition in the utility sector, and diminishing the application of monopoly power beyond the wires business. The next President should facilitate a "transition by design" approach for the sector, rather than continuing in the industry's and regulators' current fragmented, reactive mode. The President should not seek to supplant the states' traditional role in energy regulation, but to lay out a vision and pathway for change.
- Along these lines, one speaker recommended that the next President more actively promote the identification and adoption of best practices in how states are approaching competition and accommodating new entrants like rooftop solar providers. The next President could help the states work through these important issues by acknowledging the national implications of state-based decisions and promoting a dialogue that brings together a diverse set of interested stakeholders.
- Speakers noted that the President should put equity and the development of a "social compact" in terms of providing all Americans with cost-effective access to clean energy at the heart of reform in the electricity/utility space. The universal service charge used in the telecom industry was referenced as a potential template for addressing the equity issue.
- Major infrastructure investments are needed to upgrade the existing electrical grid, which was not designed to address today's emerging electricity system. The smart grid should have open source availability of key data to facilitate innovation and competition in demand reduction opportunities, the availability of distributed energy, efficiency upgrades, etc.
- Several speakers expressed concern about the potential loss of nuclear capacity in the U.S. and the importance of investing in next generation nuclear power solutions – both technical and regulatory.

(See *generally* Hundt; Karsner; Picker; Connaughton; Majumdar)

Steel, Cement, Infrastructure

- While significant attention has been directed at decarbonizing the electricity sector, more attention needs to be directed at other large energy users associated with major infrastructure (e.g., steel, cement, and other industrial applications).
- Cement and steel are global industries that are tied to infrastructure development and will continue to grow. Low carbon

technologies – including carbon capture – are urgently needed in these large, infrastructure-heavy categories.

- U.S. companies in these industries could gain a global competitive edge by successfully innovating in this space, with cost-effective carbon capture being the biggest prize for
- U.S. companies. Also, carbon capture in these industries could dramatically lower emissions in developing countries whose steel and concrete production is growing quickly to meet expanding infrastructure needs. For these reasons, the next President should press for low carbon solutions in these industries. Given the recognized need to increase investment in U.S. infrastructure, this is an arena in which there is an opportunity for the next President to lead a bi-partisan initiative.
- As a related point, one speaker emphasized that infrastructure also needs to be built intelligently – in the right places, as well as in the right (lower carbon) way – to improve resilience to climate impacts. In some cases, for example, some traditional, centralized infrastructure might give way to more distributed infrastructure. Projects should be built away from coasts and flood plains, etc.

(See generally Gordon; Chu; Picker; Reilly)

Transportation; Buildings; Energy Efficiency

- To meet the nation's climate goals, it will be important that the next President push for electrification of the transportation fleet by, for example, focusing on infrastructure development (charging stations) and other incentives.
- The next generation of CAFE standards should be a priority for the next President. One speaker suggested moving toward a “feebate” system for improving fuel efficiency in the transportation sector.
- The next President should advocate for additional investments in energy efficiency, including in the federal building stock, as typically the most cost-effective way to reduce GHG emissions. Jim Sweeney’s (Director of Stanford’s Precourt Energy Efficiency Center) forthcoming book entitled “Energy Efficiency: Building a Clean, Secure Economy,” received a shout-out; it will be published in August.

(See generally Shultz; Podesta; Picker; Reilly; Chu; Connaughton)

Land Use and Conservation

- The next President has an opportunity to emphasize, and capitalize on, the U.S.’s forests and rangelands and the carbon sequestration stronghold they represent. A relatively modest investment by the next President in developing consistent measurement and monitoring methodologies and processes can lay the groundwork for significant additional mitigation associated with increased carbon sequestration from natural landscapes, forest restoration and improved rangeland and ag land stewardship.
- The public lands provide an opportunity to pilot test carbon sequestration strategies and potentially to develop market-based opportunities to invest in low-cost sequestration options in the U.S.
- If the U.S. invests in measuring and enhancing carbon storage in our own forests and other landscapes, the U.S. will be well positioned to renew and reinvigorate global attention and strategies to reduce emissions associated with tropical deforestation – a major source of emissions in the developing world.
- Given the significant GHG emissions associated with the agriculture industry, the next President should focus on assisting farmers and ranchers to apply methane reduction strategies and enhance soil management and other carbon-friendly strategies. U.S. leadership in the sector has the potential to reap global benefits.

- Additional land use-related climate change opportunities available to the next President include:
 - Developing leasing strategies for extracting coal and other fossil fuels from public lands that take into account the carbon-related costs of such activities, and ensuring that leasing activities conform with national climate change budgets and policies.
 - Facilitating the deployment of renewable energy projects and related transmissionlines by improving both the speed and the quality of federal permitting processes.
 - Emphasizing the positive role of coastal wetlands and other natural and restored landscapes on enhancing resilience against climate impacts.

(See *generally* Hayes; Podesta; Chu)

Finance

- One speaker persuasively demonstrated that private investment interest in clean energy continues to grow and attract both U.S. and global investors. In addition, “impact investing” is gaining in currency among key financiers, and will help inject capital in the clean energy sector.
- Large institutional investors also are beginning to invest in the energy innovation space. President Obama has used his convening power to help spawn the Breakthrough Energy Coalition, the Aligned Intermediary project, etc.; the next President should continue to embrace this convening role.
- Increased federal funding of research and development is an important form of financial help for clean energy. In addition, the next President should consider administrative and legislative changes that would make REITs, Master Limited Partnerships, and Private Activity Bonds available for clean energy projects.
- As noted above, tax credits will continue to be vitally important for the renewable energy industry in the U.S., pending progress on instituting a broad-based carbon tax.
- Federal tools, including procurement, can be more effectively consolidated and used to help finance clean energy projects.
- The next President should explore how to reinvigorate DOE’s loan guarantee program and utilize its remaining authority wisely. A couple of speakers expressed caution about the relative competence of governmental decision-making in evaluating new business opportunities.
- Establishing an infrastructure bank, and promoting more public/private partnerships, has the potential to free up large amounts of capital that can be invested in clean energy infrastructure projects.

(See *generally* Pfund; Reicher; Bachher; Podesta; Shultz)

Potential Regulatory Priorities (in addition to sector-specific initiatives identified elsewhere)

- Several speakers emphasized the importance of having the next President continue to implement the Clean Power Plan as a foundational element of the U.S.’s commitment to reduce GHG emissions.
- One speaker suggested the potential “simplification” of clean energy mandates and their conversion into technology neutral, performance based, and cost capped requirements.
- Methane controls on existing oil and gas exploration and distribution systems should be a top priority for the next President, given the GHG intensity of methane and new information about the nature and scope of methane venting and leakage.

- The next President should rally the international community to address HFCs and other “super emitters” under the Montreal Protocol.

(See generally Connaughton; Podesta; Hayes)

Resilience

- Climate change already is causing significant impacts that require the development of vigorous resilience/adaptation strategies in response to sea rise, storm surge, tropical disease, drought, and other impacts.
- Risks associated with climate impacts should be a centerpiece of the next President’s agenda. Risk recognition and response is non-partisan. Companies are comfortable undertaking such reviews, and risk evaluations promote discussions about solutions, including support for mitigation.
- The nature and scope of the societal costs that climate change already are causing is underappreciated. The next President has an important opportunity to use the levers of the federal government to gather and disseminate data about the costs of climate impacts on infrastructure and on human and natural resources.
- The federal government also is well positioned to consolidate GIS-based mapping data from across the federal government and make it readily available for states and local communities who are eager to understand current and projected climate impacts on infrastructure and other resources in their area.

(See generally Gordon; Hayes; Majumdar; Podesta; Chu)

International

- Speakers emphasized the importance of continued U.S. leadership in the international arena, both in connection with implementing the Paris agreement, and in continuing bilateral dialogues and engagement with major emitting nations like China and India.
- Two speakers recommended that the next President also focus on, and take advantage of, a North American collaboration among the U.S., Canada and Mexico to facilitate the development of clean energy initiatives in the northern hemisphere.
- One speaker emphasized that developing nations will require support to reduce emissions and develop sustainable energy, and suggested that the next President lead the international community in acknowledging this need, and facilitating the delivery of such needed support.

(See generally Reilly; Majumdar; Podesta)

II. A POTENTIAL ORGANIZATIONAL/GOVERNANCE AGENDA FOR THE NEXT PRESIDENT

White House/Cabinet Relationship

- There was a broad consensus that the President and a senior advisor in the west wing should be personally and actively involved in developing climate change policy initiatives, working with appropriate White House offices and cabinet agencies, and then in supporting cabinet secretaries and their agencies in implementing agreed-upon policies.
- Speakers noted the importance of having a policy blueprint with specific benchmarks that can be used by the White House to work collaboratively with the relevant cabinet agencies to measure progress in meeting such benchmarks. Active, top level White House engagement with cabinet and sub-cabinet officials can help identify budget resources and coordinate complementary

efforts within the federal family, while pushing the agencies to implement the next President's climate plan. This model reinforces the importance of strong communication and shared accountability among the President and top White House officials and cabinet secretaries.

- One speaker emphasized the importance of having the President regard the cabinet and subcabinet as his “staff,” as a way to inspire and gain access to the career officials in the agencies who will play an indispensable role in implementing new climate policies throughout the sprawling federal bureaucracy.
- Another speaker recommended that when seeking to coordinate activities that cut across several cabinet departments (as, for example in connection with the siting of transmissionlines), the President and his top advisors should identify a lead cabinet secretary who will be held responsible for ensuring that a unified implementation plan moves forward and that the required coordination occurs, backed up by the support of the White house.

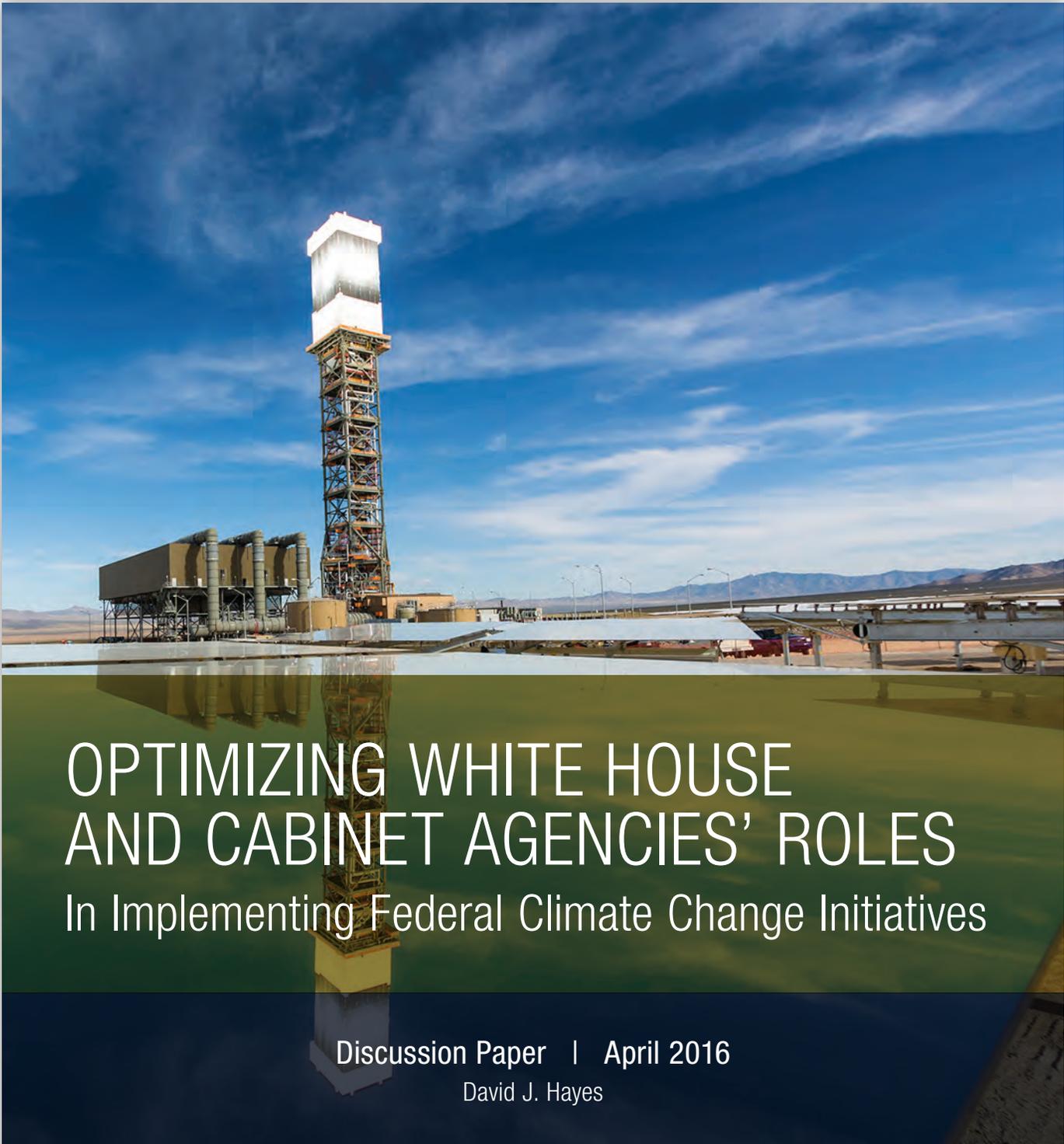
Presidential Use of Soft Power

- Several speakers emphasized that the next President should recognize, and exercise, his or her enormous “convening power,” and actively use it to advance the President's climate agenda. Using this soft power effectively is particularly important in the climate context, given the large number and type of actors in the public and private sectors that must work together to make progress on the complex and wide-ranging climate agenda.
- Effective outreach and convening should extend, for example, to state, tribal and city leaders who are on the front lines of climate issues; to regulators and industry participants who are grappling with specific issues such as modernizing the electric grid; and to governmental and private sector companies and financiers engaged in research, development and deployment of clean energy solutions.
- The next President also can exercise soft power by facilitating broad public access to important climate-related information that the federal government is in a unique position to identify and consolidate for interested governmental and private stakeholders. (See, e.g., the discussion above regarding GIS-based mapping data.)

(See *generally* Podesta; Hayes; Shultz; Granholm; Majumdar; Reilly; Chu)

A special thanks to Steve Denning, Chair of Stanford's Board of Trustees, for opening up the conference, to Larry Kramer and Tom Steinbach of the Hewlett Foundation for supporting the conference and related activities, and for the Stanford schools and institutes that sponsored the conference, including Stanford Law School; Stanford's School of Earth, Energy and Environmental Sciences; and Stanford's Woods Institute for the Environment and Precourt Institute for Energy.

— David J. Hayes
Distinguished Visiting Lecturer in Law, Stanford Law School
Consulting Professor, Stanford Woods Institute for the Environment



OPTIMIZING WHITE HOUSE AND CABINET AGENCIES' ROLES In Implementing Federal Climate Change Initiatives

Discussion Paper | April 2016
David J. Hayes





April 2016

Optimizing White House and Cabinet Agencies' Roles In Implementing Federal Climate Change Initiatives

Author

David J. Hayes, Distinguished Visiting Lecturer in Law at the Stanford Law School and a Consulting Professor with the Stanford Woods Institute for the Environment

Contact

Stanford Law School
559 Nathan Abbott Way
Stanford, CA 94305
communications@law.stanford.edu
dhayes@law.stanford.edu

This Discussion Paper was produced by the Stanford Woods Institute for the Environment, Stanford Law School, the Precourt Institute for Energy, and The School of Earth, Energy and Environmental Sciences, to inform policy directions and decisions to be discussed at the event "Setting the Climate Agenda for the Next U.S. President," convened May 6, 2016 at Stanford University. The paper and event were produced in conjunction with the Climate Implementation Project Series, organized by David J. Hayes, Distinguished Visiting Lecturer in Law at the Stanford Law School and a Consulting Professor with the Stanford Woods Institute for the Environment. For details, visit: <http://stanford.io/1S7iRSd>

Photo Credits

Front Cover: The Ivanpah Solar Electric Generating System in California's Mojave Desert. Credit: US Department of Energy/Gilles Mingasson/Getty Images for Bechtel
Above: President Obama Meets with his Cabinet in the White House. Credit: Wikimedia Commons/Pete Souza

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INTRODUCTION

This paper summarizes the conclusions reached in a comprehensive Stanford Law School report¹ that reviewed the relative effectiveness of six climate change initiatives that required cross-governmental cooperation among the White House (and, in one case, a Governor's office) and multiple agencies. The paper (and the underlying report) confirm that White House has an important role to play in helping to coordinate and guide complex, multi-agency implementation challenges, and that it has succeeded in doing so in some cases. The paper also indicates, however, that the White House's tendency to create multiple White House-centric task forces and other, one-of-a-kind management structures with purported responsibility to oversee how governmental services are delivered has, in several cases, degraded clarity of mission and accountability, and led to sub-optimal results.

The paper concludes that the next President should devote more disciplined attention on how important Administration initiatives are structured to produce optimal results. When it comes to implementing climate change priorities that have been set by the White House, responsibility should rest primarily with cabinet agencies that have the budget, staff, expertise and jurisdiction to deliver on policy promises. For implementation, the White House role typically should focus on facilitating coordination among cabinet secretaries and, where appropriate, assisting them in developing common, cross-agency implementation programs and tools.

¹ Mr. Hayes compiled and edited this report based on a submission completed by a Stanford Law School policy lab that he taught in the spring of 2015. The following students participated in drafting portions of the report on which this paper is based: Claudia Antonacci; Adam Bowling; Eeshan Chaturvedi; Siddharth Fresca; Heather Kryczka; Neil Raina; Caitlin Troyer; and Michelle Wu. The 106 page underlying report is available online at <https://law.stanford.edu/education/only-at-sls/law-policy-lab/practicums-2014-2015/energy-and-environmental-governance/106>

BACKGROUND AND SUMMARY

Over the years, successive White House administrations have taken a common approach when developing policy options in response to important issues like climate change. Typically, a senior White House lead is identified to drive policy development. The lead staffer then works in consultation with the relevant White House offices and cabinet agencies to identify and analyze policy options, solicit input on the options, and facilitate a decision-making process that pulls in the relevant cabinet and subcabinet officials through a series of “deputies” meetings (typically involving Deputy Secretaries for important policy decisions). The President then makes the final call and sets the policy direction for the Administration, in consultation with his or her top staff and relevant cabinet secretaries.

While the White House’s policy making process is well established, the broader apparatus of the federal government needs to be activated when it comes to implementing new policies. That is why, as a general matter, the White House should look to the cabinet agencies that have the budget, staff, expertise and jurisdiction to convert policy pronouncements into new, on-the-ground realities.

Unfortunately, these general rules of thumb can become blurred, especially for high-priority initiatives that require coordination among multiple agencies. Indeed, the White House’s propensity to assert overall responsibility for Administration priorities can erode the lines of authority and accountability when it comes to implementing new policies – even though the White House is poorly situated to “take charge of” how its policies are implemented by cabinet agencies.²

The Obama Administration’s climate change initiatives provide a good laboratory for evaluating the relative effectiveness of White House involvement in how agencies implement climate-related initiatives. Toward that end, a Stanford policy lab class evaluated six case studies that the federal government (and, in one instance, the State of California) has applied to facilitate interagency coordination in the climate change context. In each of these cases, the federal (or state) government and its customers sought operational results, not policy pronouncements. And in each of these cases, success largely turned on whether the interagency approach pursued by the agencies and/or the White House (or, in California’s case, the Governor’s Office) was itself well designed and well executed.

As illustrated in the six case studies summarized below, the executive branch frequently makes a number of serious mistakes when setting up initiatives that require coordinated execution across multiple agencies. In particular:

- Initiatives that blur the lines between policy-making and implementation are rarely effective from an implementation perspective. Some Executive Orders, for example, create White House-centric task forces that are well-positioned to gather information that might feed into a policy development process but that have diffuse organizational structures led by one or more White House offices that are ill-equipped to implement new directives across several agencies in a coordinated way.
- As a corollary, many processes that are styled as “interagency” in nature, and which are led by White House offices, generate a catalogue of agency-specific programs or initiatives that are rolled up into reports. Because they are not built with and around the leadership of the agencies that have to execute on new Administration-wide policy initiatives, these White House’s interagency efforts typically are not structured to take on the hard work of figuring out how to convert conflicting or incompatible agency programs into well-coordinated, cross-agency implementation efforts that will advance new, government-wide directives. This is unfortunate. The White House could play a valuable role if it were to focus on facilitating coordination cabinet secretaries and, where appropriate, assisting them in developing common, cross-agency implementation programs and tools. Remarkably little attention has been devoted to this important role.

2 See David J. Hayes, “The White House Needs to Learn When to Delegate,” *Washington Monthly* (July 15, 2015) http://www.washingtonmonthly.com/ten-miles-square/2015/07/the_white_house_needs_to_learn056594.php.

- White House-led implementation efforts also are typically disconnected from the budget process, despite the fact that budgetary augmentation often is needed to implement new Administration priorities. The failure of the Office of Management and Budget to prepare budget cross-cuts that review whether and how agency-specific implementation budgets match up also represents a missed opportunity to facilitate closer coordination among agency implementation efforts.
- Many initiatives are wrongly presumed to be first-of-a-kind undertakings that require new organizational structures, when workable, closely related existing structures may already exist.
 - Before deciding how to optimally structure a new implementation initiative, a disciplined review should be undertaken of how related tasks are currently being implemented by the relevant agencies.
 - If and when an affirmative decision is made to move in a new direction organizationally from the status quo, it is important to provide clarity on how the new structure will replace or otherwise relate to existing interagency task forces, MOUs, or other working arrangements.

The Stanford review of climate-related initiatives also identified key factors that are positive indicators of potential success for complex, multi-agency implementation efforts:

- Clear and unambiguous leadership and accountability to implement top line, White House-backed policy initiatives is an essential ingredient for success.
 - While the White House must play an important role in helping to facilitate implementation efforts, primary leadership and accountability to implement Administration priorities should typically be placed in the appropriate agency or agencies. Preferably, to avoid confusion and dilution of responsibility, only a single White House office should be identified as the White House lead.
 - Consideration should be given to designating cabinet official(s) and his or her staff(s) to lead, and have over-all accountability for, multi-agency implementation efforts, backed by the White House. Designation of this responsibility should be clearly and publicly articulated.
 - Decisions about the nature and scope of the implementation exercise, and the appropriate agency lead(s), need to be made collaboratively with the agencies that are most knowledgeable about, and will need to “own,” the implementation tasks.
- Inclusion of metrics and results-oriented reporting mechanisms in the Executive Order (or equivalent) directive will help clarify and underscore the purpose of the exercise and facilitate transparency and accountability. Initiatives that are focused on execution and on-the-ground results should embrace performance metrics and results-oriented reporting mechanisms. They should not be generating reports that simply catalogue individual agency programs.
 - Metrics should be developed in concert with the implementing agencies to enable truth-testing and to facilitate agency buy-in. In that regard, it is important to survey and take into account relevant existing agency programs, or interagency initiatives, when setting metrics and evaluating how to optimize agency participation in implementation efforts that cut across agency lines.
- As a practical matter, the effective implementation of White House initiatives often requires the active participation and support of regional and local federal officials from participating agencies. Accordingly, consideration should be given at the outset for how best to facilitate regional cooperation and buy-in.
- Implementation of high-level initiatives will almost always be improved if key stakeholders – such as state and local partners, tribes, and key interest groups – are asked to provide their input on how the feds might best approach the implementation challenge before the Administration finalizes its implementation strategy.

A final note on the important role of having the right people in place to guide complex agency implementation efforts:

- There is no question that the personal skills of the individuals involved in implementing complex governmental undertakings that cut across agency lines and that forthrightly address “turf” issues play a huge role in the success or failure of the endeavor. This is why appointments to high-level positions should take into account leadership skills, personal qualities, and experience. It also is true, however, that while having the right people involved in interagency efforts can sometimes overcome organizational dysfunction, complex interagency initiatives have a much higher likelihood of success when they are built on a sound institutional and organizational architecture.

ANALYSIS OF CLIMATE-RELATED CASE STUDIES

The Stanford review addressed the design and execution of interagency coordination efforts in six climate change contexts:

1. Responding to Climate Impacts on Natural Resources Managed by the Federal Government
2. Using Geographic Mapping Tools to Make Climate Change Impact Data Available Across Agencies and with Stakeholders
3. Federal Interagency Efforts to Address Climate Impacts to Critical Infrastructure
4. Reducing the Federal Government’s Carbon Footprint
5. Implementing State-Wide Greenhouse Gas Reductions in California
6. Coordinating the Siting of Major Renewable Energy Projects on Public Lands

While it is hazardous to make general conclusions about the relative success of complex, on-going initiatives, the Stanford review found that the first three interagency climate change efforts that it examined were not well designed and, as a result, they have had mixed success. In contrast, the last three initiatives were better conceived, and executed, and have generated more success. Taken together, the case studies reinforce the observations made above regarding the importance of devoting more disciplined attention on how important Administration initiatives are structured to produce optimal results.

The discussion below summarizes key points that are more fully laid out in the Stanford policy lab’s final report. As noted above, the complete 106 page underlying report is available online at <https://law.stanford.edu/education/only-at-sls/law-policy-lab/practicums-2014-2015/energy-and-environmental-governance/106>

1. Responding to Climate Impacts on Natural Resources Managed by the Federal Government

Climate change already is affecting our nation’s natural resources due to warmer temperatures, shifts in participation patterns, rising sea levels, and more frequent and intense extreme weather events. Current and future impacts include droughts and wildfires; loss of snow cover and melting glaciers; flooding, erosion, and inundation of coastal areas; coral bleaching; insect infestations; and changes in habitats and species loss.³ Many of these impacts will have broad, negative consequences on a wide range of ecosystem services, including access to clean water and healthy forests and rangelands.

3 U.S. GOV’T ACCOUNTABILITY OFFICE, GAO-13-253, CLIMATE CHANGE: VARIOUS ADAPTATION EFFORTS ARE UNDER WAY AT KEY NATURAL RESOURCES MANAGEMENT AGENCIES 7-8 (2013), available online at <http://www.gao.gov/assets/660/654991.pdf>.

The federal government has a major role in addressing climate change-related impacts on our natural resources because it has direct stewardship responsibility over a major proportion of our natural resources. By way of example, the federal government has direct responsibility for managing more than 700 million acres of land—or about 30 percent of the nation's total acreage—along with offshore marine resources.⁴ These responsibilities implicate water supplies, coastal resources, threatened and endangered wildlife, and fishery and marine resources in offshore waters. The federal government is also in a unique position to assist state and private natural resource managers in addressing climate impacts by sharing information about the nature and scope of expected impacts on resources and potential response strategies.

Because the federal government's wide-ranging resource management responsibilities are divided among a number of agencies, there is a premium on developing effective interagency coordination mechanisms and common, cross-agency implementation programs and tools to address climate impacts efficiently and effectively.

During the first term of the Obama Administration, a White House-led Climate Change Adaptation Task Force was the primary interagency effort utilized to address climate impacts on natural resources. It triggered an offshoot interagency effort focused on addressing freshwater resources. Two other resource-specific interagency efforts also moved forward in the first term, including the White House-led National Oceans Council and the Congress-directed National Fish, Wildlife and Plants Climate Adaptation Strategy. After the President issued his Climate Action Plan in June 2013, the Administration decided to “reboot” its interagency climate adaptation activities in the second term, leading to the issuance of a 2014 report entitled *Priority Agenda: Enhancing the Climate Resilience of America's Natural Resources*.

Key lessons from the first term's climate change adaptation efforts include:

- The Climate Change Adaptation Task Force was staffed by the White House's Council on Environmental Quality (CEQ). It focused on developing general, high-level policy approaches to adaptation; it did not seriously address implementation issues raised by the multiple federal agencies that were confronting common climate impact issues affecting shared natural resources.
 - By failing to engage the leadership of the natural resource agencies in a focused coordination effort, the Task Force stood by as virtually all of the federal natural resource agencies developed their own stove-piped adaptation and resilience programs. This unfortunate situation recently prompted the Advisory Committee on Climate Change and Natural Resource Science to observe that “the rapid development of these [natural resource agency climate change] programs, and the ever-expanding list of potential partners in these endeavors, suggests a pressing need for significant investments in coordination.”⁵
- The three resource-specific interagency efforts touching on climate change also had limited effectiveness, for a variety of reasons:
 - Two agencies with a major stake in freshwater issues—the Department of Interior and EPA—took the lead in developing an interagency approach to addressing climate impacts on freshwater resources. Because the project was being led by two agencies with significant expertise and experience, the freshwater interagency workgroup focused on implementation issues and identified a series of practical deliverables and outcomes. Unfortunately, however, because the workgroup was a subset of the White House-led Climate Change Task Force, it did not receive top-level budget or implementation attention from the White House or the Departments.
 - The National Ocean Council (NOC) is a White House-led interagency effort that focuses on climate change and other impacts on oceans. Most observers commented that the NOC effort has been disappointing. Key concerns have been the sprawling and somewhat disorganized nature of the effort, with the relatively weak White House engagement loosely overseeing more than twenty-five agencies and offices that had widely varying levels of commitment to the effort. Without strong leadership in

⁴ *Id.* at 2.

⁵ COUNCIL ON CLIMATE PREPAREDNESS AND RESILIENCE CLIMATE AND NATURAL RESOURCES WORKING GROUP, PRIORITY AGENDA: ENHANCING THE CLIMATE RESILIENCE OF AMERICA'S NATURAL RESOURCES (2014) [hereinafter PRIORITY AGENDA], available online at https://www.whitehouse.gov/sites/default/files/docs/enhancing_climate_resilience_of_americas_natural_resources.pdf.

the White House or at top levels of the key agencies, the exercise produced lengthy documents that tended to chronicle what individual agencies were doing and did not tackle difficult interagency overlap and implementation issues.

- The National Fish, Wildlife and Plants Climate Adaptation Strategy, like the freshwater interagency initiative, was largely driven by the key federal wildlife agencies (e.g., the U.S. Fish & Wildlife Service) and by companion state agencies. The White House only had nominal involvement in the initiative. The primary focus of the exercise was policy development and the participants were largely pleased with the results. A coordinating body has been established to help with implementation, but the effort is proceeding at a lower level, and without significant funding support.
- The Administration's more recent efforts over the past two years to adopt a new framework for better interagency cooperation in the area of climate impacts on natural resources holds more promise for successful integration of cross-agency efforts. The framework builds on existing agency priorities, draws input from a Task Force of state, local and tribal stakeholders, and is a clear Presidential priority—features that position it well for success. Of special note is the fact that an agency-led Climate and Natural Resources Working Group has been set up under E.O. 13653. By entrusting the agencies to take ownership of the issues, a much more ambitious avenue for interagency action has emerged in the report that the interagency agency working group released in October 2014.

2. Using Geographic Mapping Tools to Make Climate Change Impact Data Available Across Agencies and with Stakeholders

The federal government is taking a number of steps to better manage the resources for which it is directly responsible in the face of climate change. While careful stewardship of federally managed natural resources is important in its own right, the federal government also is uniquely positioned to assist local and state authorities who are attempting to understand and deal with climate impacts on properties and infrastructure for which they are responsible. Those impacts already are affecting many key sectors, including vulnerable coastal infrastructure and regional water supplies and a variety of land uses, ranging from our coasts, floodplains, forests, farms and wildlife.⁶ As a result, state, regional and local officials are particularly eager to access authoritative information about impacts so that they can respond by developing sensible adaptation and resilience strategies.⁷

The federal government currently has available data that are potentially valuable for state and local decision makers, and it is developing new tools to help land and water managers make good decisions. In particular, a number of federal agencies have developed sophisticated maps that are populated by robust data sets compiled and curated by government scientists, which can provide a visual window into how climate change–related impacts are affecting local resources. Google Maps™ and other private services have popularized these GIS (Geospatial Information System) tools for every-day use. When it comes to depicting climate impacts on infrastructure and resources, however, GIS mapping services need to draw upon reliable and constantly updated scientific data sets that can be “mashed together” on GIS-based maps.

Coordinating the collection of diverse data sets in a common format and developing standards and protocols to ensure their integrity presents a classic case example in which interagency coordination and cooperation is needed.

6 U.S. Fish & Wildlife Service. *Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change*. (Nov. 2012) at 7, available online at <http://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf>. USDA Forest Service. *USDA Forest Service Climate Adaptation Plan*. (2014) at 61, available online at http://www.usda.gov/oce/climate_change/adaptation/Forest_Service.pdf.

7 *Priority Agenda: Enhancing the Climate Resilience of America's Natural Resources*. Council on Climate Preparedness and Resilience (Oct. 2014) at 4. See generally, ESRI, *GIS for Federal Government: Building a National GIS Community*. (available online at <http://www.esri.com/library/brochures/pdfs/federalbro.pdf>)

The Federal Geographic Data Committee (FGDC) has been utilized since 1990 as the interagency coordination mechanism to develop common standards and protocols for GIS-based data and mapping products. In the last two years, in connection with the President's Climate Action Plan, the Administration has initiated a new effort to provide easier access to GIS-based data and mapping services through its "Climate Data Initiative" and the development of a related "Climate Resilience Toolkit."

Lessons learned from the FGDC's longstanding interagency efforts, and the Obama Administration's more recent climate-related data initiatives, provide insights into the ingredients of successful interagency coordination initiatives. Key takeaways include:

- Despite operating relatively well, the great acceleration in technology and data is beginning to overwhelm the lower-level and low-key FGDC interagency effort. The new demand for GIS mapping services, fueled by the need for climate impact information and other landscape-level informational needs, has triggered largely uncoordinated, agency-by-agency investments in IT and mapping software and services—leading to large expenditures and a poor user experience, as users typically must search for relevant data inefficiently, often on an agency-by-agency basis.
- Because the FGDC governance structure relies on volunteer help from the relevant agencies and does not have a history of commanding buy-in from cabinet and White House office leaders, the FGDC does not appear to have the institutional heft to force more interagency coordination in providing GIS data and mapping services.
- The Administration's Climate Data Initiative and Resilience Toolkit are intended to provide centralized, easy access to key GIS mapping tools, but the Administration has not identified a governance structure that will accomplish that difficult interagency coordination task.
 - Current participants in the effort describe the Climate Data Initiative as being run by a "coalition of the willing." Turnover among key volunteers could significantly set back progress on the initiative.
 - The Administration has not explained how its new climate data initiative—which is being loosely overseen by the Council on Climate Preparedness and Resilience—relates to the long-established, interagency Federal Geographic Data Committee. Disconnected interagency efforts around closely aligned issues create confusion and weaken the effectiveness of interagency efforts.
- Experts indicate that the federal government's push to develop more customer-friendly access to helpful, climate-related, GIS-based data and mapping tools through *Geoplatform.gov* and *Data.gov* (enhanced by the Climate Data Initiative and the Resilience Toolkit) will likely require full-time database management staff, operating with state-of-the-art software and IT tools. This points to the need to put a shared services model in place. To do so will require a strong interagency governance structure that will marry ongoing, agency-specific data generation and curation activities with a government-wide center of excellence that will use modern IT tools, and a dedicated staff, to provide efficient access to useful data and analysis. Neither the FGDC nor the more recent Administration climate data initiative have the type of strong interagency governance structure necessary to address this requirement.

3. Federal Interagency Efforts to Address Climate Impacts to Critical Infrastructure

The Stanford study includes a full discussion of the shortcomings of each of the five initiatives that have been launched in recent years to address climate change adaptation and resilience issues as they affect our nation's infrastructure. As discussed in the report, the key takeaways associated with each initiative include:

Federal Task Force. The first initiative was launched in 2009 under Executive Order 13514, "Federal Leadership in Environmental and Energy Performance," which directed the Interagency Climate Task Force to recommend ways that federal policies and programs could better prepare the Nation for the impacts of climate change. This effort was one of the first concerted interagency attempts to focus on and develop a coordinated policy around climate change impacts.

The Task Force issued reports in 2010 and 2011. As discussed in the Stanford study, the 2010 report identified policy approaches that might guide adaptation efforts.⁸ The follow-on 2011 report engaged in a cataloging exercise of agency-specific efforts.⁹ It exhibited minimal meaningful agency coordination across mission spaces. The catalog of agency initiatives demonstrates that in the absence of a clear implementation guidance or structure for cross-agency coordination, agencies defaulted to a siloed approach.

Infrastructure Resilience Working Group. The second, related initiative was launched in 2013, with the issuance of a follow-on Executive Order 13653, “Preparing the United States for the Impacts of Climate Change.” The new Executive Order replaced the Climate Change Adaptation Task Force with the Council on Climate Preparedness and Resilience, one component of which is the Infrastructure Resilience working group. The Department of Homeland Security (Office of Infrastructure Protection) and the Department of Energy chair the working group.

While it is too early to tell precisely how this effort will unfold, the current emphasis by the Council and working group appears to be on sharing information, rather than seeking to reduce the proliferation of agency-based efforts. For example, although the group aims to “forge new interagency partnerships where appropriate,” neither the Council nor the working group have identified a specific mechanism for addressing jurisdictional overlaps. In its Climate Change Adaptation Plan, for example, the Department of Energy (DOE) states that, through its participation in the Council on Climate Preparedness and Resilience and other interagency working groups, it will share “best practices” with other federal departments and agencies. There appears to be little effort to develop consistent implementation approaches across agencies.

Infrastructure Resilience Guidelines. A third initiative grew out of the Hurricane Sandy disaster. In December 2012, President Obama signed an Executive Order establishing the Hurricane Sandy Rebuilding Task Force to lead the long-term rebuilding effort in the region, while ensuring that rebuilt structures and systems were more resilient to current and future risks, particularly from climate change impacts. The President designated the Secretary of Housing and Urban Development, Shaun Donovan, as the Task Force chair. Secretary Donovan and the Task Force were charged with working across the Administration, and closely with the affected states and local jurisdictions, to identify and work to remove obstacles to resilient rebuilding in a manner that addressed current and future risks and promoted the long-term sustainability of communities and ecosystems in the affected region. The President directed the Task Force to deliver a rebuilding strategy within six months of the Executive Order.

In August 2013, the Task Force released the Hurricane Sandy Rebuilding Strategy, which established a set of guidelines for investing the appropriated funds to ensure, among other things, that the region was rebuilt with better resiliency to future risks, including climate change.¹⁰ As a key part of its work, the Task Force developed new “Infrastructure Resilience Guidelines.” The guidelines focused on the disaster at hand and developed a single, central set of guidelines that were used by all agencies in distributing Sandy recovery funds. The Task Force also recommended the guidelines be applied in a whole-of-government manner nationally, and beyond disaster recovery.

To implement the goal of broadening the applicability of infrastructure resilience guidelines beyond the Hurricane Sandy context, the Department of Homeland Security’s National Protection and Programs Directorate, with support from White House National Security Staff, initiated an interagency process to assess the value and feasibility of expanding the guidelines’ use. This effort was led by an independent evaluation of the guidelines’ implementation by the RAND Corporation.

8 INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE, PROGRESS REPORT OF THE INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE: RECOMMENDED ACTIONS IN SUPPORT OF A NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY 4 (2010), available online at <https://www.whitehouse.gov/sites/default/files/microsites/ceq/Interagency-Climate-Change-Adaptation-Progress-Report.pdf>.

9 INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE, FEDERAL ACTIONS FOR A CLIMATE RESILIENT NATION: PROGRESS REPORT OF THE INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE 6 (2011), available online at https://www.whitehouse.gov/sites/default/files/microsites/ceq/2011_adaptation_progress_report.pdf.

10 HURRICANE SANDY REBUILDING TASK FORCE, HURRICANE SANDY REBUILDING STRATEGY 14 (2013) [hereinafter SANDY 2013], available online at <http://portal.hud.gov/hudportal/documents/huddoc?id=hsrebuildingstrategy.pdf>.

The RAND report confirmed that the development of infrastructure guidelines in the context of the Hurricane Sandy recovery effort was a positive step that reinforced the importance of developing common adaptation and resilience approaches across the government. The RAND report noted, however, that at least six federal initiatives had encouraged adoption of an integrated interagency approach to resilience principles in the years leading up to and following Sandy. The proliferation of initiatives had reinforced the importance of issue but, in the absence strong, consistent and coordinated leadership by White House and cabinet secretaries, agencies were continuing to develop their own ways of addressing infrastructure adaptation and resilience needs.

The National Infrastructure Protection Plan. The fourth initiative involves the development of the “National Infrastructure Protection Plan.” The NIPP has been developed under the Homeland Security Act of 2002, which directed the Department of Homeland Security (DHS) to develop a comprehensive plan for ensuring the security of the Nation’s critical infrastructure. In response to this directive, DHS released the first National Infrastructure Protection Plan (NIPP) in 2006. The Department updated the plan in 2009. In 2013, President Obama issued Presidential Policy Directive 21 (PPD-21), Critical Infrastructure Security and Resilience, which directed DHS to update the NIPP once again.¹¹ PPD-21 directed DHS to update the NIPP in coordination with Sector Specific Agencies; other relevant Federal departments and agencies; state, local, tribal, and territorial entities; and critical infrastructure owners and operators.

In December 2013, DHS released the latest update to the NIPP, which is intended to guide the national effort to manage risk to the nation’s critical infrastructure, in conjunction with national preparedness policy.¹² The NIPP 2013 was developed through a process that included private sector entities, State and local governments, Federal departments and agencies, non-governmental organizations, and academia.

The NIPP envisions “[a] Nation in which physical and cyber critical infrastructure remain secure and resilient, with vulnerabilities reduced, consequences minimized, threats identified and disrupted, and response and recovery hastened.” According to the Department, the NIPP provides the structure for integrating the critical infrastructure security and resilience initiatives into a coordinated effort across all stakeholders (including federal departments and agencies). As such, the NIPP is intended to provide a central policy to guide efforts related to infrastructure security and resilience across federal departments and agencies.

To implement this policy, the NIPP established a coordinating structure. It has organized critical infrastructure into 16 sectors and designated a federal department or agency as the lead for each sector. These lead agencies are referred to as sector-specific agencies. In addition to the sector-specific agencies, the NIPP identified two primary federal components of the partnership structure as follows:

- Federal Senior Leadership Council (FSLC): includes officials from each sector-specific agency and other Federal departments and agencies with a role in critical infrastructure security and resilience.
- Government Coordinating Councils (GCCs): includes representatives from various levels of government to enable “interagency, intergovernmental, and cross-jurisdictional coordination within and across sectors and partner with SCCs on public-private efforts.”

The NIPP development experience demonstrates that neither FSLC nor any other federal body is effectively serving this purpose. For example, the NIPP includes a “Supplemental Tool: Incorporating Resilience into Critical Infrastructure Projects,” which recommends steps decision makers can take to promote resilience in infrastructure projects. This list is more comprehensive than the Infrastructure Resilience Guidelines that emerged from the Hurricane Sandy process, but it overlaps with the guidelines in many ways, serving as yet another redundant and confusing set of guidelines regarding infrastructure resilience.

11 Presidential Directive on Critical Infrastructure Security and Resilience; DCPD-201300092 (2013).

12 U.S. DEPARTMENT OF HOMELAND SEC., NIPP 2013: PARTNERING FOR CRITICAL INFRASTRUCTURE SECURITY AND RESILIENCE 8 (2013) [hereinafter NIPP], available online at http://www.dhs.gov/sites/default/files/publications/NIPP%202013_Partnering%20for%20Critical%20Infrastructure%20Security%20and%20Resilience_508_0.pdf.

One method for achieving a more streamlined approach would be to ensure that all departments and agencies consistently apply the NIPP framework and principles. Unfortunately, it seems that DHS is not currently well positioned to effectively lead this effort. The Government Accountability Office (GAO) released a report in September 2014 regarding interagency coordination of infrastructure vulnerability assessment efforts. It candidly stated that “DHS is not positioned to manage an integrated and coordinated government-wide approach for assessments as called for in the NIPP because it does not have sufficient information about the assessment tools and methods conducted or offered by federal entities external to DHS with [critical infrastructure] responsibilities.”¹³

The GAO recommended that DHS explore the viability of using a single assessment methodology to consolidate its assessment tools and methods with those of other agencies. This recommendation is consistent with that made in the RAND report, which called for the streamlining of federal approaches to infrastructure resilience.

With its articulated interagency structure, the FSLC could lead this effort. However, it is unclear whether the FSLC, as currently structured, will be able to drive effective change. The DHS Office of Infrastructure Protection leads the FSLC and NIPP implementation efforts, which are purely interagency initiatives without White House oversight. The Office is a third tier DHS subcomponent, which, without significant attention from the DHS Secretary — much less the White House — may not have the political stature to effectively push for toward a comprehensive, cross-agency, streamlined federal approach to infrastructure resilience.

Furthermore, in the past, DHS has not had the same expertise in the climate change arena enjoyed by agencies such as EPA and NOAA. This likely undercuts its credibility among other departments and agencies, and decreases its ability to effectively lead the effort. Finally, while the FSLC charter calls for executive-level agency participants, anecdotal evidence suggests that current participants do not have the necessary decision-making authority within their own agencies to effectively push for change. Thus, while the FSLC may be senior-level interagency coordinating structure on paper, cooperation across peer agencies is unlikely to materialize without any White House involvement or authority.

Thus, as it now stands, the NIPP and its Supplemental Tools appear to be yet another “interagency” infrastructure resilience effort that overlaps with other federal initiatives in the same space.

Federal Resource Guide for Infrastructure Planning and Design. In recognition of the fact that it is most effective to build in climate change resilience principles during the early design phases of a project, President Obama issued a Presidential Memorandum in January 2015 entitled “Expanding Federal Support for Predevelopment Activities for Nonfederal Domestic Infrastructure Assets” as a complement to his Build America Investment Initiative, which had been launched in July 2014.¹⁴ The January 2015 Presidential Memoranda called on the Departments of Agriculture, Commerce, Labor, Housing and Urban Development, Transportation, Energy, and Homeland Security, and the Environmental Protection Agency to educate grantees and the public on the benefits of predevelopment and on Federal resources available to support pre-development activities.¹⁵

In May 2015, this interagency group released the Federal Resource Guide for Infrastructure Planning and Design (the Guide). The Guide adds to the already confusing array of uncoordinated infrastructure resilience guidance provided by the federal government. The predevelopment principles articulated in the Guide overlap significantly with the Hurricane Sandy Infrastructure Resilience Guidelines, as well as those articulated in the NIPP Supplemental Tool discussed above. Yet, neither of these resources is mentioned in the Guide. As such, it appears to represent a missed opportunity to add clarity to the current patchwork of agency-by-agency efforts.

13 U.S. GOV'T ACCOUNTABILITY OFFICE. GAO-14-506, DHS ACTION NEEDED TO ENHANCE INTEGRATION AND COORDINATION OF VULNERABILITY ASSESSMENT EFFORTS 37 (2014), available online at <http://www.gao.gov/products/GAO-14-507>.

14 BUILD AMERICA INVESTMENT INITIATIVE INTERAGENCY WORKING GROUP, RECOMMENDATIONS OF THE BUILD AMERICA INVESTMENT INITIATIVE INTERAGENCY WORKING GROUP 7 (2015) available at <http://www.treasury.gov/resource-center/economic-policy/Documents/Build%20America%20Recommendation%20Report%201-15-15%20FOR%20PUBLICATION.pdf>.

15 Presidential Memorandum on Expanding Federal Support for Predevelopment Activities for Nonfederal Domestic Infrastructure Assets; DCPD-201500034 (2015).

The participating departments and agencies do not bear the full blame for this duplicative effort. The Guide is directly responsive to the Presidential Memorandum, which called on the group to provide best practices in the area of infrastructure predevelopment. As the RAND analysis suggested above, an excess of White House mandates on a particular subject can aggravate already superfluous and incongruent agency efforts. These mandates can trigger reactive agency attempts to fulfill presidential requirements on paper, without taking broader stock to the larger landscape of an issue. If departments and agencies are going to move beyond reactive, ad hoc, and siloed approaches, rather than ask for new reports, the White House should clearly require, and assist, departments and agencies in detangling, consolidating, and streamlining current guidance and efforts.

4. Reducing the Federal Government's Carbon Footprint

Early in his first term, President Obama challenged the federal government to “lead by example” by issuing Executive Order 13514 and establishing sustainability performance goals and an annual reporting framework for the federal government.¹⁶ The initiative is significant, given that the federal government is the single largest energy consumer in the United States¹⁷—it occupies approximately 500,000 buildings, operates more than 600,000 vehicles, and purchases more than \$500 billion of goods and services each year.¹⁸

Five and one-half years later, on March 19, 2015, President Obama took the unusual step of issuing revised and updated federal sustainability goals—and the mechanisms adopted to attain those goals—by signing Executive Order 13693.¹⁹ The new executive order incorporated management lessons learned from the initial implementation efforts of E.O. 13514, including a recognition of the need to fully engage agencies in implementation efforts.

The interagency process put in place by the President to oversee efforts to reduce the federal government's carbon footprint (and achieve other sustainability goals) has worked quite well. It arguably represents the most successful of the interagency efforts reviewed in this report. The key drivers for this successful interagency process include the following points:

This interagency process was focused, from the start, on the *implementation* of a climate change policy directive, in the form of executive orders, to reduce the federal government's carbon footprint (and achieve other sustainability objectives). This contrasts with many interagency efforts that involve the development of a unified *policy* approach for the federal government. While the White House is the natural lead when it comes to developing government-wide policy prescriptions, interagency efforts that focus on how best to implement or operationalize policy directions must defer to, and rely heavily on, agency leadership and expertise to be successful. These executive orders have largely achieved this important balance, as demonstrated by the following characteristics:

- Agencies were actively involved in drafting and reviewing the executive orders. As a result, there was agency buy-in for the metrics and processes established under the executive orders.
- Agency-led working groups established under the executive orders developed guidelines and best practices for groups of agencies that had similar operational characteristics.

16 *Federal Leadership in Environmental, Energy, and Economic Performance*, Exec. Order No. 13514, 74 Fed. Reg. 52,117 (Oct. 5, 2009) [hereinafter Exec. Order 13514].

17 *Cutting the Federal Government's Energy Bill: An Examination of the Sustainable Federal Government Executive Order: Hearing Before the Fed. Fin. Mgmt., Gov't Info., Fed. Servs., & Int'l Sec. Subcomm. of the S. Comm. on Homeland Sec. and Governmental Affairs*, 111th Cong. 5 (2010) (statement of Nancy Sutley, Chair, Council on Env'tl. Quality).

18 *Id.*

19 *Planning for Federal Sustainability in the Next Decade*, Exec. Order No. 13693, 80 Fed. Reg. 15,871 (Mar. 19, 2015) [hereinafter Exec. Order No. 13693].

- The executive orders' heavy reliance on agency experts to develop guidance that satisfies high-level goals set by the White House reflects a mature organizational approach that acknowledges the limitations of White House policy staff in establishing practical, workable guidelines for meeting sustainability goals.
- The two executive orders' recognition that significant interagency coordination needs to occur at the regional level illustrates the orders' practical emphasis on implementation. Not surprisingly, enhancing regional cooperation has been one of the biggest challenges under the orders; additional mechanisms may be needed to make more progress in this area.

The policy goals that drove the interagency process were clearly defined and provided metrics upon which agencies' operational success could be measured:

- The agencies were required to produce Strategic Sustainability Performance Plans and report on their results.
- The executive orders included reporting mechanisms that provided performance incentives.

Performance was taken into account during internal budget reviews with OMB; supplemental funds were provided for project investments that yielded proven results.

Agency performance results were made available to the public, in support of the President's commitment to transparency and open government.

5. Implementing State-Wide Greenhouse Gas Reductions

California has long been at the forefront of climate change policy innovation. Starting in the late 1990's, California's political leadership, backed by strong public support, responded to the global threat of climate change. The California Legislature's passage of AB1493 in 2002²⁰—the first legislation in the world to regulate greenhouse gas emissions from passenger vehicles—was an early example of the state's commitment to addressing climate change.²¹ Governor Arnold Schwarzenegger and the California legislature followed up in 2006 with enactment of one of the most comprehensive climate change statutes ever passed, the Global Warming Solutions Act—commonly known as AB32.²² Governor Jerry Brown has continued in this tradition by setting ever-higher targets for GHG emissions reductions and clean energy generation in the state.

While these laws provide the statutory framework for addressing greenhouse gas emissions in California, implementation of their complex requirements falls on the administrative agencies of state government, led by the Governor's Office. A number of state agencies have roles and responsibilities that need to be coordinated to achieve California's aggressive climate change goals. Those agencies include: the California Air Resources Board (CARB), a department of the California Environmental Protection Agency (CalEPA), which is responsible for regulating air pollution and reducing greenhouse gases; the California Energy Commission (CEC), which is responsible for energy policy and planning; the California Public Utilities Commission (CPUC), which regulates investor-owned utilities and other entities providing energy, transportation, and water services and helps with consumer protection; and the California Independent System Operator (CAISO), which is an independent non-profit entity (established by state law but not a state agency) that manages a substantial portion of California's power grid.

20 2002 Cal Stats. Ch. 200 (A.B. 1493) (West).

21 *E2 Advocacy Projects: California Clean Cars Campaign*, ENVTL. ENTREPRENEURS, available online at <https://www.e2.org/jsp/controller?docName=campaignDisplay&activityName=CalifCleanCars1493> (last visited May 19, 2015).

22 Cal. Health & Safety Code § 38500 (West 2015).

The interagency process used to launch the complex regulatory mandates included in California's AB32 holds a number of lessons that may be pertinent to federal efforts to coordinate agency climate change-related implementation efforts. The key drivers for this successful interagency process included the following:

- The Governor's Office, representing the state's chief executive, played a key role in overseeing the interagency process. Importantly, however, the Governor's Office did not seek to directly manage the process, but instead was part of it, and available to step in and enforce discipline among the agencies involved, when necessary. This model of participation by the chief executive — without purporting to be "in charge" of the implementation effort — offers a blueprint that could be useful when crafting White House involvement in interagency implementation activities.
- The California climate change legislation explicitly designated a single state agency (the California Air Resources Board, CARB) to direct a structured, interagency implementation effort. With the legitimacy afforded by the legislation and the Governor's backing, CARB was able to organize a collaborative effort that took full advantage of other agencies' input and expertise by maintaining strong lines of communication among the agencies throughout the process.
- In addition to CARB's leadership and overall accountability, the Climate Action Team—established under AB32—was divided into a number of crosscutting subgroups that enabled relevant agencies to work together to develop emissions reduction goals that made sense for all of the agencies involved. This type of hands-on involvement by agencies is a critically important element in successful interagency implementation efforts.
- All parties involved understood the importance of the task of implementing the groundbreaking elements of California's pioneering climate change law. There was a unity of purpose shared across the many agencies involved.
- As with the executive orders related to reducing the federal government's carbon footprint, AB32 included clear metrics that led to more defined goals for each agency. Success (or failure) could be identified, and measured, with each agency having an identified subset of the state's overall goal for which they were responsible.

6. Coordinating the Siting of Major Renewable Energy Projects on Public Lands

When the Obama Administration took office in January 2009, the Department of the Interior had not issued a single permit for a utility-scale solar project on its expansive public lands. Given the burgeoning interest in renewable energy, and the Southwest's powerful solar resource, a backlog of over four hundred renewable energy project applications had piled up. The new Administration wanted to move forward with clean energy projects on public lands, but because BLM's customary permitting process often took four or five years for large projects, Interior could not proceed in a "business as usual" manner and achieve its policy goals.²³

Secretary Salazar and his senior team recognized that effective interagency coordination would be needed to implement a successful permitting strategy for utility-scale solar and other renewable energy projects on the public lands. Multiple bureaus in the Interior Department needed to sign off on renewable energy permits, including agencies that might be negatively impacted by major renewable energy projects, such as the U.S. Fish & Wildlife Service, the U.S. Park Service, and the Bureau of Indian Affairs. With these conflicting agency interests under one roof, Interior was in a unique position to experiment with new approaches for facilitating a more timely and effective interagency permitting process.

23 David J. Hayes, *Leaning on NEPA to Improve the Federal Permitting Process*, 45 *Env'tl. L. Rev.* 10018, 10018 (2015).

Instead of the typical interagency challenge in which the White House oversees a process involving several different Departments with differing missions, the renewable energy context had the Secretary of the Interior acting in the White House role, overseeing an “interagency-type” coordination process (technically, an intraagency coordination process) involving several different bureaus with differing missions within the same Department. The approach taken by Secretary Salazar and his team in addressing this interagency permitting challenge was successful. DOI improved the pathway to solar and wind energy permit processing from an average of four years to one and a half years.²⁴ The Department achieved the 2005 Environmental Policy Act’s goal of siting 10,000 megawatts of renewable energy three years ahead of schedule.²⁵ Key takeaways from this “interagency” process include:

- **Leadership Mandate:** Early on, Interior Secretary Ken Salazar issued Secretarial Order 3285A1, which established renewable energy siting as a priority of the Department and established a new intraagency approach among Interior’s bureaus to facilitate permitting decisions and improve environmental results.
- **Top-Level, Hands-On Engagement:** The Interior Department formed a “Strike Team”—made up of senior decision-makers from each bureau, and managed with a representative of the Secretary—to develop and manage an efficient permitting process that respected the interests of all of the impacted agencies and stakeholders. The hands-on coordination by the Secretary’s office demonstrated the priority of the interagency effort, and the office’s willingness to troubleshoot issues for the agencies was key to the effort’s success. (There are parallels to OMB’s involvement in the infrastructure permitting modernization effort, discussed below.)
- **Early Planning and Conflict Prevention:** Interior’s interagency permitting process institutionalized early planning and conflict prevention by bringing in potentially impacted bureaus and key stakeholders to meet with project developers on the front end to identify potential fatal flaws in projects and provide an opportunity to retool projects to reduce or eliminate objections. Leadership from the Secretary’s Office played an important role in facilitating this process.
- **Finding Budget Support for Priority Needs:** The Secretary’s Office recognized that improved permitting would require more resources, and it maximized available financial tools to bring support to the effort. This contrasts with many interagency coordination efforts in which discussion of serious budget issues is taboo.
- **Focus on Implementation and Results:** This approach required an emphasis on implementation and decision-making by the principals involved. High-level individuals in the Secretary’s office and senior positions in the bureaus had to commit to the process and be accountable for results. This differed from many interagency policy efforts that revolve around report writing and the chronicling of policy improvements. Here, the emphasis was on action-oriented implementation activities, proceeding in real time.

The White House has applied some of the lessons learned from the Interior experience across the Administration through the President’s Modernizing Infrastructure Permitting Initiative. This is an ambitious and important interagency implementation effort. Important takeaways from the effort include:

- The Office of Management and Budget has invested significant White House resources in this interagency implementation effort. It is unusual for the White House to dedicate significant staff time to a project, but the benefits of the commitment have been substantial, enabling OMB to obtain a deeper understanding of the difficulties of coordinating the permitting of complex projects across several agencies.

24 U.S. Gov’t Accountability Office, GAO-13-189, *Renewable Energy: Agencies Have Taken Steps Aimed at Improving the Permitting Process for Development on Federal Lands* 18 (2013) [hereinafter “GAO Report”].

25 Steve Black & Neal Kemkar, *Obama Administration Efforts to Expand Domestic Energy Production: A View from Public Lands*, A.L.I. (Feb. 2013) at 1

- OMB has married its investment in staff time with a commitment to learn from, and adopt, best permitting practices employed by leading permitting agencies (e.g., Department of the Interior; Department of Transportation).
- There is a significant question how the permitting reforms gained through the OMB-led infrastructure permitting modernization effort can be institutionalized so they do not fall away as personnel and Administrations change. This is a serious issue for many interagency implementation efforts. In this case, there are viable legislative and regulatory actions that can be taken to lock in the operational approaches that have been piloted through the initiative.²⁶ Congress recently took a helpful step in that regard by codifying some administrative permitting reforms for large infrastructure projects in its recent enactment of the FAST Act.²⁷

CONCLUSION

The Stanford Law School report reviewed in this paper acknowledges that the White House has an important role to play in helping to coordinate and guide complex, multi-agency implementation challenges, and that it has succeeded in doing so in some cases. It is equally true, however, that the White House's tendency to create multiple White House-centric task forces and other, one-of-a-kind management structures with purported responsibility to oversee how governmental services are delivered has, in several cases, degraded clarity of mission and accountability, and led to sub-optimal results.

The next President should devote more disciplined attention to structuring important Administration initiatives in a manner that will produce optimal results. When it comes to implementing climate change priorities that have been set by the White House, responsibility should rest primarily with cabinet agencies that have the budget, staff, expertise and jurisdiction to deliver on policy promises. For implementation, the White House role typically should focus on facilitating coordination among cabinet secretaries and, where appropriate, assisting them in developing common, cross-agency implementation programs and tools.

²⁶ David J. Hayes, *Leaning on NEPA to Improve the Federal Permitting Process*, 45 *Env'tl. L. Rev.* 10018, 10018 (2015).

²⁷ David J. Hayes, *Congress Just Enacted New Permitting Requirements for Energy Projects: Did You Miss It?* (December 10, 2015), available online at <https://law.stanford.edu/2015/12/10/congress-just-enacted-new-permitting-requirements-for-energy-projects-did-you-miss-it/>

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Stanford Woods Institute for the Environment

Stanford University
Jerry Yang & Akiko Yamazaki Environment
& Energy Building
473 Via Ortega, MC 4205
Stanford, CA 94305
environment@stanford.edu
dhayes@law.stanford.edu

Stanford Law School

559 Nathan Abbott Way
Stanford, CA 94305
communications@law.stanford.edu



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IV. POLICY FORUM: NEW U.S. LEADERSHIP, NEXT STEPS ON CLIMATE CHANGE

September 15, 2016, Washington, D.C.

In September, a policy forum was hosted at the National Press Club in Washington, D.C. where experts discussed substantive recommendations, including a potential organizational/governance agenda, for the next president. Speakers presented papers with observations gleaned from a May 2016 conference “Setting the Climate Agenda for the Next U.S. President.”

The policy forum was sponsored by the Stanford Law School, the Stanford Woods Institute for the Environment, the Precourt Institute for Energy, the Stanford School of Earth, Energy & Environmental Sciences, and the Stanford Center for Innovation and Global Health, with the support of the Hewlett Foundation.

New U.S. Leadership, Next Steps on Climate Change Policy Forum

Resources

Visit the policy forum website:

<http://bit.ly/NextStepsClimate>

Watch full video of the policy forum:

http://bit.ly/CCIP_Sept-15_Video

Read the discussions papers:

<http://stanford.io/2cA9ksb>



September 15, 2016, 1:30 to 5:30 p.m. National Press Club, Washington, D.C.

New U.S. Leadership, Next Steps on Climate Change

1:30 p.m. Welcome

David Hayes—Consulting Professor, Stanford Woods Institute for the Environment; Distinguished Visiting Lecturer in Law, Stanford Law School; Former Deputy Secretary, U.S. Department of the Interior

1:45 p.m. Panel Discussions

Adaptation, Carbon Sequestration, and Public Health

Chris Field—McCarty Director of the Stanford Woods Institute for the Environment; Lane Professor in the School of Humanities and Sciences and Professor in the School of Earth, Energy and Environmental Sciences at Stanford University; Senior Fellow at the Stanford Precourt Institute for Energy; former co-chair of Working Group II of the IPCC

David Hayes—Consulting Professor, Stanford Woods Institute for the Environment; Distinguished Visiting Lecturer in Law, Stanford Law School; Former Deputy Secretary, Department of the Interior

Katherine States Burke—Deputy Director, Center for Innovation in Global Health, Stanford University School of Medicine

Clean Energy R&D and Financing

Arun Majumdar—Co-Director, Stanford Precourt Institute for Energy; Precourt Professor in the Stanford School of Engineering; Former Acting Undersecretary for Science and Energy, U.S. Department of Energy; Former Director, ARPA-E, DOE

Nancy Pfund—Founder and Managing Partner, DBL Partners

Dan Reicher—Executive Director, Stanford Steyer-Taylor Center for Energy Policy and Finance; Former Assistant Secretary of Energy; Former Director, Climate Change and Energy Initiatives, Google

Regulatory, Risk and Market-Based Approaches

Jim Connaughton—President and CEO, Nautilus Data Technologies; Board, Former Chairman, White House Council on Environmental Quality

Kate Gordon—Vice Chair for Climate and Sustainable Urbanization, Paulson Institute; Former VP for Energy Policy, Center for American Progress

Rob Jackson—Douglas Provostial Professor in the Stanford School of Earth, Energy and Environmental Sciences; Senior Fellow at the Stanford Woods Institute for the Environment and Stanford Precourt Institute for Energy

Reforming and Modernizing the Electricity Sector

Reed Hundt—CEO, Coalition for Green Capital; Former Chairman, Federal Communications Commission

Michael Wara—Associate Professor, Stanford Law School and Faculty Fellow, Steyer-Taylor Center for Energy Policy and Finance

Michael Gergen—Partner, Latham and Watkins; Adjunct Professor of Law, New York University

5:30 p.m. Adjourn

View Speaker Biographies: bit.ly/NextStepsClimate_Bios



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This event was produced in conjunction with the Climate Implementation Project Conference series sponsored by the Stanford Woods Institute for the Environment and Stanford Law School, in partnership with Stanford's Precourt Institute for Energy, School of Earth, Energy and Environmental Sciences, and Center for Innovation in Global Health. Additional support was provided by the Hewlett Foundation.

Workshops and other events in the series have been organized by David J. Hayes in his capacity as a Distinguished Visiting Lecturer in Law at the Stanford Law School and a Consulting Professor with the Stanford Woods Institute for the Environment. Learn more and download full papers from the series by visiting: <http://bit.ly/NextStepsClimate>

Join the conversation on Twitter at: #ClimatePOTUS45
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EXERCISING LEADERSHIP ON CLIMATE CHANGE

Choices For the Next President

David J. Hayes*

Over the past year, members and friends in the Stanford University community have been examining potential strategies for the next President to address the many challenges associated with combating climate change. Supported by the Hewlett Foundation, the Climate Implementation Project has explored substantive policy ideas for addressing climate change at the federal level. In addition, it has solicited recommendations on how the next Administration might address related organizational and governance questions – a particularly challenging subject for climate change, which cuts horizontally across many affected federal agencies and vertically through all levels of government.

The Stanford project gathered ideas through two workshops held at Stanford and in Washington, a major conference on the Stanford campus on May 6, 2016, and the presentation of papers at the National Press Club in Washington, D.C. on September 15, 2016.

The result is a rich compilation of serious recommendations for the next President that is available on line. The exercise has produced a pre-conference paper on Optimizing White House and Cabinet Agencies' Roles in Implementing Federal Climate Change Initiatives, summaries of take-aways from the two workshops and the May 6th conference, a dozen individual papers presented at the National Press Club, and videos of presentations made at the May and September events.

Throughout this exercise, we encouraged participants to move beyond conventional thinking and offer creative suggestions for how the next President might build out his or her climate agenda. As a result, the body of work produced through the Climate Implementation Project emphasizes thoughtful and even bold thinking, rather than laundry lists of recommendations.

To help interested observers dive in and appreciate the significance of the content produced through the Stanford project, we have identified 10 major ideas and take-aways that offer a window into the project's content. We hope that this quick review peaks your interest, and prompts you to dig deeper into the materials produced during the effort.

1. Climate Change Is Accelerating; It Must Be a Priority for the Next President

Chris Field presented a paper with Katharine Mach that reviews “Eight Ways the World Has Changed Since the Last IPCC Report.” It should be required reading for all serious policymakers.

The Fields/Mach paper reviews how recent climate data and policy developments square with analyses included the last comprehensive Intergovernmental Panel Climate Change report, which was issued in 2013 and 2014. The paper includes a number of important observations about recent scientific data and analyses. It points to studies and data that: debunk the notion that there has been a warming pause or slowdown; confirm that recent warming has been rapid; note that climate change has made extremes substantially more likely; project a higher maximum sea-level rise during the 21st century; and indicate that global economies may be more sensitive to warming than previously estimated. It is a sobering update on the science.

The paper is not all bad news. It also notes that in both 2014 and 2015, global carbon emissions barely grew or even decreased, despite modest economic growth, demonstrating initial stages of disconnecting emissions and economic activity. And it credits the Paris Agreement for memorializing ambitious climate goals and for putting in place a workable process for moving the global community forward.

* David J. Hayes is a Distinguished Visiting Lecturer in Law at Stanford Law School and a Consulting Professor at Stanford Woods Institute for the Environment. He served as the Deputy Secretary of the U.S. Department of the Interior in the Clinton and Obama Administrations from 1999-2001 and 2009-2103.

2. Competition and Innovation Should Be Unleashed in the Electricity Sector

Several participants in the Stanford project lamented structural barriers in the electricity sector that inhibit competition and innovation. There was broad agreement that transmission services are appropriately treated as a regulated monopoly, but Reed Hundt, Andy Karsner and others expressed concern that some utilities and the Public Utility Commissions that oversee them are improperly extending monopoly power to stifle competition in power generation (by working against distributed generation companies, for example) and in demand-side, “behind the meter” innovations. Even Michael Picker, Chair of the California Public Utility Commission, forthrightly stated that the utility model is outmoded and needs to be adjusted, now that competition has emerged in the industry.

Consistent with this theme, several speakers urged the next President to be more assertive in advocating a national policy that calls on state regulatory authorities to actively promote more competition in generating electricity, and in allowing behind the meter innovations. Michael Wara, for example, recommended that the next Administration clarify the grid functions that are subject to regulated monopolies. He argued that the White House, Energy Secretary and Attorney General should use antitrust authority to review mergers, challenge anti-competitive behavior in the energy generation field, and spur action by State Utility Commissions to address competition issues in their decisions.

Michael Gergen argued that DOE could take a more activist role under existing Department of Energy authorities in pushing FERC and state PUCs to take steps to deploy clean energy resources that enhance the reliability of the bulk power grid where current or expected future reliability is determined to be inadequate (e.g., energy storage, microgrids); by commencing investigations and hearings to develop model standards for the elimination of barriers to the deployment of clean energy resources; and by identifying regional districts for the voluntary interconnection and coordination of facilities for the wholesale generation, transmission and sale clean electric energy.

Several speakers acknowledged the need to address legitimate cost and rate-related issues associated with new entrants in electricity markets, and the importance of adequately and fairly funding a vibrant grid – and, indeed, an upgraded, smarter grid. On this point, Nancy Pfund urged the new team at the White House, DOE and FERC to work collaboratively with PUCs, utilities, and distributed energy companies and move beyond net metering debates and identify a distributed energy cost-benefit framework that sets clear rules and competitive opportunities for new, renewable energy entrants.

Reed Hundt identified additional policy prescriptions to increase competition and innovation in the electricity sector, including potential incentive-based mechanisms to encourage states to emulate the New York State’s innovative, competition-engendering Reform the Energy Visions (“REV”) plan. More generally, Hundt drew compelling parallels between energy and telecommunications, noting that the onset of competition in the telecommunications industry utterly transformed an anti-competitive monopoly to a super-competitive, multi-player innovation hub that has opened up new markets and delivered stunning innovations. He noted that creative financing tools, including state- based green banks, will be needed to help innovative, insurgent competitors use the utilities’ distribution platforms.

3. R&D, Deployment and Financing

In the May 6th event, Arun Majumdar emphasized the need to scale up new technologies, which can only occur with the active involvement of the private sector. He expanded on a paper that he wrote with John Deutch that argued for a Sematech-type collaboration in which companies invest jointly with national laboratories and academic research institutions in research, development and deployment activities, with an eye toward deploying new, clean energy technologies at commercially meaningful scales. Majumdar pointed out that if companies put “skin in the game” and work collaboratively with national labs and others, innovations are more likely to find scalable market opportunities.

Jennifer Granholm struck a related theme, emphasizing the importance of incentivizing states and local industries and universities to create a productive ecosystem for developing clean energy and the jobs that go with it. Granholm recommended adoption of a Clean Energy Challenge that would competitively award federal funds to states that are committing to exceed minimum clean energy

requirements by taking additional steps that might include, for example, investing in workforce development strategies; providing technology transfer and incubation opportunities; reforming permitting systems; and providing access to low-cost capital as, for example, through State-sponsored green banks.

Nancy Pfund provided a business and finance perspective. She offered a number of both practical and creative suggestions, including: how existing renewable energy tax incentive programs should be tweaked to broaden their applicability and effectiveness and how renewable energy opportunities could be extended to lower-income, disadvantaged communities. Pfund also noted that focusing on a relatively small number of high population, low penetration states could yield dramatic increases in renewable energy production. And on the legislative side, Pfund offered a variety of new program ideas to facilitate the transition toward solar energy, including the creative leveraging of overdue public housing upgrades with energy efficiency investments, and linkages between the shuttering of coal plants and investments in clean energy and worker training in affected communities.

Dan Reicher chimed in with an emphasis on expanding REIT eligibility to solar and other renewables, extending the reach of Master Limited Partnerships to clean energy technologies, bringing back tax-advantaged Private Activity Bonding authority for utilities willing to invest in carbon capture and storage, and other options. Jagdeep Bachher joined with Reicher in emphasizing the importance of drawing institutional investors into clean energy investments through creative mechanisms such as the Aligned Intermediary project, which offers sophisticated investment advice for more patient, long-term institutional investors.

Bachher, who is facilitating the University of California's participation in Bill Gates' \$20 billion dollar Breakthrough Initiative, also acknowledged the pressures being put on institutional investors to support clean energy. He believes that with increased oversight and attention by the SEC, green bond funds could become a larger and more credible financing option for clean energy projects.

4. Infrastructure Investment Presents a Climate Opportunity

Several speakers noted that the next President has an important opportunity to address climate when pursuing needed investments in new infrastructure. Workshop participants including John Porcari and Dan Tangherlini emphasized, for example, that smart infrastructure investments can have substantial indirect climate benefits by debottlenecking freight movement on roads, rails and ports, providing mass transit and other efficient transportation options, reducing the energy intensity of water treatment and conveyance infrastructure, and the like.

Kate Gordon offered an additional dimension on the infrastructure/climate connection. Her paper suggested that public spending on infrastructure projects should follow private sector practices and be subjected to a climate risk measurement and management screen. Potential physical risks associated with sea rise and storm surge, for example, should be addressed as a condition of receiving public funds. Associated climate impacts also should be considered, including the carbon intensity of infrastructure projects. Rather than relying on energy-intensive steel and concrete building materials, for example, builders should be incentivized to build low carbon infrastructure using materials such as solidified, sequestered carbon or recycled steel.

5. Using a Broader Calculus to Make Smart Energy Choices

Rob Jackson warned that policymakers should not be uni-dimensional when comparing the relative environmental merits of different energy choices. Instead, they should be guided by multiple environmental and public health considerations. He argued, for example, that while coal should be disfavored as an energy source due to its carbon intensity, coal also scores poorly on other environmental metrics. Its emissions cause serious, direct health effects and coal processing and combustion use large amounts of water and produce coal ash, which poses risks to waterways and communities.

The combustion of natural gas, in contrast, generates significantly less pollution, including less carbon dioxide, particulate matter, and the like. However, methane leakage can overwhelm natural gas' carbon advantage over coal. Jackson emphasized that natural gas may have little or no significant climate advantage over coal unless methane leakage is reduced, particularly from wet gas operations and from older distributions systems.

Steve Chu emphasized the importance that viable carbon capture and storage technologies be developed because many industries will continue to be reliance on fossil fuels for the indefinite future. Also, growing economies such India, China are likely to continue to be dependent on fossil fuels for many years.

6. Prioritizing Health

Dr. Michele Barry and colleagues at Stanford Medical School's Center for Innovation in Global Health argued persuasively in their paper that climate change is emerging as “the ultimate global health crisis.” They note that climate change already is responsible for many deaths due to extreme weather events. In addition, it functions as a risk multiplier, posing particular health dangers to the most vulnerable – children, the elderly, the poor, and the sick – due to shifting patterns of disease, food insecurity, water scarcity, excessive heat and related stresses.

Dr. Barry's paper makes a several key recommendations for the next President. The lead proposal is that the President launch a new program patterned on PEPFAR, President Bush's AIDS-focused global health initiative that saved millions of lives in Africa. The new climate change health initiative, tagged as the “President's Emergency Response to Climate Change” or “PERCC” would establish a comprehensive approach to address climate change health issues, including setting up a strong global surveillance system, developing new early-warning tools, linking existing networks, making data widely available, and creating platforms to share results. The PERCC initiative also would invest in international research, development and demonstration to advance adaptations to climate change and deepen knowledge on the co-benefits of integrating climate science and health science. Efforts would be devoted to strengthening preparedness and resilience in all health systems, particularly in low- and middle-income countries and in geographies already heavily affected by climate change.

7. Integrating Land Use Issues into the Climate Agenda

David Hayes emphasized that the next President needs to elevate the role of land use in the climate agenda. New data indicate that with modest investments in good stewardship, nature's assets have the potential to take up and store significantly more carbon dioxide in the world's forests, rangelands, and soils. A forthcoming study by the Natural Conservancy has quantified this potential. It concludes that even when taking cost constraints into account, 20 natural pathways involving conservation, restoration, and better land management across global forests, wetlands, grasslands and agricultural lands have the potential to provide more than 40% of the mitigation needed to hold warming below 2 degrees Celsius by 2030. This is 30% higher than previous estimates. There is a double bottom line benefit to investing in our natural and working landscapes: attending to the health of our landscapes will produce important co-benefits, including clean water, biodiversity, and increased agricultural production.

Land use also demands priority attention because 25 percent of the world's annual greenhouse gas emissions are directly caused by poor land use practices, including the on-going destruction of forests. Some progress has been made in reducing the rate of deforestation, but smart forest protection strategies – including cross-border forestry investments, as discussed below – can generate significant, additional emissions reductions.

In addition, the pivot to a clean energy economy depends on governments making sound, timely land use decisions to site and build new clean energy generation and transmission infrastructure. Land use issues also are front and center when it comes to climate impacts. Sea rise and storm surge already are impacting coastal infrastructure and resources.

Increased droughts, floods, wildfires and other climate change-related impacts on our landscapes are challenging cities and rural areas alike. Thoughtful land stewardship can blunt some of these impacts and make our lands and waters more resilient in the face of climate change.

Specific actions that the next President can take to actuate a land use/climate agenda include providing decision makers at all levels of government and civil society with easily accessible tools to measure and share information about climate benefits and risks associated with local land types. Also, a high-level office should address land use adaptation and resilience issues by providing

accessible mapping information that provides detailed, science-based information about existing and projected regional climate impacts on land and water resources, and a web-based clearinghouse that shares information about local, regional and national adaptation and resilience investments and strategies.

8. Engaging in International Climate Change Efforts

Several speakers noted the importance of continued leadership by the United States on the international climate change stage. Arun Majumdar noted that there are roughly 1.5 to 3 billion people in the world who do not have access to modern electricity and, as a result, are economically stranded in the 19th century without access to clean water, modern agriculture, education, information and industrial productivity. The United States and other developed nations have an obligation to help address this global energy poverty, and to do so by leapfrogging over fossil fuel-based energy to sustainable, clean energy sources. Global progress in fighting climate change depends on it. The opening of this vast new market for clean energy also provides significant business opportunities for American businesses.

Bill Reilly emphasized that the U.S. must help the developing world finance its ambitious commitments to reduce emissions and move to a clean energy economy. In addition to securing U.S. funds, Reilly recommends that the President reverse U.S. policy, which currently disfavors China's Asian Infrastructure Bank, and instead embrace the AIB and encourage China to make achievement of the Paris commitments a major thrust of the Bank's investments. He argues that the partnership of the United States and China, together with an important well-capitalized new international funding institution, could help ensure that China remains engaged in reducing its own and other countries' greenhouse gases, marshal significant funds, and set an example to other fast-growing developing countries.

David Hayes emphasized that the next President should facilitate cross-border market opportunities for U.S. companies to invest in deforestation-related emissions reductions. Carbon stocks in forests can now be quantified with objective measurement tools that provide a high degree of confidence. The time is ripe to establish investment vehicles that facilitate the protection of at-risk forests around the world.

Several speakers, including Arun Majumdar and Bill Reilly, also emphasized the importance of fostering North American climate collaboration among the U.S., Canada and Mexico, and using the Montreal Protocol model to reduce HFC emissions.

9. Regulations + Carbon Tax

Because the Stanford climate project has been focused on next steps, most speakers assumed that the Clean Power Plan would – and should – be implemented under the Clean Air Act. Similarly, several speakers noted the importance of regulating methane leakage and HFCs.

Over the course of the project, however, two broader, common themes emerged on the subject of regulations.

First, several speakers spoke in favor of pushing Congress to enact a carbon tax. Secretary George Shultz, for example, spoke forcefully in favor of a revenue-neutral carbon tax as a way to ensure that coal and other fossil fuels' true costs are reflected in the market. Others expressed support for the concept of a carbon tax, but viewed it as an unlikely political exercise, at least in the near term.

Second, several speakers, including Jim Connaughton and Andy Karsner, urged that market tools be favored over mandates, and that the next President seek to overhaul the patchwork of subsidies and one-off regulatory requirements associated with various energy sources. Connaughton pushed to simplify clean power and transportation mandates. Karsner recommended creating clean energy competitive opportunities for the business sector via a “transition by design” approach, rather than relying on a regulatory agenda that is inherently reactive in nature and likely to fail in important respects. Along the way, Karsner, Majumdar and Hundt, among others, noted that a new social compact should undergird the climate agenda, with a recognition that affordable energy must remain available to all segments of society, and that opportunities for increased clean energy choices likewise must be available to all.

Finally, several speakers, including Dan Reicher, emphasized the importance of expanding energy efficiency initiatives. Secretary Shultz also pushed this theme, recommending that conference attendees read “Energy Efficiency: Building a Clean Secure Economy” – the new book recently published by Jim Sweeney, Director of Stanford's Precourt Energy Efficiency Center.

10. Setting up the Federal Government for Success

In addition to identifying substantive policy recommendations for the next President's climate agenda, the Stanford project has focused on "governance" questions – that is, how the next President should set up his or her Administration for success.

One of the key governance questions is how to best deploy the cabinet agencies to implement a comprehensive climate agenda. A discussion paper prepared in advance of the May conference reviewed the track record of a number of Obama Administration interagency climate change initiatives. It concluded that the White House works best when it develops policy initiatives on behalf of the President. It was the White House, for example, that brought together the many White House and cabinet offices needed to develop President Obama's climate blueprint. And it was the White House that made the final calls on key policy choices.

When it comes to implementing policy initiatives, however, the Stanford study and report suggested that agencies – and not the White House – are best positioned to take the lead, since they have the budget, staff, jurisdiction and know-how to convert policy pronouncements into on-the-ground realities. The White House still has an important role. As John Podesta described at the May conference, it is more of a shared execution role, with senior White House officials communicating regularly with senior cabinet officials, providing encouragement, assistance and, where appropriate, a nudge, to ensure that the White House climate blueprint is moving forward at the agency level.

Unique challenges presented by the climate agenda also may require the White House and cabinet to explore new mechanisms to exploit their relative strengths. In particular, a strong White House voice, backed by strong agency leadership, will be needed to avoid parallel, but inconsistent, agency approaches to shared challenges associated with the deployment of clean energy, responding to climate impacts, addressing infrastructure needs, and the like.

The development of shared service centers, for example, is one option that has significant upside potential in the climate arena. Rather than having each of the major agencies develop their own mapping services that depict current and projected climate impacts on resources and infrastructure, for example, a consolidated mapping service should be developed, as noted in the Hayes paper. Similarly, the federal government is well situated to develop clearinghouse services that can provide data and case studies that will assist local and regional leaders who are grappling with climate impacts.

Finally, there was significant discussion at the January workshop in Washington about how the White House should be organized internally to develop and address a climate agenda. Concerns were raised about the multiple White House offices that all have pieces of the climate pie, from the Council on Environmental Quality; the Domestic Policy Council's climate change and energy office; the White House Office of Science and Technology; the National Security Council; the Economic Security Council; and OMB. Discussants offered a variety of organizational options around a consistent theme of consolidating a policy and coordination function at a high level, close to the President, and inclusive of all major aspects of the climate challenge, including environmental issues, energy issues, financial issues, climate impact issues, and the like. The goal is to avoid a diffusion of responsibility and accountability in the White House for strategic direction, coordination, and outreach.

Conclusion

The body of work produced by the Stanford Climate Implementation Project provides the next President's climate team with important observations and recommendations that deserve serious attention.

This short summary provides an overview of some of the most notable areas of discussion. We urge interested parties to consult with the key conference summaries, papers, and videos that are available on line for a more in-depth discussion of these, and other, important substantive and governance issues associated with our nation's climate change challenge.

CLIMATE IMPLEMENTATION PROJECT CONFERENCE SERIES

Discussion Papers | September 2016

The following discussion papers were produced in conjunction with the Climate Implementation Project Conference series sponsored by the Stanford Woods Institute for the Environment and Stanford Law School, in partnership with the Precourt Institute for Energy, the School of Earth, Energy and Environmental Sciences, and the Center for Innovation in Global Health at Stanford University. Workshops and other events in the series were organized by David J. Hayes in his capacity as a Distinguished Visiting Lecturer in Law at the Stanford Law School and a Consulting Professor with the Stanford Woods Institute for the Environment.

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Note: These discussion papers reflect research, analysis and proposals from their authors. Authors were invited to present their own findings, ideas and perspectives to inform and stimulate discussion independent of positions or viewpoints associated with Stanford University or its staff and leadership.

ENERGY INVESTING AND CLIMATE CHANGE

Recommendations for the Next U.S. President

Authors

Jagdeep Singh Bachher is Chief Investment Officer and Vice President of Investments, Office of the Chief Investment Officer of the Regents, University of California.

Amy Myers Jaffe is Senior Advisor, Energy and Sustainability, Office of the Chief Investment Officer of the Regents, University of California.

Contact

University of California
1111 Broadway, 21st Floor
Oakland, CA 94607

<http://www.ucop.edu/investment-office/>
amy.jaffe@ucop.edu

Abstract

Energy has traditionally been a focus of real asset investing, designed to enhance returns and balance against market risk such as inflation. But disruptive technologies and mounting climate change risks are presenting new challenges for energy-related investing. Fossil fuel commodity prices are increasingly volatile, and institutional investors are becoming more cognizant of the urgency to rebalance their energy portfolio to reflect climate change risk and the long-range transition to cleaner energy sources. Many U.S. pension funds and university endowments are also facing pressure from stakeholders to play a more proactive role in fostering climate change mitigation. However, multiple investment barriers remain. One barrier to the deployment of pension and endowment capital is the poor track record early efforts in clean energy investing have produced. Investor commitments to cleantech early adopters via venture capital and private equity funds produced mixed results in the 2000s. To sustain the flow of billions of dollars from long-term institutional investors into energy, new, innovative financial platforms will be needed. That's because the scale and scope of capital investment in energy infrastructure is very large, with long lead times to first earnings and a prolonged time scale for full returns. While institutional investors with patient capital could be the ideal source of finance for such long-lived asset investing, creative mechanisms are needed to overcome the hurdle of venture and technology risk. Regulatory uncertainty in the United States imposes an additional barrier to commitment of long-term capital.

Government has a role to play in promoting the regulatory and commercial conditions that allow energy cleantech developers to attract the needed capital to deploy new climate solutions. Additional financing structures and solutions are needed that can align direct opportunities in cleantech investing for long-term investors like pension funds, endowments and family offices with the long-term objectives of those institutions. What is needed is means to generate attractive risk-adjusted returns from investment in resource innovation companies and renewable energy projects in a manner that is vetted and verified by well-qualified parties.

For all these reasons, the next president should support the policies and improvements to existing oversight that enable the most successful financing mechanisms such as not-for-profit intermediaries, green bonds and tax-enabled off-balance-sheet-funding mechanisms. In particular, the next administration should

1. Strengthen Securities and Exchange Commission (SEC) oversight and rule making for the green bond market to improve disclosure, transparency and verification procedures, including for details of percentage of proceeds that will be used for new

project funding versus refinancing, as well as expanding requirements regarding impact reporting.

2. Authorize and expand capacity for the U.S. Department of Energy Clean Energy Investment Center to develop public/private investment vehicles that leverage Department of Energy (DOE) loan guarantee programs and pilot projects for later-stage investment participation by institutional investors.
3. Expand the reach and budget of the Small Business Innovation Research Program (SBIR) and the Small Business Administration (SBA) Equity and Debenture programs to provide seed funding for clean energy startups that could create a larger pipeline of investable companies for institutional investors over time. Add to the SBIR program a business plan–style competition conference bringing together early-stage companies and investors.
4. Use the purchasing power of the federal government for clean energy infrastructure projects, energy efficiency projects and advanced vehicles with tie-ins that could facilitate opportunities for private funding participation (e.g., via bonds or infrastructure investment vehicles), creating more clean energy investment opportunities with predictable, government-backed returns.
5. Lay the groundwork for achievable, visible U.S. national greenhouse gas emissions targets and policy initiatives that can put a more transparent price on carbon, sending a signal to markets that a transition in energy is not uncertain.
6. Begin the process early to extend the existing tax credits for renewables.
7. Add revenues from renewable energy production as a “qualifying” natural resource income under the IRS master limited partnership rules.

Introduction

Energy has traditionally been a focus of real asset investing, designed to diversify portfolios with investable assets that are negatively correlated with financial products such as stocks and bonds.¹ In recent years, investors have sought energy asset holdings to generate income and improve performance during times when financial assets were not offering robust growth. Since the early 1990s, investors have believed that real assets provide a form of “inflation insurance” for other assets in the portfolio,² with real estate and energy commodities deemed particularly attractive in this regard.³

Real assets investing, in particular energy investing, is aimed to be income producing and hold its value over time. During the commodities super cycle from the early 2000s to 2014, investing in oil and gas ventures provided robust returns. More recently, energy prices have been volatile, rendering investment in this sector more risky.

As oil commodity prices collapsed from an average of \$98 in 2013 and \$93 in 2014 to \$48 a barrel last year, portfolio managers have been registering losses in value and returns for energy holdings.⁴ The costs of renewables also dropped sharply – over 70 percent for solar panels since 2009 – while U.S. natural gas prices averaged not much more than \$2.25 million Btu in 2015, down from a peak of close to \$9.00 in 2008.⁵ These changes in price translated into a substantial decline in resource benchmarks in 2015. As a proxy, the MSCI index for world natural resources benchmark shed 23 percent last year versus gains of 7 percent from 2005–2010. At the third quarter of 2015, the Cambridge Associated Private Equity index, which includes real assets, posted

1 Kenneth A. Froot, “Hedging Portfolios with Real Assets,” *Journal of Portfolio Management*, (Summer 1995): 60–77 (Revised from Harvard Business School Working Paper No. 95–045, September 1993) .

2 Andrew Ang, “Real” Assets (working paper, Columbia Business School–Finance and Economics; National Bureau of Economic Research, 2012) accessed August 29, 2016, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2161124; Noel Amenc, Lionel Martellini, and Volker Ziemann “Inflation-Hedging Properties of Real Assets and Implications for Asset Liability Management Decisions,” *Journal of Portfolio Management*, 35, no. 4 (Summer 2009): 94–110.

3 Amenc, Martellini, and Ziemann, “Inflation-Hedging Properties.”

4 U.S. Energy Information Administration, <http://www.eia.gov/forecasts/steo/report/prices.cfm>.

5 Ibid.

a negative return (-1.4 percent) for the first time in several years, mainly based on write downs in energy holdings. Cambridge reported that “energy write downs drove the losses and overwhelmed positive returns from other large sectors.” By late 2015, the largest vintage in the Cambridge Associated Private Equity index from 2007 had negative returns of 2.4 percent, largely due to energy which suffered a double digit decline of 12 percent, according to Cambridge Associates.

Returns on investments in low carbon energy, or so-called cleantech, have also been uneven in recent years. The losses in some of the large-scale biofuels investments are well known. But returns in other cleantech ventures were also patchy. Solar panel manufacturing gross internal rate of return (IRR) as of March 31, 2015, was negative at -2.4 percent, for example, as was smart lighting at -3.7 percent, while energy efficiency and management only offered gains of 1.2 percent in contrast to winners such as energy storage, which offered 29.5 percent IRR on average, or smart grid, which offered 27.5 percent gross IRR, according to Cambridge Associates cleantech company performance sub-sectors benchmark.⁶

Going forward, disruptive technologies and mounting climate change risks will present new challenges for energy-related investing. Production costs for energy are falling because of technology advancements across the energy space, including emerging technologies like battery storage. Analysts believe lithium ion batteries could reach the critical \$150 Kwh tipping point in the next five to ten years. Oil and gas prices may also continue to fall over the long run based on foreign producer market share strategies and continued production cost improvements for unconventional drilling techniques in the United States and Canada. All this is translating into an increasingly volatile and uncertain outlook for energy investing.

Institutional investors are becoming more cognizant of the urgency to rebalance their energy portfolio to reflect climate change risk and the long-range transition to cleaner energy sources. Many U.S. pension funds and university endowments are also facing pressure from stakeholders to play a more proactive role in fostering climate change mitigation. The problem is that institutional investors must also ensure that sufficient returns are produced to meet ongoing and future obligations, which may include substantial payouts to retirees or cash for operating budgets of institutions and philanthropies. That means investments in cleantech must surmount an average annual returns hurdle of at least 7 to 10 percent, which has not been evident in early efforts in clean energy investing. Investor commitments to cleantech early adopters via venture capital and private equity funds produced mixed results in the 2000s.

In recent years, as mentioned above, cleantech subsectors have shown wide variations in returns. Solar panel manufacturing has been a losing proposition due to high competition in that sector. Investment in battery storage has provided attractive returns to date but carries high technology risk related to obsolescence in the event of a step change innovation. Water and wastewater are outperforming waste to energy, partly reflecting the still high cost of collecting and processing waste for the latter. Emissions control technology has yet to kick in to high returns but could improve over time as more countries regulate emissions using a price on carbon. This means that careful diligence will have to be done within the theme of clean energy investing, and creative partnerships will have to be developed to activate a pipeline of interesting opportunities that can generate the income requirements that will meet the targets for a real assets portfolio. And, for those committed to investing in climate solutions, there will be the worry that so many investor dollars will be chasing opportunities in renewable energy that values will become highly inflated.

Government Has a Role to Play

To sustain the flow of billions of dollars from long-term institutional investors into energy, new, innovative financial platforms will be needed. That's because the scale and scope of capital investment in energy infrastructure is very large, with long lead times to first earnings and a prolonged time scale for full returns. While institutional investors with patient capital could be the ideal source of finance for such long-lived asset investing, creative mechanisms are needed to overcome the hurdle of venture and technology risk

6 Risks and Opportunities from the Changing Climate, Cambridge Associates, 2015; <http://www.cambridgeassociates.com/our-insights/research/risks-and-opportunities-from-the-changing-climate-playbook-for-the-truly-long-term-investor/>.

and to generate the level of return that is needed to match earnings targets and payout obligations. Regulatory uncertainty in the United States imposes yet an additional barrier to commitment of long-term capital.

Government has a role to play in promoting the regulatory and commercial conditions that allow energy cleantech developers to attract the needed capital from institutional investors to deploy new climate solutions. Additional financing structures and solutions are needed that can align direct opportunities in cleantech investing for long-term investors like pension funds, endowments and family offices with the long-term objectives of those institutions. What is needed is means to generate attractive risk-adjusted returns from investment in resource innovation companies and renewable energy projects in a manner that is vetted and verified by well-qualified parties.

To date, to respond to these kind of challenges, the Obama administration, together with six institutional investors led by the University of California, has created an aligned intermediary (AI) that is structured as a not-for-profit, stand-alone benefit corporation that will seek investable ventures involved in climate infrastructure transactions such as clean energy, water infrastructure and waste to value.⁷ The idea of this AI is to bring together a group of professionals who can function similarly to a private equity management firm, but without the fee and profit structure that often can misalign financial goals among participating investors who might have different time horizons on a transaction. Management fees in large funds in the hundreds of millions of dollars can provide considerable income, providing incentives to create and manage cleantech funds, regardless of prospects of whether the fund will ultimately deliver adequate performance in the long run. In the renewable energy space, this trend is accentuated by the fact that organizers of funds can capture significant federal subsidies and loan guarantees flowing into the sector, multiplying the impact of their initial capital and capturing the risk mitigation as cash flow. Such incentives and loan guarantees are especially attractive because they do not dilute investor equity. The AI structure is designed to capture the best aspects of this kind of investor platform but remove the high fees and potentially misaligned time horizons and incentives. By eliminating the financial incentives for deal managers to quickly resell their own interests after collecting high fees for themselves, sometimes to the long-term detriment of the selected venture, it is hoped that the AI can provide a larger universe of vetted private, for-profit ventures for long-term investors who would be willing to stick with businesses to a later stage of their growth.

The next president should authorize and expand capacity for the U.S. Department of Energy Clean Energy Investment Center to develop public-private investment vehicles like the AI and facilitate those entities to better leverage the DOE loan guarantee programs and pilot projects for later-stage investment participation by institutional investors.

In addition to using public-private partnerships via DOE's Clean Energy Investment Center, the next president could reinvigorate the Small Business Innovation Research Program (SBIR) and the SBA Equity and Debenture programs and expand funding of these programs to provide seed funding for clean energy startups⁸ that could create a larger pipeline of investable companies for institutional investors over time. This mechanism has the advantage of avoiding technological bias as the award process is small scale and decentralized across agencies and is based on evaluation of individualized technical merits as opposed to broad categories.⁹ The SBIR program has also been found to be effective in moving technologies from academic-based laboratories to commercialization.¹⁰ Utilizing the SBA Equity and Debenture program for cleantech venture capital could also play a similar role.

7 Ashby H.B. Monk, Sarah Wood Kearney, Alicia Seiger, and Elliott Donnelley, "Energizing the US Resource Innovation Ecosystem: The Case for an Aligned Intermediary to Accelerate GHG Emissions Reduction." (June 12, 2015), accessed August 29, 2016, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2617816.

8 Andrew B. Hargadon and Martin Kenney, "Misguided Policy?: Following Venture Capital into Clean Technology," *California Management Review* 54, no. 2 (Winter 2012): 118–139.

9 Josh Lerner, "The Government as Venture Capitalist: The Long Run Impact of the SBIR Program," *Journal of Business* 72, no. 3 (1999): 285–318.

10 C. Wessner, ed., *An Assessment of the SBIR Program* (Washington DC: National Academies Press, 2008).

There might also be added benefits if a business plan–style competition conference was organized annually by the White House to bring together early-stage companies from the SBIR program and investors.

Previous administrations have used the purchasing power of the U.S. federal government for clean energy infrastructure projects, energy efficiency projects and advanced vehicle procurement. For example, the Obama administration has directed the U.S. military to deploy a total of 3 gigawatts of renewable energy by 2025. The projects will include wind, solar and biomass projects. In recent years, the Pentagon has begun building utility-scale solar farms in several locations in the United States, including Georgia and Arizona, to electrify bases in part to enhance national security by diversifying away from traditional electricity grids that can be subject to cyberattacks. The Navy is on track to produce a gigawatt of solar energy by 2020, enough to supply roughly half of the electricity supplies required at its domestic military bases. The next president should consider how future construction of federal clean energy infrastructure projects could be done with tie-ins that could facilitate opportunities for private funding participation via green bonds or infrastructure investment vehicles, creating more clean energy investment opportunities with predictable government-backed returns.

Tweaks to the tax code could also help propel more institutional private capital into the renewables sector. Master limited partnerships (MLPs) are publicly traded companies that are taxed as a partnership. To qualify for MLP status, a partnership must generate at least 90 percent of its income from qualifying sources, as stipulated by the Internal Revenue Service (IRS). The IRS code on statutory qualifying income includes oil and gas exploration, production and oilfield services, mining, midstream gathering, processing, transportation and storage, oil refining and processing, refined products transportation and terminaling, real property rent, timber processing and wood products, fertilizer production, and certain kinds of financial products. At present, energy generated by renewable energy infrastructure does not qualify for MLP treatment. MLPs allow businesses to avoid double taxation at the entity level and at the shareholder level. This is important because it means income is passed to shareholders who then only pay individual income taxes. In exchange for taking on this higher tax burden individually, investors typically receive high-yielding dividends (known as distributions) on a quarterly or monthly basis. The arrangement is one often favored by institutional investors. MLPs allow investments to potentially provide the kind of predictable, stable cash flows to institutional investors as dividend payments.

Because renewable energy ventures cannot use MLPs, other financing structures are used to limit the penalty of double taxation. Recent problems in the solar industry, for example, have stemmed from the use of so-called “yieldco” structures that allow these firms to reduce or eliminate entirely their corporate tax liabilities by using renewable asset depreciation and expenses to net out income earned from their assets. Although straightforward in theory, a number of firms have overexpanded their generating assets to maximize the number of qualifying expenses and they could potentially bear heavy debt susceptible to changes in interest rates as a result. To alleviate this problem, the next president could work with the Congress to add clean energy resources and infrastructure projects as qualifying for MLP tax treatment. Ventures using onshore and offshore wind, solar energy, biomass, geothermal, waste to value and fuel cells could be added to the list of qualifying resources, with possibly other kinds of investments such as large-scale energy efficiency upgrades for buildings, electricity storage and carbon sequestration, and storage projects.

The next president should also seek to improve oversight of other emerging cleantech financing vehicles being actively used by institutional investors such as the “green bond” market. A green bond is a fixed-income instrument whose proceeds finance projects that generate significant environmental benefits, including greenhouse gas emission mitigation. Standards for issuers of green bonds should be tightened and codified to ensure that bonds given the green distinction are generating funds whose use is predefined and transparent to the investor on projects that verifiably contribute positive net benefits for the climate or environment. Early issuances in the green bond market have, on occasion, fallen suspect to verifiable standards, thwarting the pace of market development despite strong investor interest in the concept. The green bond market allows institutional investors to incorporate environmental objectives in the normal course investing along the lines of fiduciary responsibilities associated with fixed-income investing.

The Securities and Exchange Commission should look for opportunities to enhance credibility and confidence in the green bond market by improving rules surrounding disclosure, transparency and verification procedures. Tightening standards for disclosure related to green bonds would allow investors to better compare offerings between issuers. In particular, investors are interested in

knowing what percentage of bond proceeds are being used for new project funding versus refinancing, especially for projects that were already financed prior to the start of the issuer's green bond program. Investors would also like to see better transparency, where issuers are encouraged to declare their plans for reporting project impacts, which will be publicly available and include annual reporting on beneficial climate, environmental and other impacts of their projects. Expected results should be disclosed based on estimates developed when projects are being designed and implemented.

Finally, clean energy investing is hindered when the regulatory environment surrounding climate change is lacking clear targets and direction. California's model of enunciating visible and tangible achievable greenhouse gas emission targets has successfully signaled the private sector to dedicate substantial capital and expertise to clean energy goals. It will be important for the next president to signal markets that a transition in energy is not uncertain. Stating upfront, clear aspirational objectives is a first-order action that lays the groundwork for all other actions. What is needed is a transition "by design" as opposed to a haphazard patchwork of partial approaches. Stability is important, and uncertainty regarding the renewal of the investment tax credit (deemed essential to investment in renewable energy) will dampen the thriving market for solar in 2016 as projects were taken out of the purchasing power agreement (PPA) pipeline, awaiting final word on the tax credit's fate in Congress.

Failing to account fully for the damage, and thereby the costs, that large-scale carbon emissions impose on the public through long-term climatic effects mean the country's largest emitters of carbon are – in effect – shifting the burden of their emissions onto the public. By extension, that means ultimately the U.S. taxpayer is paying for the emissions by industry since public funds are used to finance climate-related expenditures such as disaster relief and public works like levies and infrastructure repair. Pricing the carbon being produced by high-emitting entities based on the volume per ton of carbon they are emitting reallocates this "social cost" back proportionately onto the very entities now benefiting from the undervaluation of their polluting operations. Currently, the social cost of carbon is not adequately reflected in energy prices and manufacturing processes for carbon-intensive materials like cement and steel. This situation inadvertently disincentivizes businesses from making investments to reduce carbon emissions and promote energy efficiency by allowing businesses to escape the financial consequences of damage to the public commons.

Markets currently run the risk that carbon will be more accurately repriced in the future, adding to the other challenges facing long-term investors in the energy sector. Failing to provide a concrete, transparent national system that prices carbon leaves institutional investors without a means to determine the size of the climate risk they are facing or without insights into the timing regarding when a related risk might arise. Fears exist that a sudden steep drop in the valuation and pricing of carbon-intensive assets could create dislocations that could cascade through the economy. The decapitalization of U.S. coal mining firms over the past year is a harbinger of what such a problem could look like. Major U.S. coal firms went bankrupt despite the lingering need for coal supplies in the United States. Sudden bankruptcies leave no funding for costly environmental cleanup that might be needed from the facilities that are sunseting.

The next president will need to lay the groundwork for achievable, visible U.S. national greenhouse gas emissions targets and policy initiatives that can bring more transparency and planning to how carbon will be priced in our economy on a forward-looking basis. That action would allow companies to make more economically efficient decisions regarding their use of fossil fuels and to create a larger market for renewable energy. Once that important signal reaches the market, it will promote the efficient allocation of capital to infrastructure and energy production projects that are more in line with long-term environmental preservation. It will also reduce the chances that substantial capital will be squandered or large-scale projects will be built that could become stranded prematurely. If market signals are better aligned with long-term needs, the opportunities for institutional investors to deploy more capital in energy investing would expand, lowering risk and facilitating the important role we can play in promoting a better future for the country and our stakeholders.

HEALTH: THE HUMAN FACE OF CLIMATE CHANGE

Perspective and Recommendations for the Next U.S. President

Authors

Michele Barry, MD FACP, is the Senior Associate Dean for Global Health and Director of the Center for Innovation in Global Health at Stanford. As Director of the Yale/Stanford Johnson and Johnson Global Health Scholar Award program, she has sent over 1,000 physicians overseas to underserved areas to help strengthen health infrastructure in low-resource settings. As a past President of the American Society of Tropical Medicine and Hygiene (ASTMH), she led an educational initiative in tropical medicine and travelers health which culminated in diploma courses in tropical medicine both in the United States and overseas, as well as a U.S. certification exam. Dr. Barry is an elected member of the National Academy of Medicine (NAM) and is a past Chair of the NAM Interest Group on Global Health, Infectious Diseases and Microbiology. She currently sits on the Board of Directors of the Consortium of Universities involved in Global Health (CUGH), the Foundation for Advancement of International Medical Education and Research (FAIMER), and NIH Fogarty Center for International Health. She is the 2010 recipient of the Ben Kean Medal, given every three years by the ASTMH. Areas of scholarly interest include global health workforce, emerging infectious diseases, climate change impact on health, ethical aspects of transcultural training programs, and globalization's impact upon health in the developing world.

Diana Chapman Walsh, PhD, was President of Wellesley College from 1993 to 2007. Previously, as Norman Professor of Public Health and Chair of the Department of Health and Social Behavior at the Harvard School of Public Health and, before that, at Boston University, she studied social factors affecting the health of populations. Currently a member of the governing boards of the Massachusetts Institute of Technology (the Corporation and its Executive Committee), the Kaiser Family Foundation, and the Mind and Life Institute, she recently completed service on the boards of the Broad Institute of MIT and Harvard, which she chaired, and the Institute for Healthcare Improvement. She was a Director of the State Street Corporation (1999–2007) and a trustee of Amherst College (1998–2010) and is the recipient of eight honorary degrees and a member of the American Academy of Arts and Sciences. She writes, speaks and consults on higher education, leadership and the challenges of climate change.

Katherine States Burke, MBA MSc, is Deputy Director of Stanford's Center for Innovation in Global Health. In addition to climate change and its impact on health, her interests include online education and building research and training capacity in low-resource settings. Ms. Burke began her career as a writer, editor and publishing executive. She later served as a Senior Fellow in Global Health Sciences at the University of California, San Francisco. She earned a BA from Harvard University, an MBA from Northwestern University, and MSc from UCSF. She is a member of the Board of Dean's Advisors at the Harvard Chan School of Public Health and for eight years served on the board of the Accordia Global Health Foundation.

Contact

Stanford Center for Innovation in Global Health
Stanford University School of Medicine
291 Campus Drive
Stanford, CA 94305
www.globalhealth.stanford.edu
ksburke@stanford.edu

Abstract

Climate change is emerging as the ultimate global health crisis. Even if it were realistic to imagine greatly accelerated progress toward immediate and decisive action, global warming already presents unprecedented and potentially catastrophic risks to health, globally, nationally and locally. Climate change affects health directly, through extreme weather events, or indirectly, as a “risk multiplier” operating through environmental and social determinants, including access to air, water, food, sanitation and health care. Climate-related health risks, which threaten to reverse decades of hard-won public health gains, will vary by geography and population. The greatest threat is to the most vulnerable – children, the elderly, the poor and the sick.

Addressing this crisis represents a high-stakes test for global leaders and for humanity, requiring expertise and effort from every field of knowledge and every sector of society. The next president must reset the climate change discussion away from a debate between believers and doubters and toward action in the face of new and uncertain threats. The health sector has a major role to play in reframing the problem. Making health a central focus of all climate change policies, programs and planning can shift attention to widely-shared concerns and values. The administration must use all its tools – appointments, directed funding, convening power and, most of all, presidential leadership – to heighten public awareness, facilitate interagency and international cooperation, engage all stakeholders, and press for urgent and effective action to anticipate and address the health risks associated with a warming planet.

We offer three recommendations:

1. **Recognizing that climate change is central to global health security, create the President’s Emergency Response to Climate Change (PERCC).** Climate change is central to national and international security in every dimension: health security as well as economic and military security. Presidential Emergency Plan for AIDS Relief (PEPFAR), placed in the State Department in 2003, saved millions of lives and led to broad health gains across affected countries. The next president should create a similar 10-year, \$90-billion global initiative to meet climate change challenges to health.
 - Establish a strong global surveillance system, developing new early-warning tools, linking existing networks, making data widely available, and creating platforms to share results.
 - Invest in international research, development and demonstration to advance adaptations to climate change and deepen knowledge on the co-benefits of integrating climate science and health science.
 - Strengthen preparedness and resilience in all health systems. Current readiness is inadequate. New technical and organizational structures must integrate across fields, using networked coordination and systems thinking.
 - Evaluate and encourage development of co-benefits, investing in development of technology, products and services that reduce climate change and improve health.
 - Strengthen resilience in low- and middle-income countries through technical support, collaboration and innovative financing for efforts toward improved surveillance, mitigation and adaptation, especially in geographies already heavily affected by climate change.
2. **Invoke health to catalyze movement on climate change.** Appoint strong climate advocates in leading positions across the federal health apparatus. Invest in resilient health care systems, in “green hospital” initiatives and in health professionals as movement builders. Position hospitals as anchors to prepare communities to withstand the shocks of climate change. Engage public on the health benefits of slowing climate change. Support action by state and local governments, emphasizing innovation and rapid response. Engage stakeholders at all levels, especially vulnerable populations.
3. **Prioritize clean energy.** Reduced reliance on fossil fuels is essential preventive medicine. Premature deaths from outdoor air pollution are set to rise from 3 to 4.5 million by 2040. Business as usual may, by century’s end, be catastrophic for human health. The U.S. should phase out coal-fired power plants in 10 years, price other fossil fuels to reflect true costs, and intensify climate change diplomacy promoting health equity around the world.

As this century unfolds, the strength of our resolve and consequences of our actions will become evident. No one who has studied these issues seriously and objectively would deny that climate change is already here and portends a global future of widespread upheaval. We face formidable obstacles in the political and economic structure of the problem and in the reality that climate disruption is inflicting the greatest suffering on those least responsible for causing it, least equipped to adapt, least able to resist the powerful forces of the status quo. Useful responses will depend on conviction and courage, sophisticated partnerships, wise policy, effective treaties, focused investment in research and development, moral discernment, imagination and compassion. If ever there was a moment in history for inspired presidential leadership, if ever there was an issue worthy of a leader's best effort, this is the moment, this is the issue. Time is short, but it may not be too late to make all the difference.

Introduction

Health is fast becoming the human face of climate change. Almost daily, news sources feature health emergencies that are linked directly or indirectly to climate: lives lost to 100-year floods in the Gulf states and raging wildfires in the western U.S.; 58,000 deaths during a heat wave in Russia; Zika-damaged babies across the Americas; severe water shortages in parts of South Asia; starving villagers in Malawi. Rarely do the media draw the connections among these events, and more rarely still do commentators connect the dots between a warming planet and a rising burden of risks to human health.

Even if the world's people were poised to take immediate, decisive action to reduce greenhouse gas emissions and implement existing plans for adapting to the inevitable changes already under way, climate change would still portend unprecedented risks to health – globally, nationally and locally. If we fail to act now, the survival of our species may hang in the balance. Scientists are openly discussing this grim prognosis as the window for action narrows with the passage of days, weeks . . . years. If ever there were an issue awaiting presidential leadership, this is it: an economic issue, to be sure, and increasingly a security issue, but also an existential threat that must somehow be raised above the politics of the moment and our propensity to deny and distract ourselves from looming threats we fear.

Our purpose for writing this paper is to offer the health perspective as an essential frame for comprehending the stakes in climate change and for mobilizing Americans to see ways they can meaningfully act in their own interests and those of their families and communities. In it we draw from published literature on the complex relationship between climate change and health; make a case for moving health to the center of climate change policy, diplomacy and communication; and propose and support three high-level recommendations for the next administration:

- Create the President's Emergency Response to Climate Change (PERCC).
- Invoke health to catalyze movement on climate change.
- Prioritize clean energy as essential preventive medicine.

The climate crisis represents a singular test for global governance and leadership. The challenge is philosophical, technical, moral and systemic. It demands collective action and decision-making under uncertainty and will require expertise and effort from every field of knowledge and every sector of society, at every level of human organization.

While climate change is an urgent crisis, it is not amenable to quick solutions. The next president must catalyze and lead a broad and enduring global movement to create an equitable, secure and sustainable future for Americans, for all citizens of the world, and especially for future generations.

Background

Humans have been adapting to environmental change for millennia, surviving ice ages, droughts and plagues. Over some 12,000 years of the Holocene epoch, the levels of climate-warming carbon dioxide in the atmosphere remained relatively stable, as did Earth's temperature. But as the industrial revolution in the 20th century accelerated growth in population, economic activity, technology and pollution, human activities began to alter the planet's life-support systems. The scale and permanence of those impacts are such that geologists are now dating a new epoch to around 1950, calling it the Anthropocene to signify that *Homo sapiens* have pushed the Earth's natural systems into disequilibrium, moving greenhouse gas accumulations beyond levels considered safe for humanity's biologic and social well-being.¹¹

The question of specific adaptations that could protect humans and their health against the effects of climate change is becoming a major theme among specialists in public and population health, as well as some other physicians and health care administrators.¹² Scientists in other fields, however, and the general public have for the most part focused more on environmental and ecological aspects of climate change and technological questions than on human and health implications.¹³ Yet those studying climate change and health are already seeing evidence of damage to human health (for example, in rising rates of allergies, respiratory, and vector-borne diseases) and are calling for fuller study and better quantification of such impacts and their direct and indirect causes.

Climate change affects health in several ways:

- Directly: Extreme weather events, including flooding, fire, drought and heat waves, can cause trauma, death and ongoing health and mental health effects.
- Indirectly through environmental and ecological pathways: Damage to ecosystems may reduce crop yields; increase sea levels and salinity; shift patterns of disease through new distributions of ticks, mosquitoes and other vectors; and transmit water- and food-borne disease as pathogens respond to variations in temperature and precipitation.
- Indirectly through socially-mediated effects: Economic, social, cultural and political factors can amplify the burdens of climate change. Vulnerable populations are the first to suffer from food insecurity, water scarcity, extreme weather, excessive heat and the physical and mental stresses that follow: undernutrition, violence, displacement, economic losses and the destruction of protective infrastructures.

The current scientific consensus on the health effects of changes in global environmental systems has been summarized in a number of expert reports that are comprehensive, easily accessible and reader friendly. Five in particular stand out.

- *A Human Health Perspective on Climate Change*, published in April 2010 by the National Institute of Environmental Health Sciences (NIEHS), summarizes "research needs for all aspects of the research-to-decision making pathway that will help us understand and mitigate the health effects of climate change as well as ensure that we choose the healthiest and most efficient approaches to climate change adaptation."¹⁴ The report explores 11 specific disease and exposure categories, summarizing current knowledge and highlighting research needs. It concludes with this observation:

11 A. J. McMichael, "Globalization, Climate Change, and Human Health," *NEJM* (2013, April 4).

12 H. Frumkin, J. Hess, G. Luber, J. Mallay and M. McGeehin, "Climate Change: The Public Health Response," *American Journal of Public Health* 98, no. 3 (March 2008): 435–445.

13 A. J. McMichael, *Climate Change and Human Health: Risks and Responses*, World Health Organization, World Meteorological Organization, and United Nations Environment Programme (Geneva: World Health Organization, 2003).

14 C. J. Portier et al., *A Human Health Perspective on Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change* (Research Triangle Park, NC: Environmental Health Perspectives/National Institute of Environmental Health Sciences, 2010).

Natural systems adapt to environmental changes or they fail. Climate change threatens many of the natural and built systems that protect and preserve our nation's health [including] hospitals, clinics, public health agencies, trained personnel, roads and transportation systems, the electrical grid, water treatment systems, and many other components [and the] intangible or—ganizational structures (human and social capital) . . . required to maintain resilience to environmental threats. Climate change could have grave impacts on public health systems if they are not appropri—ately strengthened. Research into the vulnerability of these systems will be critical. . . . We have the capacity to avoid many of the worst health effects . . . and an ethical imperative to do so.¹⁵

- “**Human Health: Impacts, Adaptation, and Co-Benefits**,” a chapter in the 2014 *Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC), extensively documents observed and expected health risks.¹⁶ The report highlights the vulnerability of cities: By 2050, it projects that the number of urban dwellers facing chronic water shortages will rise from 150 million to 1 billion. The panel argues that policymakers should prioritize rapid development: “If economic growth does not benefit the poor, the health effects of climate change will be exacerbated.”¹⁷ The most effective means to increase resilience are reduced poverty, basic health care, access to clean water and sanitation, and improved capacity for disaster preparedness and response, it finds. The panel recommends looking closely at “scientific evaluation of the health implications of adaptation measures at community and national levels [in order to] improve understanding of the extent to which taking health co-benefits into account can offset the costs of greenhouse gas mitigation strategies.”¹⁸
- *The Third National Climate Assessment* (NCA), issued in 2014 by the U.S. Global Change Research Program (USGCRP), a joint program of 13 U.S. agencies and departments, describes “wide-ranging health impacts,” some of which are “already under way in the United States,” and argues that “public health actions, especially preparedness and prevention, can do much to protect people from some of the impacts. . . . Early action provides the largest health benefits. As threats increase, our ability to adapt to future changes may be limited.”¹⁹
- *The Lancet Commission on Health and Climate Change* published a 2015 report reiterating its 2009 conclusion that “climate change is the biggest global health threat of the 21st century.”²⁰ It cites “rigorous epidemiological research” attributing an estimated 400,000 excess deaths to climate change in 2010, “with a significant increase in this figure expected by 2030.” Climate change acts as “a ‘force multiplier,’ exacerbating many of the world’s global health challenges,” the Commission states, recommending “urgent and sustained emissions reductions, as well as effective adaptation . . . to reduce these impacts.”²¹ The Commission presents 10 policy recommendations for government, several related to increased investment in research, monitoring, surveillance and to “quantification of avoided burden of disease, reduced health-care costs, and enhanced economic productivity associated with climate change mitigation.”²² Others recommend health-promoting energy policy and urban design and new “mechanisms to facilitate collaboration . . . empower health professionals, and ensure that health and climate considerations are thoroughly integrated into government-wide strategies.”²³ Finally, the Commission establishes an international

15 Ibid.

16 K. R. Smith et al., “Human Health: Impacts, Adaptation, and Co-Benefits,” in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. C. B. Field et al. (Cambridge: Cambridge University Press, 2014): 709–754.

17 Ibid.

18 Ibid.

19 J. M. Melillo, T. Richmond, and G. W. Yohe, eds., *Climate Change Impacts in the United States: The Third National Climate Assessment* (U.S. Global Change Research Program, 2014).

20 N. Watts et al., “Health and Climate Change: Policy Responses to Protect Public Health,” *Lancet* 386 (2015): 1861–1914.

21 Ibid.

22 Ibid.

23 Ibid.

“Countdown to 2030” panel to monitor progress.²⁴

- *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (USGCRP, 2016) extends the NCA’s 2014 assessment of concerns about human health.²⁵ It synthesizes published data in a series of chapters, each focusing on a particular climate driver. The report characterizes the strength of scientific evidence along each pathway, notes improved “scientific confidence in the climate change and health link,” recognizes “populations of concern,” and identifies emerging issues.²⁶ “Every American is vulnerable to the health impacts associated with climate change,” the report states.²⁷

Taken together, these reports align with a number of other published sources in their emphasis on a set of priorities that need to be pursued aggressively and concurrently. Scientific understanding of the climate change/health nexus needs to be deepened, and evidence-based decision-making augmented at the same time that adaptation plans are being developed and disseminated to manage uncertainty and risk. What has been lacking to date is adequate funding and support for moving such a complex agenda forward at a reasonable pace.

First, it is widely agreed that advancing the science will require better tracking of data on multiple levels and linking of environmental conditions to health risks and outcomes. Data from disparate sources (clinical, meteorological, ecological, biological, economic), collected at different scales and using different methods, needs to be better integrated. Further, there is an urgent need for enhanced analytic capacity, including modeling and forecasting health risks related to climate change and quantifying the potential to reduce disease and health care costs through timely and effective adaptation. This, in turn, points to the need for systematic development and testing of alternative strategies to reduce risk.

All of this requires multilevel, interdisciplinary, integrated approaches that operate, in terms of governance, both from the bottom up and the top down, recognizing that it is generally at the local and state levels (where resources are often strained) that threats and vulnerable populations can best be identified and reached, adaptation strategies designed and tested, and emergency responses activated. Local health departments are the first line of defense, and they are grievously underfunded and understaffed. The hospital sector has a significant and as-yet underdeveloped role to play. Robust partnerships are essential, as are new collaborations across a wide range of disciplines, jurisdictions and domains within and across agencies of government; the private sector; community, religious and faith-based organizations; universities; nonprofits; and the health and public health infrastructure.

Second, a high priority should be to identify locations and populations that are in harm’s way and the specific threats they face. Displaced populations are particularly vulnerable, and water and food security are fundamental to human health. Strategies for community development and for adaptation of the built environment, the transportation systems and the public health infrastructure are also important. Response plans need to envisage specific exposures and needs. Mental health consequences of extreme weather events can be severe and need to be anticipated: anxiety, depression, grief, trauma and the losses and stresses of mass displacement and regional conflicts.

Third, it is widely agreed that new resources are needed for capacity and workforce development, for enhancement of the resilience of the public health and health care infrastructures, and for dissemination of a new set of cross-disciplinary competencies across the research and service-delivery sectors of the health and public health systems.

24 Ibid.

25 U.S. Global Change Research Program. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. A. Crimmins et al., eds., (Washington DC: U.S. Global Change Research Program, 2016).

26 Ibid.

27 Ibid.

Fourth, it is generally acknowledged that communication and risk communication need to be enhanced, targeted, refined and tested to strengthen public appreciation of individual and community risks, to encourage preparedness and to galvanize support for the kinds of public investments that are needed to fortify the nation's defenses against climate change.

Finally, a persistent theme in the literature is the need for new ways of collaborating: faster, more flexible, with more and new partners, and often with transient structures focused sharply on specific problems. A top-down approach is not flexible or agile enough. The imaginations and experiences of people and communities at every level are needed, and, to accomplish this, researchers and other professionals will have to reach beyond traditional partners and cross into unfamiliar territory.

For this, there may be models to follow. Global networks of research, development and demonstration (RD&D) increasingly exist in the private sector, and often in government and civil society as well. While 30 years ago, talent, resources, expertise and experience seemed to be clustered in a few hundred institutions, primarily in North America and Europe, today's researchers, policymakers and activists can tap into a dense network of working relationships among individuals and institutions located in a far more diverse set of entities around the world. "Multinational corporations, governments, and civic institutions operate global RD&D enterprises relying on both in-house and outside (sourced) talent and intellectual property, organizing these efforts around an applied research mission, market opportunity, or civic need," notes Bruce Guile in a working paper.²⁸ As an example, the Defense Advanced Research Projects Agency (DARPA) recruits exceptional leaders from government, academia and industry for three-to-five-year cycles, in order to press for transformational, rather than incremental, change.²⁹ At the recommendation of a panel of the National Academies of Science, the DARPA model has been adopted by the Advanced Research Project Agency–Energy (ARPA-E) and could be deployed to address health impacts of climate change.³⁰

The world's increasing interconnectedness can be leveraged not only to advance RD&D, but perhaps also to drive public engagement in fighting climate change. Environmental communication (and the subfield of climate change communication) has matured over the past 30 years, along with the fields of health promotion and social marketing, all of which conduct experiments to identify effective strategies to improve knowledge, reshape attitudes and influence behavior – all in the service of communicating risks, and protecting and advancing the public's health. Social media add another dimension – accessible and interactive, opening multiple avenues of approach and offering opportunities to learn from instant feedback. Critics have raised concerns, on the other hand, that ever more pervasive and invasive technology-based communication media have created information overload, polarization, privacy concerns, escapism and social isolation, all of which may undermine the goal of arousing appropriate concern about impending threats. Here, too, more research is needed with an eye toward communication approaches that emphasize compassion and support, respect, and restoration of connection. Moser sees a pressing need for what she calls a "humanistic turn in environmental communication."³¹ The world is increasingly complex.

And yet, paradoxically, these times of great uncertainty and unprecedented environmental and social challenge may open extraordinary opportunities for the next president of the United States to put a human face on climate change, harmonize the many voices across the nation's landscape and mobilize the can-do spirit that makes this country great. We offer three recommendations, all building on the dual premise that (a) the health sector has a major role to play in reframing the problem of climate change and (b) making health a central focus of all climate change policies, programs and planning can shift attention to concerns and values the

28 B. Guile, *The Resilience Project: Research, Development, and Demonstration Targeting Successful Human Adaptation to Climate Change* (working paper, The New Advisory Group, Washington DC, September 2016).

29 Defense Advanced Research Projects Agency website, accessed September 6, 2016, <http://www.darpa.mil/about-us/about-darpa>.

30 Committee on Prospering in the Global Economy of the 21st Century: An Agenda for American Science and Technology, Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, Institute of Medicine, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. (Washington, DC: National Academies Press, 2007).

31 S. C. Moser, "Whither the Heart(-to-Heart)? Prospects for a Humanistic Turn in Environmental Communication as the World Changes Darkly," in *The Routledge Handbook Of Environment and Communication*. A. Hansen and R. Cox, eds., (New York: Routledge, 2015).

American public deeply holds and broadly shares.

Our three recommendations are grounded in seven basic operating principles:

- Align with promising efforts already in place rather than creating new institutions that are redundant and dilutive.
- Adapt successes from the past to inform new efforts and needs (PEPFAR and DARPA are two examples).
- Reward cross-cutting collaborations and new ways of thinking and working.
- Reach beyond traditional actors to engage at every level and through every channel.
- Keep climate change front and center, with health concerns as a primary motivator and health professionals and institutions as ubiquitous sources of influence and stability.
- Vigorously pursue mitigation strategies to slow and eventually reverse global warming trends, while advancing knowledge and preparations to meet and manage impending risks.
- Emphasize that U.S. policy on climate change should be consistently global, focusing on helping low- and middle-income nations leapfrog into a clean energy future and close gaps in health equity climate change threatens to widen.

RECOMMENDATION #1

Recognizing that climate change is central to global health security, create the President's Emergency Response to Climate Change (PERCC), locating this initiative in the U.S. State Department to global health security and diplomacy and to enable U.S. agencies and other partners to advance adaptation and mitigation through the lens of health.

Established in 2003, PEPFAR is the largest and longest commitment by any nation to address a single disease and remains the flagship for HIV response around the world. PEPFAR has supported more than 9.5 million people on antiretroviral treatment, saved 1.1 million lives, and lowered sub-Saharan African mortality by 10 percent.³² In addition, it strengthened health systems and led to broad health gains in affected countries.³³ Over 10 years, the United States invested \$63 billion dollars, and PEPFAR remains the cornerstone of the Presidential Global Health Initiative.³⁴ Government agencies and academic institutions have used PEPFAR funds to study and treat HIV with remarkable health outcomes.

We suggest a similar 10-year, \$90-billion fund to meet climate-related health challenges. Climate change is central to national and international security in every dimension: health security as well as economic and military security. The surest long-term strategy to fight transnational threats is to promote global health and stability. As with HIV, climate-related health impacts will not respect borders. Moreover, health security can easily spill over into other dimensions of national security, triggering military, economic, social and political concerns. We therefore propose the PERCC as a means to better characterize and respond to these new threats, both at home and abroad. Our model is based on the PEPFAR example.

Specifically, PERCC can help:

- **Establish a strong global surveillance system**, developing new early-warning tools and building on existing networks. Better surveillance of food- and water-borne diseases, vector transmigration, and deaths, injuries and disease sequelae of extreme

32 E. Bendavid and J. Bhattacharya, "The President's Emergency Plan for AIDS Relief in Africa: An Evaluation of Outcomes," *Annals of Internal Medicine* (2009).

33 E. Bendavid, "Past and Future Performance: PEPFAR in the Landscape of Foreign Aid for Health," *Current HIV/AIDS Report* (2016).

34 Committee on the Outcome and Impact Evaluation of Global HIV/AIDS Programs Implemented Under the Lantos-Hyde Act of 2008, Board on Global Health, Board on Children, Youth, and Families, Institute of Medicine, *Evaluation of PEPFAR*, (Washington, DC: National Academies Press, 2013).

weather can help decision-makers at all levels of government and civil society predict and prepare for adverse climate-related health outcomes. In addition, such systems should incorporate information from nonhealth sources: Linking meteorological, agricultural and other “big data” sources could, for instance, enable predictive modeling and preventive health measures. Data should be made widely available, and new platforms developed to share results.

- **Invest in research, development and demonstration (RD&D) to advance adaptation** to climate change and deepen knowledge about the co-benefits of integrating climate science and health science. Currently, few medical, nursing and public health schools have strong climate and health divisions, and few climate scientists are well-informed on health impacts. Limited grants are awarded by the NIEHS or the Centers for Disease Control (CDC) to advance the science of climate’s impact on health or methods of mitigation and adaptation through the lens of health. More funding is urgently needed to solidify this emerging cross-disciplinary field.
- **Strengthen preparedness in all health systems** by integrating across fields using networked coordination and systems thinking. PERCC funding can facilitate vulnerability mapping, enhance planning for food and water security, and encourage innovation by states and counties to modernize, strengthen, and streamline public health services and infrastructure. It can target areas of vulnerability, such as public and private water systems. PERCC support may also create incentives for the private sector to rapidly prototype and bring to market new products, services and collaborations that enhance adaptation to climate change impacts.
- **Evaluate and encourage leveraging of co-benefits**, investing in technology, products and services that reduce climate change and improve health. For example, grants could showcase urban planning that supports healthy lifestyles, energy-efficient building, low-cost public transportation and open spaces, thereby reducing urban pollution and rates of cardiovascular disease, asthma, pulmonary disease, obesity, diabetes and mental health disturbances.
- **Strengthen resilience in low- and middle-income countries (LMICs)** by funding efforts toward food and water security, and improved surveillance of changing vector distribution, zoonoses, and emerging infectious diseases. Strengthening LMIC capabilities to monitor and respond to disease outbreaks protects the health of U.S. citizens as well as the world’s, as diseases respect no boundaries. To achieve resilience, LMICs must prioritize investment in health and health systems, as well as build capacity to monitor climate change and adapt to impacts. The U.S., through PERCC, can partner with them, offering technical support, collaboration and innovative financing, especially in geographies already oppressed by climate-related damage to ecological and life-support systems.

We suggest PERCC reside in the U.S. State Department, as PEPFAR did, to highlight the need for climate diplomacy and security. Multiple U.S. agencies should be eligible to apply for funding, and PERCC should encourage multilateral engagement of international funds and country partners to strengthen U.S. investments.

When HIV emerged in Africa, it became clear that the world and not just a continent was threatened by this devastating disease. The U.S. stepped up to protect those vulnerable populations least resourced to protect themselves. Led by a bold executive decision by President George W. Bush, the United States made an extraordinary commitment to spur global as well as U.S. initiatives for research and treatment to counter AIDS. President Obama honored and extended that American commitment to stem a world crisis.

As HIV did, climate change presents unprecedented risks to public health – globally, nationally and locally – and likewise disproportionately threatens vulnerable populations. PERCC could have a similar catalytic impact by underwriting global RD&D applied to the political, economic, medical and social context of climate change. PEPFAR dramatically changed the path of AIDS. PERCC can funnel similar energy and attention to the potentially cataclysmic course of climate change.

RECOMMENDATION #2

Invoke health to catalyze movement on climate change.

Our second recommendation directs the attention of the next administration to a potentially powerful resource for progress in sustainability: the nation's health sector, together with the public's interest in personal health. This recommendation envisages government support of networked and distributed health care leadership pursuing three major imperatives: (a) studying and improving the resilience and readiness of the health care delivery system as an essential community resource in times of crisis; (b) advancing the drive toward sustainability and renewable energy in the health sector itself, and (c) planning for a healthier future.

Activating these resources will require attention to a fourth, and deeper, imperative, namely the selection of leaders across all federal health agencies who understand the urgency of climate change, the inadequacy of existing scientific evidence to support preparedness and adaptation, and the critical need for investment in predictive modeling and robust evidence for decision support.

In his 2013 Comprehensive Climate Action Plan for the United States, President Obama charged the Department of Health and Human Services (DHHS) to “ensure that the medical system is resilient to climate impacts” and that public health professionals and community leaders are preparing their communities “for the health consequences of climate change.”³⁵

A number of federal agencies, notably the NIEHS and the CDC, have begun developing leadership models at multiple levels of governance (federal, state, regional, municipal, community) to advance the movement against environmental degradation and global warming. We believe the health care sector – at home and abroad, public and private – can play a critical role in accelerating the momentum to address climate change.

Some of this work involves public-private partnerships with university-based and free-standing organizations. An example is Health Care Without Harm (HCWH), founded in 1996 as a grassroots coalition. HCWH has driven interventions with documented success and has evolved a vision of a health care sector positioned to play a pivotal role in “healing, or restoring, ecological, economic and social capital” in communities served by hospitals and large health care conglomerates, here and around the world.³⁶

The Healthcare Delivery System: Resilience and Readiness

The first imperative, articulated by DHHS, is “to assure the continuity and quality of health and human care before, during and after extreme weather events.”³⁷ Events like Hurricane Katrina and superstorm Sandy broadcast the special vulnerabilities of underserved populations and the inability of existing health care organizations to rally to their aid. The resilience of the entire health care system needs to be re-thought – ground up, top down, and across the interstices – asking questions well beyond emergency planning as traditionally understood.

Healthcare executives will need sensing systems that are local, fine-grained and geographically specific. For example, NIEHS developed in collaboration with HCWH a “toolkit,” which has been piloted in 10 major health care systems and is ready for wider dissemination.³⁸ The next administration could bring to every U.S. hospital these tested tools, training methods and strategies. This would also strengthen hospitals' community needs assessments, mandated by the Affordable Care Act, and should be designed to help document and quantify the immediate health benefits achievable through successful actions to reduce the impacts of climate change.

35 “The President's Climate Action Plan,” Executive Office of the President, 2013, accessed September 6, 2016, <https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

36 Health Care Without Harm website, accessed September 6, 2016, <https://noharm-global.org>.

37 “The President's Climate Action Plan.”

38 “Primary Protection: Enhancing Health Care Resilience for a Changing Climate,” U.S. Department of Health and Human Services, 2014, accessed September 6, 2016, <https://toolkit.climate.gov/topics/human-health/building-climate-resilience-health-sector>.

Sustainability and Renewable Energy in the Health Sector

The second imperative is the “greening” of the health care industry itself, a \$3-trillion economic enterprise, 18 percent of the U.S. economy. In some 200 American cities, the hospital is the primary economic engine and sociocultural pillar of the community.³⁹ Health facilities produce an estimated 8 percent of U.S. greenhouse gas emissions, 12 percent of acid rain, 10 percent of smog and 9 percent of respiratory disease-causing pollutants, accounting annually for an estimated 470,000 disability-adjusted life years (years lost from illness, disability or early death).⁴⁰

National and international coalitions are pressing forward the work of identifying and eliminating known health hazards embedded in hospital operations. Hospitals are beginning to face, measure and address their damaging impacts and document the results. An example is the private Gundersen Health System in Lacrosse, Wisconsin, whose investment of \$2 million in sustainability improvements in 2008–2009 now produces more than \$3 million in annual savings, money they reinvest in further innovation.⁴¹ Conservation can be demonstrably profitable.

The next administration could take a page from the private sector and work out methods to finance cycles of innovation through savings accrued from squeezing out waste. It could establish a revolving capital fund enabling hospital systems to innovate and then pay back as they achieve savings from meeting sustainability goals. Project designs should be required to capture and disseminate what has been learned about key vulnerabilities and successful strategies to increase resilience.

Messaging for a Healthier Future

The third imperative is to bring sustainability into the mainstream of public health education, communication and promotion. For years the world’s scientists labored to rally the public around the threat of climate change. A decade ago the Center for Climate Change Communication at George Mason University began to study “framings” that might break through the public’s resistance. In scores of studies dissecting gaps in understanding the realities of climate change, the Center consistently found that the connection between climate and health is invisible to the average American.⁴² And yet messages about personal health resonate deeply with the public. In fact, even those most deeply skeptical of the climate message, the Center’s studies reveal, can support cleaning up the atmosphere for “the better life” this would bring family and friends who suffer from respiratory and other ailments. “Just don’t try to sell it to me on climate change,” they say in focus groups. “That’s a hoax.”⁴³

The Center has been reaching out to the medical and health communities with materials and advice that draw on this research foundation and reframe the climate message in terms of personal goals for health and well-being that Americans understand and value.

The next administration could encourage and support this work by the health care and public health professions, already poised to roll out a nationwide communications plan. Health professionals can reframe climate change as a public and personal health issue, thus activating support for essential climate change policies that are politically stalled, such as pricing carbon, eliminating coal, supporting the EPA’s Clean Power Plan, enforcing renewable energy standards and releasing research funds. As trusted members of society, doctors and nurses can convey the necessity of moving away from fossil fuels for the sake of healthy communities, a healthy planet and the well-being of future generations.

39 D. Zuckerman et al., *Hospitals Building Healthier Communities: Embracing The Anchor Mission*, (Takoma Park: The Democracy Collaborative at the University of Maryland, Takoma Park, 2013).

40 M. J. Eckelman and J. Sherman, “Environmental Impacts of the U.S. Health Care System and Effects on Public Health,” *PLoS ONE* (2016).

41 J. A. Ferenc, “A Sustainable Mission: Gundersen Nears Total Energy Independence,” *Health Facilities Management* (2014).

42 E. W. Maibach et al., “Do Americans Understand That Global Warming Is Harmful to Human Health? Evidence from a National Survey,” *Annals of Global Health* (2015).

43 Ibid.

To bolster such messages, the administration, through both its health research arms (CDC and NIH) as well as other relevant agencies including EPA and NOAA, should stimulate vital research on specific impacts of climate change on health and on achievable gains that can be realized, both immediately and in the longer term, through timely mitigation and adaptation measures.

Some of the imputed savings could be reinvested in preventive programs, especially those that arouse public awareness of the interplay between personal and planetary health. An ambitious sustainability perspective on public health would analyze and quantify a whole range of structural, economic and social factors that affect the health of populations and of the planet: aspects of urban planning and transportation, agricultural and fossil fuel subsidies, and regulation of chemicals and pharmaceuticals, for instance. The ultimate goal would be to identify targets of opportunity to improve the nation's health through evidence-based environmental policy.

New Leadership for New Challenges

Beyond these three specific imperatives lies a fourth, more immediate, one. The current reality is that the federal health apparatus is far from adequately staffed, funded or mobilized to meet the magnitude of the coming challenges associated with climate change. Leadership at the highest levels, delegated directly from the Secretary of Health and Human Services, is needed to communicate consistently that preparedness for climate change is fundamental to all aspects of the federal health mission. And Cabinet-level understandings are needed to penetrate firewalls between existing jurisdictions, so that research capacity and funding will be directed toward advancing regional climate science and expertise that crosses agency boundaries. Thus, the preeminent imperative facing the next administration in the short term is to appoint strong climate advocates in leading positions across the federal health infrastructure.

RECOMMENDATION #3

Prioritize clean energy as essential preventive medicine.

Transitioning to clean energy sources – not just in the U.S. but globally – is the essence of preventive medicine. Business as usual could, by century's end, be catastrophic for human health and civilized society.

If global warming continues on its current trajectory, the world – even with current pledges for cutting greenhouse gas emissions – is on path to temperature increases of 4 degrees C, a level associated with cataclysmic change: extreme heat waves, widespread and intense shortages of food and water, inundated cities, devastating storms and large-scale displacements of people.⁴⁴ *Turn Down the Heat*, a 2016 World Bank report prepared by the Potsdam Institute for Climate Impact Research (PIK) and Climate Analytics, notes that the Earth's life-support systems do not respond to climate change in a linear way. "If we venture far beyond the 2°C guardrail, towards the 4°C line, the risk of crossing tipping points rises sharply," notes PIK Director H. Joachim Schellnhuber. "The only way to avoid this is to break the business-as-usual pattern of production and consumption."⁴⁵

As World Bank Group president Jim Yong Kim has said, "Lack of action on climate change threatens to make the world our children inherit a completely different world than we are living in today."⁴⁶

44 Ibid.

45 World Bank, "New Report Examines Risks of 4 Degree Hotter World by End of Century," press release, November 2012.

46 N. Watts, "Why the Global Health Community Is Calling on the G7 to Pull the Plug on Coal." *BMJ* (blog), May 18, 2016.

To avoid this outcome and its almost unimaginable consequences, the United States must move beyond short-term thinking and partisanship to take decisive action. A rapid transition to clean energy sources will be disruptive and painful, much more so in some communities, regions and countries than others. The next administration will have to use its convening power to engage stakeholders on all sides of the issue and navigate a path forward.

The innovator's dilemma, described by Harvard Business School professor Clayton Christensen, notes that in times of complexity and rapid change, companies often fail to recognize that they will have to choose between adapting incrementally to better serve existing clients and markets or risking disruptive actions to open new markets and opportunities for future growth. The next administration should take a hard look at how this thinking might apply to energy use: If federal goals and efforts remain oriented toward incremental progress, for which it is easier to build consensus, then will it be possible to achieve the transformative change demanded by the scientific consensus on climate change?

We suggest three elements of a solution, none easy but each important.

Phase Out Coal

The United States should commit to meet the United Kingdom's ambitious goal of phasing out coal-fired power plants within 10 years. If all the coal-fired power plants currently planned or under construction are deployed over their expected lifetimes, the additional greenhouse gases will substantially increase levels of global warming.⁴⁷ Already, coal is associated with four of five leading causes of death in the U.S.⁴⁸ The World Health Organization estimates deaths from air pollution at about 7 million globally and identifies such pollution as the leading cause of mortality in some countries.⁴⁹

Reducing coal use offers compensating co-benefits in improving health and mitigating global warming. Quantifying those health and climate gains more accurately can help make the case for change and is a promising target for research. Investments in clean coal technology, while achieving some success, will not win the race against climate change. Federal policy needs to address the serious economic and social challenges that many communities dependent on older energy technologies will face as renewable sources develop.

Price Other Fossil Fuels to Reflect True Costs

It is important to recognize that policies developed over decades favor use of fossil fuels and fail to account for costs to health and climate that accompany their use. The U.S. should move away from support of fossil fuels through subsidies, public finance and other instruments, and direct such monies toward sustainable energy sources.

Prices of carbon-based fuel sources should reflect true costs, including environmental and health damages, now and for future generations. The U.S. can advance this effort by further implementing carbon pricing schemes, along with 40 national jurisdictions and more than 20 cities, states and regions.⁵⁰ In addition, it can encourage development of national and international emissions trading markets. As part of this effort, the U.S. can implement the inclusion of natural capital in assessments of energy, infrastructure and other development projects, incentivizing energy efficiency, active transport, "green" building methods, and greater reliance on sustainable energy. Many of these policies offer co-benefits for health and climate.

47 Ibid.

48 A. H. Lockwood, K. Welker-Hood, M. Rauch, and B. Gottlieb, *Coal's Assault on Human Health: A Report from Physicians for Social Responsibility*, 2009, www.psr.org/coalreport.

49 A. Pruss-Ustun et al., "Preventing Disease through Healthy Environments: A Global Assessment of the Burden of Disease from Environmental Risks," World Health Organization, 2016.

50 A. Kossoy et al., *State and Trends of Carbon Pricing*, World Bank and Eocfys, September 2015.

Intensify Climate Change Diplomacy

As a nation that led in industrialization and has reaped the economic, social and political benefits of development over many decades, the United States has a moral obligation to lead in mitigating and adapting to the human-induced changes to the environment. The next administration should approach this challenge with some humility, reflecting the nation's role in creating the problem and in continuing relatively high levels of energy consumption, yet also with a willingness to use the United States' political and financial capital to advance climate change diplomacy.

Actively promoting and implementing ambitious measures for mitigation and adaptations to climate change diplomacy is not just a moral obligation, however. It is also essential for global peace and security. The geopolitical and socioeconomic consequences of climate change will need to be addressed, now and even more so in the future. The next administration will have to keep climate change and its health impacts in prominent view as it engages internationally with other governments, civil society and the commercial sector around issues of environment, development, global health and trade. Climate change diplomacy can build strong relationships, defuse tensions and misunderstandings, foster cooperation around RD&D, and promote dialogue and understanding as the nations of the world move toward an uncertain future.

Conclusion

While climate change has entered mainstream thinking – in a March 2016 Gallop poll nearly two-thirds of Americans expressed a “great deal” or a “fair amount” of worry about global warming – few understand the implications for human health.⁵¹ This paper highlights the work of scholars and activists who have underscored health as an essential frame for comprehending the stakes in climate change and for encouraging Americans to grasp that it is within their power to advocate, collaborate and take actions that will protect their own health and that of their families, neighbors and communities. Writer and speaker Kathleen Dean Moore is invariably asked by audiences, “What can one person do?” “Stop being one person,” she replies.⁵²

The climate crisis is a collective action problem that no single sector can solve alone. It presents a singular test, we believe, not only to global governance and leadership, most especially that of the next president of the United States whose wise action will be indispensable, but also to democracy, to cities, counties, states, and ordinary citizens of this and every nation. In our review of the literature, we find much we all might fear. But in it we find, as well, a measure of mature hope, the kind that is activated and amplified by a resolution to act.⁵³ We offer these few recommendations in the hope that they may be of some service in the ongoing effort to arouse and orchestrate a worthy response to the formidable challenge of climate change, a response that may in time actualize the hope of an equitable, secure and sustainable future for Americans, for all citizens of the world and for generations to come.

51 L. Saad and J. M. Jones, “U.S. Concern About Global Warming at Eight-Year High,” March 2016, accessed September 6, 2016, <http://www.gallup.com/poll/190010/concern-global-warming-eight-year-high.aspx>.

52 K. D. Moore, *Great Tide Rising: Finding Clarity and Moral Courage to Confront Climate Change* (Berkeley, CA: Counterpoint Press, 2016).

53 S. C. Moser and C. Berzonsky, *Hope in the Face of Climate Change: A Bridge Without Railing* (forthcoming).

CLIMATE CHANGE 2016: EIGHT WAYS THE WORLD HAS CHANGED SINCE THE LAST IPCC REPORT

Authors

Christopher B. Field, is the Perry L. McCarty Director of the Stanford Woods Institute of the Environment and Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies in the School of Humanities and Sciences at Stanford University. Field is also a Professor in the Stanford School of Earth, Energy and Environmental Sciences, former co-chair of Working Group II of the Intergovernmental Panel on Climate Change and founding director of the Carnegie Institution's Department of Global Ecology.

Katharine J. Mach is a Senior Research Associate at Carnegie Science's Department of Global Ecology. Mach also served as Director of Science for Working Group II of the Intergovernmental Panel on Climate Change.

Contact

Stanford Woods Institute for the Environment
473 Via Ortega, MC 4205
Stanford, CA 94305
<https://woods.stanford.edu/>
cfield@stanford.edu
kmach@carnegiescience.edu

Abstract

The Intergovernmental Panel on Climate Change releases periodic reports that serve as definitive sources of information concerning what is known and what is not known about the science of climate change. The most recent comprehensive report, released in 2013 and 2014, assesses studies published through early 2013 (for the physical science basis) or mid 2013 (for impacts, adaptation, vulnerability and mitigation).⁵⁴

The state of the climate, the maturity of the science and the landscape of climate policy are all dynamic, with some large and consequential changes in the two years since the IPCC report. Eight changes paint a portrait of the magnitude and importance of the shifts. The eight changes concern the following observations, projections and solutions:

- The idea of a warming pause or slowdown has been debunked, and recent warming has been rapid.
- In both 2014 and 2015, global CO₂ emissions barely grew or even decreased during years of modest economic growth. These trends demonstrate initial stages of disconnecting emissions and economic activity.

54 IPCC, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2013), 1535; IPCC, *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. C. B. Field et al. (Cambridge: Cambridge University Press, 2014), 1132; IPCC, *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. V. R. Barros et al. (Cambridge: Cambridge University Press, 2014), 688; IPCC, *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. O. Edenhofer et al., (Cambridge: Cambridge University Press, 2014); IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. C. W. Team, R. K. Pachauri, and L. A. Meyer (Geneva, Switzerland: IPCC, 2014), 151.

- The science of single-event attribution matured to a stage where it is now routinely used to assess the way climate changes to date have altered the odds of actual extremes. The results in many cases underscore that climate change made particular extremes substantially more likely.
- For the loss of ice from major ice sheets, especially in Antarctica, new studies use information from a wider range of past conditions and incorporate a broader suite of physical mechanisms. These advances have led to a substantial increase in the projections for maximum sea-level rise during the 21st century compared to past assessments.
- New analysis of global macroeconomic patterns indicates that economies may be much more sensitive to warming than previously estimated, particularly in regions where historical conditions were already warm.
- Several lines of evidence point to the feasibility of building an energy system with very low or even zero emissions based on continued improvement and integration of existing technologies.
- New studies identify a wide range of possible co-benefits, with investments in climate change mitigation, climate change adaptation or sustainable development potentially reinforcing each other.
- The Paris Agreement represents only first steps in bringing greenhouse gas emissions to zero. But its global consensus on ambitious goals and a process moving forward creates a strong signal about the direction of future policy, contributing to the predictability that is so important for long-term investments in the public and private sectors.

The overall implication of these eight changes is that the case for rapid, ambitious and sustained action to reduce emissions is substantially strengthened, even compared to the most recent report from the IPCC.

Hiatus? Hardly

In the period from about 2007 until 2013, the concept of a warming hiatus or slowdown was a prominent feature of questions, especially from climate skeptics. Most of the questions were grounded in the optics of starting a time series from 1998, an exceptionally warm El Niño year, and in limited appreciation of the relative roles of long-term (multidecade) climate forcing from greenhouse gas (GHG) emissions and short-term (year-to-year) variability. The IPCC Fifth Assessment Report on the physical science basis of climate change, released in 2013, dedicated a substantial amount of discussion to the hiatus, explaining it as reflecting a combination of internal variability (especially with the transition to the cold phase of the Interdecadal Pacific Oscillation), atmospheric aerosols (through incomplete representation of cooling effects of volcanic eruptions), solar radiation (with an effect of the declining phase of the 11-year solar cycle) and the tendency of a casual observer to overemphasize the very warm El Niño year of 1998.⁵⁵

While scientifically sound, the IPCC analysis is complicated. Still, emphasis on a hiatus has rapidly faded for three reasons. First and most important, recent years have been exceptionally warm. 2014 was the warmest year in the instrumental record until 2015, which broke the previous record by the largest margin ever (see Figure 1). 2015 was also the first year in the instrumental record with a global average temperature more than 1 C (1.8 F) above preindustrial. The first part of 2016 has been even warmer, with the first three months scraping 1.5 C (2.7 F) above preindustrial. July 2016 was the 15th consecutive month with record-warm global land and ocean temperatures. In a plot of global temperatures running from the beginning of systematic measurements in 1880 to the present, it is easy to see year-to-year variability but hard to see indications that the last two decades deviate from the trend. Careful statistical analysis indicates that recent warming is slower than many model projections,⁵⁶ but there is no question that warming has continued.

55 IPCC, *Climate Change 2013*; G. Flato et al., *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. T. F. Stocker et al. (Cambridge: Cambridge University Press, 2013), 741–866.

56 J. C. Fyfe et al., “Making Sense of the Early-2000s Warming Slowdown,” *Nature Climate Change* 6 (2016): 224.

A second line of evidence comes from a reanalysis of the global temperature data. Karl and colleagues found that the global temperature record produced by NOAA can be made slightly more accurate with improved corrections for the technology used to measure ocean temperatures (from buckets thrown overboard to engine intakes to autonomous buoys) and through using information from an expanded network of land-based weather stations.⁵⁷ These corrections were so small that they had hardly any effect on temperature trends over the second half of the 20th century, but they approximately doubled the average rate of warming over the period from 1998 to 2012. With this correction, the rate of global warming is close to the same for the “hiatus” period of 1998–2012 and the second half of the 20th century. Improving the analysis strengthens the case for continuing warming.

A third line of evidence comes from asking the question about whether there was a hiatus in more precise statistical terms. Rajaratnam and colleagues tested for a hiatus defined in four different ways,⁵⁸ using the historical temperature dataset with and without the corrections from Karl and colleagues. None of the tests suggested a slowing or a cessation of warming.

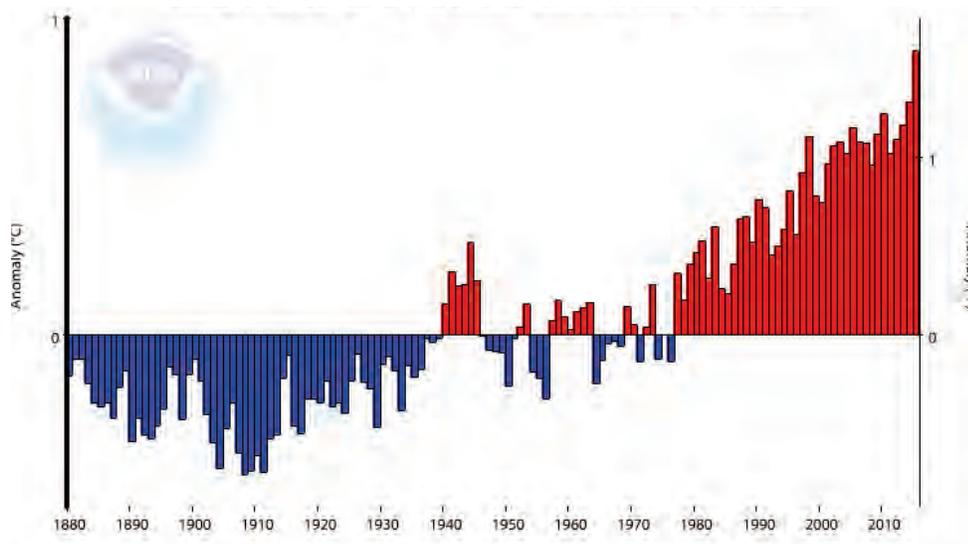


Figure 1: Global temperature anomalies relative to the 20th-century average from the NOAA Merged Land–Ocean Surface Temperature Analysis (MLOST3.5), from R. S. Vose et al., “NOAA’s Merged Land–Ocean Surface Temperature Analysis,” *Bulletin of the American Meteorological Society* 93 (2012): 1677.

In 2013, addressing the possibility of a warming hiatus was appropriate. Now, it is clear that warming has not slowed. In contrast, much of the recent discussion has focused on the regularity and magnitude of recent record warmth.

Moderating Trends in Emissions Growth

A striking feature of the GHG emissions trajectory from the IPCC Fifth Assessment Report is the acceleration after 2000.⁵⁹ The average growth rate in global GHG emissions from energy, agriculture, industry and land use was 1.3 percent per year from 1970 to 2000 and 2.2 percent per year from 2000 to 2010, the most recent year considered in the report. Looking at carbon dioxide only, the rate of increase was 1 percent per year from 1990 to 1999 and 3.2 percent per year from 2000 to 2009.⁶⁰ Even the major recession of 2008–2009 resulted in only a brief pause in the rate of carbon dioxide emissions growth.

57 T. R. Karl et al., “Possible Artifacts of Data Biases in the Recent Global Surface Warming Hiatus,” *Science* 348 (2015): 1469.

58 B. Rajaratnam, J. Romano, M. Tsiang, and N. S. Diffenbaugh, “Debunking the Climate Hiatus,” *Climatic Change* 133 (2015): 129.

59 IPCC, *Climate Change 2014*.

60 C. Le Quéré et al., “Global Carbon Budget 2015,” *Earth System Science Data* 7 (2015): 349.

But the pattern changed dramatically for the last two years. In 2014, global carbon dioxide emissions were 0.6 percent greater than in 2013. For 2015, initial estimates put them at 0.6 percent less than 2014.⁶¹ In contrast to past emissions dips, 2014 and 2015 were both years of modest economic growth at the global scale. According to the World Bank, global gross domestic product (GDP) grew at 2.6 percent in 2014 and 2.4 percent in 2015 (see Figure 2).

This dramatic slowing of carbon dioxide emissions growth during a time of economic growth should not be interpreted to imply that emissions have peaked. Several lines of evidence, including pledges for the Paris Agreement, indicate that increases will continue for some time.⁶² The encouraging feature of the pattern over the last two years is in the decoupling of global GDP and carbon dioxide emissions. The new data make it clear that, even before emissions have peaked, the path for future growth need not be based on carbon.

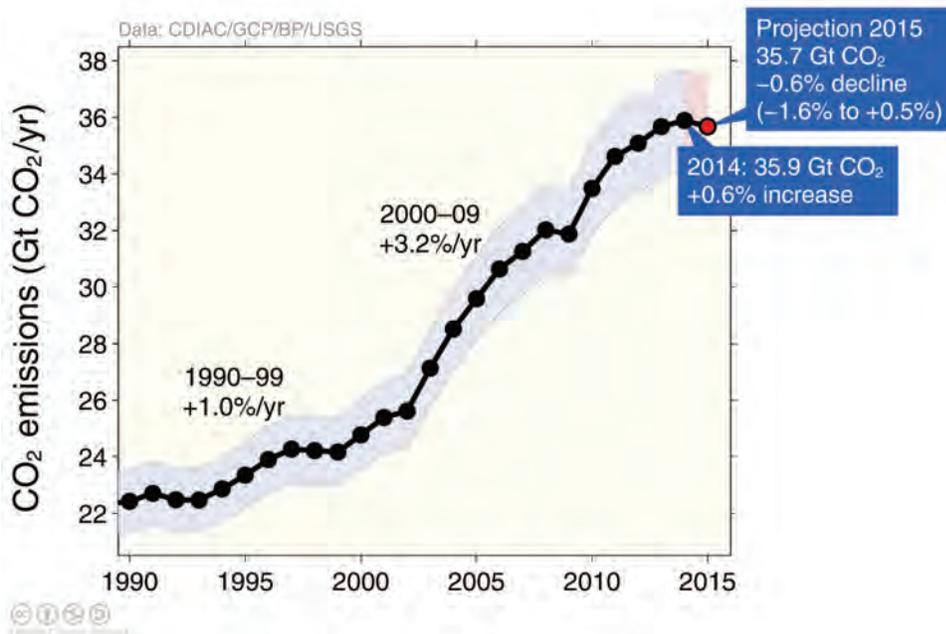


Figure 2: Global CO₂ emissions from fossil fuel use and industry from 1990 to 2015. Estimates for 2012 to 2015 are preliminary. From C. Le Quéré et al., “Global Carbon Budget 2015,” *Earth System Science Data* 7 (2015): 349.

Single-Event Attribution

Until recently, climate scientists had a more or less standard response to questions about whether climate change caused a particular storm, flood or heatwave. The answer was, “We know that some kinds of extremes are expected to become more frequent or severe with climate change, but it is not possible to forge a causal link between climate change and any particular extreme event.” Single-event attribution, the technical term for establishing the role of climate change in particular events, does not occur in the glossary or the index of the 2013 IPCC report on the physical science basis of climate change.⁶³

61 R. B. Jackson et al., “Reaching Peak Emissions,” *Nature Climate Change* (2015).

62 Ibid.

63 IPCC, *Climate Change 2013*.

But the science is changing rapidly, and single-event attribution is increasingly in the mainstream of climate science. The first papers on single-event attribution appeared about a dozen years ago. By comparing the frequency of simulated heat waves in climate models with and without anthropogenic GHGs, Stott and colleagues were able to demonstrate that climate change at least doubled the odds of an event like the European heat wave.⁶⁴ They did not conclude that climate change was the direct cause, but they showed how it altered the risks. Technical approaches for single-event attribution have advanced rapidly. Research teams around the world are applying sophisticated approaches for analyzing extreme events. Beginning in 2012, the *Bulletin of the American Meteorological Society* started publishing an annual supplement on “Explaining Extreme Events,”⁶⁵ a supplement that has grown to 32 events in the most recent 2015 version.⁶⁶ The technology for single-event attribution is now so robust that several groups are discussing rapid-response capabilities to provide information on the human role in close to real time.

Since 2012, papers in the “Explaining Extreme Events” supplements have analyzed 79 events. In more than half of these events, human-caused climate change had an influence. The influence was most consistent for extreme heat events, with detectable human influence in 21 of 22 cases.⁶⁷ For extremes of heavy precipitation, there was a human role in 10 of 20. Human influence has been detected in the odds of some but not all droughts,⁶⁸ tropical cyclones,⁶⁹ and wildfires.⁷⁰ The available analyses do not say that climate change is involved in every extreme. They do, however, establish a foundation for adding context to broad discussions, for considering specific implications of real events and for detailed analyses of the costs of the climate changes that have already occurred.

Reconsidering Century-Scale Risks from Sea-Level Rise

Threats from rising seas are among the most palpable concerns about climate change. Risks from rising seas are diverse, extending well beyond gradual inundation. Earlier and more widespread risks include coastal erosion, loss of coastal ecosystems, salination of freshwater aquifers, increased sunny-day nuisance flooding and more frequently overtopped coastal defenses.⁷¹ One of the reasons sea-level rise plays such a prominent role in discussion of climate change risks and damages is its deeply existential nature. Entire communities, indeed entire nations, will be forced to relocate if sea level overtops their low-lying homelands. Kiribati, under the presidency (2003–2016) of Anote Tong, was the first nation to develop a detailed plan for relocation of the entire population.

Sea-level rise has two main components: thermal expansion of warmer water and transfer of water from ice on land to the oceans. The first process, thermal expansion, is challenging to model because an accurate prediction requires detailed knowledge of the way heat spreads through the oceans, a process that requires many centuries to reach equilibrium. But models of ocean circulation are increasingly sophisticated, facilitating robust projection.

64 P. Stott, D. Stone, and M. Allen, “Human Contribution to the European Heatwave of 2003,” *Nature* 432 (2004): 610.

65 T. C. Peterson, P. A. Stott, and S. Herring, “Explaining Extreme Events of 2011 from a Climate Perspective,” *Bulletin of the American Meteorological Society* 93 (2012): 1041.

66 S. C. Herring, M. P. Hoerling, J. P. Kossin, T. C. Peterson, and P. A. Stott, “Explaining Extreme Events of 2014 from a Climate Perspective,” *Bulletin of the American Meteorological Society* 96 (2015): S1.

67 S. C. Herring, M. P. Hoerling, J. P. Kossin, T. C. Peterson, P. A. Stott, “Summary and Broader Context,” *Bulletin of the American Meteorological Society* 96 (2015): S168.

68 N. S. Diffenbaugh, D. L. Swain, and D. Touma, “Anthropogenic Warming Has Increased Drought Risk in California,” *Proceedings of the National Academy of Sciences* 112 (2015): 3931.

69 H. Murakami et al., “Investigating the Influence of Anthropogenic Forcing and Natural Variability on the 2014 Hawaiian Hurricane Season,” *Bulletin of the American Meteorological Society* 96 (2015): S115.

70 J.-H. Yoon et al., “Extreme Fire Season in California: A Glimpse into the Future?,” *Bulletin of the American Meteorological Society* 96 (2015): S5.

71 P. P. Wong et al., in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*, eds. C. B. Field et al. (Cambridge: Cambridge University Press, 2014), 361–409.

The transfer of water from ice on land to the oceans is the big unknown. The quantity of sea-level equivalent is massive: ice on Greenland represents 24 feet of sea-level equivalent, Antarctica 190 feet, and alpine glaciers about 1.5 feet. The mechanisms that control the transfer of water from ice on land to the oceans are diverse and incompletely understood. Major mechanisms are hotly debated in the scientific literature, as are rates and magnitudes of past changes.

The IPCC has struggled with ways to accurately reflect the state of knowledge concerning the potential for sea-level rise in the 21st century and beyond. In the 2007 report, the working group on physical sciences reported projections that were a sum of projected thermal expansion and glacier melt, plus a contribution from ice sheet loss set nominally as a continuation at the rate of the late 20th century. This led to a likely range of 7 to 21 inches above late 20th-century levels, explicitly excluding any effects from accelerating flows of major ice sheets.⁷² The working group on impacts took a more risk-based approach, noting that major deglaciation of Greenland and West Antarctica, possible over centuries to millennia, could lead to sea-level rise of 13 to 20 feet or more.⁷³

By the time of the IPCC Fifth Assessment Report, quantitative models of ice sheet loss were advanced enough for incorporation into estimates but with important caveats about the limited number of mechanisms included. With these new models, the projected likely range for the 21st century grew to 10 to 39 inches above late 20th century levels, with a comment that collapse of grounded ice (resting on surfaces below sea level) could increase this range.⁷⁴

This picture has changed substantially with the publication of three important new lines of evidence. The first is that the combination of historical evidence and models enables improved estimates of the potential range for 21st-century sea-level rise, setting a new likely range of 11 to 52 inches, with the top of the range 33 percent higher than in the IPCC report.⁷⁵ Second, new work on the physical strength of tall ice cliffs makes it clear that the IPCC models were missing an important mechanism. Including the strength of ice cliffs in the calculation leads to the conclusion that potential for 21st-century ice loss from Antarctica alone could be more than 40 inches, compared to the IPCC estimate of 8 inches or less from both Antarctica and Greenland combined.⁷⁶ Finally, several new studies focus on risks of sea-level rise over several centuries to millennia. With very large amounts of warming caused by burning the world's entire reserves of fossil fuels, commitment to sea-level rise over several millennia includes all the ice currently on Antarctica, about 190 feet, rising at a rate of almost a foot per decade during the first millennium.⁷⁷

Macro-Trends in the Economics of Climate Change

Most of the existing literature on economic damages from climate change is based on integrated assessment models developed in the 1990s. These models include estimates of the climate sensitivity of various economic sectors and use relationships built into the model to track the implications of these impacts as they spread across the global economy. The treatment of climate impacts in these models is far from complete. Among the unanswered questions is whether impacts should be understood as affecting current output, future growth, or both.⁷⁸

72 IPCC, in *Climate Change 2007: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, S. Solomon et al., Eds. (Cambridge University Press, , 2007), 1–21.

73 IPCC, in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. M. L. Parry et al. (Cambridge: Cambridge University Press, 2007), 7–22.

74 IPCC, *Climate Change 2013*.

75 M. Mengel et al., “Future Sea Level Rise Constrained by Observations and Long-Term Commitment,” *Proceedings of the National Academy of Sciences* 113 (2016): 2597.

76 R. M. DeConto and D. Pollard, “Contribution of Antarctica to Past and Future Sea-Level Rise,” *Nature* 531 (2016): 591.

77 R. Winkelmann, A. Levermann, A. Ridgwell, and K. Caldeira, “Combustion of Available Fossil Fuel Resources Sufficient to Eliminate the Antarctic Ice Sheet,” *Science Advances* 1 (2015): e1500589.

78 F. C. Moore and D. B. Diaz, “Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy,” *Nature Climate Change* 5 (2015): 127.

A summary of results of these models from the 2014 IPCC Fifth Assessment Report on Impacts, Adaptation, and Vulnerability concludes that with 2100 global average temperatures somewhere in the range of 2 to 10 degrees F warmer than preindustrial, the world can expect a GDP impact in the range of +2.3 percent (a positive impact of climate change) to -6.1 percent, with an average of -1.1 percent for models that project 2,100 warming in the middle of the range (4–5 F).⁷⁹

One recent study of the sensitivity of macroeconomic output to historic climate sensitivity comes to a dramatically different conclusion. Burke and colleagues detected a general pattern of warm conditions increasing economic growth in cool areas but decreasing it in warm areas.⁸⁰ Extrapolating from these observations through the 21st century leads to an estimate that warming by 2100 decreases global GDP by 23 percent, with effects that are largest in countries that are currently poor (see Figure 3).⁸¹ While this much larger economic impact is from one study only, the new results open several important questions, suggest new research approaches and imply that economic damages from climate change may be much larger than the estimates discussed by the IPCC.

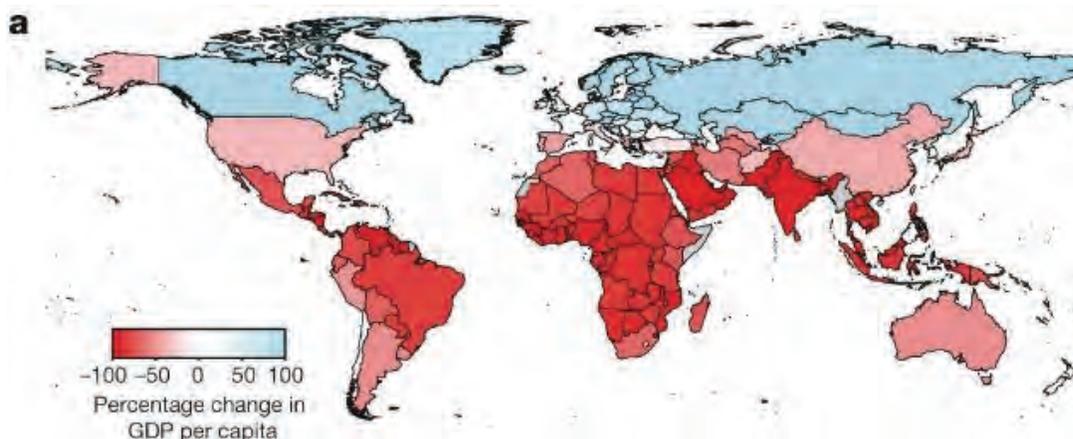


Figure 3. Projected impact of warming through 2100 with continued high emissions on per capita GDP, relative to constant climate at 1980–2010 average conditions. This analysis is based on macroeconomic responses to historical temperature variations, from M. Burke, S. M. Hsiang, and E. Miguel, “Global Non-linear Effect of Temperature on Economic Production. *Nature* 527 (2015): 235

Feasibility of a Zero Emissions Energy System

Over the past couple of decades, the dialogue about pathways for reducing GHG emissions has wandered between two poles. At one pole, Hoffert and colleagues stressed the magnitude of the challenge and expense of decarbonizing energy production, the limitations of currently available technologies and the need for intensive research and development to discover, scale and mature new technologies.⁸² At the other pole, Pacala and Socolow argued that continued progress with existing technologies can get the world well along the path to solutions.⁸³ From either perspective, decarbonization requires appropriate incentives and regulations. But the perspectives differ in their emphasis on the need for massive investments in new energy technologies.

79 D. J. Arent et al., *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A.*

80 M. Burke, S. M. Hsiang, and E. Miguel, “Global Non-linear Effect of Temperature on Economic Production,” *Nature* 527 (2015): 235.

81 Ibid.

82 M. I. Hoffert et al., “Energy Implications of Future Stabilization of Atmospheric CO₂ Content,” *Nature* 395 (1998): 881; M. I. Hoffert et al., “Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet,” *Science* 298 (2002, November 1): 981.

83 S. Pacala and R. Socolow, “Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies,” *Science* 305 (2004): 968.

The IPCC AR5 presents an overall picture of decarbonized energy systems that share features of both perspectives. Energy systems that limit warming to 2 C (3.6 F) place a huge emphasis on energy efficiency and are feasible at lower costs when they use the widest range of technologies (as argued by both Hoffert et al. and Pacala and Socolow). But in the IPCC report, some of the energy models cannot solve for a cost-effective energy system that limits warming to 2 C, especially without overshoot (as argued by Hoffert et al.), and the costs are high – an average reduction in consumption of 4.8 percent, relative to pathways without decarbonization.⁸⁴

Costs of some renewable energy technologies, especially solar photovoltaics, have fallen very rapidly. At the same time, technologies for energy storage, grid integration and demand management all continue to improve. While Hoffert and colleagues, writing in 1998, were fully justified in arguing about the need for new technologies, it is increasingly feasible to sketch the outlines of a zero-GHG energy system based on technologies that are either proven at scale or well along that trajectory. Jacobson and colleagues, for example, sketch a portrait of a zero emissions energy system that meets 100 percent of the energy needs of the United States based on renewable only, without nuclear or fossil energy with carbon capture and storage.⁸⁵ While the technology assumptions in this study are optimistic, the evidence for feasibility of a 100-percent renewable energy system suggests that the discussion is entering a new era, where the focus is increasingly not on whether the world can build a zero-GHG energy system but on how it can be built most inexpensively.

Co-benefits from Investments in Climate Action

The classic framing of the climate challenge is as a trade-off. Critical resources can be invested in economic development or reducing the amount of climate change that occurs or adapting to the climate changes that cannot be avoided. With this framing, investments in climate change mitigation or adaptation compete with each other and pull resources away from other important development goals. While this framing is not intrinsic to the way the IPCC analyzes the climate challenge, it is reflected in important features of the structure of the IPCC reports and the nature of the IPCC process. In the IPCC, mitigation and adaptation are considered by separate working groups that write separate reports. The costs and benefits of adaptation tend to be framed with different metrics, vocabularies and emphases. Because the working group on mitigation is not looking at avoided damages, investments in mitigation tend to look like costs, even when the consequence of mitigation is a net benefit for the economy.

Sustainable economic development is a top priority across the United Nations (UN) system, especially in the sustainable development goals, but the agenda for development is handled by government organizations largely unconnected to the IPCC and other organizations that deal with climate change.

As a consequence of these structures, it is not surprising that the topic of co-benefits has not been a central feature of IPCC reports or of other climate change activities, but this is beginning to change. In the IPCC AR5, the mitigation report examines one important co-benefit, improvements in air quality from decreased particulate emissions from energy production.⁸⁶ The special report on managing the risks of extreme events and disasters places a major emphasis on low-regrets actions that simultaneously address development and reduce vulnerability to climate change.

Recently, the picture has begun to change in two ways. First, discussion about two categories of co-benefits considered by the IPCC, health from reducing combustion emissions and adaptation-development interactions, has intensified. Second, policymakers are increasingly interested in structuring investments in adaptation, mitigation and development to encourage co-benefits.

84 O. Edenhofer et al., in *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2014).

85 M. Z. Jacobson, M. A. Delucchi, M. A. Cameron, and B. A. Frew, “Low-Cost Solution to the Grid Reliability Problem with 100% Penetration of Intermittent Wind, Water, and Solar for All Purposes,” *Proceedings of the National Academy of Sciences* 112 (2015): 15060.

86 IPCC, *Climate Change 2014*.

Health benefits of decreased combustion are prominent, partly because the health impacts of combustion emissions are so clear. Caiazzo and colleagues estimate that combustion emissions in United States account for approximately 200,000 premature deaths per year, with major contributions from electricity generation, industry, buildings and transportation.⁸⁷ Worldwide, the World Health Organization estimates that air pollution results in seven million early deaths per year, or one of every eight deaths. The potential to address health impacts from air pollution is a huge co-benefit of decreasing the use of fossil fuels (especially coal), in electricity generation, industry and heating buildings. Health benefits feature prominently in the Environmental Protection Agency (EPA) analysis of the U.S. Clean Power Plan.

Investments in adaptation and development can be competitive, but they can also be mutualistic. Co-benefits of development for adaptation and vice versa have been documented in many cases, especially in lower-income countries. Investments in transportation infrastructure, agricultural technology and public health infrastructure can all play a role in climate adaptation, especially in dealing with extremes; at the same time they promote economic activity more broadly. Economic development can also help increase adaptive capacity and decrease vulnerability to climate shocks.⁸⁸

Adaptation and mitigation can also be competitive or mutualistic. High-performance buildings provide clear cases of mutualism, with occupants better equipped to deal with climate extremes while at the same time energy requirements are reduced. Other examples of adaptation-mitigation mutualisms include the role of a more reliable electrical grid in coping with extremes and the role of improved energy access in fighting poverty.

Many potential co-benefits from addressing climate change involve new jobs in climate- and energy-related areas. Evaluating the net balance of jobs lost in the fossil energy sector and new jobs created in climate mitigation and adaptation is not straightforward. Opportunities in an innovation-oriented economy are clear, but these will be successful only if coupled to programs designed to address the changing needs of the workplace.

Other potential mutualisms with development include broadened energy access and decreased reliance on imported energy. While none of these co-benefits occurs automatically, the recognition of possibilities can provide a compelling dimension of a multidimensional case for climate action.

The Paris Agreement: Implications of a Global Goal

For many years, two of the most consistent concerns about steps to address climate change have been (1) that actions in some but not all countries will create unfair advantages for countries that do not participate, and (2) that the lack of predictability in regulatory frameworks and market signals increased the cost and risk of investments in climate change solutions. The fundamental advance from the Paris Agreement, especially with last week's commitment of ratification from the United States and China, is that it resolves both concerns.

The agreement is as close to universal as possible. As of September 3, 2016, 179 states and the European Union (accounting for more than 95 percent of global GHG emissions) have signed the agreement. Twenty six (accounting for 38 percent of emissions) have ratified. The agreement goes into force when ratifying nations account for 55 percent of global greenhouse gas emissions. The Paris Agreement builds on the concept of common but differentiated responsibility. This core element of the UN Framework Convention on Climate Change lays a framework for ground rules to establish mutually agreed-upon standards of fairness. A central element of the Paris Agreement, missing from the earlier Kyoto Protocol, is the recognition that all nations need to participate

87 F. Caiazzo, A. Ashok, I. A. Waitz, S. H. Yim, and S. R. Barrett, "Air Pollution and Early Deaths in the United States. Part I: Quantifying the Impact of Major Sectors in 2005," *Atmospheric Environment* 79 (2013): 198.

88 M. Chambwera et al., in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*, eds. C. B. Field et al. (Cambridge: Cambridge University Press, 2014), 945–977.

in emissions reductions and that GHG emissions eventually need to fall to zero. The framework of common but differentiated responsibility allows for differences in timing, with earlier commitments by the countries with financial and technical resources. But it does this in a way that acknowledges both sides of the fairness issue – the concern that nonparticipants should not receive an unfair advantage and the concern that it is unfair to demand early commitments from countries with minimal contributions to historical GHG emissions and with pressing needs for economic development. While individuals or corporations might have liked adjustments to the specifics, the existing agreement addresses the fairness issue in a way judged acceptable by the vast majority of the world's nations.

The Paris Agreement is a strong starting point for predictable regulatory frameworks and market signals. It sets clear targets for emissions reductions through 2025 and establishes a broad pattern for the pattern of emissions after that. The commitments in the Paris Agreement, crafted individually by each country through their Intended Nationally Determined Contributions, are, for developed countries, ambitious but reachable. Achieving the emissions reductions they specify will require continued progress and sustained investment, but it will not require dramatically new technologies or policy environments. Achieving the emissions reductions will require what the private sector has been requesting – a consistent policy framework adjusted gradually over time to accommodate new information. This is something the world can do.

DOE AS A CATALYST FOR INNOVATIVE AND TRANSFORMATIVE ECONOMIC REGULATION OF THE BULK POWER SYSTEM?

Author

Michael Gergen is a partner in the Washington, DC, office of Latham & Watkins, LLP (Latham & Watkins) and an Adjunct Professor of Law at the New York University School of Law.

Contact

Latham & Watkins
555 Eleventh Street, NW
Suite 1000
Washington, DC 20004-1304
<https://www.lw.com>
MICHAEL.GERGEN@lw.com

Abstract

The bulk power system will require a dramatic transformation if it must be decarbonized over the next few decades to meet internationally agreed-upon targets for deep reductions in carbon emissions. It is expected that such a transformed bulk power system would comprise a variety of supply-and-demand response resources, including wide-scale deployment of intermittent utility-scale renewable generation resources interconnected with high-voltage, long-distance transmission facilities and a vast panoply of smaller-scale and distributed energy resources (e.g., distributed solar generation, energy storage systems, fuel cells, microgrids) and smart-grid technologies, and it would be complemented by a largely electrified transportation sector.⁸⁹ The current construct for economic regulation of the bulk power system by the Federal Energy Regulatory Commission (FERC) under the Federal Power Act (FPA)⁹⁰ is already being challenged by nascent public policy initiatives to reduce the carbon intensity of electricity generation and transform distribution-level grids into multisided markets that interact directly with the bulk power system. The construct for economic regulation of a bulk power system that is rapidly decarbonizing and tied to increasingly transactive distribution grids will almost certainly be very different than the current construct.

Could the U.S. Department of Energy (DOE) act as a catalyst for innovative and transformative economic regulation of the bulk power system under the FPA? The short answer is yes, DOE has the power under the DOE Organization Act of 1977 (DOE Act)⁹¹ and the FPA to help set the agenda and be a bully pulpit for innovative and transformative economic regulation of the bulk power system.⁹² The exercise of such authority would be consistent with the legislative direction under the DOE Act that DOE pursue a

89 See, for example, Energy and Environmental Economics, Inc. (E3), Lawrence Berkeley National Laboratory, and Pacific Northwest National Laboratory, *Deep Decarbonization Pathways Project (DDPP), Pathways to Deep Decarbonization in the United States* (November 2015); E3, DDPP, *Policy Implications of Deep Decarbonization in the United States* (November 2015).

90 41 Stat. 1063 (1920), as amended, 16 U.S.C. § 791a et seq.

91 91 Stat. 565 (1977), 42 U.S.C. § 7101 et seq.

92 The same could be said with regard to DOE's authority with respect to economic regulation of the transportation of natural gas in interstate commerce under the Natural Gas Act (NGA), 52 Stat. 821 (1938), as amended, 15 U.S.C. § 717 et seq. Consideration of this issue is beyond the scope of this paper.

national energy program concerning, among other things, renewable energy deployment, environmental protection and general economic welfare, including an adequate, reliable, affordable and competitive energy supply. The exercise of such authority would also not be unprecedented. DOE exercised both bully-pulpit and agenda-setting authority with respect to FERC's economic regulation of the natural gas industry under the National Gas Act (NGA) during the fossil fuel energy crisis of the late 1970s.

Background: The DOE Act and DOE and FERC Functions Under the FPA

DOE and FERC share a common statutory origin born out of the fossil fuel energy crisis of the early and mid-1970s – the DOE Act. Under the DOE Act, FERC was created as an independent regulatory commission within DOE and was expressly provided with the authority to perform many of the functions of the former Federal Power Commission (FPC) under the FPA (FERC Functions).⁹³ At the same time, the DOE Act transferred to DOE the functions of the FPC that were not expressly transferred to FERC (DOE Functions). The FERC Functions include various economic regulatory powers under the FPA, namely

- the establishment, review and enforcement of rates and charges for the transmission or sale at wholesale of electric energy (sections 205 and 206),
- the authority to establish physical nonemergency interconnection of facilities for the generation, transmission and sale at wholesale of electric energy (section 202(b)), and
- the regulation of FPA-jurisdictional mergers and securities acquisitions (section 203).⁹⁴

By order, DOE has delegated to FERC the authority to carry out certain DOE Functions (DOE Delegated Functions), though DOE retains the authority to carry out these functions as well. The DOE Delegated Functions under the FPA include those relating to

- the division of the country into regional districts for the voluntary interconnection and coordination of facilities (section 202(a)),
- determining and fixing adequate and sufficient interstate service (section 207),
- the use of boards composed of state representatives and cooperation with state commissions (section 209), and
- investigations regarding the generation, transmission, distribution and sale of electric energy (section 309).⁹⁵

Thus, in some instances, DOE and FERC have overlapping powers under the FPA (e.g., DOE Delegated Functions), while in other instances, their powers are separate (e.g., FERC's authority under section 205 and DOE's authority under section 202(c), discussed below). The same is true with respect to new powers added to the FPA after the DOE Act. For example, FERC and DOE have somewhat overlapping authority under section 216 (regarding siting of interstate electric transmission facilities), while FERC has sole authority under sections 211 and 212 (regarding transmission wheeling) and 215 (regarding electric reliability).

93 In relevant sections, the DOE Act refers to the "Commission" when referring to FERC and refers to the "Secretary" and the "Department" when referring to the Secretary of DOE and DOE, respectively. For current purposes, reference to DOE can mean either the Secretary or the Department, and reference to FERC means the Commission.

94 DOE Act, § 402(a)(1)(B), (F).

95 See Delegation Order No. 00-004.00A (May 5, 2006).

DOE's Stated Role to Act as a Catalyst for National Energy Policy

The DOE Act provides that the integration of previously separate programs and functions under DOE was required for the “formulation and implementation of a national energy program” needed to “meet the present and future energy needs of the Nation consistent with overall national economic, environmental and social goals.”⁹⁶ The DOE Act enumerates a number of purposes to be achieved by DOE, some of which were specific to the facts and circumstances of the fossil fuel energy crises of the 1970s, but many of which are more forward-looking and remain relevant to current and future domestic energy regulation and policy, especially as related to deep decarbonization of power grids. These include (1) coordination across federal, state and local governments in the formulation and implementation of national energy policy, (2) creation and implementation of a comprehensive energy conservation strategy, (3) placing major emphasis on the development and commercial use of technologies using renewable energy resources, (4) planning, coordination, support and management of a balanced comprehensive energy research and development program, (5) assuring incorporation of national environmental protection goals in the formulation and implementation of energy programs, and (6) pursuing general economic welfare goals, including the provision of an adequate and reliable supply of energy at the lowest reasonable cost and fostering and assuring competition among parties engaged in the supply of energy.⁹⁷

DOE's Role as Related to Economic Regulation Under the FPA

DOE's general policy and rulemaking authority under the FPA ranges from bully-pulpit authority to more expansive agenda-setting authority, including what issues FERC must consider and by when.

Bully-Pulpit Authority

Section 405 of the DOE Act provides that DOE may as a matter of right intervene or otherwise participate in any proceeding before FERC, subject to the rules of procedures of general applicability governing FERC proceedings. (Another federal law born out of the energy crisis of the mid-1970s, the Public Utility Regulatory Policies Act of 1978 (PURPA),⁹⁸ provides DOE similar bully-pulpit authority with respect to state public utility commission proceedings regarding certain issues.⁹⁹) As for DOE's use of its bully-pulpit authority under section 405 of the DOE Act, there are a small number of reported instances in the early history of DOE and FERC where DOE intervened and participated in FERC proceedings relating to the economic regulation of the then-restructuring natural gas industry.¹⁰⁰

Agenda-Setting Authority

Section 403 of the DOE Act authorizes FERC and DOE to propose rules, regulations and statements of policy of general applicability with respect to any FERC Functions under the FPA. DOE may propose (but not prescribe) rules, regulations and statements of policy of general applicability. FERC has exclusive jurisdiction with respect to the proposal made by DOE but is directed to consider and take final action on any measure proposed by DOE in an expeditious manner within the reasonable time limits as may be set by DOE. There is one reported instance in the early history of DOE and FERC where DOE used its agenda-setting authority under

96 DOE Act, § 101.

97 See DOE Act, § 102.

98 92 Stat. 3117 (1978), as amended, 16 U.S.C. § 2601 et seq.

99 Under sections 111 and 121 of PURPA, DOE can intervene and participate as a party as a matter of right in state public utility commission proceedings regarding retail metering for and interconnection of distributed generation, energy storage technologies and microgrids, as well as policies relating to utility rate design.

100 See Edward J. Grenier Jr. and Robert W. Clark III, “The Relationship Between DOE and FERC: Innovative Government or Inevitable Headache?” *Energy Law Journal* 1 no. 325 (1980): 359–64. This article summarizes DOE's participation in a FERC proceeding in the late 1970s regarding the proposed rates and tariffs of natural gas pipeline companies as a financing mechanism for commercial-scale coal gasification project sponsored by pipeline companies.

section 403 of the DOE Act to prompt a rulemaking by FERC to facilitate direct purchases of natural gas from producers by large users to displace the use of fuel oil.¹⁰¹

Section 404 of the DOE Act authorizes the DOE to propose rules, regulations and statements of policy of general applicability in the exercise of any DOE Function under the FPA. When DOE seeks to propose such a rule, regulation or policy, it must notify FERC and prescribe a period within which FERC can determine, in its discretion, if the proposed action regarding a DOE Function may significantly affect any FERC Function. If FERC makes such a determination, then DOE must immediately refer the proposed rule, regulation or policy to FERC, which shall provide an opportunity for public comment. Following an opportunity for public comment and after consultation with DOE, FERC must (1) concur in the adoption of the proposed rule, regulation or policy, (2) concur in the adoption of the proposed rule, regulation or policy only with changes as recommended by FERC, or (3) recommend that the proposed rule, regulation or policy not be adopted. DOE then has the option either to issue the proposed rule, regulation or policy in form approved by FERC or not to issue any such rule, regulation or policy. While there do not appear to be any recent precedents of DOE using its agenda-setting authority under section 404 of the DOE Act, there are at least two reported instances in the early history of DOE and FERC where DOE proposed rules regarding curtailment priorities for natural gas transportation and deliveries, and FERC exercised its discretion to have DOE refer the proposed rule to FERC for public comment and final disposition.¹⁰²

DOE as a Catalyst for Innovative and Transformative Economic Regulation Under the FPA?

As understood at the time of their creation under the DOE Act, DOE and FERC were seen as playing complementary roles. DOE would propose and advocate policies and pursue programmatic goals, while FERC would act as an impartial tribunal to conduct hearings on proposed policies, especially as they related to economic regulation under the FPA.¹⁰³ In the decades since the creation of DOE and FERC, and with regard to the bulk power system, DOE has periodically pursued programmatic goals focused on scientific and technological innovation, and more recently innovative financing support, related to clean energy. Meanwhile, FERC, particularly since the mid-1990s, has actively and consistently pursued a regulatory agenda focused on the economic regulation of the bulk power system based on fuel- and technology-neutral market-based competition for the wholesale sales of electric energy and associated open-access regulation of transmission.

As discussed previously, in the early history of DOE and FERC, which coincided with the fossil fuel energy crisis of the late 1970s and the early restructuring and transformation of the natural gas industry, DOE used both its bully-pulpit and agenda-setting authority to influence the economic regulation of the natural gas industry under the NGA. DOE could do the same today with respect to economic regulation of the bulk power system under the FPA.

Use of Bully-Pulpit Authority

DOE could use its bully-pulpit authority under section 405 of the DOE Act to act as a catalyst for innovative and transformative economic regulation of the bulk power system by actively participating in FERC proceedings on matters regarding FERC Functions under the FPA, such as bulk power market design and implementation, transmission planning and transmission rates matters. Such matters could include FERC proceedings regarding the identification and removal of barriers to market participation for clean

101 In March 1979, DOE proposed a rule to FERC (via a letter to FERC and notice in the Federal Register). DOE directed FERC to act on its proposed rule on an interim basis by mid-May 1979, which FERC did in an order adopting the substance of DOE's proposed rule. See *Transportation Certificates for Natural Gas for the Displacement of Fuel Oil*, Order No. 30, 7 FERC ¶ 61,173 (1979). DOE actively participated in the FERC proceeding (presumably under its authority under section 405 of the DOE Act) and actively engaged with FERC prior to formally proposing a rule. See Grenier and Clark, "The Relationship Between DOE and FERC," 352–55.

102 See, for example, *Proposed Rule of the Department of Energy Relating to Protection of Essential Agricultural Uses from Curtailment of Natural Gas Deliveries by Interstate Pipelines*, 6 FERC ¶ 61,209 (1979).

103 See Grenier and Clark, "The Relationship Between DOE and FERC," 342–45.

energy resources and the development of market rules to promote the economically efficient entry and retention of clean energy resources. For example, DOE could actively participate in FERC proceedings regarding the development of pay-for-performance markets for electric energy, capacity and ancillary services (e.g., operating reserves) that better reflect the value provided by flexible resources (e.g., stand-alone energy storage or energy storage coupled with clean generation resources). In furtherance of the use of bully-pulpit authority under the DOE Act, DOE could use its investigatory powers under section 311 of the FPA (a DOE Delegated Function) to conduct investigations regarding the generation, transmission, distribution and sale of electric energy, however produced and whether otherwise subject to the jurisdiction of FERC. (DOE could also act under section 209 of the FPA (a DOE Delegated Function) to hold joint hearings with state public utility commissions or call together a board composed of state-designated representatives to confer about such matters.)

Use of Agenda-Setting Authority

DOE could use its agenda-setting authority under section 404 of the DOE Act, coupled with its authority over DOE Functions and DOE Delegated Functions under the FPA, to act as a more direct catalyst for innovative and transformative economic regulation of the bulk power system. Catalytic actions could include the following, among others:

- **The voluntary interconnection and coordination of clean electric energy resources.** DOE could act under section 202(a) of the FPA (a DOE Delegated Function) to engage in a rulemaking or rulemakings to divide the country into regional districts for the voluntary interconnection and coordination of facilities for the generation, transmission and sale at wholesale of clean electric energy. (FERC used its delegated authority under section 202(a) to support Order No. 2000,¹⁰⁴ which encouraged the formation of independent Regional Transmission Organizations (RTOs) to operate regional wholesale power markets and transmission facilities on an open-access basis.) Such regions may not correspond with existing RTO footprints given the likelihood of the need to transmit relatively low-cost renewable generation from remote locations across multiple RTO footprints to distant load centers (e.g., wind generation in the Great Plains serving load centers in the Midwest and Southeast and on the East Coast). Moreover, given the stated purpose of section 202(a) of the FPA to encourage voluntary coordination to “assure an abundant supply of electric energy” with “the greatest possible economy” and with “regard to proper utilization and conservation of natural resources,” such coordination in theory could include efforts to facilitate the economic regulation of pollution resulting from the generation, transmission and sale at wholesale of electric energy. For example, DOE could act as a catalyst for the development of voluntary regional markets directed at the economically efficient avoidance or abatement of carbon emissions associated with the generation of electric energy (e.g., regional markets for the trading of zero-emission carbon credits).
- **The deployment of clean energy and clean energy enabling resources to enhance the reliability and flexibility of the bulk power system.**
 - DOE could act under section 202(c) of the FPA (a DOE Function) to initiate a rulemaking to require public utilities to submit contingency plans that detail adverse impacts on the reliability (both security and adequacy) of the bulk power system that may occur as a result of future reliability threats, such as major natural disasters associated with climate change, and that are likely to result in an emergency situation on the bulk power system, such as a shortage of electric energy or of the facilities for the generation or transmission of electric energy. Through such a rulemaking, DOE could encourage (or possibly even require) public utilities to mitigate these potential adverse impacts through deployment of clean energy, enabling resources that enhance the reliability and flexibility of the bulk power system (e.g., interstate transmission, energy storage, smart-grid technologies). (Public utilities compelled to take mitigation actions would be entitled to just and reasonable compensation as provided under section 202(c). Such compensation presumably would be determined by FERC consistent with its ratemaking precedents under section 205.)

104 Order No. 2000, *Regional Transmission Organizations*, F.E.R.C. Stats. & Regs. ¶ 31,089, 65 Fed. Reg. 809 (2000), codified at 18 C.F.R. Part 35.

- In response to a complaint of a state public utility commission, DOE could act under section 207 of the FPA (a DOE Delegated Function) to determine or have FERC determine if the interstate service of a public utility or utilities (e.g., interstate transmission for remotely located renewable generation) is inadequate or insufficient. If such a determination is made, then DOE or FERC must determine and fix by order, rule or regulation the proper, adequate, or sufficient level of service to be provided.¹⁰⁵ While DOE or FERC could not compel a public utility to enlarge its generating facilities (e.g., deploy new clean energy generation resources) or sell or exchange energy if it would impair its ability to render adequate service to its customers, it may be able to compel a public utility to enlarge its interstate transmission facilities to accommodate needed new clean energy generation resources or deploy clean energy enabling resources such as energy storage or smart-grid technologies (and possibly in the alternative compel a public utility to engage in market-based procurement of such facilities and resources from third parties). (While section 207 does not speak to this issue, presumably any interstate service provided in accordance with section 207 would be compensated at just and reasonable rates as determined by FERC.)

Conclusion

DOE could act as a catalyst for innovative and transformative economic regulation of the bulk power system under the FPA. DOE has the authority under the DOE Act and the FPA to exercise bully-pulpit and agenda-setting authority with respect to economic regulation under the FPA. The exercise of this authority would not be unprecedented and would be consistent with the legislative direction under the DOE Act that DOE pursue a national energy program concerning, among other things, renewable energy deployment, environmental protection and general economic welfare, including an adequate, reliable, affordable and competitive energy supply.

¹⁰⁵ In several different circumstances DOE has acted under its emergency powers under section 202(c) of the FPA, while FERC has acted once under section 207 of the FPA (complementing action by DOE under section 202(c) by requiring a transmission-owning public utility and an RTO to work together to deploy transmission upgrades to obviate the need to rely on the operation of an electric generation facility in possible violation of the Clean Air Act). See Michael Gergen, Claudia O'Brien, Eli Hopson and David Pettit, "Walking the Line Between the Clean Air Act and the Federal Power Act: Balancing Emission Reductions and Bulk Power Reliability," *Electricity Journal* 25 no. 1 (January/February 2012): 16.

WANT CLIMATE ACTION? LOOK TO INFRASTRUCTURE

Author

Kate Gordon is Vice Chair of Climate and Sustainable Urbanization at the Paulson Institute, where she provides overall strategy and coordination for the Institute's climate change, air quality, and sustainable urbanization programs both in the United States and China. She is also a nonresident Fellow at the Center on Global Energy Policy at Columbia University and a regular contributor to the Wall Street Journal as one of the paper's "Energy Experts."

Contact

Paulson Institute
5711 S. Woodlawn Avenue, Chicago, IL 60637
<http://www.paulsoninstitute.org/>
kgordon@paulsoninstitute.org

Abstract

We are at a schizophrenic moment for climate action in the United States. On the one hand, partisan divides in Congress continue to prevent the United States from passing a comprehensive federal policy, such as a price on carbon, to spur the necessary transition to a low-carbon economy. On the other hand, the private sector is increasingly focused on the real risks to investments and supply chains from unmitigated climate change – and the need to decouple their business models from fossil fuel dependence going forward. Witness the increase in companies' disclosing their carbon footprints and climate risk to shareholders, even without a strong mandatory Securities and Exchange Commission (SEC) standard, or the huge number of multinational companies signing onto letters supporting international climate action at the Paris conference in 2015.

One area where business interest may intersect with federal policy is through an infrastructure bill that incorporates climate resilience and low-carbon investment priorities. Infrastructure investment tends to be a bipartisan, business-friendly policy, in large part because the need is so great. The American Society of Civil Engineers estimates that the United States will need to spend \$3.6 trillion between 2013 and 2020 to simply maintain its current transportation, water and energy infrastructure.¹⁰⁶ Both major presidential candidates have made infrastructure investment part of their platform. A March 2016 national poll found that 75 percent of respondents supported increasing infrastructure spending.¹⁰⁷

Infrastructure is by definition place-based, long-term investment of exactly the kind most vulnerable to physical climate risk. Therefore infrastructure policy offers a critical opportunity to incorporate climate risk assessment (to address impacts that area already "baked in" to the system) and mitigation (to help reduce future impacts) into the initial bill design. For example, within the next 15 years, higher sea levels and increased hurricane activity from climate change will likely cost an additional \$7.3 billion in damaged coastal property and infrastructure annually in the United States.¹⁰⁸ Incorporating climate risk planning into new coastal infrastructure investments would make businesses and local economies more resilient to climate change. Making sure these investments are also low-carbon, for instance through using concrete with carbon sequestration, or building renewable energy

106 2013 Report Card on America's Infrastructure (American Society of Civil Engineers, 2013), available at <http://www.infrastructurereportcard.org/>

107 Frank Newport, Americans Say 'Yes' to Spending More on Infrastructure (Gallup, 2016), available at <http://www.gallup.com/poll/190136/americans-say-yes-spending-infrastructure.aspx>

108 Kate Gordon, Risky Business: The Economic Risks of Climate Risk in the United States (Risky Business Project 2014), available at http://riskybusiness.org/site/assets/uploads/2015/09/RiskyBusiness_Report_WEB_09_08_14.pdf

generation plants instead of fossil fuel plants, would further arm these communities for the future – while simultaneously providing construction jobs and other immediate economic benefits.

This paper will make the case for a bipartisan, business-focused approach to infrastructure that incorporates strong climate action goals. In particular, it will recommend that the next president work with Congress to introduce a bipartisan infrastructure bill that requires climate risk assessment for all federal spending and federal match funds. To the extent possible, the bill should require the same kind and level of analysis that the SEC is considering requiring from companies in their 10K forms. The paper will also recommend corresponding administrative action so that federal spending on key long-term infrastructure through HUD, DoD, DOE, and the Department of Commerce also incorporate climate risk criteria and evaluation.

Introduction

We are at a schizophrenic moment for climate action in the United States. On the one hand, partisan divides in Congress continue to prevent the United States from passing a comprehensive federal policy – including but not limited to a price on carbon – to spur the necessary transition to a low-carbon economy. From the failure of the American Clean Energy and Security Act, which would have implemented a national cap and trade system but never received a vote in the Senate, to the Clean Power Plan, which has been stayed after legal challenges from conservative states, recent experience has shown that it will be politically difficult for the United States to implement federal policies that explicitly address climate change. In fact, new research shows the issue may be even more politically polarizing than it was a decade ago.¹⁰⁹

At the same time, the private sector is increasingly focused on the real risks to investments and supply chains from unmitigated climate change – and the need to make long-term investments to become more resilient while also diminishing reliance on volatile fossil fuels. Large corporations are directly investing in renewables to reduce their climate impact and lock in long-term energy prices,¹¹⁰ while also working to reduce energy use overall throughout their supply chains. It has also become clear that climate change will pose billions of dollars of risk to private businesses, with impacts ranging from heat-related labor productivity declines to coastal-property flooding and inundation.¹¹¹

As a result, more companies are disclosing their carbon footprints and climate risk to shareholders, even without a strong mandatory SEC standard. A strong showing from 110 multinational companies that signed onto letters supporting international climate action at the Paris conference in 2015 demonstrates that the private sector is taking climate change seriously.¹¹²

The next president's climate plan will need to navigate this fraught political landscape while leveraging the private sector's increased attention to climate change. I suggest that plan should focus squarely on the bricks and mortar necessary to support a low-carbon economy, that is to say, on infrastructure.

109 Iley E. Dunlap et al, *The Political Divide on Climate Change: Partisan Polarization Widens in the U.S.* (Environment Magazine, Vol. 58 No. 5, 2016), available at <http://www.tandfonline.com/doi/full/10.1080/00139157.2016.1208995>.

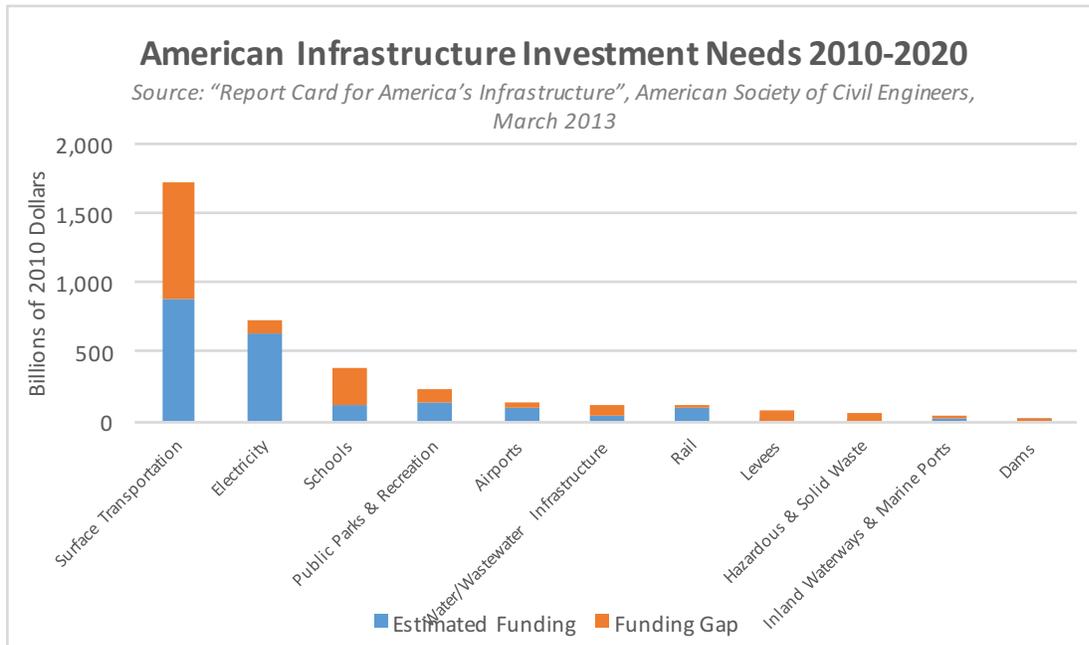
110 David Labrador, *First-time buyers dominate corporate renewable purchasing* (Greenbiz, 2016), available at <https://www.greenbiz.com/article/first-time-buyers-dominate-corporate-renewable-purchasing>.

111 Kate Gordon, *Risky Business: The Economic Risks of Climate Risk in the United States* (Risky Business Project 2014), available at www.riskybusiness.org/site/assets/uploads/2015/09/RiskyBusiness_Report_WEB_09_08_14.pdf

112 Sara Sciammacco, *100+ Companies Salute the Signing of the Paris Agreement and Call for Swift Action on Clean Power Plan* (Ceres, 2016), available at <http://www.ceres.org/press/press-releases/companies-salute-paris-agreement>

We Need a Climate-Conscious Infrastructure Bill

Infrastructure is a place where climate action, business interests and politics will have the potential to intersect. Infrastructure investment tends to be a bipartisan, business-friendly policy, in large part because the need is so great. The American Society of Civil Engineers estimates that the United States will need to spend \$3.6 trillion between 2010 and 2020 to simply maintain its current transportation, water and energy infrastructure.¹¹³ Yet there is an estimated funding shortfall of \$1.6 trillion or approximately 45 percent of the total requirement. In the American Society of Civil Engineers' Infrastructure Report card, most infrastructure categories received a D+, with only one category, solid waste infrastructure, receiving a B- or higher.



The need is greater than the current investment, but that is not to say investment is not happening. Globally, the Organization for Economic Cooperation and Development (OECD) has estimated that approximately \$90 trillion will be invested in new infrastructure between 2015 and 2030. The question is not whether these investments will happen but how they will happen. As the OECD states in its recent infrastructure report, "By default or by design, these investments will affect countries' resilience to climate change."¹¹⁴

Closing the infrastructure gap is already a major priority for both major U.S. presidential candidates. Hillary Clinton has proposed increasing federal infrastructure funding by \$275 billion over a five-year period, paid for through business taxes, with an additional \$225 billion in direct loans and loan guarantees.¹¹⁵ She plans to set up a \$25 billion national infrastructure bank, which would allow government infrastructure investment to continue even if Congress refused to reauthorize federal infrastructure funding; the bank could also be used to leverage private investment. Donald Trump has pledged \$550 billion in infrastructure investment funded through government bonds¹¹⁶ and has emphasized the need for preventing cost overruns in

113 American Society of Civil Engineers, 2013 Report Card on America's Infrastructure (ASCE, 2013), available at <http://www.infrastructurereportcard.org/>

114 The Role of Government in Making Infrastructure Investment Resilient: Draft Survey of Current Practices (Organisation for Economic Co-operation and Development, 2016), available at [www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/WPCID\(2016\)2&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/WPCID(2016)2&docLanguage=En)

115 The Briefing: Hillary Clinton's Infrastructure Plan: Building Tomorrow's Economy Today (Hillary for America, 2016), available at <https://www.hillaryclinton.com/briefing/factsheets/2015/11/30/clinton-infrastructure-plan-builds-tomorrows-economy-today/>

116 Adam K. Raymond, Donald Trump Pitches Half-Trillion-Dollar Plan to Rebuild America's Infrastructure (Daily Intelligencer, 2016), available at <http://nymag.com/daily/intelligencer/2016/08/donald-trump-calls-for-yuuuge-infrastructure-plan.html>

federal infrastructure projects. Such plans have broad popular support: a March 2016 national poll found that 75 percent of respondents supported increasing infrastructure spending.¹¹⁷

Economic Benefits of Infrastructure Investment

In this era of partisan bickering, why does infrastructure spending garner such strong support across party lines, regions and economic sectors? It's simple: infrastructure investments create jobs and economic opportunities. Every billion dollars in infrastructure investment creates an estimated 13,000 jobs, many of them blue collar or "middle skilled" – meaning requiring less than a college degree – and above median wage.¹¹⁸ In particular, these investments create jobs in the construction sector, which has high multiplier effects due to associated transportation, manufacturing and service jobs. Infrastructure investment also creates a net economic benefit, with every dollar in infrastructure investment leading to a cumulative \$3.21 increase in gross domestic product (GDP) over a 20-year period. Given the current low interest rates and the high demand for infrastructure repairs, such investments should be a no-brainer.

Infrastructure investment is also critically necessary for the United States to maintain its international business competitiveness. The World Economic Forum ranks the United States 12th globally in "Quality of Overall Infrastructure," lower than the prerecession rank of ninth.¹¹⁹ And 65 percent of manufacturers surveyed by the National Association of Manufacturers did not believe that American infrastructure would be sufficient for their competitive needs in the next 10–15 years.¹²⁰

Climate Benefits of Infrastructure Investment

The strong political backing and clear economic benefits of infrastructure investment make it an ideal vehicle through which to approach climate policy. Infrastructure – whether transportation, energy or water – is by definition the kind of place-based, long-term investment most vulnerable to physical climate risk. Once you build a highway, it's hard to move it; ditto for a power plant or water treatment facility. Therefore, infrastructure policy offers a critical opportunity to incorporate climate risk assessment (to address impacts that are already "baked in" to the system) and mitigation (to help reduce future impacts) into the initial bill or regulation design. For example, within the next 15 years, higher sea levels and increased hurricane activity from climate change will likely cost an additional \$7.3 billion in damaged coastal property and infrastructure annually in the United States.¹²¹ Incorporating climate risk planning into new coastal infrastructure investments would make businesses and local economies more resilient to climate change.

117 Frank Newport, Americans Say 'Yes' to Spending More on Infrastructure (Gallup, 2016), available at <http://www.gallup.com/poll/190136/americans-say-yes-spending-infrastructure.asp>

118 Employment Impacts of Highway Infrastructure Investment (U.S. Department of Transportation, 2016), available at <http://www.fhwa.dot.gov/policy/otps/pubs/impacts/>

119 Klaus Schwab, The Global Competitiveness Report 2014-2015 (World Economic Forum, 2014), available at http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf

120 Catching Up: Greater Focus Needed to Achieve a More Competitive Infrastructure (National Association of Manufacturers, 2014), available at <http://www.nam.org/Issues/Infrastructure/Surface-Infrastructure/Infrastructure-Report-2014-Executive-Summary.pdf>

121 Kate Gordon, Risky Business: The Economic Risks of Climate Risk in the United States (Risky Business Project 2014), available at http://riskybusiness.org/site/assets/uploads/2015/09/RiskyBusiness_Report_WEB_09_08_14.pdf

Value of State Property Below Mean Sea Level



Data Source: Rhodium Group

Measuring and Managing Climate Risk to Infrastructure

There are several different ways the next administration could address climate risk through infrastructure policy design. In general, investors and analysts break climate risk into three categories:

- **Physical Climate Risk:** The risk that climate change alters the physical environment in a way that jeopardizes the project's operation or viability. This includes risks like flooding or extreme heat.
- **Financial Climate Risk:** The socioeconomic risks that climate change may pose to a project, including changes in investor/funder sentiment, changes in the surrounding communities that render the project unnecessary or obsolete (e.g., in the event of migration away from an area due to climate change) and policy changes that could result in stranded assets (such as an aggressive price on or regulation of carbon).
- **Associated Climate Impact:** This includes the greenhouse gas footprint of the project and the consideration of lower-impact alternatives.

Of these, the first and third lend themselves most easily to infrastructure policy. Though financial climate risk is important, it may be the hardest to predict and quantify, whereas we already know full well that physical impacts that have been baked into our system will likely pose specific asset-level risks, and we know even better that reducing carbon emissions in all projects is key to reducing the worst impacts from climate change in the future.

Some governments and agencies are already trying to incorporate physical risk planning into their investments: for example, the Australian government recently built its new runway at the Brisbane airport a full 4.1 meters above sea level in direct response to projected storm tides resulting from sea level rise. Here in the United States, the Federal Highway Administration has developed a new climate data processing tool that allows transportation agencies to understand potential flooding and select appropriate pavement materials and binders as a result. Most recently and most far-reaching, the Council on Environmental Quality just released new guidance for federal departments and agencies on how to begin considering climate risks and greenhouse gas emissions in

projects covered by the National Environmental Policy Act (NEPA).¹²²

But these examples are still few and far between and largely inconsistent with one another in regard to the type and extent of risk analysis they require. In an exhaustive analysis of government actions taken to account for climate risk, the OECD recently concluded that “[t]here are no commonly agreed methods of reporting climate risks. Several new voluntary initiatives are emerging from investors, as they increasingly recognise this information’s relevance for their investment decisions.”¹²³

The next administration should step into this void and provide some clear direction for climate risk measurement and management. But in so doing, it must work hand in glove with the private sector. As the Australia and federal highway examples above underscore, while climate change itself is a global issue, climate risks and carbon mitigation solutions are extremely local and context-specific. While one region and set of investments may be vulnerable to sea level rise, another may be most focused on extreme heat, or wildfire risk or ocean acidification. In addition, these risks will likely change over time as more carbon enters the atmosphere and what was a 1-in-100 event becomes a 1-in-20, or more likely, outcome.

No one is better able to identify and catalogue these kinds of very specific risks than the businesses for whom they are a real threat to the bottom line. No government agency or Congressional committee, no matter how dedicated, can fully understand the range of physical assets and associated climate risks that make up the complex and diverse U.S. economy. That’s why efforts like the Department of Energy’s Resilience Partnership, which brings together 18 utilities to provide data aimed at increasing resilience in the power sector, are so important. Such public/private partnerships allow for knowledge exchange and information sharing at a level – and at a speed – that is simply impossible to achieve using only government resources.

On the flip side, many businesses currently lack the kind of climate data necessary to fully understand how a changing physical climate will affect their projects. Government can bring data and science to the table and allow engineers to better incorporate climate risks into infrastructure project design.¹²⁴ Government research can also highlight new and innovative solutions to reduce the carbon footprint of new construction. For example, cement and steel, the core of most major infrastructure projects, are major sources of greenhouse gas emissions, accounting for 8 percent of greenhouse gas emissions from manufacturing in the United States.¹²⁵ Making sure that new infrastructure investments are also low-carbon, for instance through using concrete with carbon sequestration or recycled steel, would help reduce the climate impact of new construction.

There is an important co-benefit to all this innovation: developing a competitive advantage in low-carbon infrastructure could also allow the United States to export those technologies and expertise abroad – an estimated \$3.3 trillion of annual infrastructure investment is necessary to support currently expected rates of growth, with 60 percent of that spending occurring in emerging economies, many of which have signed onto the Paris Agreement and will be looking for ways to reduce emissions as they urbanize and grow.¹²⁶

122 Christina Goldfuss, Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews (Memo from Council on Environmental Quality, 2016), available at https://www.whitehouse.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf

123 The Role of Government in Making Infrastructure Investment Resilient: Draft Survey of Current Practices (Organisation for Economic Co-operation and Development, 2016), available at [www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/WPCID\(2016\)2&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/WPCID(2016)2&docLanguage=En)

124 Building a 21st Century Power System (Presidential Climate Action Partnership, 2016), available at <http://pcap2016.org/building-a-21st-century-power-system/>

125 Sabine Brueske et al, U.S Manufacturing Energy Use and Greenhouse Gas Emission Analysis (Energetics Incorporated, 2012), available at http://www.energy.gov/sites/prod/files/2013/11/f4/energy_use_and_loss_and_emissions.pdf

126 Jonathan Woetzel et al, Bridging global infrastructure gaps (McKinsey Global Institute, 2016), available at <http://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/bridging-global-infrastructure-gaps>

Recommendations

The next president should take a bipartisan, business-focused approach to infrastructure that incorporates strong climate action goals. This is not just politically smart, it is eminently fiscally responsible. In particular, the president should do the following:

- Work with Congress to introduce a bipartisan infrastructure bill within the first 100 days that includes a basic climate risk accounting standard focused on both physical climate risk and associated impact and that requires potential contractors to provide a more granular, asset-level analysis of the physical risk and carbon footprint of each proposed project. Any accounting standard included in the bill must include provisions for regular updates based on the best available climate science and risk-modeling tools. As part of the bill, the president should set up a standing interagency group of experts, also including select outside members from the business and investment communities, with the technical background to support applicants in doing basic climate risk assessment. This group would also be tasked with feeding important information from the business sector back into the federal procurement process to ensure the accounting standards are not overly onerous and to address the key issues of physical risk to, and climate impacts on, America's core infrastructure investments.
- At the same time, the next president must account for infrastructure risk across existing federal agency spending beyond what might be in a stand-alone infrastructure bill. To that end, consistent with recent recommendations out of the President's Climate Action Partnership (PCAP), the Office of Management and Budget should develop and regularly update a methodology for identifying the true costs of federally funded infrastructure projects, including physical climate risk and the potential for future costs to carbon emissions. This methodology should allow for comparisons of climate risk across projects and should be fully consistent with the risk accounting methodology in a Congressional bill.¹²⁷
- Finally, in the interests of consistency and public/private investor certainty, both legislative and agency accounting standards for climate risk should be mirrored by the SEC as it begins to require climate risk disclosure in the same kind and level of analysis the SEC is considering requiring from companies in their 10K forms, including disclosure of the physical and, to the extent possible, financial climate risks of the project and the associated climate impact. This would ensure a consistent level of transparency about climate risks in the public and the private sectors. Projects like the Sustainable Accounting Standards Board have already started to develop standards for such disclosures.¹²⁸

Accounting for climate risk in infrastructure planning should not be seen as yet another layer of regulation. Rather, it should be taken as a mainstream business risk approach and a safeguard on taxpayer spending that will insure these scarce dollars are invested in a prudent, far-reaching way. This should appeal on the right and the left alike.

Ultimately, if the public sector commits to disclosing and minimizing its own climate risk and to asking federal contractors to do the same – all while ramping up infrastructure spending, creating jobs and strengthening American competitiveness – the cost of climate impacts will slowly and steadily be internalized into public- and private-sector investment practices. And that, in turn, will slowly and steadily reshape American infrastructure into something that can safely anchor a low-carbon economy.

127 Building a 21st Century Power System (Presidential Climate Action Partnership, 2016), available at <http://pcap2016.org/building-a-21st-century-power-system>

128 Sustainable Accounting Standards Board website available at <http://www.sasb.org/>

LAND USE AND CLIMATE CHANGE

Recommendations for the Next President

Author

David J. Hayes is a Distinguished Visiting Lecturer in Law at Stanford Law School and a Consulting Professor at the Stanford Woods Institute for the Environment. He also is a Senior Fellow at the Center for American Progress. Hayes was the Deputy Secretary and Chief Operating Officer at the U.S. Department of the Interior for Presidents Clinton and Obama from 1999-2001 and 2007-2013.

Contact

Stanford Law School
c/o Resources for the Future
1616 P Street, N.W.
Washington, DC 20036
<https://law.stanford.edu/>
dhayes@law.stanford.edu

Abstract

Most conversations about tackling climate change focus on energy. This is appropriate. Three-quarters of the United States' and the world's greenhouse gas emissions emanate from the combustion of fossil fuels for energy. The U.S., and the rest of the world, cannot retard climate change without dramatically boosting energy efficiency and expanding renewables, nuclear and other non-emitting power sources in the electricity, transportation, industrial and building sectors.

But energy production and use is not the only climate change story. For at least four key reasons, land use issues loom large and deserve the full attention of the next administration.

First, approximately 25 percent of annual global greenhouse gas emissions are caused by the destruction of forests and other agricultural and land use practices. While there has been progress in reducing the rate of deforestation in some countries, large land-clearing operations continue in many developing nations. In addition, the U.S. and other countries face large forest die-offs due to pest infestations, hard droughts, catastrophic wildfires and other extraordinary climate-related events. Meanwhile, agricultural emissions continue to grow, particularly with increased livestock production in Africa, Asia and, to a lesser extent, the Americas.

Second, investing in improved land use practices will increase the quantities of carbon dioxide forests and other lands remove from the atmosphere – over and above the 20 percent of global greenhouse gas emissions they already are absorbing and sequestering. With modest investments in good stewardship, nature's assets have the potential to take up and store significantly more carbon dioxide in the world's forests, rangelands and soils. There is a double bottom-line benefit to investing in our natural and working landscapes: attending to the health of our landscapes will produce important co-benefits, including clean water, biodiversity and increased agricultural production.

Third, land availability to site renewable energy projects and transmission lines will be needed to scale up the clean energy power sector. Smart land use strategies, including landscape-scale planning and improved permitting and review procedures, must be employed to ensure that clean energy projects are developed in the right way and in the right places.

Finally, when it comes to climate impacts, land use issues are front and center. Sea rise and storm surge already are impacting coastal infrastructure and resources. Increased droughts, floods, wildfires and other climate change-related impacts are challenging cities and rural areas alike. Thoughtful land stewardship can blunt some of these impacts and make our lands and waters more resilient in the face of climate change.

Despite the huge role that all of these nature-based factors are playing, they are receiving only modest top-level attention in climate change circles. The next president should change course and embrace land use issues as a core part of the new administration's climate change agenda. In particular, the next administration should

- Provide decision-makers at all levels of government and civil society with easily accessible tools to measure and share information about climate benefits and risks associated with local land types. In particular, the administration should take affirmative steps to measure and disclose both greenhouse gas emissions and carbon uptake and sequestration in forests, grasslands, wetlands and agricultural lands in the U.S. and globally.
- Identify and track land use opportunities to materially improve U.S. climate performance and develop an action plan that relies on a mix of public and private investments, regulatory reforms, and market- and incentive-based programs – including bilateral and multilateral international initiatives – that will
 - Reduce greenhouse emissions associated with natural and working landscapes;
 - Preserve and enhance carbon sequestration in natural and working landscapes; and
 - Facilitate the siting of renewable energy and transmission projects in the right way and in the right places.
- Establish a high-level office in the White House or appropriate cabinet agency or agencies that will address land use adaptation and resilience issues by providing
 - Accessible mapping information that provides detailed, science-based information about existing and projected regional climate impacts on land and water resources;
 - A web-based clearinghouse that facilitates sharing information about local, regional and national adaptation and resilience investments and strategies;
 - A reassessment of national policies and incentive programs that may be inconsistent with emerging adaptation and resilience strategies; and
 - Federal leadership in promoting sound adaptation and resilience strategies that are applied to federally managed land and water resources.

Land Use and Climate Change

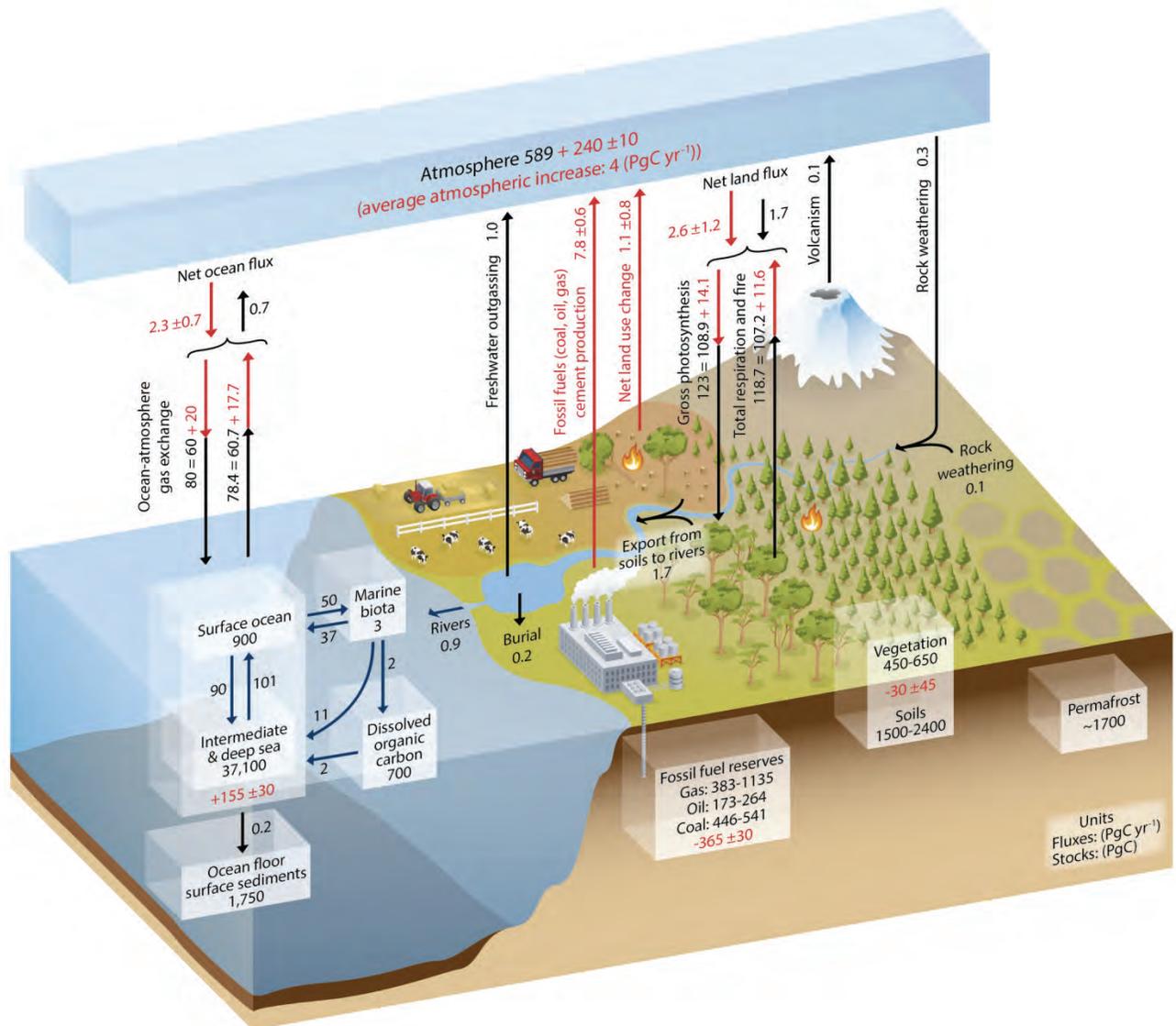


Figure 1. Annual carbon flux, from IPCC AR5.

Background on the Natural Carbon Cycle

The natural carbon cycle processes enormous quantities of carbon dioxide – the primary greenhouse gas – through the constant uptake of atmospheric carbon dioxide into plants, soils and water bodies. Carbon dioxide is stored in natural carbon “sinks”: our trees and plants, soils and waters. Through natural processes such as decay and combustion, carbon dioxide is then released back into the atmosphere, and the cycle continues.

Until modern times, the natural carbon cycle managed to keep carbon dioxide in the atmosphere in balance. As the Intergovernmental Panel on Climate Change (IPCC) and other scientists have confirmed, however, mankind’s burning of fossil fuels, venting of methane and production of other powerful greenhouse gases has thrown nature’s self-regulating carbon cycle out of whack.

The volume of carbon “fluxes” that flow into and out of the atmosphere on an ongoing basis is massive. As depicted in the carbon cycle figure included in the IPCC’s Fifth Annual Report and reproduced in Figure 1, the annual, natural carbon flux that moves from the atmosphere into forests and other land types via gross photosynthesis approximates 109 GtC per year – a quantity that is balanced in virtually equal measure by total naturally occurring carbon dioxide released via respiration and fire.¹²⁹

The annual emissions associated with global industrial emissions and other anthropogenic factors are less than one-fifth of the total carbon flux that is occurring in the terrestrial system. Thankfully, our natural carbon system has some excess capacity built into it and, even without significant effort on our part, nature is absorbing about 20 percent of these industrial-related and other anthropogenic greenhouse gas emissions each year.¹³⁰

Imagine, then, the potential carbon uptake payoff that could accompany investments in better managing the United States’ and the world’s forests, wetlands, peat bogs and other rich, carbon-absorbing lands, and in managing rangeland and agricultural soils. As the IPCC’s macrolevel figure above demonstrates, even a relatively small percentage of increase in the uptake of carbon dioxide in the world’s landscapes could offset a significant portion the world’s greenhouse gas emissions.

A forthcoming study by the Nature Conservancy has quantified this potential. It concludes that even when taking cost constraints into account, 20 natural pathways involving conservation, restoration and better land management across global forests, wetlands, grasslands and agricultural lands have the potential to provide more than 40 percent of the emissions reductions needed to hold warming below 2 degrees Celsius by 2030. This is 30 percent higher than previous estimates. The study notes that a third of this benefit can be delivered at low cost. It concludes: “To avoid catastrophic climate change, greening the planet is a social imperative.”¹³¹

I. Measuring the Land Use and Carbon Interface

The first step in addressing land use-related carbon emissions and taking advantage of upside sequestration opportunities is to pull together and make publicly available easily accessible, state-of-the-art information about land-use related emissions sources, carbon sinks and additional carbon sequestration opportunity areas.

Much of this information is available on a piecemeal basis through a variety of existing sources, including the EPA’s greenhouse gas emissions inventory and, on the carbon sequestration side, through data the U.S. Forest Service maintains, and through a major, nationwide carbon sequestration project that the United States Geological Survey (USGS) has completed at the direction of Congress.¹³² Also, California and some other states have been devoting significant resources to developing state-specific inventories of sequestered carbon stocks in its forests and other land types.

The carbon sequestration data amassed by the USGS provides a window into the potential power of land use carbon emissions and storage data. The reports that USGS prepared under Section 712 of the Energy Independence and Security Act of 2007 provide a national assessment of carbon fluxes in major terrestrial ecosystems (including forests, grasslands/shrublands, agricultural lands and wetlands) and aquatic ecosystems (rivers, streams, lakes, estuaries and coastal waters). The studies lay out baseline carbon flux information (based on the period of 2001 through 2005) and future projections of carbon emissions and storage in land types through 2050.

129 Intergovernmental Panel on Climate Change Fifth Assessment Report (hereinafter referred to as “IPCC AR5”) at Figure 6-01, <https://www.ipcc.ch/report/graphics/index.php?t=Assessment%20Reports&r=AR5%20-%20WG1&f=Chapter%2006>.

130 See B.W. Griscom et al., *Natural Pathways to Climate Mitigation* (forthcoming, 2016).

131 Ibid.

132 See generally https://www2.usgs.gov/climate_landuse/land_carbon/.

The USGS analytics are stunningly informative. The report on carbon storage in the eastern portion of the United States, for example, confirms that the eastern U.S. is a carbon storage powerhouse, led by private and public forests in the southeastern U.S. Indeed, USGS researchers project that terrestrial ecosystems in the eastern U.S. will store 35 percent more carbon by 2050 – with 70 percent of that increase attributable to eastern forests.¹³³

USGS's analysis of carbon uptake in terrestrial systems in Alaska tells much the same story. Alaska is an important carbon sink, and even taking into account future carbon losses associated with increased fires and lower expected productivity from boreal forests, the USGS researchers project that carbon sequestration in upland and wetland ecosystems in Alaska may increase five- or even tenfold by the end of the century, from 3.7 TgC/yr to 18.2 to 34.4 TgC/yr.¹³⁴

Unfortunately, little attention has been drawn to these important data sources and the profoundly important implications they have for climate policy directions in the U.S. and globally. Despite their central importance, land use issues have had difficulty breaking into the U.S.' climate change policy discussions.

The lack of clear, authoritative and consistent information on terrestrial carbon emissions and sequestration is a big part of the problem. The federal government offers no centralized, authoritative mapping service, for example, that meshes the best currently available data in a format that federal, state or local decision-makers and interested citizens can use to evaluate the positive carbon impacts that would be associated with forest management or other carbon-enhancing investments in a particular area or, alternatively, to project carbon losses that will flow from clearing forests, converting rangelands or other significant land use changes.

The next president has an opportunity to address this shortcoming. Toward that end, the president should direct the relevant federal agencies (including, for example, the Interior Department's USGS and Bureau of Land Management, the USDA, including the U.S. Forest Service, and the EPA) to work with state officials and private experts and coalesce around agreed-upon protocols to quantify carbon storage in terrestrial land types. Particular attention should be paid to projections of potential future carbon storage opportunities and agreed-upon measurement protocols that can chart progress in terms of net increases (or decreases) in carbon storage in U.S. lands.

The president should also direct his or her administration to develop a single web portal that will make consolidated information about current and projected carbon sequestration levels in land types throughout the United States available to decision-makers and interested citizens. This information should be readily accessible, in a map-based format that non-IT experts can easily navigate. The website at www.landcarbon.org, constructed by the USGS in collaboration with UC Berkeley's Spatial Innovation Facility, provides an excellent start in this regard.

Also, where there are clear weaknesses in calculating and/or confirming the carbon content in certain land types, the president should direct more resources to fill those key gaps. Having better data and measurement capabilities to quantify the carbon content in agricultural soils, for example, could play a major role in helping farmers increase carbon storage, while also increasing the productivity of their lands.¹³⁵

133 Zhu, et al, *Baseline and Projected Future Carbon Storage and Greenhouse-Gas Fluxes in Ecosystems of the Eastern United States* (2014), <http://pubs.usgs.gov/pp/1804/>.

134 Zhu, et al, *Baseline and Projected Future Carbon Storage and Greenhouse-Gas Fluxes in Ecosystems of Alaska* (2016), <http://pubs.usgs.gov/pp/1826/pp1826.pdf>. The USGS projections appear to be particularly optimistic given the large uncertainties regarding potential methane emissions associated with the loss of permafrost and the albedo effect associated with added forest cover.

135 USDA has launched innovative tools to help address this issue (see, e.g., <http://cometfarm.nrel.colostate.edu/>), but, as a general matter, the forestry sector has commanded more measurement-related resources and attention.

The importance of having the federal government take advantage of its unique ability to generate, and make readily available, information about carbon stocks in our lands cannot be overemphasized. Most land use decisions in the United States are made at the state, regional, tribal and local levels. These decision-makers, however, should have access to information about the carbon implications of their actions. That is information that the federal government is uniquely well-positioned to provide.

The federal government is an important land use decision-maker in its own right, and it also would benefit from access to carbon emissions and storage information. In particular, the federal government has management responsibility over one-third of the land mass of the United States. Having ready access to information about carbon stocks on its lands would enable federal officials to make better, more-informed decisions regarding the long-term land management of carbon-rich lands and the identification of carbon strongholds that may deserve protection through the Land and Water Conservation Fund and other mechanisms.

The easy availability of data that quantify the carbon benefits of existing landscapes can also facilitate market-based transactions to protect natural carbon stocks from conversion and related emissions. The recent investment by General Motors' Chevrolet division in avoiding the conversion of carbon-rich lands in the Prairie Pothole region of our northern Great Plains illustrates this market potential.¹³⁶

More generally, having readily available carbon storage information will provide an important input into the many decisions that are informed by environmental analysis required under the National Environmental Policy Act (NEPA). In that regard, new NEPA guidance released last month by the Council on Environmental Quality explicitly notes that federal agencies should consider the potential effects of proposed actions by assessing greenhouse gas emissions “includ[ing], where applicable, carbon sequestration.”¹³⁷ The guidance emphasizes the importance of using “quantification tools and methodologies” that can provide estimates of greenhouse gas emissions from “carbon sequestration for many of the sources and sinks potentially affected by proposed resource management actions.”¹³⁸ Obviously, having better access to centralized, authoritative carbon information sorted by geography and land use types would make it easier to complete this analysis and generate more reliable and consistent analytics around carbon gains and losses associated with land use decisions.¹³⁹

II. Land Use/Climate Opportunities: Reducing Land Use-Related Emissions Sources and Increasing Carbon Sequestration in Natural and Working Landscapes

As noted above, deforestation and agriculture-related greenhouse gas emissions account for about 25 percent of global anthropogenic greenhouse gas emissions – with each sector accounting for approximately half of the total.¹⁴⁰ The next president has an important opportunity to help reduce a significant portion of these emissions while, at the same time, affirmatively enlisting nature to “do its thing” and absorb and sequester *additional* carbon dioxide from the atmosphere. Big quantities of greenhouse gases are at stake on both sides of the equation. As such, land use emissions reduction and sequestration strategies have the unique potential to significantly move the climate change needle in a positive direction for the U.S. – and the world.

136 S. J. Keller, “Chevrolet Just Helped Bring Grasslands into the Carbon Market,” High Country News, Nov. 26, 2014, <https://www.hcn.org/articles/chevrolet-just-helped-bring-grasslands-into-the-carbon-market-1>.

137 Final NEPA Climate Change Guidance from the Council on Environmental Quality, 4, https://www.whitehouse.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf

138 *Ibid.*, 12.

139 *Ibid.*, 14. The recently released NEPA guidance also indicates that environmental reviews should address the reasonably foreseeable climate impacts associated with the use of resources extracted from public lands. Thus, for example, when the BLM is considering leasing publicly-owned coal resources to a third party, the deciding official should know what the likely greenhouse gas emissions associated with the downstream combustion of the coal will be, in addition to on-site carbon impacts. Having a fuller understanding of climate impacts, based on solid data, can only help improve all aspects of land use decision-making.

140 IPCC AR5, 825.

Deforestation, Restoration and Afforestation

Deforestation received a significant amount of attention as a major global emissions source a few years ago, but domestic clean energy issues now dominate the climate change agenda in the U.S. This is not surprising. President Obama's climate action plan leans heavily into fossil fuels – the largest source of U.S. emissions. Plus the Paris Agreement focuses primarily on indigenous opportunities to reduce emissions, which, for the U.S., does not include deforestation. Also, casual observers may be assuming that given the well-publicized decline in the rate of deforestation in Brazil,¹⁴¹ and the generous contributions that Norway and a few other nations have made to the United Nations' REDD+ (reducing emissions from deforestation and forest degradation) program, deforestation is no longer a topline climate change issue.

The reality, of course, is that deforestation continues to account for a large share of global emissions.¹⁴² The peat and forest fires that blanketed Indonesia for months last year, generating daily greenhouse gas emissions that were equivalent to the entirety of the U.S.' daily industrial emissions – as well as the devastating spring wildfires that destroyed much of Fort McMurray in Alberta earlier this year – should have reminded us that the world's forests need our attention.¹⁴³ Forestry must get back on the global climate agenda if we hope to keep global temperature increases below 1.5 or 2.0 degrees Celsius.

Forests are a particularly good climate change issue for the next president to focus on for additional reasons as well. In particular, stopping the destruction of forests, and promoting expanded, healthy forests and other landscapes, speaks to our hearts, as well as our heads. American people understand – and are drawn to – forests. They resonate with us, more so than climate change's techno-geeky issues, like methane leaks and the latest advances in fuel cells, nuclear reactors, or fill-in-the-blank. Indeed, a focus on forests can increase public literacy and optimism about climate change, at the same time that it can materially improve the globe's overall greenhouse gas emissions profile.

U.S. Forests – Increasing Carbon Uptake and Addressing Looming Concerns

While U.S. forests are not being systematically destroyed and, in fact, are healthy enough overall to serve as net carbon sinks, the time is ripe for a comprehensive domestic forest initiative that would increase the carbon uptake on our forests while addressing issues that are creating concerns about the long-term viability of some of our forests.

As noted above, the comprehensive USGS and Forest Service analyses of U.S. forests confirms that, overall, forests are serving an important role as carbon sinks and have significant upside potential to increase their positive carbon productivity.¹⁴⁴

The next president should jump on this good news and launch an American Forests Initiative that doubles down on the U.S.' robust forest resources and seeks to increase carbon sequestration in our forests. Communities should be challenged to plant trees by the

141 Ibid.

142 The overall share of global emissions associated with deforestation has dropped from roughly 20 percent in 2007 to 10 percent today. See generally B. Griscom, "Forests: A Rising Global Climate Superpower?" *Cool Green Science*, August 21, 2013, <http://blog.nature.org/science/2013/08/21/forests-a-rising-global-climate-superpower/>. Ten percent is, however, an enormous share of overall emissions. It is roughly equivalent to two-thirds of the global emissions associated with the transportation sector and one-half of all of industry's global emissions. See <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>.

143 See, e.g., <http://www.wri.org/blog/2015/10/indonesia%E2%80%99s-fire-outbreaks-producing-more-daily-emissions-entire-us-economy>.

144 Ibid. The Forest-Climate Working Group, a coalition of forest stakeholders that includes landowner, industry, conservation, wildlife, carbon finance and forestry organizations has estimated that U.S. forests currently reduce annual U.S. greenhouse gas emission by roughly 13 percent – the equivalent to emissions from almost 2,000 coal fired power plants per year. See Forest-Climate Working Group: Policy Platform, April 4, 2014, <http://www.forestry.state.al.us/Carbon/FCWG%20Policy%20Recommendations%20Report.pdf>. The Forest-Climate Working Group has identified a series of recommendations to increase carbon uptake in U.S. forests, including better managing and restoring of existing federal, state and private forests, promoting forest products and increasing urban forests. They claim that the resulting carbon emissions savings would account for "almost 5percent of new emissions reductions needed to achieve the 17percent U.S. emissions goal in the President's Climate Action Plan."

tens of thousands in their urban heat islands, in suburban open spaces and in the countryside. Federal and state foresters should work in tandem with the private forestry sector to promote varied, multispecies growth patterns while protecting key old growth and wildlife habitat. And to reduce the number of climate change-related, unnaturally destructive fires,¹⁴⁵ and facilitate more rapid postfire revegetation (and associated carbon uptake), excess fuels should be more actively managed through mechanical thinning and controlled burns.

Taking its cue from the IPCC,¹⁴⁶ the U.S. should also explore adopting a policy preference to substitute wood products that “deliver the same service” for products “with higher GHG emissions” – such as “the replacement of concrete and steel in buildings with wood”¹⁴⁷ – as an emissions reduction strategy. Likewise, positive climate benefits can be gained through the substitution of wood waste for fossil fuels.¹⁴⁸

In addition to providing climate benefits, these initiatives would generate important economic benefits, including new forestry-related jobs in hard-hit rural America.¹⁴⁹

U.S. Leadership in Address Global Deforestation

Addressing global deforestation issues also presents an opportunity for U.S. leadership on the global stage, as a follow-up to the Paris Agreement. Notably, while Paris focused primarily on country-specific commitments to reduce emissions, it explicitly acknowledged the need to address global deforestation issues. In addition, many of the commitments made in Paris by developing countries rely on reduced emissions from the forestry and other land use sectors.¹⁵⁰

Given this opening, the new president’s climate change team should explore creative mechanisms that would enable the U.S. to help reduce deforestation in developing nations and garner credit for the attendant large emissions reductions. Constructing a rigorous, forest-centered offset program that would tie into emissions reduction goals (via the Clean Power Plan, for example, or other appropriate vehicles), might augment domestic U.S. emissions reductions and provide additional, low cost opportunities for U.S. actors to reduce global greenhouse gas emissions.

The time is ripe for the U.S. to expand the tools available to meet its national emissions reduction commitments with bilateral or multilateral programs that generate cost-effective reductions of forest-related emissions in developing nations. Much of the groundwork for an international trading and/or investment program has been laid by both international and domestic players.¹⁵¹ The State of California, for example, has been conducting spade work on a potential forestry emissions reduction credit program

145 Massive die-offs have occurred in many western forests due to climate-related factors, including insect infestations and long-term droughts. The die-offs have added to the already-high fuels loadings in U.S. forests. When combined with climate change’s high temperatures and extended fire seasons, the West is plagued with more frequent catastrophic fires that are traveling farther, and burning hotter, than natural wildfires.

146 See generally IPCC AR5, Table 11.2, page 830, for a menu of forestry “practices and impacts” that can increase carbon uptake in forests.

147 IPCC AR5, 829.

148 Ibid., 818. See also *ibid.*, 841.

149 One of the presidential candidates has explicitly recognized the connection between forest health and climate change. Specifically, Hillary Clinton’s campaign has released a “Plan for Conservation and Collaborative Stewardship of America’s Great Outdoors,” which notes the important role that federally managed forests play in sequestering carbon, while also providing economic, recreation, and water co-benefits. See <https://www.hillaryclinton.com/briefing/factsheets/2016/06/01/hillary-clintons-plan-for-conservation-and-collaborative-stewardship-of-americas-great-outdoors/>. (“Clinton will work with the U.S. Forest Service and Bureau of Land Management to set clear management goals that not only recognize the value of forests and public lands for sustainable timber, but for the carbon they absorb, the wildlife habitat they furnish, and the recreation opportunities and clean drinking water they supply.”) The Plan notes that well-managed forests have the potential to substitute wood and other organic wastes for fossil fuels, via “a joint Department of Interior/Department of Agriculture program to commercialize biomass energy opportunities associated with sound forest management and agricultural practices.”

150 See generally <http://www.worldbank.org/en/news/feature/2015/12/18/outcomes-from-cop21-forests-as-a-key-climate-and-development-solution>.

151 See generally IPCC AR5, 864–67.

as part of its state-based cap and trade program and the subnational Governors' Climate and Forests Task Force, which includes representatives from more than 30 subnational jurisdictions.¹⁵²

In sum, the next president has an important opportunity to develop a viable domestic and, potentially, international carbon offset and trading program as part of a national strategy to cost effectively reduce emissions.

Additional Opportunities on Rangelands, Wetlands and Other Land Types

Forests get the most attention because they account for approximately three-fourths of the nature's terrestrial uptake of carbon, but the draining, tilling, and/or burning of rangelands, wetlands, peat bogs and other carbon-absorbing lands also produces significant greenhouse gas emissions. Plus the world loses the benefit of these lands' ongoing uptake of greenhouse gases from the atmosphere.

On the upside, like the forestry sector, more active restoration and management activities in rangelands, wetlands and other important landscapes hold the promise of increasing the uptake of carbon dioxide.

Coastal lands provide a particularly attractive opportunity to sequester more carbon, while providing important co-benefits. Coastal marshes and other natural barriers have been proving their effectiveness as "green infrastructure" that can protect against sea rise and storm surge. Inspired by the possibilities, the international Blue Carbon Initiative has formed scientific and policy working groups to develop and promote carbon mitigation strategies in coastal areas.¹⁵³

Important research is also underway to enhance carbon uptake in rangelands and other soils through the spreading of compost and/or biochar over existing soils. The amended soil cover reduces carbon emissions by stabilizing underlying soils. At the same time, compost and biochar typically increases the carbon uptake of grasslands and other plant growth on less fertile lands, without the application of fertilizers that give off powerful nitrogen oxide and methane greenhouse gas emissions.¹⁵⁴

The potential carbon payoff of these soil amendment practices could be significant. Researchers at the Marin Carbon Project, for example, suggest that if compost were applied to 5 percent of California's rangelands, 28 million metric tons of annual carbon dioxide emissions would be removed and sequestered from the atmosphere – the equivalent of removing nearly 6 million cars from the road.¹⁵⁵

Agriculture

Agriculture-related greenhouse gas emissions make up the other half or so of the approximately 25 percent of land-use related anthropogenic emissions. Agriculture-related carbon dioxide emissions are considered "neutral" and are not treated as being anthropogenic due to their association with annual cycles of carbon fixation and oxidation through photosynthesis. The primary emissions sources of concern in the agriculture sector include methane emissions from livestock (so-called "enteric fermentation," which produces methane through burping and flatulence) and nitrogen oxide releases from soil that has been chemically fertilized, which together make up 70 percent of total ag-related anthropogenic emissions. Manure management

152 See <http://www.gcftaskforce.org/>. See also F. Seymour, "California Should Take the Lead on Protecting Tropical Forests," Los Angeles Times, July 1, 2016, <http://www.latimes.com/world/global-development/la-fg-global-tropical-forests-oped-snap-story.html>.

153 See generally <http://thebluecarboninitiative.org/>.

154 IPCC AR5, 833. The IPCC report provides additional information on the potential for biochar to positively impact land use-related emissions. The Marin Carbon Project website includes information regarding the potential for composting and other "carbon farming" techniques to increase the quantities of land-based carbon sequestration. See www.marincarbonproject.org.

155 See <http://www.marincarbonproject.org/policy/rangeland-compost-protocol>

makes up another 7 to 8 percent of emissions from global ag operations, along with paddy rice cultivation (9–11 percent) and biomass burning (6–12 percent).¹⁵⁶

It will not be easy to tackle the two largest sources of anthropogenic ag emissions: livestock-related methane emissions and fertilizer-based soil emissions. Improved feed and dietary additives hold the most promise to reduce emissions from enteric fermentation.¹⁵⁷ Improved livestock breeds may also reduce emissions.¹⁵⁸ And, of course, over the longer term, demand-side options, including changing human dietary consumption patterns, could reduce livestock-related emissions.¹⁵⁹

Nearer-term, more scalable emission reduction opportunities are available to address manure management-related emissions. In particular, anaerobic digesters provide an efficient, proven technology to extract methane from liquid manure waste streams and beneficially utilize methane as a fuel source. Less intensive chemical fertilizer use also can significantly reduce nitrogen oxide emissions from agricultural soils.

On the upside of the equation, farmers can take a number of steps that will retard carbon dioxide emissions from ag soils and, even more importantly, add significant amounts of carbon into carbon-depleted soils through “carbon farming” or regenerative farming techniques.¹⁶⁰ These techniques include “refraining from tilling, or turning, the soil; mixing crops together rather than growing large fields of just one type; planting trees and shrubs near or among crops; and leaving stalks and other cuttings on fields to decay.”¹⁶¹

The U.S. has taken some initial steps to reduce agricultural emissions through a series of voluntary, “building block” programs that Agriculture Secretary Tom Vilsack announced in April 2014. In particular, with regard to livestock emissions, the USDA announced that it will “encourage broader deployment of anaerobic digesters, lagoon covers, composting and solids separators to reduce methane emissions from cattle, dairy and swine operations, including the installation of 500 new digesters over the next 10 years.”¹⁶² USDA also committed to encourage improved nitrogen stewardship through “focus on the right timing, type, placement and quantity of nutrients to reduce nitrous oxide emissions and provide cost savings through efficient application.”¹⁶³

On the plus side, the USDA announced its intentions to help U.S. farmers replenish and keep more carbon in agricultural soils by “promoting conservation tillage and no-till systems, planting cover crops, planting perennial forages, managing organic inputs and compost application, and alleviating compaction.”¹⁶⁴ The effort “aims to increase the use of no-till systems to cover more than 100 million acres by 2025.”¹⁶⁵

Through this series of voluntary, incentive-based “building block” efforts – which include some forestry-related initiatives as well – the USDA estimates that net emissions in the U.S. ag and forestry sectors will be reduced, and carbon sequestration enhanced, by over 120 million metric tons of carbon dioxide equivalent per year – about 2 percent of economy-wide net greenhouse emissions – by 2025.¹⁶⁶

156 Ibid., 822–23.

157 See chart and associated references at IPCC AR5, 831.

158 Ibid.

159 Ibid., 818, 844.

160 Beth Gardiner, “A Boon for Soil, and for the Environment,” *New York Times* Special Report, May 18, 2016.

161 Ibid.

162 See USDA News Release, *Voluntary, Incentive-based Efforts Will Reduce Greenhouse Gas Emissions, Expand Renewable Energy Production, Help Producers Boost their Operations and Grow the Economy*, April 23, 2015, <http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=2015/04/0109.xml>.

163 Ibid.

164 Ibid.

165 Ibid.

166 Ibid.

Secretary Vilsack's efforts to improve the carbon profile of the U.S. agriculture sector are laudable, but progress is likely to be slow. As in other sectors, farmers have only a spotty understanding of farming's and ranching's roles in greenhouse gas emissions, on the one hand, and new carbon storage possibilities, on the other hand. Also, the USDA's "building blocks" program includes limited incentives to augment current carbon levels in soils. And, as noted above, there are challenges in measuring higher carbon levels in soils.

Frankly, unless and until carbon commands a market price or until a specialized trading or offset program that extends to the ag sector is developed (including, potentially, international ag markets), it appears unlikely that the U.S. agricultural sector will be able to systematically reduce greenhouse gas emissions or sequester additional carbon in agricultural lands. Progress may need to await a more generalized, heightened awareness of the role of agricultural lands in the carbon cycle and the appearance of a climate-related driver that provides farmers with a stronger incentive to adopt more climate-friendly practices.

III. Land Use/Climate Challenge: Siting Clean Energy Projects

Another important intersection between land use and climate change revolves around the need to find suitable sites to build renewable energy infrastructure such as wind farms and large solar arrays, as well as the transmission lines that are needed to bring otherwise-stranded renewable energy assets to load centers. In order for the U.S. to increase its output of renewable energy – which currently accounts for only about 13 percent of U.S. electricity generation¹⁶⁷ – a massive amount of new renewable energy will need to come on line. This means that hundreds of new wind farms need to be built and rooftop, community-based, and utility scale solar projects must sprout up around the country, along with new storage facilities and an expanded and upgraded smart grid.

Thus, a serious, national commitment to clean energy also means that land use siting issues must be addressed in a forthright, fair and efficient manner so that needed projects can be built in the right way, and in the right places, without unreasonable delays.

This is a tall order. And it is a challenge that extends, more generally, to other important infrastructure projects that also will help reduce greenhouse gas emissions, such as building new high-speed trains, improved airports and other new mass transit facilities; untangling rail, truck and passenger vehicle bottlenecks; and constructing water conveyance, storm water and wastewater treatment facilities that can address growing water needs in a more energy efficient manner.

Good planning and smart permitting strategies at the federal, state and local levels are needed to make this happen.

The next president should use his or her bully pulpit to call all levels of government together to take on this challenge. The feds must do their part and take a leadership role in working with state and local officials, developers and key stakeholders to facilitate both planning and permitting activities.

Planning

On the planning front, the next president should direct the major land management agencies, and other agencies that have primary permitting responsibility, to participate fully in state and local planning activities that seek to clarify and help streamline the siting and permitting of renewable energy and other important infrastructure projects. In California, for example, the governor's office and the California Energy Commission have been engaged in important planning efforts focused on renewable energy, including a solar energy siting initiative in the San Joaquin Valley, and an ambitious renewable energy conservation planning effort in Southern California. The feds should do their part to help such planning efforts succeed.

167 See U.S. Energy Information Administration, Frequently Asked Questions, <http://www.eia.gov/tools/faqs/faq.cfm?id=92&t=4>.

When it comes to siting renewable energy projects on the public lands and in offshore waters, the federal government has direct decision-making and management responsibility, and sound planning exercises should be pursued to help facilitate the siting of major projects in the right way and in the right places.

The Obama administration's Western Solar Plan provides a good template for renewable energy planning, with its identification of "solar energy zones" in which solar developers are encouraged to site their projects. Solar energy zones are identified based on reduced environmental conflicts, access to transmission, the availability of regional mitigation opportunities and other relevant factors that can speed project reviews and permitting.¹⁶⁸ Early experience with this landscape-scale planning process has been largely positive, with some developers being able to move forward with siting approvals much more quickly than the traditional approach in which developers are required to undertake pre-siting analysis and come forward with proposals that they develop on their own, disconnected to a planning process.¹⁶⁹

The planning approach also has been used successfully to facilitate developer interest in siting offshore wind facilities in the mid and north Atlantic. The Obama administration worked with the governors of Atlantic coastal states to form task forces with state officials and key stakeholders to identify de-conflicted offshore areas that are good candidates for potential offshore wind development. The lead permitting agency also engaged in outreach with key federal players, including the Coast Guard, the Department of Defense and the National Oceanic and Atmospheric Administration (NOAA), among others, to identify lower conflict offshore areas.¹⁷⁰

Based on this planning effort, offshore "wind energy areas" have been identified, and the U.S Department of the Interior has opened them up for developers through a successful auction process. Because the areas have been prescreened for potential conflicts, permitting processes should proceed far more efficiently than those experienced by the Cape Wind project in Nantucket Sound, which is located in a self-nominated offshore tract that generated significant controversy and conflict.

These types of planning efforts also can improve both the process and results that agencies use to identify mitigation required by developers to address unavoidable environmental impacts. Traditionally, mitigation issues are dealt with at the end of the permitting process, when neither the developers nor the agencies have the time nor the inclination to identify the most environmentally productive and cost-effective mitigation options. Planning exercises, however, provide an opportunity to scope out regional mitigation opportunities that could provide major environmental dividends for area landscapes. The Western Solar Plan introduced this concept and the Bureau of Land Management (BLM) has successfully piloted a regional compensatory mitigation scheme at the Dry Lake Solar Energy Zone to counter the unavoidable effects of development in that area. Rather than restricting mitigation measures to the project site, this initiative has identified landscape-level mitigation opportunities to conserve desert tortoise habitat, conserve ecosystem services and counter visual impacts.¹⁷¹

While federal planning efforts hold great promise for facilitating the siting of major infrastructure projects on public lands, they must not become overly complicated and so bogged down in process that rather than helping to streamline siting and permitting decisions, they exacerbate delays. To avoid this result, federal planning efforts should be refreshed as needed. Solar energy zones and wind energy areas, for example, should not be set in stone, and assumed to be the only appropriate areas for development

168 Bureau of Land Management., Final Solar Energy Development Programmatic Environmental Impact Statement (Solar PEIS) (2012), 2, <http://solareis.anl.gov/documents/fpeis/index.cfm>.

169 Scott Streater, *Interior OKs First Solar Projects through Streamlined Reviews*, E&E Publishing, June 1, 2015, <http://www.eenews.net/>.

170 See generally Bureau of Ocean Energy Management., BOEM 2012-003, Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia: Final Environmental Assessment (2012), http://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Mid-Atlantic_Final_EA_012012.pdf; Marcilynn A. Burke, *Regional Mitigation on Public Lands*, American Bar Association Section of Environment, Energy, and Resources (Oct. 8–11, 2014), 6, http://www.americanbar.org/content/dam/aba/events/environment_energy_resources/2014/10/22nd-fall-conference/course_materials/18-burke_marcilynn-paper_authcheckdam.pdf.

171 Bureau of Land Management, Regional Mitigation Strategy for the Dry Lake Solar Energy Zone: Technical Note 444 (Mar. 2014), 2.5.1, http://www.blm.gov/style/medialib/blm/wo/blm_library/tech_notes.Par.29872.File.dat/TN_444.pdf.

once they are created. Additional zones and areas should be added as needed and as justified. Also, developers should have the opportunity to make the case to develop projects in variance areas that fall between protected areas and energy zones. The imperative to move forward with significant new renewable energy and other infrastructure projects demands that the federal government adopt a dynamic planning process that facilitates – rather than retards – timely siting and permitting decisions.

Permitting

Many large infrastructure projects trigger a variety of federal permitting and review requirements. Projects that receive funding from the federal government and/or that require federal permits and reviews of one kind or another also typically must undergo an analysis of potential environmental impacts under the National Environmental Policy Act.

Traditionally, federal permitting and reviews have been a major source of frustration. As the White House itself noted when commenting on the permitting process for infrastructure projects, disaggregated federal permitting responsibilities have “resulted in more than 35 distinct permitting and review responsibilities across more than 18 Federal agencies and bureaus, implemented by staff at headquarters and hundreds of regional and field offices.”¹⁷²

The Obama administration made a significant effort to improve the permitting and review process for renewable energy projects and for large infrastructure projects, more generally. Under Secretary Salazar’s leadership, for example, the Department of the Interior improved the pathway to solar and wind energy permit processing from an average of four years to one and a half years.¹⁷³ The department achieved the 2005 Environmental Policy Act’s goal of siting 10,000 megawatts of renewable energy three years ahead of schedule,¹⁷⁴ and to date has successfully approved more than 50 commercial scale renewable energy projects on public lands.¹⁷⁵

Taking its cue from Interior’s success, the president issued Executive Order 13604 – “Improving Performance of Federal Permitting and Review of Infrastructure Projects” – in March 2012.¹⁷⁶ The E.O. established a steering committee to identify a “transparent, consistent, and predictable [permitting] path for both project sponsors and affected communities.”¹⁷⁷

The steering committee is co-chaired by the Chief Performance Officer, White House Office of Management and Budget and the Chair of the Council on Environmental Quality, and is composed of committee members including deputy secretaries and their equivalents at the 12 federal agencies in charge of the effort.

172 Steering Committee on Federal Infrastructure Permitting and Review Process Improvement, Implementation Plan for the Presidential Memorandum on Modernizing Infrastructure Permitting (2014), 7 [hereinafter “Plan for Modernizing Infrastructure Permitting”]. See also Exec. Order No. 13653, Improving Regulation and Regulatory Review (2011).

173 *Renewable Energy: Agencies Have Taken Steps Aimed at Improving the Permitting Process for Development on Federal Lands* (GAO-13-189) (Washington DC: U.S. Government Accountability Office, 2013), 18.

174 Steve Black and Neal Kemkar, “Obama Administration Efforts to Expand Domestic Energy Production: A View from Public Lands,” *A.L.J.* (Feb. 2013): 1.

175 Interior Secretary Sally Jewell on Energy and the Environment, C-SPAN (Mar. 17, 2015), <http://www.c-span.org/video/?324886-1/interior-secretary-sally-jewell-remarks-energy-agenda>.

176 Exec. Order No. 13604, “Improving Performance of Federal Permitting and Review of Infrastructure Projects” (2012), <http://www.gpo.gov/fdsys/pkg/FR-2012-03-28/pdf/2012-7636.pdf>.

177 *Ibid.*

President Obama followed up on his executive order with the issuance of a Presidential Memorandum which recognized that there is no “silver bullet” to improve permitting processes. He instead called for “sustained leadership focus, dedicated implementation capacity, and the development of performance indicators.”¹⁷⁸ The president challenged the steering committee to cut permitting time in half for major federal infrastructure projects.¹⁷⁹

Based on these instructions, the steering committee prepared an “Implementation Plan for the Presidential Memorandum for Modernizing Infrastructure Permitting.”¹⁸⁰ The Implementation Plan adopted, and built upon, many of the innovative approaches piloted by the Department of the Interior for renewable energy projects. Its innovations include developing agency-specific permitting plans; using permitting dashboards to centralize information about project permitting for developers and stakeholders, and for agencies to use to track permitting schedules; making common data bases available to reviewing agencies; encouraging early coordination and collaboration among federal agencies and developers; and utilizing landscape-scale planning approaches to improve permitting.¹⁸¹

To date, these efforts to improve interagency coordination for infrastructure permitting have been quite successful. Based on reviews for over 50 selected major infrastructure projects on the permitting dashboard, “[e]stimated [permitting] time savings range from several months to several years.”¹⁸²

Institutionalizing Permitting Reforms

Although the Obama administration has made good progress in reforming the permitting process for infrastructure projects, there have been concerns about how to institutionalize its reforms and give them more teeth. Congress provided a partial answer when it inserted new, stand-alone statutory permitting requirements for infrastructure projects into the FAST Act (“Fixing America’s Surface Transportation”) that Congress passed in December 2015.

New requirements laid out in the FAST Act will have broad applicability to large infrastructure projects. “Covered projects” under the new law include projects that “require authorization or environmental review by a Federal agency involving construction of infrastructure for renewable or conventional energy production, electricity transmission, surface transportation, aviation, ports and waterways, water resource projects, broadband, pipelines [and] manufacturing,” when such projects are subject to NEPA and are likely to require a total investment of more than \$200 million.¹⁸³

The law establishes a number of new, permitting-related legal obligations that largely track the Obama administration’s administrative reforms, including, for example, a new centralized permitting structure in the White House;¹⁸⁴ the identification and application of

178 Steering Committee on Federal Infrastructure Permitting and Review Process Improvement, Implementation Plan for the Presidential Memorandum on Modernizing Infrastructure Permitting (2014), 5 [hereinafter “Plan for Modernizing Infrastructure Permitting”].

179 The White House, Report to the President: Rebuilding America’s Infrastructure: Cutting Timelines and Improving Outcomes for Federal Permitting and Review of Infrastructure Projects (May 2013), <http://www.whitehouse.gov/sites/default/files/omb/reports/report-to-the-president-rebuilding-america-s-infrastructure.pdf>.

180 “Plan for Modernizing Infrastructure Permitting.”

181 See generally Executive Order 13604; “Plan for Modernizing Infrastructure Permitting.”

182 Report to the President, 4–5.

183 See generally David J. Hayes, “Just Enacted New Permitting Requirements for Energy Projects: Did You Miss It?,” *Stanford Law School Blog* (Dec. 10, 2015), <https://law.stanford.edu/2015/12/10/congress-just-enacted-new-permitting-requirements-for-energy- Congress-projects-did-you-miss-it/>.

184 *Ibid.* The law requires establishment of a “Federal Permitting Improvement Council” that is chaired by a president-appointed executive director, and includes deputy secretary-level representatives of key cabinet agencies. Also, each agency is required to appoint a “Chief Environmental Review and Permitting Officer” or “CERPO.” CERPOs are responsible for overseeing implementation of new review and permitting requirements within their agencies and supporting the Federal Permitting Improvement Council. CERPOs are expected to “standardize, simplify, and improve” the efficiency of processes, policies and authorities applied to environmental reviews and permits, through the use of guidance, best practices, information technology and geographic information system tools.

best practices; the development of permitting performance schedules; requirements to create an inventory of covered projects and to develop a publicly available dashboard with timetables identified for each project; the development of a coordinated project plan for coordinating public and agency participation in, and completion of, any required federal environmental review and authorizations for projects, and other requirements intended to regularize; and move along, federal permitting processes for large projects.¹⁸⁵

It will fall on the next president to implement these new permitting reforms and to facilitate their adoption throughout the federal bureaucracy. This will require significant high-level attention and support, particularly because federal permitting processes are decentralized, with decisions typically being made in regional and local offices. The new requirements anticipate a more coordinated and centralized permitting process that cuts across agency jurisdictional lines. It will be a monumental challenge to transform the high ambitions set forth in the new permitting law into comprehensive, across-the-board permitting reforms.

Potential NEPA Reform

The next president has additional opportunities to modernize federal permitting and review processes.¹⁸⁶ While NEPA tends to get unfairly blamed for permitting delays, some criticism is merited and, on the plus side, NEPA's regulations could be updated in a way that would help institutionalize many of the permitting reforms that the Department of the Interior, the Office of Management and Budget (OMB) and the White House have been implementing.¹⁸⁷

Certain aspects of NEPA's regulations are out of step with today's realities. NEPA's regulations were finalized, for example, at a time when most projects were permitted by a single agency. As a result, they do not anticipate a multiagency environmental review and permitting process. The lead agency has no obligation to contact the project proponent, other agencies and key stakeholders before beginning the NEPA process. They allow reviewing agencies to hang back and delay their involvement in the environmental review and permitting process until after the lead agency has completed its NEPA review.

Updating the NEPA regulations to require lead agencies to reach out and have early engagement with other agencies and stakeholders to help scope out the project and lay the groundwork for a comprehensive environmental review under NEPA, and to require that non-lead agencies participate meaningfully in pre-NEPA scoping and related activities, could be transformative. By mandating that all reviewing federal agencies work together on the front end to coordinate their environmental reviews and related permitting processes, NEPA would once again become an important organizing force around federal review and approval of major projects impacting the environment.¹⁸⁸

IV. Land Use/Climate Challenge: Impacts, Adaptation and Resilience

The climate/land nexus that is so critical on front-end efforts to reduce greenhouse gas emissions is also critical on the back end – namely, in dealing with climate impacts.

Climate change is already affecting our lands and waters. Coastal erosion and sea rise are creating headaches for cities and towns from Miami, Florida, to Shismaref, Alaska. Inland, the wicked combination of increased temperatures, longer fire seasons, hard droughts and severe floods are straining wildfire budgets, forest and rangeland health, community safety, and energy and water infrastructure. Looking ahead, governmental officials, corporations and private citizens are asking how we can build more resilience into our lands and waters – the natural infrastructure upon which our communities depend.

185 Ibid.

186 John D. Porcari, *Environmental Reviews: Undo the Do-Over Loop*, ENR.com (Apr. 7, 2014), <http://enr.construction.com/opinions/viewpoint/2014/0407-project-environmental-reviews-undo-the-doover-loop.asp>.

187 David J. Hayes, *Leaning on NEPA to Improve the Federal Permitting Process*, 45 *Env'tl. L. Rev.* 10018, 10018 (2015).

188 Ibid., 10022.

The land use/climate nexus presents unique “governance” challenges. Climate impacts express themselves at the local and regional level, and in widely varying ways. Many communities are not yet facing immediate threats due to climate impacts, while others are scrambling to adapt. Faced by climate challenges that differ widely in their nature and scope, state and local officials and impacted businesses and residents have no playbook to follow in addressing short-term needs or in developing longer-term strategies to buttress community resilience to future climate-related impacts.

It is vitally important that the next president provide needed leadership in this arena by moving out smartly with four key adaptation and resilience initiatives for land use and water resources.

First, the president should direct the new administration to provide consolidated, accessible mapping data that depicts current and expected climate impacts on local land and water resources throughout the country. Responsible officials and interested citizens need to have the best baseline and projected information data available on existing and potential climate impacts so that they can make sound adaptation and resilience decisions.

An enormous amount of relevant data is available in various corners of the federal government, but state and local officials have no way of efficiently accessing it. USGS, NOAA, EPA, FEMA, the Bureau of Reclamation, NASA, USDA, and other agencies have relevant climate impact information on land and water resources including, in some cases, model-based projections of potential future impacts. Some of the information is available in mapping formats that rely on GIS-based data (geographic information systems) that we are becoming accustomed to using through Google Maps™, Arc-GIS™ and related services. But interested parties must hunt from one website to the next to find relevant information and try to stitch it together.¹⁸⁹

A recent Stanford study identified the confusing patchwork of well-meaning interagency processes that are failing to get the job done for customers who need access to climate impact information.¹⁹⁰ The next president can cut through these bureaucratic barriers and create a climate map that will enable the president, and every American, to help address the resilience challenge. John Podesta has described putting together a climate map room in the White House “to be able to see where effects are taking place, to keep it real time, to use the technologies that are available, to try to imagine what is happening in the natural world and what the impact of that is going to be on the economy and the society.”¹⁹¹

Second, the federal government should provide a web-based clearinghouse that brings together in one place information about how communities are addressing climate impacts. This is another context in which the federal government can provide a significant public service by providing officials and policymakers with organized access to information that will help them make better and more-informed decisions. The goal is to help communities avoid having to “reinvent the wheel” by sharing stories and lessons learned about adaptation and resilience decision-making processes and results. The clearinghouse should include, for example, cost-benefit and other analyses of gray and green architecture strategies that are being applied in different locations to address sea rise and storm surge. The web portal also would include information about major adaptation and resilience projects, including, for example, coastal resilience work funded after Hurricane Sandy and resilience-related investments that are being made in Gulf coastal states with funding from the 2010 Gulf oil spill.

Third, the next president should systematically reexamine national policies that may impact community resilience efforts in positive or negative ways and make adjustments in such policies, as needed. Housing financing and flood insurance incentives need to be updated, for example, to take into account the increased flood and fire risks associated with climate change. Also, the president

189 See Stanford Law School Policy Lab Report, *A 21st Century Governance Challenge: Finding Effective Mechanisms to Address Climate Change Across the Federal Government* (July 13, 2015), 99 (“Locating GIS Maps with Flood Risk Data: An Instructive Example”), <https://law.stanford.edu/education/only-at-sls/law-policy-lab/practicums-2014-2015/energy-and-environmental-governance/#slnav->

190 *Ibid.*, 94–103.

191 Forbes, *Hillary Clinton Plans to Have a Climate “Map Room” in the White House*, Podesta says (May 8, 2016), <http://www.forbes.com/sites/jeffmcmahon/2016/05/08/hillary-clinton-plans-a-climate-map-room-in-the-white-house-podesta/#7fc75e811912>.

will have an important opportunity to work with the business community and state and local governments to sort out the confusing array of infrastructure-building guidelines that are emanating from various agencies at all levels. As reviewed at length in a recent Stanford study, the federal government has produced a particularly confusing array of infrastructure-building guidance.¹⁹²

Finally, the next president must address adaptation and resilience issues pertinent to the substantial land and water resources that the federal government has the responsibility to manage, for the benefit of both current and future Americans. As noted above, the federal government has direct responsibility for managing more than 700 million acres of land – or about 30 percent of the nation’s total acreage – along with offshore marine resources.¹⁹³ These responsibilities implicate water supplies, coastal resources, threatened and endangered wildlife, and fishery and marine resources in offshore waters.

The Obama administration has undertaken a series of interagency initiatives to facilitate adaptation and resilience cooperation across the many federal agencies that have significant land and water management responsibilities. As described in Stanford-led studies, the Obama administration’s resilience-related efforts have lagged behind its other climate change initiatives in terms of effectiveness.¹⁹⁴ Federal land management and water agencies are still largely taking their own separate paths in how they deal with adaptation and resilience issues. The White House has not, to date, insisted that they join forces and develop shared services and common programs to more efficiently and effectively address these serious issues.¹⁹⁵

The proliferation of programs led a distinguished outside review panel to lament this state of affairs when issuing a report to the Secretary of the Interior. Specifically, the Advisory Committee on Climate Change and Natural Resource Science observed that “[w]ith so many [climate change-related] science and decision-support providers, there is a great need to clarify the roles and strengths of various federal programs, coordinate efforts, minimize the potential for redundancy, and identify and address unmet stakeholder needs.”¹⁹⁶ It noted that “the rapid development of these programs, and the ever-expanding list of potential partners in these endeavors, suggests a pressing need for significant investments in coordination.”¹⁹⁷

In sum, the next president has an important opportunity to improve how the federal government addresses adaptation and resilience issues. Bringing together the many climate change response programs across the federal government will provide benefits to our public lands and waters, while also providing templates for collaboration with state, local, tribal and private landowners and water users.

Conclusion

The next administration should take on the land use side of climate change as a complement to decarbonizing the energy sector. Priorities should include reducing land use-related emissions, increasing carbon uptake, adopting smart clean energy siting strategies, and investing in adaptation and resilience needs.

192 See Stanford Law School Policy Lab Report, 56–76.

193 *Climate Change: Various Adaptation Efforts Are Under Way at Key Natural Resources Management Agencies* (GAO-13-253) (Washington, DC: U.S. Government Accountability Office, 2013), 7–8, <http://www.gao.gov/assets/660/654991.pdf>, 2.

194 See generally Stanford Law School Policy Lab Report, 77–93. See also David J. Hayes, *Optimizing White House and Cabinet Agencies’ Role in Implementing Federal Climate Change Initiatives* (April 2016), https://woods.stanford.edu/sites/default/files/documents/POTUS45ClimateDiscussionPaper-DJH-April2016_2.pdf.

195 An exception, and one of the emerging bright spots, has been the increased cross-agency coordination in responding to the severe drought situation through institutionalization of the National Drought Resilience Partnership. See Presidential Memorandum: Building National Capabilities for Long-Term Drought Resilience (March 21, 2016), <https://www.whitehouse.gov/the-press-office/2016/03/21/presidential-memorandum-building-national-capabilities-long-term-drought>.

196 Advisory Committee on Climate Change and Natural Resource Science, *Report to the Secretary of Interior*, (Mar. 30, 2015), 17, https://nccwsc.usgs.gov/sites/default/files/files/ACCCNRS_Report_2015.pdf.

197 *Ibid.*, 16 (emphasis added).

COMPETITION AS THE MEANS TO BUILDING THE CLEAN POWER PLATFORM

Author

Reed Hundt is CEO of the Coalition for Green Capital. He is also the Principal of REH Advisors, an advisory firm serving private firms. Mr. Hundt was chairman of the Federal Communications Commission (FCC) from 1993 to 1997.

Jill Bunting is a Program Director at the Coalition for Green Capital.

Contact

Coalition for Green Capital
1875 Connecticut Avenue NW
10th Floor
Washington, DC 20009
www.coalitionforgreencapital.com
rehundt@gmail.com
jill@coalitionforgreencapital.com

Abstract

Regulation and public financing must accelerate the move of the American and global economy to the clean power platform in order to win the battle against climate change.¹⁹⁸ But government should trust competitive markets to define the structure, conduct and performance of all relevant power markets: consumption, transmission, generation and transportation. Investment must pour quickly into each of these sectors, but the ultimate goal is power that is not only extremely emissions-light but also abundant and affordable.

From 1995 to 2001, federal action to unlock competition in the information and communication technology sector spurred the investment of more than \$700 billion of private capital to create the mobile, digital network of networks that today underlies every form of social and business activity. Competition was the means to attract and reward that investment. The result was a wholly new communications platform where voice, video and data is generated and exchanged in ways that are vastly faster, better and cheaper. A similar transformation is possible in electricity markets if government adheres to basic antitrust principles in creating competitive power markets. By legislation, regulatory persuasion or litigation, the federal government should make sure markets not only deliver clean power but also give consumers ways to pay the same or less for all the uses of power in a modern society and economy.

Introduction

The American economy and society must move quickly to a clean power platform. Because of the need for speed, regulatory and financial tools must drive transformation in energy markets. But, even while fulfilling the imperative of reducing carbon emissions, the ultimate goal must be to have abundant, reliable, affordable and efficiently consumed power.

198 For more on this see Reed Hundt, *Zero Hour: Time to Build the Clean Power Platform* (Odyssey Editions, 2013).

All goods and services in modern economies require energy as an input. Indeed, energy is an increasingly important input as economies become more advanced. To improve American and global standards of living, clean power solutions must be delivered at the lowest possible price. Regulation alone is rarely, if ever, the best means to minimize price. Better and cheaper products are far more likely to be invented and sold successfully in competitive markets. Although governments should boost research, development and deployment of clean power solutions, buyers and sellers in markets, not regulators, should create the clean power platform.

Energy and environmental regulators can command behavioral change, such as requiring certain amounts of renewable power to be purchased. They can stimulate demand for efficiency by providing incentives and mandates. They can tax carbon-based power so as to give a competitive advantage to renewable power or to create an incentive for consumers to consume less on the old carbon platform. They can use permits or caps to create a simulacrum of a carbon tax. It is important to solve the political and design problems that have hampered these useful techniques. But regulators should be the first to agree that nothing makes a regulator's job easier, or makes change happen faster, than when consumers happily choose the goods and services that compose the necessary new platform for economic and social activity.

Regulators can and should foster a pro-competitive clean energy platform. "Pro-competitive" does not mean anti-regulation – it means regulation aimed at removing barriers and promoting the development of competitive alternatives to the current carbon-based power platform. The new platform would give consumers the opportunity to choose among competitive sources for power, competitive offers for efficiency, and competitive providers of low-emissions vehicles. Government should clear the way for clean power to win in these markets, using as many regulatory and financial tools as politics permits. But ultimately consumer choice, and not regulators, should define the structure, conduct and performance of the clean power platform.

By embracing competition in the production and consumption of power, the United States will attract the maximum amount of private sector investment while at the same time making consumers better off.¹⁹⁹ Innovators can bring new forms of generation, transmission, distribution and consumption into existing markets, and can create new goods and services not yet seen. Investment in the new platform can increase gross domestic product (GDP) by as much as 1 percent extra annually. That is approximately equal to the impact on GDP realized by the replacement of the old communications platform by the new digital, wireless platform between 1994 and 2000. Moreover, delighting consumers is far more likely to be politically sustainable than punishing them with higher prices or pushing them to spend their money on something they do not value.²⁰⁰

The next president should champion competition in all power and power consumption markets.²⁰¹ The Executive Branch, independent agencies and Congress should collaborate to

- Use the authority of the Federal Energy Regulatory Commission (FERC) to promote competition in generation and transmission.
- Argue for competition in all state utility commissions.
- Require the Department of Energy (DOE), the Environmental Protection Agency (EPA) and FERC to collaborate on a single comprehensive statement of competition policy in all markets composing the clean power platform.
- Use DOE grants and loans to reward competition and refrain from providing such financial support to firms or states not acting in a pro-competitive manner.

199 As Adam Smith observed, "in general, if any branch of trade, or any division of labour, be advantageous to the public, the freer and more general the competition, it will always be the more so."

200 For further discussion of ideas for energy transformation, see the Coalition for Green Capital's memo to the next president: www.coalitionforgreencapital.com/2017-energy-policy-memo-march.

201 Regulatory mandates, such as the EPA's Clean Power Plan and state Renewable Energy Standards, should create demand for clean power and efficient consumption. That is pro-competitive as long as the demand is met by competitive offers.

- Insist on competition in all markets as a condition of permitting mergers in energy markets.
- Sue firms that seek to entrench or expand monopolies in power markets.²⁰²
- Adopt pro-competitive policies for subsidies in emissions-light transportation markets.
- Pass legislation promoting competition in all power markets.

Regulators of the grid should adopt organizational and technological methods that enhance service-level competition in adjacent markets and over the distribution network. New York’s Reforming the Energy Vision (REV) commands and rewards the distribution monopolist for becoming a platform for competition in the distributed energy resources market (a term that includes distributed power, efficiency and other retail services).²⁰³ The clean power platform should be a track on which firms are “racing to introduce new or improved products,”²⁰⁴ as opposed to only raising prices on carbon-intensive products or subsidizing regulators’ choices of clean power solutions. The platform should host three markets: retail services behind the meter, retail service over the distribution grid, and generating wholesale power. In all of these, firms should compete on price and/or value.²⁰⁵ The truly desperate need to reduce emissions is not a reason to abandon competition as the means for constructing the clean power platform.

The federal government should not insist on imposing a single regulatory method in every state. Instead it should use incentives²⁰⁶ and, where necessary, legislation and litigations to guarantee that every state has some workable method of facilitating the maximum amount of competition in every relevant market. Marketplace choice is the best way to guarantee rapid platform change, whether the platform is the internet, wireless communications, electronic commerce, transportation, or commercial and residential building materials.

Competition and Monopolies in the Electricity Sector

The growth of clean energy over the past decade²⁰⁷ belies the larger truth that clean energy remains a tiny part of our overall electricity mix. Consumers paid nearly \$400 billion in retail electricity and associated expenses in 2015.²⁰⁸ Consumers’ bills are divided between charges for transporting electricity and the cost of generating that electricity. Looking just at the generation side of the equation, we see renewables capturing very little of this market. Wind and solar represent less than six percent of electricity generation, and solar is less than one percent.²⁰⁹

202 Utilities and incumbent firms often cite the state action doctrine as a defense to federal antitrust action in regulated markets. While this is undeniably a hurdle, it is not an insurmountable one. To avail itself of the defense, a private utility must demonstrate that its entry into competitive markets is “clearly articulated and affirmatively expressed as state policy” and the policy or action is “actively supervised” by the state. See *California Retail Liquor Dealers Ass’n v. Midcal Aluminum*, 445 U.S. 97, 105 (1980). Public utilities and state PUCs need only meet the first prong by demonstrating that their “anticompetitive activities were authorized by the State ‘pursuant to state policy to displace competition with regulation or monopoly public service.’” See *Hallie v. Eau Claire*, 471 U.S. 34, 38-39 (1985).

203 State of New York, Department of Public Service, “Order Adopting a Ratemaking and Utility Revenue Model Policy Framework” (May 19, 2016): 49–50.

204 H. A. Shelanski, “Information, Innovation, and Competition policy for the Internet.” *University of Pennsylvania Law Review* 161 (2012): 1663–1705.

205 Probably, the distribution grid should be thought to be the service.

206 The federal government should provide federal capital to state and local authorities that want to capitalize public lending institutions to offer affordable capital to clean power and efficiency measures. The Green Bank Act of 2016 (H.R. 5802) accomplishes this by creating a National Green Bank to fund state and local institutions. But this sort of incentive should be offered fairly to competing providers so as to enhance competition in clean power solutions.

207 According to the Department of Energy, installed wind power capacity grew nearly seven-fold between 2005 and 2015. SEIA estimates that, from 2010 to 2015, annual solar capacity installed in the U.S. grew over 600 percent percent

208 United States. Energy Information Administration, “Form EIA-826 detailed data.”

209 United States. Energy Information Administration, “Net Generation by Energy Source: Total (All Sectors), 2006– May 2016.”

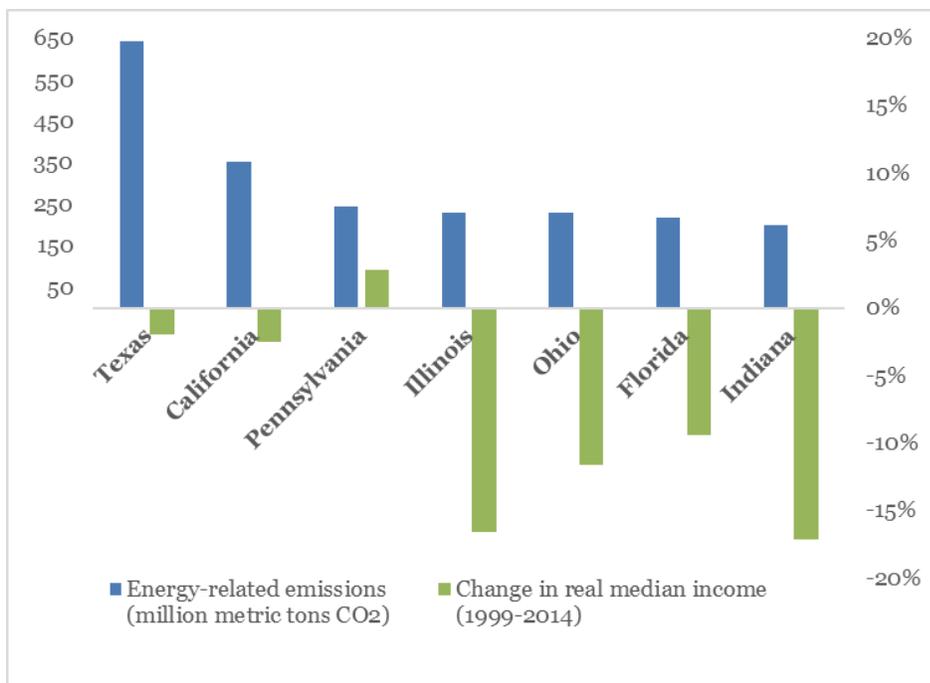


Figure 1. States with highest carbon emissions, change in state median household income

Moreover, the most vulnerable consumers are often in the states where the move to the new clean power platform is critical. The following chart shows the seven states with the highest energy-related carbon emissions and how median income has changed in these states.²¹⁰

The lesson is that by seeking to substitute clean power for carbon-emitting power and at the same time to make consumers better off, government can do what is necessary and also equitable. Clean power should provide the desired use – heating, lighting, air-conditioning, industrial processes, and transportation – at the same or lower total cost as the carbon energy platform provides to consumers today.²¹¹ Competition can create this outcome.

However, monopolies naturally dominate the local distribution grid used to deliver electricity to retail customers. There is a single network of distribution substations and radial power lines that deliver electricity to your house and other houses around you because no other distribution company could make a profit constructing a second distribution network unless it delivered electricity at a lower cost. But in that case, the second line would soon become the monopoly distributor – a natural monopoly.²¹² In electricity markets in the United States, state regulators recognize the natural monopoly of distribution utilities and thus regulate those utilities so that they cannot charge monopoly prices to end users. Another example may be the charging station grid. Such networks are not sufficiently deployed to draw final conclusions, but it is likely that government should issue licenses for charging station deployment so as to assure rapid deployment with minimum state subsidies.

210 Household median income from U.S. Census, as analyzed by Justin Fox in *Bloomberg* (“Where Median Incomes Have Fallen the Most,” 19 August 2016). 2013 emissions data from U.S. Energy Information Administration.

211 Forty percent of American households make less than \$40,000, but have purchased less than 5 percent of distributed solar installations. Robustly competing firms could address this inequality by aiming at all market segments.

212 R. A. Posner, “Natural monopoly and its regulation.” *Stanford Law Review* (1969): 548–643.

Many energy markets, however, can and should be structured to encourage competition. These include at least the following:

- On the end-user side of distribution utilities, in what New York calls the distributed energy resource (DER) market, firms like Solar City and SunRun can compete to provide electricity both to end users and to the distribution utility itself.²¹³ Building management and building materials firms can compete to make energy use more efficient (by minimizing the electricity or fuel used for heating, lighting, air-conditioning or industrial processes).
- Generation of electricity, typically from a wind farm, solar panel array, natural gas or nuclear power facility, or some other source of electricity. These competing sources require access to transmission and then distribution networks in a fair and efficient manner in order to compete. The Energy Policy Act of 1992, FERC Orders 888 and 889, and other subsequent regulation have ensured that this is possible. Creating independent grid operators and market overseers in all regions can further ensure competitive access. Retail competition would eliminate the monopsony faced by generators in some markets that hamper wholesale generation competition.
- In some regions, new transmission lines can bring new power sources to regional grids to introduce new competition from clean power generation. For example, new transmission lines would allow energy to flow from windy and sunny parts of the country to other regions. Researchers at the National Oceanic and Atmospheric Administration (NOAA) have found that, with improvements to the transmission system, renewables could supply most of the United States' electricity at costs similar to today.²¹⁴ This squares with the National Renewable Energy Laboratory (NREL) analysis, which found that existing technologies combined with a "more flexible electric system," are more than sufficient to supply 80 percent of total U.S. electricity generation in 2050.²¹⁵
- In transportation, a national network of vehicle charging stations will allow firms to compete on total cost of vehicle ownership and/or a more desirable driving experience, rather than the ability to access a preexisting network of stations.

Competition Goals Across the Energy Sector

Behind the Meter

Goal: Create competition on service, quality and price

Firms should be able to compete to offer energy services such as solar and energy efficiency to consumers. Distributed energy firms should be able to compete against each other on a level playing field – none should be preferred. All need at least four obstacles to market growth removed by regulatory change or litigation:

- Distributed energy firms should not be subject to unnecessary regulatory burdens such as the requirement to become certified utilities.
- The owners of distributed energy generation facilities should be able to earn renewable energy credits and be paid a fair price for selling their electricity to the utility distribution firm. Alternatively, they should be able to sell renewable energy credits or delegate their right to sell electricity to a state Green Bank or another consortium.
- Incumbent distribution utilities should only compete in this market through structurally separate subsidiaries, and the utilities must offer the same terms and conditions to rivals in DER.

213 Utilities have been worried for some time about competition in these market segments; see for example, P. Kind, "Disruptive Challenges," Edison Electric Institute, www.eei.org/ourissues/finance/Documents/disruptivechallenges.pdf.

214 A. E. MacDonald et al., "Future Cost-Competitive Electricity Systems and Their Impact on US CO₂ Emissions," *Nature Climate Change* (2016).

215 M. M. Hand et al., "Renewable Electricity Futures Report," *United States National Renewable Energy Laboratory*, www.nrel.gov/analysis/re_futures/.

- In states where regulators allow distribution utilities to gain more profit if they sell more electricity (more profit by volume, not by increased margin), then the utility has an incentive to discourage firms from succeeding in their mission. The pro-competitive antidote is the regulatory measure called “decoupling,” where a distribution utility’s revenue is unlinked from the amount of throughput on its system. Only 17 states have adopted electricity decoupling.²¹⁶ Where decoupling does not exist, utilities will be reluctant to invest in efficiency or (more importantly) support the growth of efficiency markets since efficiency diminishes their revenue.

In some states, utilities and state regulators limit or hinder competition in behind-the-meter markets. In solar, utilities have moved to increase fixed charges for customers, reducing the incentive for customers to adopt solar or any technology that reduces energy consumption. A recent study found that increases to fixed charges or creation of bill minimums were proposed by at least 38 utilities across 19 states from 2013 through 2015.²¹⁷ Although some charges may be justified, any charge above long-run incremental cost is prima facie anticompetitive.

Utilities also follow varying standards for purchasing surplus electricity from distributed solar generation (a policy known as “net metering”). In the second quarter of 2016, 36 utilities across 24 states considered or enacted changes to net energy metering policies, and 15 states plus the District of Columbia formally examined or planned to examine the value of distributed generation or the costs and benefits of mandating net metering.²¹⁸ Moreover, some states change the standards with little or no notice, thus deterring competitive entry. After regulators in Nevada increased solar fixed charges and reduced payments for excess generation, new residential solar installations in the state fell 92 percent in the first quarter of 2016.²¹⁹ It is intrinsically anticompetitive for a utility to refuse to purchase solar power generated by a rooftop installation behind the meter. The price can and should be set at a reasonable and predictable level.²²⁰ In Florida and North Carolina, third-party ownership of solar panels is banned – effectively eliminating a form of competition in rooftop solar. Analysts consider the regulatory landscape for third-party ownership of behind-the-meter generation to be “unclear” in other states throughout the Southeast.²²¹ National competition is discouraged when rooftop solar firms face a patchwork of varying degrees of obstacles to entry.

Utility participation in behind-the-meter markets should also be rigorously reviewed. Currently, utilities are mandated to participate in energy efficiency markets in many states. Even in decoupled²²² regions, efficiency and other behind-the-meter programs rarely provide utilities with the opportunity for real earnings growth. This creates an incentive for utilities to create programs that go as far as required by regulatory mandate – but no further.²²³ Utility spending on energy efficiency programs reached nearly \$6 billion in 2014, yet the savings achieved that year amounted to only 0.6 percent of total retail sales.²²⁴ Achieving transformative reductions under such a system would require a massive expenditure of ratepayer money, resulting in onerous bills for consumers. Permitting downstream entry by utilities also creates an opportunity for monopolists to compete unfairly with independent efficiency

216 D. Sullivan and D. DeCostanzo. “Gas and Electric Decoupling,” *Natural Resources Defense Council*, 30 August 2014, www.nrdc.org/resources/gas-and-electric-decoupling.

217 M. Wara, “Fostering Competition in the 21st Century Electricity Industry,” *Harvard Environmental Law Review* 40, no. 2 (2016): 41–48.

218 J. Pyper, “42 States Took Policy Action on Distributed Solar in Q2 2016,” *Greentech Media*, 3 August 2016.

219 M. Muro and D. Saha, “Rooftop Solar: Net Metering is a Net Benefit,” *The Brookings Institution*.

220 For example, only 13 states credit at the retail rate with no expiration on credits. Meanwhile, 11 states compensate excess generation from solar at less than the retail rate. See DSIRE, “Customer Credits for Monthly Net Excess Generation (NEG) Under Net Metering July 2016.”

221 RMI Outlet. “In the Southeast, Could Third-Party Ownership of Solar Power Be Taking Root?” *Rocky Mountain Institute*, 30 June 2015, www.blog.rmi.org/blog_2015_06_30_southeast_third_party_ownership_of_solar_power.

222 I.e., regions where regulators have unlinked distribution utility revenue from volume of electricity distributed.

223 For more on the limits of conventional demand-side management programs, see Akin Gump White Paper: www.akingump.com/images/content/3/0/v2/30870/ADSM-Regulatory-Equivalent-White-Paper-July-2014-FINAL.pdf.

224 American Council for an Energy-Efficient Economy, “The State Energy Efficiency Scorecard 2015,” aceee.org/sites/default/files/pdf/state-sheet/2015/usa.pdf.

installers.²²⁵ Distribution utilities should not be able to leverage their natural monopoly so as to provide them advantages in competition in behind-the-meter markets.

Behind-the-meter markets need a level playing field where all rivals share such public goods as consumption information, access to the grid, billing functionality and access to capital. Although several states and municipalities have adopted energy data disclosure laws, in practice it is often difficult for building owners and energy service providers to access that data.²²⁶ Data transparency is key for market actors to innovate. A consent decree obtained by the Department of Justice (DOJ) could assure that consumers are not abused by unfair practices. The DOJ would want to consider whether the distribution grid should be subject to open access rules similar to those for the bulk power grid – namely, with an independent system operator having operational control over the distribution grid.

The federal government should consider urging that New York’s REV plan, or its functional equivalent, be adopted in every state. The REV proceeding is taking steps to open up competition in behind-the-meter markets.²²⁷ New York Public Service Commission chair Audrey Zibelman has stated that “NY’s new regulatory compact demands that promotion of market-driven, clean-energy innovation is in front of and behind the meter.”²²⁸ Importantly, REV changes the compensation for distributed energy resources by looking at their “LMP+D” (or location-based marginal price plus distribution) value. This allows these resources to compete on that sought-after level playing field without incurring charges for the utility’s generation and new utility capital expenditures. REV also articulates a pro-competitive approach to limiting utility participation in competitive markets except when the “principal effect is to facilitate the growth and operation of markets.”²²⁹ Utilities are further required to make data available to and easily shareable by customers and market participants at no cost.

As the Federal Trade Commission and others have noted in their comments on the REV proceedings, the REV plan calls on utilities themselves to be the operators of the new power platform, opening up the door to potential unfair competition. However, even with a proposed code of conduct governing utility actions in the new marketplace, incumbent monopolists stand to gain advantage simply because they are incumbents. Some commenters on the REV proceeding expressed concerns about utility participation in competitive markets and asked for an outright ban. It remains to be seen whether this is the right approach, but this type of innovation and experimentation should be looked at as a model that the federal government should insist all states use.

In order to incentivize states to adopt REV-like plans, the federal government should offer to reward pro-competitive actions by capitalization of state Green Banks. In states where such institutions have been created, evidence shows that combinations of public and private capital can drive investment in projects where private sector capital provides up to 90 percent of the financing.²³⁰

225 As the National Energy Marketers Association observed: [A]fter nearly two decades of experience with competitive retail markets, it is abundantly clear that the anti-competitive impacts of monopoly utility participation in competitive energy markets, be it for commodity supply or new energy-related value-added services as a [distributed energy resource] provider, is poor public policy, is not in the public interest and deters and discourages . . . private capital investment and technology innovation. “Comments of the National Energy Marketers Association on Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision,” www.documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B929C1EFF-B6C6-4779-934A-23EDD5DA11D2%7D.

226 Barriers to data disclosure include limited visibility into legal liability, privacy concerns, and threats to the utility’s ability to monetize usage data. See “Freeing Energy Data,” *Abrams Environmental Law Clinic, University of Chicago*.

227 State of New York, Department of Public Service, “Developing the REV Market in New York: DPS Staff Straw Proposal on Track One Issues” (Aug. 22, 2014) (“Straw Proposal”).

228 Audrey Zibelman, Chair, NY PSC, “Reforming the Energy Vision,” presentation to the New England Electric Restructuring Roundtable, June 27, 2014.

229 See State of New York Public Service Commission’s Order Adopting Regulatory Policy Framework and Implementation Plan, Issued Feb. 26, 2015. Criteria specified for utilities participating in DER market: “a) whether the service facilitates the growth and operation of markets; (b) whether there is already a third-party market for the service that adequately serves all sectors of the market; (c) whether utility economies of scale and/or existing utility expertise are likely to result in cost-effective stimulation of the market; (d) whether utility provision of the service is likely to prevent other providers from entering the market; and (e) the extent to which a utility has proposed placing shareholder funds at risk.”

230 The Connecticut Green Bank has achieved a ratio as high as 10 dollars of private investment for every dollar from the Green Bank; see www.ctgreenbank.com/wp-content/uploads/2015/11/CEFIA_AR_2013-final-for-web.pdf

Rooftop solar can be economically viable in most states, even without net metering. However, this requires that financing be offered at a sufficiently low interest rate,²³¹ such as one provided by a Green Bank. Access to financing quite simply makes the difference between a competitive market's expanding or shutting down, as has occurred in Nevada.

Distribution

Goal: Create open access for electricity sellers to retail customers

Clean power needs equal access to the grid in order to compete with consumers. As noted above, the electric industry remains vertically integrated in 35 states. In these markets transmission and distribution monopolies own generation. Even in restructured markets, many utilities deregulated generation affiliates. Although utilities are not allowed to purchase electricity from their own facilities that is above the cost of competing bids, utilities should not be tempted to favor utility-owned or affiliated generation companies.²³²

Creating independent organizations to oversee wholesale markets is the solution. FERC Order 2000 encouraged the voluntary formation of Regional Transmission Organizations (RTOs) to oversee the regional transmission grid. The Order further outlined the characteristics and functions that an entity must satisfy in order to become an RTO or independent service operator (ISO).²³³ ISOs and RTOs ensure reliability and optimize supply and demand bids for wholesale electric power in all or portions of 33 states. This represents roughly 60 percent of the U.S. power supply.²³⁴ These entities can create well-designed markets that send strong price signals and remove discrimination.²³⁵ Where RTOs do not constitute a neutral platform for buying power at wholesale, FERC has tried to assure open access for competitive providers under its regulatory powers for the bulk power grid.²³⁶ The DOJ has favored the ISO/RTO structure by insisting on it as a condition of certain mergers, such as in 2012 when it insisted that Entergy join an RTO and sell its transmission facilities to a third party.²³⁷ The next president, with Congressional support, should establish in every state an RTO structure so that competitive generators can sell at wholesale in fair and open auctions.

The federal government can pursue this policy in multiple ways: requiring it as a condition of mergers, persuading state regulators to adopt competition, providing grants or loans to states to fund transitions to this policy. The government can seek a national rule by means of legislation. It can litigate against utilities and regulators that oppose or limit retail competition, taking on the state action doctrine as discussed in the introduction. In telecommunications reform, some state regulators proved to be tenacious advocates against the assertion of federal jurisdiction over various aspects of the communications platform. In the seminal case of *AT&T vs. Iowa Utilities Board*, 525 U.S. 366 (1999), the states lost 5–3, Justice Scalia writing for the majority. The same result will occur, eventually, in the other electromagnetic wave industry: the power platform.

231 Coalition for Green Capital analysis.

232 E.g., Public Utility Commission of Texas, 23 Tex. Reg. 5294 (May 22, 1998): “[T]here is a strong likelihood that a utility will favor its affiliates where these affiliates are providing services in competition with other, non-affiliated entities. . . . [In addition,] there is a strong incentive for regulated utilities or their holding companies to subsidize their competitive activity with revenues or intangible benefits derived from their regulated monopoly businesses.”

233 United States. Federal Energy Regulatory Commission. “Regional Transmission Organizations (RTO)/Independent System Operators (ISO).”

234 United States. Energy Information Administration. “About 60% of the U.S. Electric Power Supply Is Managed by RTOs,” www.eia.gov/todayinenergy/detail.cfm?id=790.

235 According to American Wind Energy Association staff, a well-designed market includes “fast sub-hourly generator dispatch, fast transmission scheduling, wind energy forecasting, and ancillary services markets to efficiently provide flexibility. And markets tend to be large balancing areas, which are a lot more efficient for accommodating variability.” See: www.greentechmedia.com/articles/read/Ten-Years-in-Texas-Electric-Utility-Deregulation.

236 See *NY v FERC*, 535 U.S. 1 (2002), affirming FERC Order 888.

237 United States Department of Justice, “Statement on Entergy Corp.’s Transmission System Commitments and Acquisition of KGen Power Corp.’s Plants in Arkansas and Mississippi,” 14 November 2012.

Consumers should be able to choose among retail electricity providers. Only 15 states and the District of Columbia have restructured their vertically integrated electric monopolies (i.e., split up generation and distribution) and offer consumers retail electricity choice.²³⁸ Creating retail choice for consumers has not been a smooth ride in all states.²³⁹ Seven states have suspended the breakup of the vertically integrated utility model,²⁴⁰ while some restructured states have moved to limit competition in the wake of consumer complaints.²⁴¹ But Texas offers lessons on how to achieve positive outcomes. Texas created a renewable portfolio standard (RPS) at the same time it began opening the door to competition. Renewable power companies competed with one another, and retail customers were easily able to choose clean power. This led to the growth of rivals, like Green Mountain Energy, selling only clean power to retail consumers.

Today, the majority of customers in deregulated Texas markets opt to purchase their electricity from a competitive provider.²⁴² The state met its original RPS goal four years early, and renewable energy generation continued to soar. Electricity generated by wind now accounts for nearly 12 percent of all electricity consumption in Texas.²⁴³ Retail choice does not guarantee clean energy growth. Indeed, Texas is a leader in energy-related carbon emissions. But combined with other policies to ensure fair pricing and grid access, consumer choice can deliver attractive outcomes to consumers.

Generation and Transmission

Goal: Create opportunity for clean energy suppliers to take market share

Different types of electricity generation optimally provide electricity at low prices under various conditions. Obviously, at noon on a cloudless day, a solar panel generation firm will maximize its output at no additional incremental cost. A West Texas wind farm generates more electricity when a northerly wind is blowing through the tower array. A coal-fired boiler incurs extra costs when it is shut down and then started up again. And so on. As a result, fair competition is best assured when generators can sell in auctions in order to adjust prices to ever-changing conditions. Auctions exist in all the RTOs and ISOs and should be used across the United States. Supply is sold in aggregate (injections) and bought at wholesale in aggregate (withdrawals) in these markets, although there can be different clearing prices for different locations on the relevant bulk power grid. The Electric Power Supply Association and others have noted that this leads to transparent and nondiscriminatory markets. In turn, the real cost faced by the utility should translate to the price seen by the customer. This type of real-time pricing can provide environmental and economic benefits.²⁴⁴ Rates that vary depending on a customer's usage and the overall level of demand on the system (so-called demand charges) should be adopted in all markets. These charges will send the correct price signal to consumers and create massive markets for energy efficiency and storage. A demand-based tariff structure will increase the utilization of the grid by better matching power supply and demand, reducing the need for excess power plant capacity.

238 United States Energy Information Administration, "Status of Electricity Restructuring by State," www.eia.gov/electricity/policies/restructuring/restructure_elect.html.

239 Common arguments against include concerns about higher prices and a lack of consumer protection, e.g., www.energizingmichigan.org.

240 Most notable of these negative experiences is the California electricity market manipulations of 2000–2001.

241 The New York PSC recently curtailed retail competition in the residential and small commercial markets; see Order Resetting Retail Energy Markets Establishing Further Process, Cases 15-M-0127, 12-M-0476, 98-M-1343 (February 23, 2016).

242 United States Energy Information Administration, "State Electric Retail Choice Programs Are Popular with Commercial and Industrial Customers," 14 May 2012, www.eia.gov/todayinenergy/detail.cfm?id=6250#tabs_RenewablesMaps-3.

243 ERCOT. "ERCOT Quick Facts," 15 August 2016.

244 Amir-Hamed Mohsenian-Rad, and Alberto Leon-Garcia, "Optimal Residential Load Control with Price Prediction in Real-Time Electricity Pricing Environments." *IEEE Transactions on Smart Grid* 1.2 (2010): 120–133.

Contract length is another issue for providing consumers with more renewable energy generation. Regulators in Idaho, for example, recently approved a utility request to reduce the length of negotiated renewable energy contracts from 20 years to just two years. Renewable developers say this will have an adverse impact on clean energy growth in the state, while utilities say that longer contracts lead to higher prices.²⁴⁵ The correct answer may vary from state to state, but promoting competitive entry by clean power producers should be the guideline everywhere.

The vast majority of states also currently give preferential treatment to “locally made” renewables in complying with RPS goals.²⁴⁶ This is not only an apparent violation of the Commerce Clause, but it also makes clean energy more expensive for in-state consumers. The federal government should challenge these limitations.

In addition, new transmission lines can bring more clean energy to consumers. As recently as 2011, over 4,000 MW of wind power in Texas needed to be “curtailed” (i.e., idled) because the grid was unable to transport that energy to where it was needed. In response to this challenge, the Public Utility Commission established five “competitive renewable energy zones” with high wind power potential and authorized a series of transmission projects to allow 18,500 MW of wind power to flow from these zones to the rest of the state. As these projects have been completed, the amount of wind curtailment in Texas has fallen dramatically.²⁴⁷ New York is similarly planning an “energy highway,” which will better connect clean hydropower with downstate energy consumers.²⁴⁸ Identifying these regions and providing low-cost financing should be a goal. This can help alleviate the long wait time and high costs imposed on generators to access existing transmission. Early indicators suggest that FERC Order 1000 is having the intended impact of making planners work together across regions. To further this, FERC should, as America’s Power Plan recommends, build on Order 1000 to prioritize transmission that delivers renewable energy.²⁴⁹ Transmission companies everywhere should be required to compete to build transmission based upon proposed cost of capital. By funding in whole or in part new or upgraded transmission, government can also enable new sources of renewable generation to compete in the bulk power market while at the same time reducing the retail price of electricity. Finally, breaking up vertically integrated utilities will remove opposition from utilities who do not want additional generation competition.

Transportation

Goal: Enable consumers to drive miles without using gas or to use less gas per mile driven

The goal for transportation markets is to enable consumers to drive miles without using gas or to use less gas per mile driven. There is little point to subsidizing the purchase of an electric vehicle that is hardly ever used.

A network of electric vehicle (EV) charging stations that is located so as to maximize use and minimize cost would be most conducive to EV growth. In California, utilities are being allowed to invest ratepayer money into owning EV charging infrastructure. This should be prohibited for all the reasons discussed above. But if the charging station grid is net present value negative, then the argument for creating a competitive market to build such grids is weak.

245 R. Walton, “Idaho Regulators Reduce PURPA Contracts from 20 to 2 years,” *Utility Dive*, 25 August 2015, www.utilitydive.com/news/idaho-regulators-reduce-purpa-contracts-from-20-to-2-years/404518/

246 H. Reiter, “Removing Unconstitutional Barriers to Out-of-State and Foreign Competition from State Renewable Portfolio Standards,” *Energy Law Journal* 36 (2015): 4–68.

247 United States. Energy Information Administration, “Fewer Wind Curtailments and Negative Power Prices Seen in Texas after Major Grid Expansion,” www.eia.gov/todayinenergy/detail.cfm?id=16831#tabs_SpotPriceSlider-1

248 Although these plans have faced local opposition due to siting and other issues, for example: www.politico.com/states/new-york/albany/story/2015/02/key-component-of-cuomos-energy-highway-stalls-019547.

249 John Jimison and Bill White. “Transmission Policy: Planning for and Investing in Wires,” *America’s Power Plan*, www.americaspowerplan.com/wp-content/uploads/2013/09/APP-TRANSMISSION-PAPER.pdf.

In addressing this issue, the federal government should copy the method by which the Federal Communications Commission (FCC) initially approached the cell phone industry. The first cell phones were large and expensive and had no network to use. The FCC licensed two network licenses in every geography. Firms built on the geographies that had the greatest demand. The logic was to offer service where it was going to be most valued.

Similarly, the federal government should choose an agency and authorize that entity to award by auction a single license for the charging station grid in every major metropolitan market. The license should require build-out of a charging station network in a timely manner, say two years, and a guaranteed, bonded promise to provide electricity at a preset price. The license should describe the minimum network build desired to provide enough service for the market.

Presumably, the auction bidders will ask to be paid rather than offering to pay for the right to build charging stations. In either event, the winner of the auction will either pay the most or ask for the least from the government. The Coalition for Green Capital has studied this issue for New York State and concluded that the costs of installing and operating a charging station grid are unlikely to recoup from selling electricity.²⁵⁰ Our study found that Level 3 charging stations (so-called fast chargers) are net present value negative under any set of realistic assumptions. A small number of discrete geographical markets (e.g., 10) should be auctioned as an experiment – cellular networks were similarly built in just a few markets in trial phases. The FCC is very experienced in this sort of testing rollout of networks. The White House can play a critical role in setting up these early auctions.

As a requirement, the charging station grids should provide equal access to all competing vehicles (i.e., be interoperable). This will promote the most robust market for electric vehicles. In a similar vein, all subsidy programs should provide equal opportunities for firms to compete in substituting for gas miles driven.

Lessons from Telecom

The state of energy markets reminds us of the situation in telecommunications in the 1970s. The local telephone company extended its distribution monopoly (think of the telephone lines on the pole outside the house) to monopolize the long distance market. The local telephone company tried to limit competition in devices that connected to its network, such as the telephone itself.

The DOJ filed a lawsuit in 1974 against AT&T, the dominant local telephone and long distance company, challenging its monopoly over the long distance and telephone equipment industries (Western Electric). After the Reagan administration came into office, the head of the antitrust division, Bill Baxter, pursued the litigation aggressively, and AT&T was split into long distance and multiple local telephone companies under a consent decree in 1982.²⁵¹ That move then led to various state reforms culminating in the national paradigm of competition in both local and long distance markets as prescribed by the 1996 Telecommunications Act, passed on an overwhelming bipartisan vote. Seeing opportunity in competing in previously closed markets and in newly created markets like wireless and internet access, private investors poured about \$1 trillion into building a new information platform that was composed of digital and wireless technologies in large part. That new platform has almost totally replaced the old fixed line telephone system. Because consumers elected faster, better and cheaper solutions, the move from the old to the new platforms occurred at exciting speed, to general plaudits among the public. That is the history that can and should be emulated.

250 Coalition for Green Capital, “Review of New York State Electric Vehicle Charging Station Market and Policy, Finance, and Market Development Solutions,” www.nyserda.ny.gov/-/media/Files/Publications/Research/Transportation/2015-10-EV-Charging-Stations-Financing.pdf.

251 J. Pinheiro, “AT&T Divestiture & the Telecommunications Market,” *High Technology Law Journal* 2.2 (1987): 303–355.

Conclusion

It is appealing for some to depend on distribution monopolies to lead the way to the clean energy platform. Those who look to the utilities for leadership in moving to the new clean power platform may be especially sympathetic to the notion that each state presents different economic and social issues. Or they may be suspect of the efficacy and consistency of federal intervention. Perhaps they believe command-and-control regulation imposed on utilities is the fastest way to reduce emissions.

Certainly no one can deny that distributions monopolies are likely to continue to exist if they are distributing clean energy or carbon-generated electricity. They have access to reasonably low-cost capital. They can recover their costs under their state-run regulatory regimes.

However, the right economic policy is to deliver not just clean energy but also the lowest priced energy solution. Efficiency measures may lower price; so too innovation in generation may lower price. The goal is to obtain the lowest price for the economy including consideration of the cost of the dreadful externality of climate change and other atmospheric and environmental harm.

Innovation and choice are the two trustworthy mechanisms to achieve this goal. Moreover, if clean power is not affordable, then the move to the new clean power platform will run into consumer resistance, be subject to political opposition and take longer than if consumers can clamor for it in the marketplace.

And one thing more: competition produces unpredictable breakthroughs that monopolies are rarely geared to introduce. New entrants think of ways to make existing goods and services in new and different ways, or new goods and services that provide previously unknown value propositions. They conceive of goods and services not yet in any market. Regulators cannot issue commands to adopt what does not exist. So depending purely on command-and-control regulation to cause the transformation of the existing carbon power platform to a clean power platform will likely preclude the new new thing, the renewable wonder, and the efficiency miracle, from having a market in which to sell. The existing power platform will be entrenched, and the breakthroughs that could hasten the change in platforms will not materialize in time to meet the challenge of climate change.

Competition, in any case, is integral to the American market system. Economic experts have increasingly focused on monopoly's cost to the economy.²⁵² It is thought to contribute to secular stagnation. More than that, it forecloses those who are young or young at heart from trying to change that world. That alone is a reason to adopt a competition policy in all power markets.

252 For example, see J. Schmitz Jr., "The Costs of Monopoly: A New View," *The Minneapolis Fed*, www.minneapolisfed.org/publications/the-region/the-costs-of-monopoly-a-new-view.

ENERGY CHOICES

Author

Robert B. Jackson is Douglas Provostial Professor and Chair of the Department of Earth System Science at Stanford University.

Contact

Department of Earth System Science

473 Via Ortega, Room 140

Stanford, CA 94305

<https://jacksonlab.stanford.edu/>

rob.jackson@stanford.edu

Abstract

Energy fuels our lives, raising our standard of living and improving our health. This year, change is in the air. U.S. coal consumption declined by 15 percent in 2015 to levels not seen since the early 1980s and fell an additional 20 percent through May of 2016.²⁵³ Natural gas should surpass coal in electricity generation for the first time this year as well.²⁵⁴ Wind and solar will provide most of the newly installed electrical capacity in the United States and globally, just like in the past two years.²⁵⁵

There are economic and environmental reasons to support the transition from coal to renewables and natural gas that is already occurring. A recent study from Duke University estimated that the 49,000 jobs lost in the coal industry between 2008 and 2012 were outpaced by 175,000 jobs gained in the wind, solar and natural gas industries.²⁵⁶ Coal is a carbon- and water-intensive fuel that generates air pollution, killing at least 10,000 Americans and a million or more people around the world each year. Reducing our reliance on coal will save lives, create jobs, cut water use and help the climate and the environment.

The greenhouse gas benefits of renewables compared with coal are clear, but the case for natural gas is more complicated. Burning natural gas generates only half the CO₂ emissions per unit of electricity that coal combustion does.²⁵⁷ However, methane's potency as a greenhouse gas means that emissions and leakage from the natural gas infrastructure need to be less than approximately 3 percent of production to provide net climate benefits. Right now we are near to, or possibly above, that threshold nationally. We need to do better.

In this paper, I make four energy-related recommendations:

- Allow coal use to continue to fall, cutting greenhouse gas emissions, saving water and reducing mercury, particulate and sulfur pollution that kill more than 10,000 Americans each year.
- Reduce methane and hydrocarbon emissions from oil and natural gas infrastructure through best practices, new incentives and regulatory enforcement; natural gas currently provides little net climate benefit compared with coal – but it could.

253 Energy Information Administration, *Monthly Energy Review*, August 2016.

254 Ibid.

255 REN21, *Renewables 2016 Global Status Report*, <http://www.ren21.net/status-of-renewables/global-status-report/>.

256 D. Haerer and L. Pratson, "Employment Trends in the U.S. Electricity Sector, 2008–2012," *Energy Policy* 82 (2015): 85–98.

257 Energy Information Administration, "How Much Carbon Dioxide Is Produced Per Kilowatt-hour When Generating Electricity with Fossil Fuels?," www.eia.gov/tools/faqs/faq.cfm?id=74&t=11.

- Promote renewables, including wind and solar photovoltaics, that are carbon and water neutral and that generate no air pollution during use.
- Charge federal agencies to collect more data and develop energy metrics that combine multiple environmental factors – including health, water quantity and quality, air pollution, and greenhouse gas emissions.

Energy Choices

1. Allow coal use to continue to fall, cutting greenhouse gas emissions, saving water and reducing mercury, particulate and sulfur pollution that kill more than 10,000 Americans each year.

Coal has been the fuel of choice for electricity generation for decades. It is cheap, domestically abundant and energy-dense compared to the biomass energy it originally replaced.

Despite these benefits, domestic coal use is plummeting. According to the Energy Information Administration, coal consumption dropped by approximately 30 percent over the past decade.²⁵⁸ Its use fell another 20 percent so far this year compared to 2015, and we are now at levels of consumption not seen since in the United States since the early 1980s.

Several factors are responsible for coal's decline, including cheap natural gas derived from hydraulic fracturing, the costs of environmental compliance, such as the recent mercury rules issued by the Environmental Protection Agency, and the build-out of renewables through Renewable Portfolio and Renewable Electricity Standards and other policy levers. Coal is the most carbon-intensive of fossil fuels, producing the highest greenhouse gas emissions per kilowatt-hour (kWh) of electricity generated.

Climate change is not the only reason to justify reducing coal use further. Air quality has been improving for decades in the United States, but poor air quality still kills hundreds of thousands of Americans and millions of people around the world each year. A recent MIT study concluded that 200,000 Americans died each year from particulate (PM2.5) pollution associated with combustion sources; 52,000 of them were attributed to the power sector.²⁵⁹ The Environmental Protection Agency's estimate for 2016 is lower, approximately 17,000 deaths from the electricity sector, in part reflecting stronger pollution controls put in place over the last decade.²⁶⁰ This more conservative number is still higher than the annual murder rate in the United States. Coal-fired power plants are also responsible for about half of all U.S. emissions of mercury, a hazardous air pollutant, and sulfur dioxide, another "big-six" criteria pollutant that causes acid rain.²⁶¹ Phasing out coal-fired power pollution will save lives and improve the environment.

Another benefit to phasing out coal-fired power and some other sources will be to save water and improve water quality. Cooling water for power plants is responsible for half of all fresh surface withdrawals in the United States.²⁶² Coal-fired power plants are not the only water-intensive technologies. Nuclear plants consume about the same amount of water as coal plants do per kWh. In contrast, combined-cycle natural gas plants in closed-loop or once-through systems consume half or less the amount of water;

258 Energy Information Administration, "Changing U.S. Energy Mix Reflects Growing Use of Natural Gas, Petroleum, and Renewables," July 21, 2016.

259 F. Caiazzo et al., "Air Pollution and Early Deaths in the United States. Part I: Quantifying the Impact of Major Sectors in 2005," *Atmospheric Environment* 79 (2013): 198–208.

260 N. Fann, et al., "The Recent and Future Health Burden of Air Pollution Apportioned Across U.S. Sectors," *Environmental Science and Technology* 47 (2013): 3580–3589.

261 Environmental Protection Agency, "2011 National Emissions Inventory," www.epa.gov/mercury; <https://www.epa.gov/so2-pollution>.

262 M. A. Maupin et al., "Estimated Use of Water in the United States in 2010," *U.S. Geological Survey Circular* 1405, (2014), <http://dx.doi.org/10.3133/cir1405>.

renewable wind and solar PV consume no water at all.^{263, 264}

Water quality will improve further as coal's market share in the electricity sector continues to decline. The mercury, sulfur dioxide and other air pollutants released by coal (but not by nuclear, natural gas or renewables) end up in our rivers, lakes and streams and, for mercury, in the fish and other animals we eat. Left behind when the coal is burned, 130 million tons of fly ash stack up each year in the United States – a toxic mix of lead, arsenic and other elements and compounds.²⁶⁵ After decades of coal use, billions of tons of coal ash sit unused at more than 500 plants across the United States. Some of this fly ash spills, leaks and contaminates our water by leaching into groundwater and streams and through spills, most notably at the Kingston site in 2008 that flushed more than a billion gallons of coal ash slurry across homes and into the Emory River in Tennessee.

Phasing out coal-fired power over time will have many environmental benefits, but we need to address some human costs. I have sampled the water of dozens, even hundreds, of homes in rural Appalachia. In some of these areas, the extraction of coal and other natural resources is one of the only ways for people to earn a living. Where the mines are closing, we need to invest more in training for families and communities. Three of the top four coal-producing companies in the United States – Peabody, Arch, and Alpha Natural – declared bankruptcy this year.

We also need to remember that the loss of coal-mining jobs is not the whole story. Duke University scientists recently estimated that the 49,000 jobs lost in the coal industry between 2008 and 2012 were offset by 95,000 new jobs in the natural gas industry and 80,000 in wind and solar.²⁶⁶ The balance is a net gain of approximately 125,000 jobs. Coal-mining communities are hurting, but our country is benefitting economically and environmentally from the energy transition.

2. Reduce methane and hydrocarbon emissions from oil and natural gas infrastructure through best practices, new incentives and regulatory enforcement; natural gas currently provides little net climate benefit compared with coal – but it could.

Saving water and millions of lives globally each year are good reasons to continue transitioning from coal to natural gas and renewables. The potential greenhouse gas benefits are also clear for renewables such as wind and solar but less clear currently for natural gas compared with coal.

Natural gas combustion generates only half the CO₂ emissions per unit of electricity generated that coal combustion does.²⁶⁷ The precise number depends on the quality of coal used and the types and ages of the power plants compared. Regardless, the benefit at the smokestack is reliable.

What is less clear is the extent to which natural gas emissions (planned) and leakage (unplanned) offset all or part of the combustion benefit. Methane is far more potent as a greenhouse gas than carbon dioxide. Compared to CO₂, the global warming potential of methane is 86 times greater for a 20-year window and 34 times greater over a century.²⁶⁸

A new natural gas power plant is estimated to be better than a new coal plant if natural gas emissions are less than 3.2 percent of total natural gas production (a figure that includes methane released during coal mining).²⁶⁹ Emissions include everything

263 J. Macknick et al. "Operational Water Consumption and Withdrawal Factors for Electricity Generating Technologies: a Review of Existing Literature," *Environmental Research Letters* 7 (2012): 4.

264 R. B. Jackson et al., "The Environmental Costs and Benefits of Fracking," *Annual Review of Environment and Resources* 39 (2014): 327–362.

265 C. L. Carlson and D. C. Adriano, "Environmental Impacts of Coal Combustion Residues," *Journal of Environmental Quality* 22 (1993):227–247.

266 Haerer and Pratson, "Employment Trends."

267 Energy Information Administration, "How Much Carbon Dioxide?"

268 IPCC Fifth Assessment Report, 2014.

269 R. Alvarez et al., "Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure," *Proceedings of the National Academy of Sciences USA* 109 (2012): 6435–6440

upstream from the wellpad through pipeline delivery downstream to the power plant (or to homeowners, when discussing heating and appliances).

How do recent field data compare to the break-even point of approximately 3 percent methane emissions? Recent studies upstream show large differences between fields that produce natural gas only (dry gas) and those also producing heavier condensates and oil (wet gas). Upstream emissions in dry-gas fields tend to be well below 3 percent, typically 1 to 2 percent.²⁷⁰ (We also need to add another approximately 0.5 to 1 percent for transmission, storage and, where relevant, distribution.) In wet-gas regions, though, upstream emissions are typically twice as high or higher: 4 percent or more of natural gas production and as high as 10 percent.²⁷¹ Weighting estimates based on overall production and adding approximate values for transmission and storage suggests a total countrywide emission of at least 2.5 to 3.5 percent.

Right now, then, the evidence suggests natural gas is providing few climate benefits compared to the coal it is displacing. There could be considerable climate benefits, though, if we reduce methane emissions through improved best practices, government incentives and, in places, stronger regulations.

If emissions were only 1 percent of total production, a target of the ONE Future program initiated by industry,²⁷² then the greenhouse gas savings compared to coal would be approximately one-third. If methane emissions were eliminated completely, an unrealistic goal because of cost, the savings would be approximately 50 percent fewer emissions compared to coal and equivalent to the smokestack benefit for combustion alone. Short of carbon capture and storage technologies, we cannot change the combustion factors for CO₂ substantially for either coal or natural gas.

In considering how to reduce emissions, one of the biggest opportunities is in oil-producing regions. In fields such as the Bakken, Uintah, Eagle Ford, and Permian Basin, where the economic returns value oil and condensates (i.e., butane and heavier), operators apparently are not being as careful in controlling for methane emissions. The evidence is not just in the basin-wide results discussed earlier. My colleagues and I recently completed a helicopter study using infrared cameras to video 8,200 random wellpads across the United States. Large emissions were far more common – as much as 10 times so – in oil-producing regions such as the Bakken and Uintah basins than in dry-gas regions.²⁷³

Even within the same basin, this result held true. In the Barnett of north-central Texas, one out of every five wellpads in oil-producing areas had emissions visible from the helicopter; less than one in a hundred wellpads producing natural gas had visible emissions. Differences within the same basin cannot be explained by different policies and regulations. Perhaps companies in oil-producing areas do not value cheaper natural gas, particularly if they are flaring it. Alternatively, there are more tanks, valves and infrastructure in wet-gas areas that can leak. Ninety percent of the emissions we filmed from helicopters were from tank vents and hatches.

270 A. Karion et al., “Aircraft-Based Estimate of Total Methane Emissions from the Barnett Shale Region,” *Environmental Science and Technology* 49 (2015): 8124–8131.

271 J. Peischl et al., “Quantifying Atmospheric Methane Emissions from Oil and Natural Gas Production in the Bakken Shale Region of North Dakota,” *Journal of Geophysical Research Atmospheres* (2016), doi: 10.1002/2015JD024631; A. Karion et al., “Methane Emissions Estimate from Airborne Measurements over a Western United States Natural Gas Field,” *Geophysical Research Letters* (2015), doi: 10.1002/grl.50811.

272 ONE Future, “EPA Finalizes ONE Future Program,” August 4, 2016, <http://www.onefuture.us/epa-finalizes-one-future-program/>.

273 D. Lyon et al., “Aerial Surveys of Elevated Hydrocarbon Emissions from Oil and Gas Production Sites,” *Environmental Science and Technology* 50 (2016): 4877–4886.



Figure 1. Infrared image showing natural gas emissions from a pair of tanks in the Barnett in Texas. From Lyon et al.²⁷⁴

There are key opportunities to reduce emissions and leaks from natural gas infrastructure downstream as well. My group and colleagues produced the first public, citywide maps of pipeline leaks across cities such as Boston²⁷⁵, Washington, D.C.²⁷⁶, and Manhattan.²⁷⁷ In cities with older infrastructure, we typically found about four leaks per mile using methane-detecting lasers as we drove every city block. In Boston, rooftop measurements over the course of a year showed that natural gas infrastructure accounted for 60 to 100 percent of the methane in the city's air, depending on the season; the average loss rate was 2.7 percent – two and a half times higher than the Massachusetts inventory suggested it should be.²⁷⁸

The greatest opportunity for reducing methane emissions in downstream pipelines is in older U.S. cities in the Northeast and Midwest. Partnerships among companies, states, and public utility commissions to accelerate pipeline replacements have already succeeded. Our methane mapping showed that cities such as Cincinnati, Ohio, and Durham, North Carolina, that replaced all their century-old cast-iron and unprotected steel pipes had 90 to 95 percent fewer leaks per mile²⁷⁹ than cities like Manhattan, Washington, D.C., and Boston, where progress was slower. Based in part on our work, Massachusetts passed an accelerated pipeline replacement program in the summer of 2014. The program, which is estimated to cost a household about \$1 a month, will reduce leaks and greenhouse gas emissions and make the system safer from the risks of fire and explosion.

274 Ibid.

275 N. Phillips et al. "Mapping Urban Pipeline Leaks: Methane Leaks Across Boston," *Environmental Pollution* 173 (2013):1–4.

276 R. B. Jackson et al., "Natural Gas Pipeline Leaks across Washington, D.C.," *Environmental Science and Technology* 48 (2014): 2051–2058.

277 M. E. Gallagher et al., "Natural Gas Pipeline Replacement Programs Reduce Methane Leaks and Improve Consumer Safety," *Environmental Science and Technology Letters* 2 (2015): 286–291.

278 K. McKain et al., "Methane Emissions from Natural Gas Infrastructure and Use in the Urban Region of Boston, Massachusetts," *Proceedings of the National Academy of Sciences USA* 112 (2015): 1941–1946.

279 Gallagher, "Natural Gas Pipeline Replacement Programs."

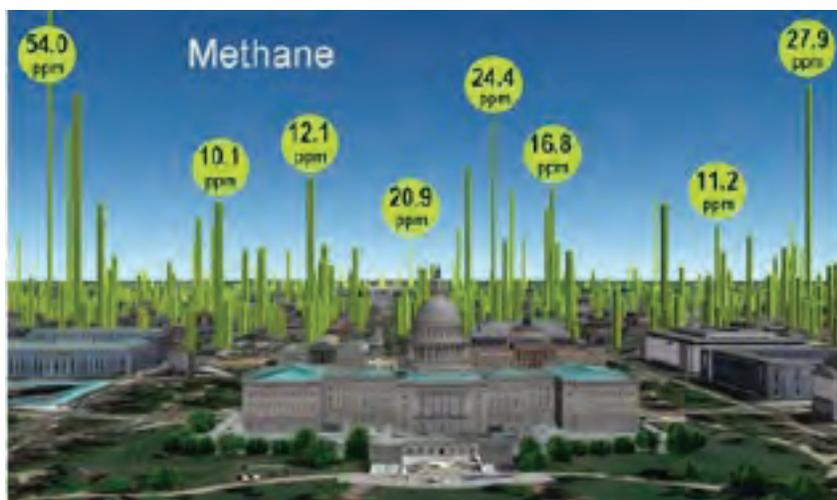


Figure 2. Natural gas leaks around Capitol Hill in Washington, D.C. From Jackson et al.²⁸⁰

These examples illustrate how much progress companies have made, and need to keep making, to reduce methane emissions. New aircraft- and satellite-based technologies already being deployed will help identify the super-emitters that generate most of the emissions.²⁸¹ If we work hard at this – through improved best practices, government incentives and, in some cases, stronger regulations – we can reduce the climate footprint of natural gas and strengthen natural gas safety.²⁸² Doing so will maximize its benefits compared to coal and minimize its shortcomings compared to renewables.

3. Promote renewables, including wind and solar photovoltaics, that are carbon and water neutral and that generate no air pollution during use.

Along with the rise of natural gas, a second energy transformation is occurring in the United States and globally – explosive growth in low-cost renewables. The United States is now the global leader in wind power, having generated a record 191 million kWh in 2015.²⁸³ Net U.S. electricity generation from wind doubled from 2010 to 2015 and has jumped 30-fold since 2000. Solar power has grown even faster. Net U.S. solar generation jumped 20-fold from 2010 to 2015 to 26 million kWh.²⁸⁴ Solar is projected to add more new capacity this year in the United States than any other source.²⁸⁵

Renewables are being selected for many reasons, including their falling costs, clean-power credentials and policy incentives. According to Lawrence Berkeley National Laboratory, the price of utility-scale solar dropped by more than half from 2009 to 2014.²⁸⁶ Wind and solar PV not only generate zero greenhouse gas emissions during use, they also generate zero air pollution, including particulates, mercury and sulfur dioxide. As mentioned above, air pollution from the power sector kills at least 17,000 people each year.²⁸⁷ The value could be zero with a renewable-based portfolio.

280 Jackson, “Natural Gas Pipeline Leaks.”

281 C. Frankenberg et al., “Airborne Methane Remote Measurements Reveal Heavy-Tail Flux Distribution in Four Corners Region,” *Proceedings of the National Academy of Sciences USA* 113 (2016): 9734–9739.

282 A. R. Brandt et al., “Methane Leaks from North American Natural Gas Systems,” *Science* 343 (2014): 733–735.

283 Energy Information Administration, *Monthly Energy Review*.

284 Ibid.

285 Energy Information Administration, *Today in Energy*, March 1, 2016, <http://www.eia.gov/todayinenergy/detail.cfm?id=25172>.

286 Lawrence Berkeley National Laboratory, “Utility-Scale Solar 2014” (2015).

287 Fann, “The Recent and Future Health Burden of Air Pollution.”

Some renewables, such as wind, have the added benefit of requiring no water for their operation as well.²⁸⁸ Cooling water for thermoelectric power is responsible for half of all fresh surface-water withdrawals across the United States, followed closely by agriculture.²⁸⁹ In contrast to wind and solar PV, which use no water, pulverized coal power plants typically use at least 1,500 liters of water per MWh of electricity generation; natural gas combined-cycle plants use less than half as much, approximately 500 to 800 liters.²⁹⁰

We can save a lot of water by deploying renewables, but not all renewables are the same. Despite its low-carbon status, nuclear power (a renewable in some portfolios) requires as much or more cooling water as a typical once-through or closed-loop coal plant. Nuclear is low carbon and low air pollution, but it is a water-intensive technology. Utility-scale concentrated solar is also water intensive, at least currently – as much or more so than coal and nuclear – because of the water needed to cool the reflective lenses and mirrors and to run the steam turbines. Research is needed to reduce the water requirements for all these technologies and to reduce the economic costs of dry cooling that would benefit many types of power plants.

In summary, wind and solar PV emit zero carbon emissions and air pollution and require no cooling water for operations. No other sources of energy can make this claim. For those reasons, and for their rapidly falling costs, we should continue promoting their use through policy vehicles, including renewable portfolio standards, renewable electricity standards and more.

4. Charge federal agencies to collect more data and develop energy metrics that combine multiple environmental factors – including health, water quantity and quality, air pollution, and greenhouse gas emissions.

Linking energy sources to multiple goods and services, including greenhouse gas emissions, health, and water benefits, will inform the energy choices we make. The final recommendation of this paper is to gather more environmental data and to create new quantitative metrics that combine multiple goods and services, using those new metrics to compare energy technologies.

Multiple federal agencies and institutions contribute to this effort, as do researchers in the private sector, universities and nongovernmental organizations. The U.S. Geological Survey²⁹¹ and Department of Energy both carry out extensive research on water quantity and quality metrics for the extraction of fuels and the generation of electricity. Many gaps remain, however; the scarce water-use data collected from many nuclear and geothermal plants²⁹² is one example. The Environmental Protection Agency is responsible for data and metrics associated with air pollution. The National Institutes of Health is an obvious partner for incorporating human health-related aspects of energy generation and use. Collecting more data and making the data publicly available will provide benchmarks for the future and incentives for improvements and greater efficiencies.

The point of using and developing integrated metrics is to provide a framework for comparing different energy sources and accompanying tradeoffs. Coal is abundant and cheap in the United States, but it is water- and greenhouse-gas-intensive to use, and the pollution it generates kills people. Natural gas is better than coal for water and air pollution and, potentially, for greenhouse gas emissions, if we can reduce methane emissions and leakage further. Nuclear is an expensive option that provides a low-carbon, low-air-pollution source of energy but one that is water intensive. Only a subset of renewables provides benefits for climate, air pollution, water and human health. We should acknowledge these differences and incorporate them directly into our energy choices.

288 Jackson, “Environmental Costs”; Macknick, “Operational Water Consumption.”

289 Maupin, “Estimated Use of Water.”

290 Jackson, “Environmental Costs.”

291 Maupin, “Estimated Use of Water.”

292 T. H. Diehl et al., *Methods for Estimating Water Consumption for Thermoelectric Power Plants in the United States*, U.S. Geological Survey Scientific Investigations Report 2013, 5188.

ALIGNED INNOVATIONS

Opportunity for a Sustainable and Secure Energy Future with no American Left Behind

Author

Arun Majumdar is the Co-Director of the Precourt Institute for Energy and the Jay Precourt Professor of Mechanical Engineering at Stanford University. He is former Acting Undersecretary for Science and Energy and former Director, ARPA-E, at the U.S. Department of Energy.

Contact

Precourt Institute for Energy

Y2E2 Building, Suite 324

473 Via Ortega

Stanford, CA 94305

<https://energy.stanford.edu/people/arun-majumdar>

amajumdar@stanford.edu

Aligned Innovations

Opportunity for a Sustainable and Secure Energy Future with no American Left Behind

During the birth of our nation 240 years ago, our Founding Fathers could not have possibly imagined that we would be using LEDs to light our homes, MRI and X-ray machines to look inside our bodies, computers for video chats across the world and airplanes to travel across the continent in a matter of hours. This remarkable period of human ingenuity and innovation has dramatically increased our prosperity and improved our quality of life. And this has all been possible because of how we have sourced, distributed and used energy, predominantly fossil energy. Without energy, our modern life would come to a standstill. At the very roots of this historic success, however, are now serious concerns about climate change due to carbon dioxide and other greenhouse gas emissions from fossil fuels. Climate change is not just happening, it is accelerating. Our current path is unsustainable in the long term. How and when we act will determine our future.

There is no question that we should address climate change with the “fierce urgency of now”— not doing so would be irresponsible. But because of our long history of economic growth based on fossil energy, such a rapid fundamental change towards decarbonizing our energy system is a tectonic shift in our society. Hence, we must undertake such an endeavor thoughtfully and responsibly so that we avoid the trauma of major societal dislocations. We face two daunting challenges:

5. How can we deeply decarbonize our energy system and in doing so, create opportunities for all Americans to economically prosper from such a change?
6. How can we best adapt, so that we avoid the ordeals that climate change may inflict on our society?

Looking globally, there are roughly 1.5-3 billion people who do not have access to modern electricity and are thereby economically stranded in the 19th century without access to clean water, modern agriculture, education, information and industrial productivity. Enabling them to leapfrog to the 21st century would offer opportunities for our own economic prosperity, while also having the positive impact on our global leadership. Thus, the third challenge we face is:

7. How can we enable access to an affordable and secure supply of modern energy for every human being?

These three challenges offer unprecedented opportunities to shape a better future. Innovations will be the key differentiator in how we avail these opportunities. What are these innovations?

Innovations in Technology

Just like we needed innovations to create LEDs, air conditioners, the electricity grid, cars and airplanes, we need multiple technology innovations to deeply decarbonize our energy system. The network of research laboratories across our universities, national laboratories and businesses is the most advanced science and engineering infrastructure on Earth and the envy of the world. We also have the uncanny ability to attract and nurture some of the world's best science and engineering talent. These attributes give the U.S. an unambiguous competitive advantage to create innovative technologies that are clean, affordable and of value worldwide. Our government must invest in long-term research to nurture and amplify this core competence. This is the goose that continues to lay golden eggs.

Innovations in Finance

Technology innovation is necessary, but not sufficient. In the energy sector, if a technology does not scale up in volume and scale down in cost to become economically competitive in the market, it will become irrelevant. The scaling of innovative technologies takes time and money – to demonstrate improved performance, create supply chains, meet regulatory compliance and manufacture in volume – and is best done by the private sector. Hence, innovations in finance are needed to offer access to low-cost, long-term capital with sufficiently healthy returns that are commensurate with the risk of introducing technology innovations. We have the world's most dynamic and robust financial system, but innovations in finance must align with innovations in technology and scaling.

Innovations in Education and Local Economic Development

For all Americans to receive the benefit of a sustainable energy future, we must create opportunities for local economic development across the U.S., especially in regions that would otherwise be left behind in this tectonic shift. Local and state institutions need to appreciate these opportunities and introduce policies to competitively attract financial and human capital. Furthermore, for Americans to avail these emerging opportunities, we need innovations in vocational education in new technologies, finance and business. Because the private sector will benefit from access to human and financial capital, such innovations in education must involve private-public partnerships with policies to incentivize and align them.

Innovations in Policy

One of the key strengths of the US is the role of the market and the vibrant ecosystem of competition and collaboration it creates within in the private sector. For this ecosystem and our iconic entrepreneurial spirit to thrive, it needs predictable outcome-oriented policy signals from governments – federal, state and local – that will create the right business and regulatory environment as well as a level playing field. These policy innovations must be aligned with the innovations in technology, finance, education and business to offer new products and services to people around the world.

It should become abundantly clear that while innovations in technology, finance, education, business and policy are important, each is necessary but not sufficient. To accelerate the pace of change and to create opportunities for all Americans to receive the benefit of this change, these innovations must be aligned to reinforce each other. What is the role of the federal government?

- It must continue to support research, and help attract and nurture the best talent in science and engineering.
- To do so most effectively, it must have leadership that can attract the best talent to the government to create excellence in governance as well as parity with the talent it funds.
- It must maximize the use of existing federal authorities to rapidly align incentives and innovations across technology, finance, education, business, institutions and policies.
- It ought to convene the stakeholders in local governments (states, counties, cities) and the private sector and, through a competitive process, help them create local ecosystems where innovations are aligned and reinforced. This could offer opportunities for a variety of regions to economically prosper.
- Become a first adopter of new technologies in order to de-risk them for society.
- Accelerate the North American (U.S.-Canada-Mexico) partnership on energy and climate to secure our regional future.
- Facilitate our innovation ecosystems to have global impact by helping other nations with access to affordable and secure supply of energy, and address their own energy and climate goals.

The 20th century is often called the American century because most of the innovations that shaped the last 100 years – airplanes, polio vaccination, electrification, green revolution for food, nuclear energy, transistors, integrated circuits, modern computers, lasers, fiber optic and wireless communication, and the internet – started here and enabled the rest of the world. With the daunting challenge of decarbonizing our global energy system to address climate change and of providing access to modern energy to every human being, we have the opportunity of making this century the American century as well. We should never let such a serious crisis go to waste.

THE 2017 INAUGURATION

Empowering a Clean Energy Nation

Authors

Nancy Pfund is the Founder and Managing Partner of DBL Partners.

Kristofer Holz is a joint degree candidate in the Yale School of Management.

Contact

DBL Partners San Francisco
One Montgomery Street
Suite 2375
San Francisco, CA 94104
<http://www.dblpartners.vc/>
nancy@dblpartners.vc

Abstract

The energy industry is at a major junction. We've had our grandfather's electricity system for 100 years, with no major changes or innovations. Now, the energy industry is in an innovation cycle across many sectors, from electricity to transportation to agriculture and beyond. The transformation is akin to what we've experienced in phones, computers, and even music distribution over recent decades. Uniquely, this innovation is fueled not just by economic opportunity, but by environmental imperative as well – energy-related carbon dioxide emissions account for more than 80 percent of U.S. greenhouse gas emissions. i From industry icons like First Solar, Tesla, SunPower and SolarCity to exciting upstarts like UtilityAPI, Farmers Business Network, Advanced Microgrid Solutions and Off Grid Electric, our country's entrepreneurs are increasingly focused on creating the 21st century energy sector. With this focus comes not only a flow of capital, but a flood of job creation. The solar industry alone offers over 200,000 well-paying jobs as of last year, growing at an annual rate of 20% compared to 1.74% for the rest of total non-farm American job growth. ii The growth rate in cleantech not only exceeds that of other fast-growing tech companies, but has been populated by a more demographically diverse workforce than that of other energy and technology industries. iii Despite its promise and remarkable growth rate, the 21st century energy sector is still a budding industry – solar only represents about one percent of U.S. electricity generation and electric vehicles are still less than three percent of U.S. auto sales iv. Maintaining U.S. leadership in clean energy and the attendant growth rate in job creation will require America's next president to think holistically about the industry and take a broadly strategic approach to energy policy.

We offer three major areas of recommendation. The most important achievements the next president can accomplish for clean energy are fostering stakeholder unity behind the shift to renewables, increasing accessibility and viability for investors, and improving nationwide energy literacy. Importantly, these three categories of recommendations will reinforce one another.

- Building a Cleantech Coalition: Consumers create the political climate which, in turn, influences the policies that either support or repress investment into sustainability and renewable energy. The next president should therefore unify the country in support of clean energy by enacting policies that bring renewables to populations for whom they have previously been out of reach for economic or political reasons. In addition, the administration should work closely with the electric utilities to find solutions that allow both incumbent and new business models to thrive. This would allow utilities to move their significant policy influence behind renewables, promote cooperation rather than conflict, and open up new paths to innovation.

- **Supercharging our Future – Investment Policies that Build an Onramp to our Clean Energy Economy:** Surveys of consumer attitudes towards renewables find that although environmental ramifications are important, it is ultimately the economics of renewable energy that primarily motivate consumer outlook. Consumers in the U.S. and worldwide will not make the switch to clean energy unless increased investment makes it economical to do so. The next administration should therefore refine and build on the existing frameworks of the Investment and Production Tax Credits, the Community Reinvestment Act, and the Capital Gains Tax to incentivize sustainable and clean energy investment. In addition, we recommend the next president address ongoing energy data policy discussions to facilitate investment garnering innovation throughout the energy industry.
- **Educating the Next Generation of Cleantech Entrepreneurs – Fostering Nationwide Energy Literacy:** Finally, by increasing nationwide energy literacy, particularly among the nation's youth, the next president can encourage continued progress beyond the term of her presidency. We recommend a three-pronged approach to the president's energy literacy campaign:
 - The DOE should work with celebrities, from both inside the energy industry and out, to create viral content and establish concrete audience behavior goals. Website visits or purchases of a specific energy-saving device, for instance, would create measurable results and the ability to refine campaign strategy accordingly.
 - The DOE's Energy 101 class was a good start, but it can be reimagined to be more effective by working with the College Board to create an AP test designed specifically for energy.
 - The "solarize" model has been tremendously successful at driving down solar installation costs and increasing penetration by harnessing the competition amongst residential solar installers in a growing number of states. The federal government should direct the DOE to announce a national solarize competition among the states.

By leveraging policy concepts old and new, local and federal, and appealing to all, from wonks to average Jills, our 45th president can drive a low carbon economic boom and preside over a nation that leads from sea to sustainable sea.

THE 2017 INAUGURATION: Empowering a Clean Energy Nation

Nancy E. Pfund & Kristofer Holz

September 2016



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About the Authors

Nancy E. Pfund is Founder and Managing Partner of DBL Partners (formerly DBL Investors), a venture capital firm whose goal is to combine top-tier financial returns with meaningful social, economic and environmental returns in the regions and sectors in which it invests. Ms. Pfund currently sponsors or sits on the board of directors of several companies, including; SolarCity (NASDAQ: SCTY), Farmers Business Network, The Muse, Advanced Microgrid Solutions, Off-Grid Electric and Primus Power, and, prior to their public offerings, Tesla Motors and Pandora Media. Ms. Pfund also sits on the Board of Trustees of the National Geographic Society, the Advisory Council for Stanford University's Bill Lane Center for the American West, and the Advisory Boards of Lawrence Berkeley National Labs and the U.S. Alliance on Impact Investing (formerly the National Advisory Board on Impact Investing). She speaks and writes frequently on matters relating to clean tech and impact investing, including the widely cited studies *What Would Jefferson Do?* and *Renewables are Driving up Electricity Prices – Wait, What?*

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Kristofer Holz is a joint degree (MBA/MEM) graduate student at Yale University, studying at the School of Management and the School of Forestry and Environmental Studies. He joined DBL Partners as a Summer Associate during the summer of 2016. Prior to graduate school, Mr. Holz worked in commercial and industrial solar project acquisitions for SunEdison and as a regulatory analyst for the Energy Division of the California Public Utilities Commission.

EXECUTIVE SUMMARY

The energy industry is at a major junction. We've had our grandfather's electricity system for 100 years, with no major changes or innovations. Now, the energy industry is in an innovation cycle across many sectors, from electricity to transportation to agriculture and beyond. The transformation is akin to what we've experienced in phones, computers and even music distribution over recent decades. Uniquely, this innovation is fueled not just by economic opportunity, but by environmental imperative as well – energy-related carbon dioxide emissions account for more than 80 percent of U.S. greenhouse gas emissions.¹ From industry icons like First Solar, Tesla, SunPower and SolarCity to exciting upstarts like UtilityAPI, Farmers Business Network, Advanced Microgrid Solutions and Off Grid Electric, our country's entrepreneurs are increasingly focused on creating the 21st century energy sector. With this focus comes not only a flow of capital, but a flood of

job creation. The solar industry alone offers over 200,000 well-paying jobs as of last year, growing at an annual rate of 20 percent compared to 1.74 percent for the rest of American job growth.² The growth rate in cleantech not only exceeds that of other fast-growing tech companies, but also has been populated by a more demographically diverse workforce than that of other energy and technology industries (see Figure 1).³ Despite its promise and remarkable growth rate, the 21st century energy sector is still a budding industry – solar only represents about one percent of U.S. electricity generation and electric vehicles are still less than three percent of U.S. auto sales.⁴ Maintaining U.S. leadership in clean energy and the attendant growth rate in job creation will require America's next president to think holistically about the industry and take a broadly strategic approach to energy policy.

Clean Energy Jobs Promote a More Diverse Workforce

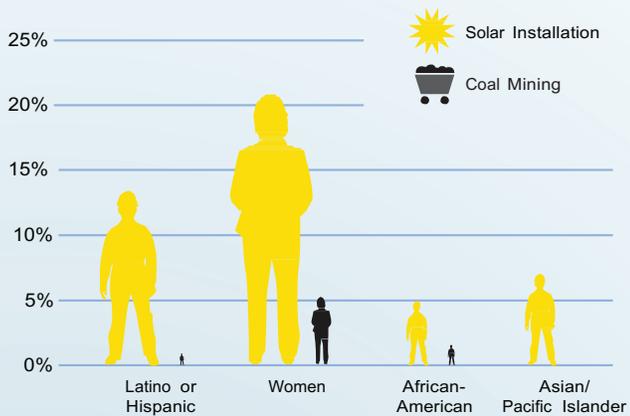
Figure 1

Solar Installation Employs 15,000 More Latinos, nearly 5,000 More African-Americans, 8,000 More Asian/Pacific-Islanders and 21,000 more Women Than The Coal Mining Industry

The U.S. solar industry supports a more demographically diverse workforce compared with traditional energy generation industries. Only 5.2% of the U.S. coal mining industry is female compared to 21.1% of solar installation workers who are women. While there is always room for improvement, solar is more diverse across a range of demographic categories and the solar workforce is becoming increasingly diverse over time.

Not only is the solar sector more diverse than traditional energy generation like coal mining but there are also more solar jobs than coal jobs. The Solar Foundation National Jobs 2015 Census reports that the solar sector employs 140,930 more workers than the coal mining industry.

Comparison of solar and coal workforce



Sources: The Solar Foundation National Jobs Census 2015 Report and the Bureau of Labor Statistics, U.S. Department of Labor.

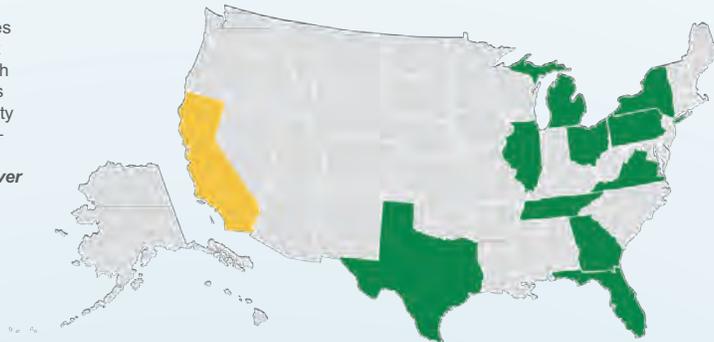
We offer three areas of mutually reinforcing recommendations. The most important achievements the next president can accomplish for clean energy are fostering stakeholder unity behind the shift to renewables, increasing accessibility and viability for investors, and improving nationwide energy literacy.

1. Building a Cleantech Coalition: Consumers create the political climate, which, in turn, influences the policies that either support or repress investment into sustainability and renewable energy. The next president should therefore unify the country in support of clean energy

by enacting policies that bring renewables to populations for whom they have previously been out of reach for economic or political reasons. The figure below depicts the potential of one such community – high population states with low penetrations of renewables. In addition, the administration should work closely with the electric utilities to find solutions that allow both incumbent and new business models to thrive. This would allow utilities to move their significant policy influence behind renewables, promote cooperation rather than conflict, and open up new paths to innovation.

Solar States of Mind – Wish They All Could Be California Solar Stats

If the next president's energy policies can push these 10 large states past solar grid parity and help them catch up to California's level of solar watts per capita, the nation's solar capacity will **double***, increasing by 34 GW – **enough to power over 6.6 million American homes and generate over \$67 billion in economic activity**.



State	Population Size	Grid Parity?	MW of Solar Installed	Current Watts Per Capita (WPC)	Total MW at California WPC (257.7)	Total Solar Opportunity in MW
Texas	27,469,114	Close	479	17	7,078	6,599
Florida	20,271,272	Very Close	206	10	5,223	5,018
New York	19,795,791	Yes	583	29	5,101	4,518
Illinois	12,859,995	Very Close	52	4	3,314	3,262
Pennsylvania	12,802,503	Very Close	204	16	3,299	3,095
Ohio	11,613,423	Medium	108	9	2,992	2,884
Michigan	9,922,576	Close	36	4	2,557	2,521
Georgia	10,214,860	Close	120	12	2,632	2,512
Virginia	8,382,993	Medium	29	3	2,160	2,131
Tennessee	6,600,299	Medium	82	12	1,701	1,618
TOTAL	139,932,826		1,897		36,055	34,158

Sources: US Census Bureau, US Energy Information Administration, Solar Energy Industries Association; Greentech Media "GTM Research: 20 US States at Grid Parity for Residential Solar"

*Based on Q2 2016 SEIA and GTM Research U.S. Solar Market Insight Report figure of 29.3 GW total installed U.S. solar capacity

† Estimate of economic activity calculated using nationwide weighted average cost of solar in 2015, derived from GTM Research and Solar Energy Industries Association's U.S. Solar Market Insights Reports for Q2 2016 and 2015

2. Supercharging our Future – Investment Policies that Build an Onramp to our Clean Energy Economy: Surveys of consumer attitudes toward renewables find that although environmental ramifications are important, it is ultimately the economics of renewable energy that primarily motivate consumer outlook. Consumers in the U.S. and worldwide will not make the switch to clean energy unless increased investment makes it economical to do so. The next administration should therefore refine and build on the existing frameworks of the Investment and Production Tax Credits, the Community Reinvestment Act and the Capital Gains Tax to incentivize sustainable and clean energy investment. In addition, we recommend the next president address ongoing energy data policy discussions to facilitate investment-garnering innovation throughout the energy industry.

3. Educating the Next Generation of Cleantech Entrepreneurs – Fostering Nationwide Energy Literacy: Finally, by increasing nationwide energy literacy, particularly among the nation's youth, the next president can encourage continued progress beyond the term of her presidency. We recommend a three-pronged approach to the president's energy literacy campaign:

- a. The DOE should work with celebrities, from both inside the energy industry and out, to create viral content and establish concrete audience behavior goals. Website visits or purchases of a specific energy-saving device, for instance, would create measurable results and the ability to refine campaign strategy accordingly.
- b. The DOE's Energy 101 class was a good start, but it can be reimagined to be more effective by working with the College Board to create an AP test designed specifically for energy.
- c. The "solarize" model has been tremendously successful at driving down solar installation costs and increasing penetration by harnessing the competition amongst residential solar installers in a growing number of states. The federal government should direct the DOE to announce a national solarize competition among the states.

By leveraging policy concepts old and new, local and federal, and appealing to all, from wonks to average Jills, our 45th president can drive a low carbon economic boom and preside over a nation that leads from sea to sustainable sea.

An Investor's Perspective: Policy Recommendations for the Next President



The Clean Jobs Transition Act – Help new industries revitalize coal communities. Stimulate investment in clean jobs and technology

Cash for Clunkers Redux: Solar for Scrap Metal – Offer utilities with aging coal infrastructure a way out through reinvestment in renewables

Overcoming the Deferred Maintenance Overhang – Low income housing managers must invest in long-neglected maintenance ahead of renewables and energy efficiency. Instead of one or the other, help them do both

Community Solar: Roofs not Required – Roof ownership is limited among the low income community. Increase community solar accessibility for low income Americans by decreasing developer cost

Solar States of Mind – Grid Parity is here or fast approaching in many states. Those with large populations offer clean energy businesses a big opportunity. We show the math

Beyond DER Drama: Best Practices from the White House – Extended net metering battles are costly to clean tech, taxpayers, and climate change efforts. Convene stakeholders to write a playbook

Green Button II – Data access is crucial to grid innovation. Make Grid Neutrality a priority

Share the Love: Expand the ITC – Other capital intensive clean technologies should be made ITC eligible – start with storage

Democratizing the Tax Equity Pool – The scarcity of investors makes tax equity financing expensive. Change the ITC and PTC accounting rules to expand the pool

Two Scoops of Solar: ITC meets LIHTC – Translate the success of LIHTC in low-income housing to low-income solar

The Carbonless Gains Tax – Take inspiration from capital gains tax policy. Recognize green activity and incentivize green decisions by giving investors a small tax break

Three-Pronged Energy Literacy Campaign – Americans need to know the energy market in order to lead it. Celeb Power, High School AP Energy Courses, and using the power of solarize to "put-solar-on-it" can help get us there

BUILDING A CLEANTECH COALITION

Philosophical support for clean energy has spread to the point of ubiquity across the nation's voters.⁵ Still, physical uptake is far from an even distribution across geographical and socioeconomic spectrums. As communities that have traditionally depended on demand for coal to drive their economies suffer the rise of natural gas, they often incur spikes in unemployment and feelings of resentment toward agendas that promote environmental protection and cleaner sources of energy.⁶ And whether in coal states or sunshine states, lower income Americans have also been left behind in the transition to renewables. Moreover, segmentation of energy policy jurisdiction by state boundaries creates the risk of state policymakers and energy regulators

in populous states excluding large segments of the American public from the transition to clean energy. The good news is that these three communities – coal states, low income populations, and large states with unrealized potential for renewables – offer the next presidential administration exceptional opportunities to spread renewables into untapped markets. By doing so, the administration will further strengthen pro-renewables political willpower. In concert with seeking to reduce the tensions between utilities and distributed energy resources (DERs), the next president can work with these three key communities – our Clean Energy Trifecta – to create a nationwide coalition of political support.

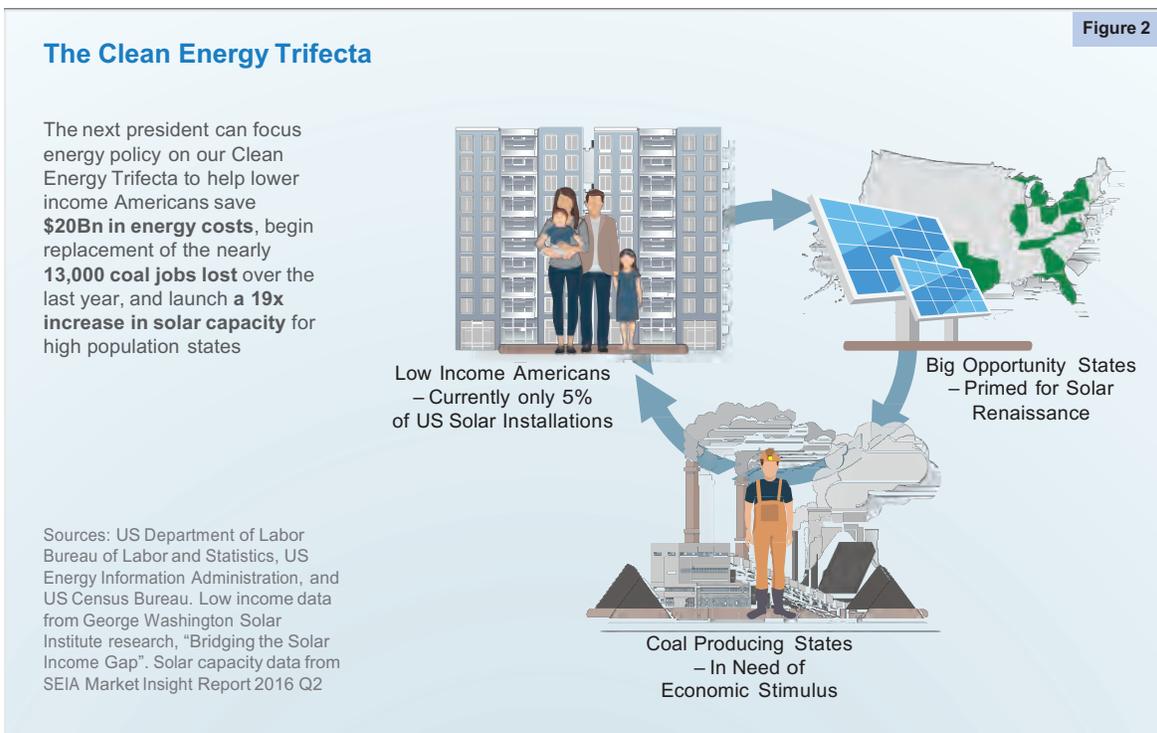
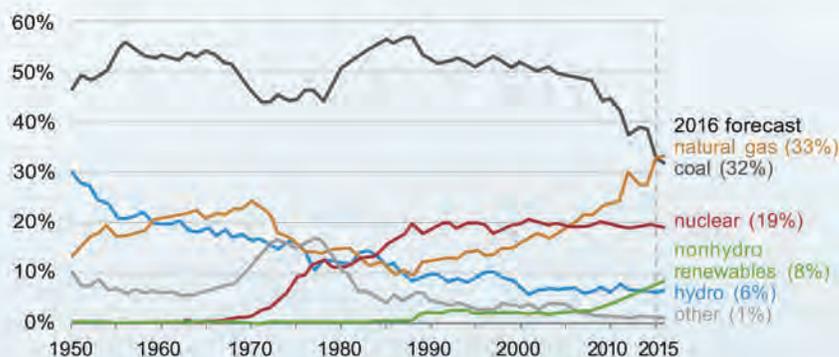


Figure 3

Natural Gas Surpasses Coal as Leader in U.S. Electricity Generation, and Renewables are on the Rise
75 Years of Energy History



Source: U.S. Energy Information Administration, Monthly Energy Review and Short-Term Energy Outlook (March 2016)

Community #1: Coal 2 Green

The wave of coal bankruptcies sweeping across our nation leaves in its wake thousands of unemployed workers in need of retraining. As Figure 3 notes, coal has been losing a significant share of U.S. electric generation to natural gas, and increasingly renewables, since the late 2000s. Unsurprisingly, the states with the greatest volumes of coal mining—Wyoming, West Virginia, Kentucky, Pennsylvania, and Illinois—have traditionally had low electricity costs and consequently some of the lowest rates of solar adoption per capita.^{7,8} Kentucky and West Virginia have low rates of wind penetration as well.⁹ For example, West Virginia, the second largest coal producing state in the nation, had the fourth lowest retail electricity rate in the country for 2015 and ninth lowest solar watts per capita. With coal losing out to natural gas, however, that dynamic is changing—West Virginia’s average retail electricity rate increased 18 percent between April 2014 and April 2016.^{10,11} Meanwhile, the state has the fourth highest unemployment rate at 6.2 percent.¹² The combination of high unemployment, soon to be obsolete power infrastructure, and rising electricity prices makes coal states a prime target for a presidential administration seeking to redress energy and economic inequality and increase the penetration of renewable energy and other sustainable technologies.

The Clean Jobs Transition Act

The precipitous decline in coal jobs across the United States should be addressed through policies that promote retraining of coal workers into locally viable industries capable of revitalizing sustainable growth in struggling communities. Local demand for solar and wind jobs in these states is not yet high enough to save coal state economies alone. Yet as renewable prices fall while traditional energy prices rise, the solar and wind industries will play an increasingly large role in putting

unemployed coal families back to work. Solar jobs are growing at a 20 percent annual rate and are employing over three times as many workers as coal mining.¹³ The next presidential administration should seek to harness this growth for those suffering the decline of the coal economy by creating funding opportunities for transitioning workers and communities to clean energy. The next steps should push beyond the Obama administration’s 2010 Partnerships for Opportunity and Workforce and Economic Revitalization (POWER) initiative by passing a **Clean Jobs Transition Act**. This act would require coal companies to help struggling communities by sharing in the provision of funding and administration for retraining laid-off workers. The **Clean Jobs Transition Act** would look to the early 2000s for guidance on using high profile energy bankruptcies to create community benefits. In 2001, Pacific Gas and Electric filed for bankruptcy after fallout from the California Energy Crisis caused its debts to begin increasing at a rate of \$300 million per month.¹⁴ While the bankruptcy was a burden on the state’s ratepayers, regulators were able to reframe the proceeding as an opportunity to create funding for state economic recovery. A California Public Utility Commission (CPUC) decision following the bankruptcy required PG&E shareholders to distribute \$30 million over five years to establish the California Clean Energy Fund, or CalCEF, a public benefit fund that invested in clean energy activities and companies. Drawing from the CPUC’s requirement that PG&E create CalCEF, the **Clean Jobs Transition Act** would require coal companies to both fund solar training programs for newly unemployed workers as part of their bankruptcy settlement and provide resources dedicated to assisting with enrollment in such training programs.

The **Clean Jobs Transition Act** would allow the next president to transform the downward spiral of coal bankruptcies into the upward mobility of opportunity by creating additional funding for The Solar Training Network* and other clean energy growth programs.

* Recently, the Obama administration announced the rollout of a DOE Sunshot program called the Solar Training Network that will connect people interested in solar careers industry training and employers. The program is the successor to the Solar Instructor Training Network

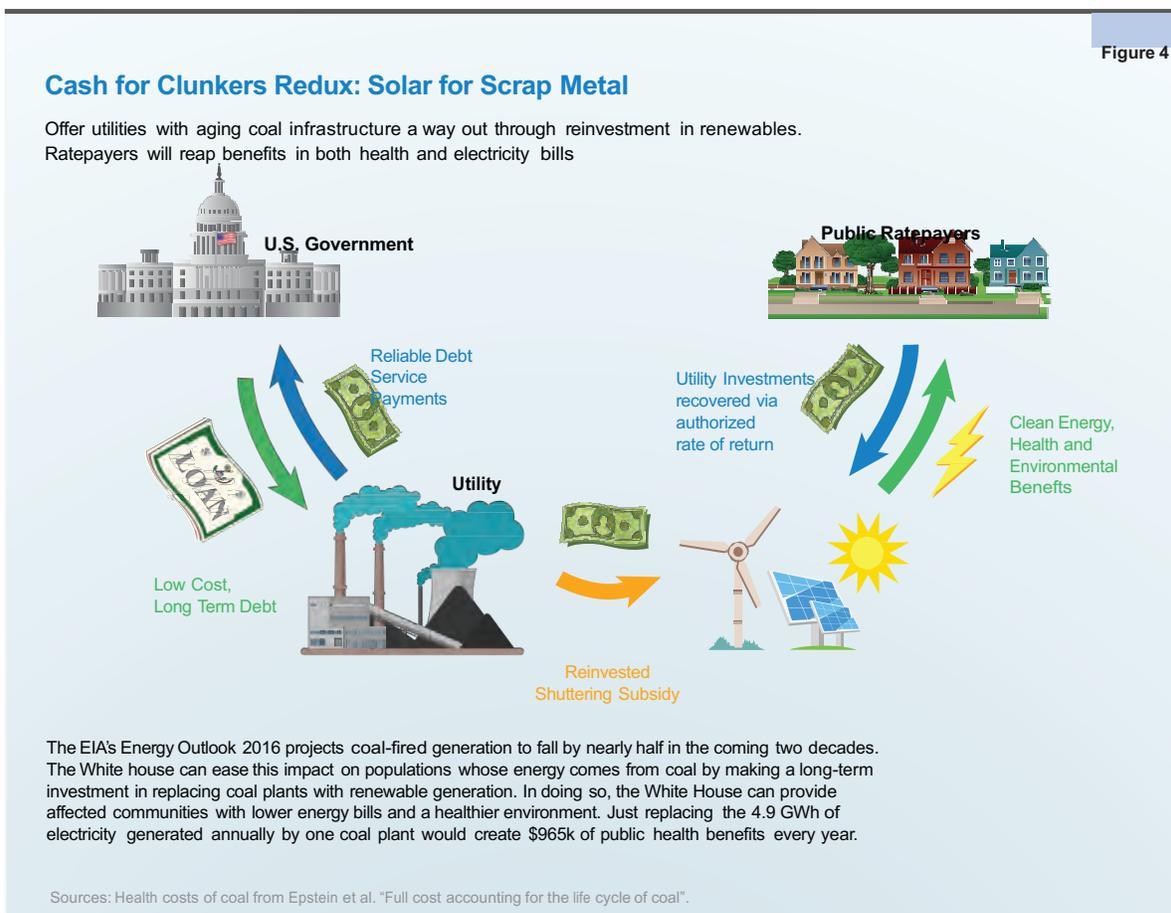
(SITN), spearheaded by the Interstate Renewable Energy Council, and will be administered by the Solar Foundation under a limited pool of funding from the DOE—\$2.1 million over two years.

The administration could apply this funding model to create additional, scalable programs for coal worker retraining and employment in other industries as well. The Coalfield Development Corporation's Quality Jobs Initiative offers an instructive model. Coalfield Development Corporation is a West Virginia Community Based Organization that provides well-made and affordable homes, creates reliable jobs and generates opportunities for increased quality of life for low-income southern West Virginia families impacted by the downturn of the coal industry.

Cash for Clunkers Redux: Solar for Scrap Metal

In 2015, POWER awarded \$14.5 million in funding for projects dedicated to improving the health and economies of coal communities. None of this funding, however, directly addressed the extensive costs incurred by utility ratepayers as a result of the closure.¹⁵ Shutting power plants is expensive – the costs of demolition, hauling, safe handling of hazardous substances, and environmental remediation add up. Another program aimed at updating aging technology, Cash for Clunkers, can act as a precedent. Under the

Clean Jobs Transition Act, the next president should launch a similar program for power plants – **Solar for Scrap Metal**. The federal government could subsidize the cost of shuttering a plant with a grant or low cost loan, up to the amount that was reinvested in renewable energy. Provided the cost of capital from the federal government was lower than what traditional debt providers would offer to finance a solar plant, the utilities already under economic and political pressure to close coal plants would see a strong incentive to participate in the Solar for Scrap Metal program. Meanwhile, the federal government could recoup its costs from ratepayers over a longer term than the utility would otherwise, easing the burden of shuttering plants on consumers. Additionally, consumers and the general public would benefit from reduction of coal generation's environmental and health externalities. A 2011 Harvard study found that coal generation placed a \$0.197/kilowatt-hour (kWh) (in 2016 dollars) burden on the public from a combination of land, air quality and human health effects.¹⁶ Shutting one of Kentucky's coal plants that generated 4.9 GWh of power in 2014,¹⁷ for example, would therefore create \$965,300 in annual social benefit. Figure 4 shows a schematic of how this program could work.



Community #2: Reaching Low Income Americans

It's no secret that consumers with lower incomes have been difficult for the clean energy industry to reach at scale. Especially in their early days, solar panels were historically only within the budget of higher income Americans. Yet over the past eight years, developers have introduced financing options like leases, loans and power purchase agreements (PPA)s that dramatically cut or even eliminate the customer's up-front cost of solar installation. At the same time, the all-in cost of residential solar installation fell by 55 percent between 2009 and 2015.¹⁸ These factors combined with the continued existence of the solar Investment Tax Credit have helped funnel billions of private sector dollars into solar development and helped America's middle class become the fastest growing solar customer segment¹⁹ - see Figure 5 below. Still, low income Americans have yet to experience this growth. Some state programs, like the CPUC's Multifamily Affordable Solar Housing (MASH) program, have begun to close the gap but are often fully subscribed long before demand is satiated.²⁰

Defining "lower income" as American households making less than \$40,000 per year, a recent study by the George Washington Solar Institute found dramatic differences in solar adoption rates below and above this threshold. While 40 percent of American households fall

into the "lower income" category, this segment of the population only accounts for about 5 percent of nationwide solar installations.²¹ And while zero-money down options like PPAs and solar leases are helping to erode this discrepancy, personal credit remains a hurdle and there are barriers aside from pure economics that stand between low income Americans and clean energy. Two such barriers we see as prime targets of the next president's policy agenda are the accumulation of deferred maintenance amongst state housing authorities and the high rate of rental housing for low income consumers. Addressing these issues will allow the next presidential administration to make clean energy relevant for the nearly 50 million lower income American households.

Overcoming the Deferred Maintenance Overhang

Lower income Americans are more likely to live in buildings with deferred maintenance than those with higher incomes.²² This prevents the adoption of clean energy measures in two ways. First, it creates a housing maintenance financial obligation that supersedes investment in renewables. Second, some deferred maintenance issues can physically prevent a homeowner from conducting home energy upgrades. In older homes with asbestos risk, for example, homeowners

Figure 5

Solar to the People: State-wide Residential Solar Breakdown by Median Owner Occupied Household Income

Residential solar is being installed increasingly on middle income homes – in California the \$40-\$55k household income segment has made the greatest strides in market share since 2013



Source: Kevala Analytics "Income Distribution of Rooftop Solar Customers"

are discouraged from making any changes to existing insulation before taking on the added cost of contracting an asbestos abatement professional.²³ Moreover, conducting weatherization improvements before addressing air quality issues arising from deferred maintenance can lead to an unhealthy buildup of combustion gases and volatile organic compounds.²⁴ Unfortunately, deferred maintenance has reached astronomical levels in some state housing authorities. New York City Housing Authority (NYCHA), for example, has 270 buildings over 30 years old and has accumulated \$16 billion in deferred maintenance. NYCHA's operating deficit of \$98 million perpetuates this situation.²⁵

In order to address deferred maintenance and help bring new energy solutions to low income populations living in public

and Section 8 housing, the federal government could establish a dual purpose **Deferred Maintenance Overhang Loan** program for both deferred maintenance and energy efficiency investment. The DOE should create a task force designed to expand existing home energy assessment programs by including the cost of the initial deferred maintenance upgrades required. By providing deferred maintenance costs, the costs of suggested energy efficiency upgrades, and the projected energy savings, the assessments would allow the government to forecast the upfront costs and payback period of each project. The government could then issue "**Dual Purpose Deferred Maintenance and Energy Upgrade Bonds**" with a similar maturity to the forecast payback period. The proceeds of the issue would fund loans to state housing authorities in the amount of the aggregated project costs under their jurisdiction.

Weather or Not: The Case for Supporting Weatherization in Low Income Housing

Consumers with lower incomes cannot avoid the necessity of heating, cooling, and lighting their homes and are thus disproportionately affected by the cost of energy. While middle- and upper-income families typically spend 5% or less of their income on energy, lower-income Americans frequently spend upwards of 10%.

Weatherization measures make economic sense - A recent study of the DOE's Weatherization Assistance Program's cost-effectiveness found a savings to investment ratio of 1.5 for 2008 WAP projects.

Aside from household economics, weatherization measures provide significant health benefits to the inhabitants whose homes receive them. The same study found that for every DOE dollar spent, homeowners and society realized \$2.08 nonenergy benefits such as reductions in asthma, thermal stress, and carbon monoxide poisoning

Typical Measures Installed	Energy Savings	Payback Period
Homes weatherized July 1988 to June 1989		
<ul style="list-style-type: none"> • Caulking • Weatherstripping • Replacement Windows • Storm Windows • Attic Insulation 	Single Family – Gas Heat 10% Single Family – Electric Heat 5% Mobile Homes 10%	30 years 21 years 53 years
Homes weatherized July 1989 to June 1990		
<ul style="list-style-type: none"> • Advanced Air Sealing • Attic Insulation • High-Density Wall Insulation • Heating Safety and Efficiency Improvements 	Single Family – Site Built 24% Mobile Homes 17%	10 years 17 years

Sizing our Deferred Maintenance Overhang Loans: The chart above is a sample payback period analysis used by the DOE to provide training for weatherization technicians in Virginia. Such analyses, expanded to the measures required to eliminate deferred maintenance requirements, could be applied to low income housing energy projects and used to calculate the appropriate term for our proposed loans.



Sources: Information on energy budgets from "Energy Burden and the Need for Integrated Low-Income Housing and Energy Policy", by Diana Hernández and Stephen Bird. Weatherization cost effectiveness and health impacts from "Weatherization Works" retrospective evaluation by Oak Ridge National Laboratory. Photo and Weatherization chart credit to the US Department of Energy.

This could also be accomplished via Property Assessed Clean Energy (PACE) financing. The Federal Housing Administration (FHA) has recently announced that they will begin insuring mortgages on properties with PACE liens provided that the PACE liens remain subordinate to the mortgage. The announcement broadens the scope of buildings under which PACE financing can be used. In some cases, PACE financing could stand in for government bonds as a source of funding for state housing deferred maintenance and energy upgrade projects. At the beginning of 2016, California Governor Jerry Brown initiated a multifamily PACE pilot program in partnership with HUD. The pilot program is intended to test the viability of PACE loans for HUD-assisted and HUD-insured multifamily housing. The next administration should follow the results closely and direct HUD to apply the learnings of the California pilot to a national program.²⁶

Community Solar: Roofs not Required

The second barrier to low income renewable energy and energy efficiency adoption lies in the fact that lower income citizens are also less likely to own their roof due to higher rates of renting and living in multifamily housing. Forty-nine percent of lower income households are renters versus just under 22 percent of households with incomes greater than \$40k.²⁷ This makes entering into a solar agreement difficult, but community solar programs offer a solution. Community solar programs allow customers without a suitable location for a solar array to make use of one built elsewhere. Participants either invest in a portion of a solar farm and partake in the profit of selling the energy or enter into a contract with their local utility to purchase renewable energy from a shared solar facility operated by the utility or a third party. Community solar is growing in popularity with 25 states now home to at least one operating project.²⁸ In addition, the DOE SunShot Initiative recently announced its intention to develop a \$5 million Community Solar Challenge. Still, the federal government could lend developers and their low income customers a huge boost by directly lowering the costs of community solar development.

One way to lower costs and boost community solar development would be to **include the land purchase or present value of lease payments under the basis of the Investment Tax Credit** for projects built exclusively for community solar purposes. Landowners are quickly becoming aware of the value of their land for renewable developers and are raising their prices accordingly. Allowing these costs to be tax credit eligible for investors would help bring down project costs, encourage investment and ultimately help improve solar access to low income customers. Another tactic would be to provide the land itself. Secretary Clinton has set a goal of a tenfold increase in renewable energy production on public lands and waters within 10 years.²⁹ This goal could be further refined to target low income customers by **decreasing federal land lease or sale rates for community solar projects** in proportion to the percentage of the solar farm dedicated to serving low income customers. The cost savings achieved would then be passed on to community solar

customers in the form of a lower cost of investment or cheaper utility bill depending on the community solar model.

Community #3: Solar States of Mind

A notable feature of the political landscape as it pertains to renewable energy is the segmentation of policy by state. As renewable technologies that have to interact with the utility grid are largely at the mercy of state policy, state borders can function as massive barriers to adoption. Due to the varying sizes of state populations, state policies that are prohibitive to renewables growth can potentially hold a disproportionate share of the U.S. population captive with traditional energy sources. In the fight for the hearts and minds of U.S. voters, populous states with low deployment are an attractive frontier. To construe large, low renewables penetration states as low-hanging fruit would understate the challenge of inspiring change among state policymakers showing or facing resistance to promoting renewables. Yet, when these large states with low solar penetration are subdivided into those which also happen to be approaching solar grid parity (the point at which an alternative energy source provides power at a levelized cost of energy equal to that of conventional sources of power) and are home to large populations, we have large, juicy, increasingly obtainable fruit.

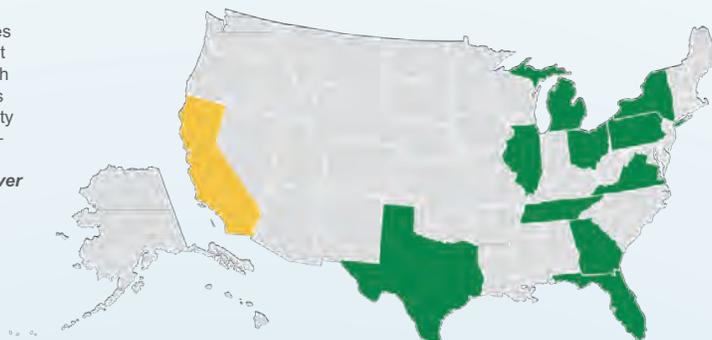
Wish They All Could Be California Solar States

The Energy Information Administration (EIA) Electric Power Monthly report for July 2016 includes a data set on solar capacity by state. Cross-referencing this data with the state population data from the U.S. Census Bureau, we've created a measure of solar penetration in watts per capita (WPC) for all of the 50 states. Layering in Greentech Media's recent study on grid parity and accounting for overall population size, we found a set of populous states with low solar penetration but closing in on or at grid parity – exactly that low hanging fruit mentioned above. We then compared these states to California, the nation's leading state in terms of both total solar capacity installed and solar job creation.³⁰ Though California's sunny weather certainly lends its solar market an advantage, those states at or nearing grid parity have the potential to compete proportionally with the Golden State. Using California's WPC, we calculated the overall opportunity for additional solar capacity constituted by our set of target states and illustrated this opportunity below. Combined, these states represent over 106 million citizens of voting age,³¹ 190 congressional votes and 43 percent of the U.S. population.³² Moreover, two of the top 10 biggest opportunity states – Illinois and Pennsylvania – are also among the top 5 coal-producing states.³³ The data also shows that of the five largest states by population – California, Texas, Florida, New York, and Illinois – only California is in the top 30 percent of states by solar penetration per capita.³⁴ Targeting our set of opportunity states will allow the next presidential administration to address both large populations and those that have suffered the ramifications of a declining coal economy.

Figure 6

Solar States of Mind – Wish They All Could Be California Solar Stats

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¹ Estimate of economic activity calculated using nationwide weighted average cost of solar in 2015, derived from GTM Research and Solar Energy Industries Association's U.S. Solar Market Insights Reports for Q2 2016 and 2015

An Offer They Can't Refuse: Federal Energy Bonds

Picking certain states for exclusive subsidies would be both unfair and politically unpalatable. However, by targeting states that are just on the verge of grid parity, the next president can optimize the allocation of federal support to nascent solar markets with the most potential for success. The VirginiaSAVES Green Community Program offers an example of how the federal government might accomplish this. VirginiaSAVES provides low cost loans to developers of energy efficiency, renewable energy, and alternative fuels projects by using Virginia's allocation of the Department of Energy's Qualified Energy Conservation Bonds (QECBs). QECBs and the similar Clean Renewable Energy Bonds (CREBS) are a taxable bond structure that allows issuers to reduce their cost of financing. The issuer – a government entity in the case of QECBs – receives a cash rebate from the U.S. Department of Treasury to reduce the size of the net interest payments to bondholders. The rebate has historically reduced VirginiaSAVES interest rates by 2-3 percent allowing the program to pass this savings along to project developers in the form of low cost loans.^{35,36,37} The federal government should **offer to help other states set up this framework and work with the DOE to issue more QECBs and CREBs** for the capital requirements. By fine tuning

the size of the Treasury's interest rate reduction to the cost of capital required by state developers, the federal government would effectively set a threshold for which states could find such a program economically attractive.

Leadership from the Utilities: Good Bye Battles, Hello Collaboration

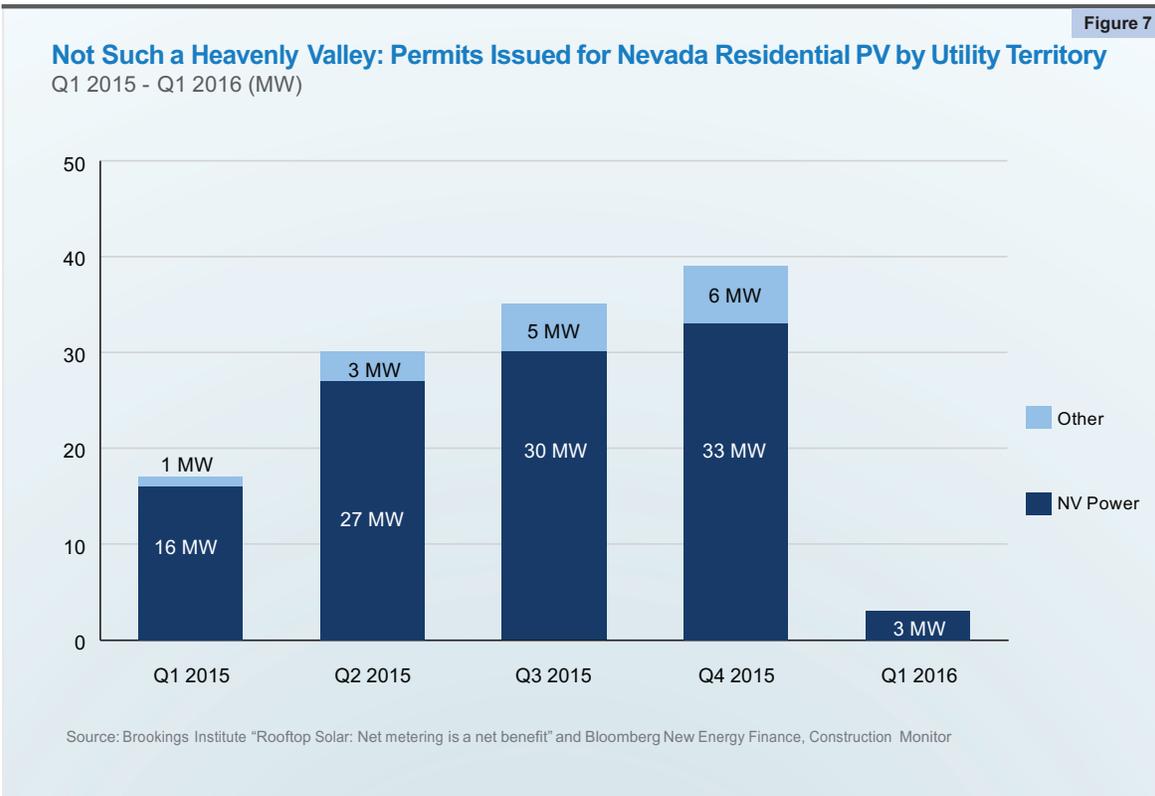
Net metering policy is one of the critical components of residential solar economics. It is a common regulatory policy in which residential solar customers are reimbursed by the utility on a \$/kWh basis for the electricity their solar panels generate that isn't immediately used by the home. Net metering has been credited with enabling the nascent distributed solar market to emerge by offering a simple-to-understand compensation mechanism to consumers.³⁸ The policy has also been contentious in some states, especially where utilities admonish the program as an alleged subsidy for rooftop solar providers.³⁹ In fact, state specific net metering battles have dominated solar news publications and taken a major toll on solar jobs, growth and investment over the last year. In Nevada, for example, the state regulator eliminated net metering for both new and existing customers in December 2015. The controversial decision caused SolarCity, Sunrun, Vivint and other

solar developers to suspend their operations in the state. This decision cost over 700 solar installers their jobs and removed the majority of Nevada's solar growth – see below.^{40,41,42}

Utilities have a simple motivation for decrying net metering: it reduces their revenue. Utilities argue that in the process of doing so, net metering shifts costs from solar customers to nonsolar customers by reducing the payments coming from solar customers to cover the costs of the grid. This theoretical shift would subsequently result in higher utility bills for nonsolar customers. Yet the truth of the matter is more complicated. First, the assertion that net metering results in a cost shift to nonsolar customers has been heavily disputed by a number of studies. Indeed, a recent report by the nonpartisan Brookings Institute analyzing the major cost effectiveness studies to date found that net metering provides a net benefit to ratepayers. The paper finds that: “In short, while the conclusions vary, a significant body of cost-benefit research conducted by PUCs, consultants, and research organizations provides substantial evidence that net metering is more often than not a net benefit to the grid and all ratepayers.”⁴³ Second, utilities are financially disincentivized from supporting customer-owned distributed energy resources (DERs) that reduce their system operating costs. The traditional

“cost-of-service” utility business model relies on profits from capital investments to infrastructure – new substations, transformer upgrades, centralized generation (depending on the regulatory regime) and the like. Some have argued that utilities which do not provide centralized generation under a “decoupled” regime are not in competition with DERs like rooftop solar.⁴⁴ Counter to this point, recent utility transmission plans have shown that the grid-benefiting attributes of DERs decrease the need for upgrades and therefore decrease utility revenue streams, even in decoupled scenarios.⁴⁵ Utilities cannot be faulted for seeking to avoid slowing revenue growth – they are simply operating within the constraints of an outdated regulatory paradigm – but their incentives must be kept in mind when considering their position on net metering and other grid innovations.

Despite the findings of the Brookings institute in support of net metering, the dispute is far from settled. The debate in Nevada rages on, and as of the end of 2015 more than half of U.S. states were studying or considering changes to their net metering policies.⁴⁶ Nevada aside, there were some recent big successes for the solar industry – the net metering decisions in California, Colorado, Massachusetts, and Arizona, which together accounted for



67 percent of the new U.S. solar capacity installed last year, were widely hailed as a victory for solar.^{47,48} Yet the fact that these battles are hard fought and can potentially occur on 50 separate stages is enormously expensive to society in terms of legal costs, court costs and the opportunity costs of lost solar installations.

Beyond DER Drama: Best Practices from the White House

We see a role for the next administration to encourage thoughtful progress related to distributed solar policies at the state level, including net metering. In particular, we recommend that the federal government work with the Federal Energy Regulatory Commission (FERC) and the DOE to create a **DER cost-benefit framework and supporting playbook** that lists best practices for quantifying DER cost-benefit categories. State regulators could then turn to the framework and playbook when net metering battles inevitably reach their doorstep, and even mitigate exacerbated and costly conflict by foreseeing those battles and initiating proceedings proactively. Additionally, the DOE and FERC could augment the playbook with a **quantitative public tool** that allows third parties to run their own cost-benefit analyses in order to comment on regulatory proceedings. The data generated

from these analyses could be pooled to create a national database useful for predicting the ramifications of state policy changes. Moreover, as technologies change and analytical methodologies improve, the cost-benefit framework and best practices playbook should be updated. The most near-term example of this is the arrival of “solar + storage” on residential rooftops, which will impact net metering and other utility policies significantly. The framework will need to be adjusted to account for the increasing value of excess solar energy once it can be stored and used flexibly. The DOE and FERC should **convene conferences to seek industry feedback** both at the point of creation and when updating these tools to build consensus and prevent future disagreement at state level proceedings. To do so will require an impartial government agency host, broadly respected voices on energy, and attendance from all of the relevant parties – utilities, renewable energy representatives, public utilities commissioners, environmentalists and consumer advocate groups. It will undoubtedly be difficult to build consensus among such a group. Yet, if the next presidential administration is successful in doing so, it will have removed one of the largest remaining barriers to the clean energy revolution and laid the foundation for a presidency full of clean energy collaborations rather than conflicts.

Aligning with the Future – Grid Reform Models



The misalignment of utility incentives under the current regulatory paradigm will be a barrier to customer choice and DERs until the model is changed. Fortunately, several states are already considering major changes to their regulatory paradigms. We suggest the next president direct the DOE to partner with FERC in analyzing the potential of several of the new models under consideration, and use the results of these analyses to weigh in on ongoing proceedings at the state level.

The CA DRP Model: California’s proposal for reforming the grid seeks to incentivize utility investment into DERs, but does so within the traditional “cost-of-service” utility model. Similar to IDSO, CA utilities would own the grid infrastructure. However, under the CA model the utilities would also still be responsible for planning and procurement of resources. The innovation of the CA Distributed Resources Plan (DRP) proceeding is that it expands the generation technologies under which CA utilities can earn a return on investment. As it stands, when CA utilities make such a choice they receive no return – the expense of DER energy is simply passed through to ratepayers at cost. Under the DRP proceeding, California regulators have proposed to allow utilities a return on investment when they choose to procure energy from DERs rather than centralized generation. With California’s high penetration of renewables, this proceeding takes on considerable significance and will provide valuable insight to regulators in growing solar markets.

The IDSO Model: In the late 1990s, FERC encouraged the voluntary formation of Independent System Operators and Regional Transmission Organizations to manage the country’s long-distance electrical transmission infrastructure in a manner fair and objective to the ratepayer. This was done to avoid the misalignment of incentives between ratepayers and transmission system owners who might be

tempted to operate the grid in a manner that benefited their affiliated power businesses on the electrical generation side of the grid. The IDSO model proposes establishing the same set of independent operators at the distribution level. While utilities would continue to own the distribution system, the planning and operations would be managed by an independent organization. IDSOs would select generation sources on a competitive basis, evaluating DERs and traditional generation sources for the benefit of the grid. If DERs like solar and storage ultimately proved to be more competitive in the IDSO framework, there would be no barrier or disincentive for utilities to invest in them.

The NY REV Model: Under the New York REV (Reforming the Energy Vision) proceeding, the state intends for its utilities to become “distributed system platform providers”. The key to NY REV is that it seeks to incentivize utility investment in DERs by expanding the platforms under which utilities can earn revenue. As noted above, the cost-of-service model requires utilities to forecast revenue requirements, make investments in grid infrastructure, and then recoup their investment via regulator-approved rates. In May, the New York Public Service Commission voted to allow utilities to earn revenue for the use of customer PV, demand management, and energy efficiency measures. Additionally, utilities will be allowed to earn revenue on provision of grid services to DER providers, such as interconnection or financing facilitation. Rather than simply earn a return on identifying costs for upgrades and purchasing them, utilities under NY REV would earn a return on identifying costs and avoiding them (while still providing safe, reliable service). While nascent, this NY REV model bears watching as its early results will surely offer useful lessons for other states.

SUPERCHARGING OUR FUTURE – INVESTMENT POLICIES THAT BUILD AN ONRAMP TO OUR CLEAN ENERGY ECONOMY

Investment in cleantech has been accelerating at a remarkable pace. Investors poured a record \$329 billion into global clean energy last year.⁴⁹ Still, in the wake of the landmark agreements reached in Paris at COP 21, the worldwide conversation has turned to the renewable energy “investment gap.” Estimates put the investment in clean energy needed to achieve the goal of limiting global temperature rise to 2 degrees Celsius at between \$12 and \$13 trillion over the next 25 years.⁵⁰ This is approximately \$5 trillion above current projections. Fortunately, there are many opportunities within the U.S. to start closing this gap. National rates of electric vehicle adoption highlight one such opportunity and the potential for increased investment to realize others. In Norway, where average exemptions on aggressive taxes for carbon-fueled cars equated to over \$23k per car in 2014 U.S. dollars, plug-in EVs represented over 22 percent of Norwegian auto sales in 2015.⁵¹ The United States has a long way to go by comparison – with the U.S. federal incentive capped at \$7,500, EVs make up just under 1 percent of American auto sales.^{52,53,54} Consumers in the U.S. and worldwide will not make the switch to clean energy unless increased investment makes it economical to do so. Despite our slower adoption rates, the 373,000 pre-orders for the less expensive Tesla Model 3 in the weeks after its debut provide a clear illustration of U.S. customers’ price sensitivity⁵⁵ when considering an electric vehicle. Without significant venture, equity and debt investments, moving down the cost curve would have been prohibitive for Tesla or any other EV manufacturer. To both proliferate the spread of clean technology and broaden its political support, the next president of the United States must seek to increase cleantech investment wherever possible. Here we present several areas in which the president can directly affect levels of investment through policy change.

Investing in the Energy Amazons of Tomorrow: Data Access is Key

Imagine if Uber was not able to access your locational data through your phone. The drivers would have to call you individually, get your address, plug it into Google Maps themselves, and then drive to find you. There would be missed calls, misheard addresses, and ultimately an inefficient app that created unsafe driving conditions. Imagine if Amazon, not the consumer, chose the seller of any product searched for on its site. Moreover, imagine if Amazon only displayed the sellers it had chosen and never revealed the options it had to choose from or the criteria of its decision. Shopping at Amazon would ultimately offer no advantage over visiting a manufacturer’s

website directly. Amazon would today not be a household name, and consumers would have missed out on the ability to weigh price and quality to source their own goods. Yet this is the landscape we face in the energy sector – the public, and therefore entrepreneurs, do not have access to grid data that is absolutely critical for improving the efficiency of electricity transmission and distribution. Without democratizing access to data we can’t create the Ubers, Amazons or Googles of our future energy industry.

In addition to limiting the ability of entrepreneurs to create new solutions to the problems of an aging utility business model, lack of access to data interferes with the adoption of existing renewable energy. For example, there is a direct cost to renewable energy developers resulting from lack of ability to determine the costs of interconnection. Without reliable estimates of interconnection costs, developers have trouble forecasting project profitability. As a result, investors ascribe to their funds an increased level of risk and therefore cost of capital.⁵⁶ Second, lack of access to models and cost assumptions used in avoided cost calculations* and long-term planning prevents public stakeholders from debating utility decision-making with regards to renewable energy. This limits collaboration and leads to combative decision-making like that seen in Nevada over net metering, which cost over 700 jobs, a steep decline in solar equity values, and an undoubtedly high sum in legal costs borne by ratepayers.

Green Button II: Getting to Grid Neutrality

The federal government can ameliorate these barriers to investment through the extension of a past successful initiative. The White House took a major step toward data standardization and transparency with the Green Button Initiative in 2012. This measure allows utility customers to easily download their usage data for purposes of energy efficiency and management. In many states there are ongoing debates in public utility commissions to make the aforementioned data and investment decision-making frameworks open to the public.⁵⁷ The federal government could launch a **Green Button Phase II** initiative to standardize methods and set a floor for data sharing. In California utilities are proposing rollouts of data sharing apps but have been slower to cooperate with one another or third parties on what the final format of the data will be.⁵⁸ **Green Button Phase II** should be launched ASAP by convening all stakeholders, including data experts like Amazon, Google, Uber and Microsoft, to advise state regulators and encourage utilities to create

* Avoided Cost is calculated as the marginal cost of energy production and delivery. When utilities choose to procure energy from nontraditional sources, such as DERs, they are literally avoiding the cost of incremental energy generation. Hence, regulators often employ an avoided

cost methodology in determining how much DERs and other alternative sources of energy should be paid by the utilities.

data products that can easily be blended into regional or nationwide data sets. Otherwise, disparate data sets will create an enormous challenge for economists, utilities, policymakers and entrepreneurs interested in improving the function of the grid.

Improving on Successful Policies: Updating the Investment and Production Tax Credits

The Solar Investment Tax Credit (ITC) and Wind Production Tax Credit (PTC) have been vital to the growth of the solar and wind industries in the U.S. According to the American Wind Energy Association, the PTC “has helped more than quadruple wind power in the U.S. since 2008.”⁵⁹ Similarly, the Solar Energy Industries Association reports that solar capacity has increased 8,300 percent since 2008, when solar tax credits received a longterm extension.⁶⁰ When the most recent ITC extension was passed in late 2015, Greentech Media’s forecast for solar growth in the following five years increased 54 percent.⁶¹ Before the PTC expires in 2020 and the ITC follows suit in 2022, America’s next president should build on their success by expanding the rapid growth we’ve seen in solar and wind to other technologies. Additionally, the ITC and PTC both suffer from a major shortcoming that should be addressed. Their structure has created a limited pool of investors, giving undue strength to suppliers of tax-equity investment. Consequently, solar developers often face a challenging 10 percent or higher cost of capital from tax equity investors.⁶² The federal government could make a number of changes to alleviate this problem.

Share the Love: Expanding the ITC to include Storage

The first and most obvious technology to begin incorporating into the ITC is energy storage. Though energy storage currently qualifies for the ITC if installed with solar PV or wind, the requirements for qualification are complicated and create uncertainty for investors. They include a provision that 75 percent of a storage property’s energy consumption must come from the renewable energy source they are installed with in order for the storage investment to receive the most recent ITC. If the property falls below the 75 percent threshold for even one year of the five-year ITC compliance period, the tax credit becomes subject to claw back by the IRS. If the property meets the 75 percent requirement, the amount of ITC received is pro-rated to the percentage of energy stored from the associated renewable generation between 75 and 100 percent. Inherent variation in the annual generation from weather-dependent renewables therefore creates uncertainty in the amount of storage ITC received under the current policy. Bipartisan legislation to create a more straightforward storage ITC was recently re-introduced in both the House (H.R. 5350) and Senate (S. 3159), and U.S. Representatives Chris Collins (R-NY) and Mark Takano (D-CA) launched an Energy Storage Caucus in late 2015. Initially, the next president should **call on Congress to work the storage ITC legislation through to passage and publicly endorse the Energy Storage Caucus**. Once this legislation is passed the federal government should direct the DOE to examine other capital-intensive renewable technologies and determine their suitability for inclusion under the expanded ITC.

Get Active or Experience a Passive Loss: Democratizing the Tax Equity Pool

Addressing the limited pool of PTC and ITC tax equity investors and attendant high costs of monetization should also be a priority for the next administration. Part of the issue is the difficulty for every day citizens and smaller businesses to take advantage of the tax credits. They



are nonrefundable tax credits, so investors in renewable energy projects can only take advantage of the ITC or PTC up to the amount of their existing tax burden. The existing statutes somewhat alleviate this problem by allowing the credits to be carried forward to future tax burdens, but the credits do not appreciate to account for the lost time value of money. In order to make the ITC and PTC easier to monetize and hence available for investment by the general public, the federal government could change the credits from nonrefundable to refundable or allow the credits to accrue interest at the going federal funds rate.

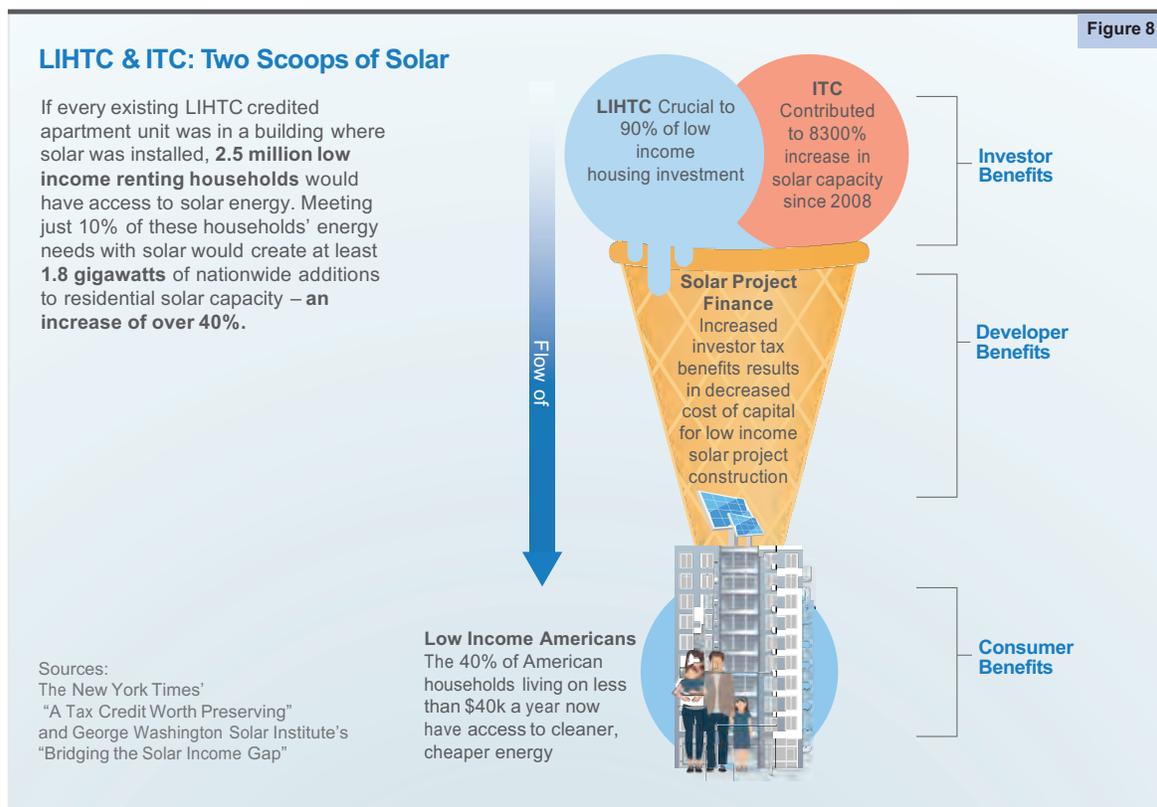
Another change that would help address the limited pool of tax equity investors would be to allow individual investors and closely held corporations to more efficiently claim these tax credits by changing the passive loss and at-risk rules as they apply to renewable investments. Currently, individual investors and closely held corporations are typically prevented from efficiently investing as tax equity partners because the tax benefits are limited by passive loss rules. These rules prevent tax credits and deductions from offsetting most forms of taxable income. The at-risk rules that limit tax credits proportionally based on the amount of investment are another barrier to smaller investors. Relaxing these rules as they apply to renewables could significantly expand the available investor pool. While this rule change would be significant, it is not totally unprecedented. A more limited special exemption to the passive loss limitation already exists for the federal Low Income Housing Tax Credit (LIHTC) program, and has contributed to the program’s success described below. Enacting any of these changes would open renewable energy finance to a more diverse pool of investors, enable novel financing solutions, and drive down the overall cost of projects.

Two Scoops of Solar: ITC meets LIHTC

Low income communities represent one of the biggest untapped opportunities for both renewable energy investors seeking a green return and policymakers seeking to evenly distribute the benefits of renewable energy. As noted earlier, one of the biggest hurdles to solar adoption among low income citizens is that many do not own their own homes and are hence prohibited from making investments in renewable energy. The existing problem can be addressed by the expansion of community solar programs and funding for deferred maintenance, as we advocate above. The federal government also has a tremendous opportunity to prevent this problem for future low income housing developments by incentivizing housing developers and the banks that fund them to go solar from the beginning. The Low Income Housing Tax Credit (LIHTC) has much in common with the Solar ITC. Both are a dollar for dollar, nonrefundable credit against investors' tax appetites, and both include a clawback period during which the infrastructure funded by the credit must remain operational for the credit to be retained. LIHTC was instituted to counteract the diaspora of investors out of rental housing as a result of the Tax Reform Act of 1986. Since a decrease in the creation of new rental housing would have disproportionately affected the low and middle income population, Congress passed LIHTC to incentivize investors with a sizable tax credit for costs incurred in low income housing development. In addition to the tax credit value, LIHTC investments count toward banks' requirements to provide low income communities with credit and lending opportunities under the Community Reinvestment Act. The program

has been so successful that nearly 90 percent of low income rental property investments now incorporate a LIHTC credit.⁶³

While the ITC has proven highly effective at spurring solar development, it could be made more effective for low income customers if paired with the LIHTC program. The White House should work with state housing finance agencies to **ensure that solar projects built on LIHTC-eligible developments are eligible for both the ITC and full LIHTC tax credit.** In this manner, banks that would normally invest in solar projects to monetize the ITC could also take advantage of the LIHTC tax credits, and in doing so gain points on their Community Reinvestment Act (CRA) exams. In a mature market, the addition of LIHTC credits would enable solar developers to achieve a lower cost of capital from the banks providing tax equity investment. LIHTC tax credits captured by the investors and the resultant lower cost of capital realized by developers would ultimately be passed on to the consumers in the form of lower rent. LIHTC laws require that maximum rent is set based upon the Area Median Income (AMI). In order to qualify for the LIHTC credit on solar, the new standard could lower the maximum rent in proportion to the credit received. 50 percent of the LIHTC credit could be shared among each of the units and spread over the length of the 15 year LIHTC clawback period, thereby creating longterm savings for low income renters. Meanwhile, developers would have a much stronger incentive to include solar on their low income rental properties and banks would open up more CRA-eligible funds to address this market – See Figure 8 below.





The Carbonless Gains Tax

Demand for sustainable investment options is growing. The UN-supported Principles for Responsible Investing Initiative network grew to 1,380 signatories with \$59 trillion in assets under management by the end of 2015.⁶⁴ A 2015 Morgan Stanley survey found that the portion of assets considered sustainable under professional management was up 50 percent from 2012 to 2014.⁶⁵ At DBL Partners, we are firsthand witnesses and beneficiaries of investor appetite for social good, but we want to see DBLs proliferate all over the country. One of the ways the next president can create more DBLs and continue fueling the cleantech investment trend is through creation of the **Carbonless Gains Tax**.

The Capital Gains Tax qualified dividends provision allows investors some relief from taxation. Most regular dividends from U.S. corporations fall under the qualified dividend distinction and as such are taxed at a maximum of 15 percent (for anyone other than those in the highest tax bracket) rather than the ordinary income tax rate. The next president should work with Congress and the IRS on expanding qualified dividend policy to further incentivize investment in green company equities. Under a **Carbonless Gains Tax** policy, dividends would be taxed at a lower rate than the current qualified tax regime. Doing so would effectively increase after-tax dividend yields to investors. Therefore, corporate managers of green companies could

allocate considerably less of their annual earnings *on a pre-tax basis* to dividend payouts and still achieve the same *after-tax* dividend yield to investors. For example, a company that pays out \$100 in dividends to investors who are taxed at a 15 percent rate and one that pays out \$97.70 to investors taxed at 13 percent are both providing investors with \$85 after tax, but the second company now has an extra \$2.30 to invest. To qualify for the green dividend program under a **Carbonless Gains Tax**, the IRS would require corporations to submit an application demonstrating a plan for use of the savings achieved toward qualified green product development, emissions-reducing activities or other corporate sustainability goals.

Alternatively, the administration could focus its efforts on the capital gains tax realized at the point of sale. Currently, the capital gains tax is structured to incentivize investors to hold stocks for a longer duration by taxing the gain on sale of equities held for one year or longer at a lower rate than those sold less than a year after purchase. While short-term gains are taxed at an individual's ordinary income tax rate, long-term capital gains are taxed at 15 percent for single filers with incomes less than \$415k. Similarly, the government could incentivize investment in companies that qualify for **Carbonless Gains Tax** status by making their long-term capital gains rate lower than current rates.* This would serve to increase investor demand for green equities and therefore incentivize companies to make investments to qualify for Carbonless Gains Tax status.

* Empirical studies conducted by the National Bureau of Economic Research in the wake of the Tax Payer Relief Act of 1997, which lowered the top capital gains tax rate from 28% to 20%, showed that investors reacted quickly and materially to changes in the capital gains rate. Since

the resultant changes to equity prices are somewhat unpredictable, policymakers should consider implementing the Carbonless Gains Tax incrementally to gauge market response.

EDUCATING THE NEXT GENERATION OF CLEANTECH ENTREPRENEURS – FOSTERING NATIONWIDE ENERGY LITERACY

The next president will lead a nation increasingly interested in the impact of its energy choices. The majority of millennials favor protection of the environment, even at the risk of the economy.⁶⁶ The next president will have the opportunity to teach young people that they need not choose one or the other but can instead choose both. She or he can give this hopeful new generation the tools to change the economy and the environment for the better. Though we recommend an approach targeted to future generations, the next presidential administration should also launch a nationwide energy literacy campaign to foster broad, cross-generational interest in confronting the challenge of a sustainable energy landscape.

The DOE defines energy literacy as “an understanding of the nature and role of energy in the world and daily lives accompanied by the ability to apply this understanding to answer questions and solve problems.”⁶⁷ Recent studies show American energy literacy to be fairly low, with significant numbers of survey respondents unable to correctly provide an example of a fossil fuel or renewable energy source.⁶⁸ When Americans are uncertain of the climate impacts of wind energy versus natural gas, they cannot be expected to make informed choices about energy at the polls. Recognizing the opportunity to provide decision-making tools, the Department of Energy made great strides in energy literacy as part of its 2011 strategic plan. The Energy Literacy Initiative and the Energy 101 educational framework that grew out of it laid a strong foundation for spreading energy awareness among Americans. Now is the time to build upon these efforts and embed energy as a topic in the national conversation. The next administration should employ a three-pronged approach in pursuit of this goal.

Prong 1 – The Power of Celebrity: The DOE should work with celebrities, from both inside the energy industry and out, to create a modern media awareness campaign. President Obama, for example, was tremendously successful in reaching young people to explain the benefits of the Affordable Care Act by making a guest appearance on Zach Galifianakis’s internet series “Between Two Ferns”. Within a day of the feature posting, traffic on the Affordable Care enrollment website shot up 40 percent.⁶⁹ The DOE could replicate this success by tapping into modern media sources and seeking to create viral content. By tying its content to finite audience behavior goals, like website visits or purchases of a particular energy savings device, the DOE would be able to generate measurable results and refine its campaign accordingly. Using public figures with both technical expertise and celebrity status, such as Richard Branson, Elon Musk or Bill Gates would unite credibility with entertainment. Relaunching a Bill Nye the Science Guy miniseries with a focus on energy would play well with nostalgic millennials. Short, educational energy public service announcements featuring such environmentally conscious celebrities as Leonardo

DiCaprio, Rachel McAdams, Mark Ruffalo or Scarlett Johansen could be very effective in capturing the attention of celebrity-obsessed Americans if broadcast across the right medium.

Prong 2 – Raise them Ready: The Energy 101 class was a good start, but it can be reimagined to be more effective. The current iteration is a guidebook and course framework that has been designed for a collegiate level course. The **DOE should be more ambitious with an energy curriculum – it could be aimed at a larger, younger audience.** A joint program of the Department of Energy and the Department of Education would offer the most logical and comprehensive approach. There are excellent (but disparate) existing programs being managed by various private, nonprofit, and state organizations. However, none match the strength and effectiveness that a federal agency based initiative would bring to K-12 energy education. The initiative should establish a clear, nonpartisan agenda that draws on the latest science and economics available to provide stakeholders (educators, administrators and parents) a gateway to vetted resources for educating our nation’s future innovators, policymakers and investors.

Additionally, we recommend the White House direct the DOE to work with the College Board to **create an Advanced Placement (AP) exam designed specifically for energy.** It should seek to create an objective, holistic understanding of the electrical grid’s past, present, and future while helping students evaluate the merits of various energy sources through the latest and most comprehensive cost-benefit analyses. The course should also use the momentum behind increasing cultural desire to understand the environmental implications of consumer decisions to fully engage students in critical thinking. For example, the high growth rate in demand for organic agricultural goods presents an opportunity to make a meaningful connection between students’ food consumption habits and their energy use.^{70,71} Consumption-conscious students will feel an increased connection to the energy curriculum when presented with facts like “In 2014, greenhouse gas emissions from agriculture accounted for approximately 9 percent of total U.S. greenhouse gas emissions”⁷² and “The U.S. agriculture industry used nearly 800 trillion British thermal units (Btu) of energy in 2012, or about as much primary energy as the entire state of Utah.”⁷³ In further support of such a program, a recent Gallup Poll found a strong inverse relationship between age and prioritization of the environment – 60 percent of 18-29 year old respondents favored protection of the environment at the risk of curbing economic growth compared to only 39 percent of those over 65.⁷⁴ Not surprisingly, AP Environmental Science is one of the fastest growing Advanced Placement courses in popularity.⁷⁵ By reaching teenage students on the cusp of voting age, the administration will be helping the next generation of voters make more informed decisions about energy.

Want to Fix the Climate? Start by Fixing our Food Chain



Climate Relevance

Globally, agricultural production is responsible for nearly 30% of all human-caused greenhouse gas emissions.¹ Moreover, agriculture accounts for approximately 80% of US consumptive water use.

Ongoing Changes

Agriculture is becoming increasingly data driven on the **supply side**. Young “agtech” companies like the Farmers Business Network are helping all farmers aggregate and share their data. Others use drones and satellite imagery to monitor soil and crop health, and moderate irrigation levels. All this innovation equates to a more level playing field for all farmers and more efficient use of resources. On the **demand side**, US organic food sales have shown double digit annual growth rates almost every year since the 1990s, and approached \$37Bn in 2015.² Entrepreneurs are meeting this growth with increasingly advanced solutions to drive down the cost of an organic lifestyle. One such company, Juicero, has pioneered a home, office, and retail-based cold-press juicing machine that minimizes produce waste by using cloud computing to track the freshness of the juice ingredients.

How the Next President Can Address Climate Change, Stimulate Agtech, and Help Meet Organic Demand

1. Align agricultural subsidies with the government’s recommendations for nutritional health. A recently published study in the Journal of American Medicine found a 37% greater risk of obesity in adults who consumed high level of federally subsidized foods compared to those at lower levels.³ Moreover, the large carbon footprint of meat production relative to most crops has been well-documented and many experts call for a more balanced agricultural approach to developing animal and plant-based protein. By realigning subsidies with health cost-benefit analysis, the next president can promote both a healthier America and a healthier climate.

2. Incorporate cost of natural resources into subsidy allocations.

When determining the size of crop-specific subsidies, consider the water and carbon intensity of each crop. Netting out such costs from subsidies will reduce incentives to plant environmentally demanding crops, and level the playing field for farmers interested in planting sustainably.

Sources:

- 1 - Gilbert, Natasha. “One-third of our greenhouse gas emissions come from agriculture”. Nature News
- 2 - Greene, Catherine. “Consumer Demand Bolstering Organic Production and Markets in the U.S”. USDA Blog
- 3 - O’Connor, Anahad. “How the Government Supports Your Junk Food Habit”. New York Times

Prong 3 – Put-Solar-On-It 50 States Challenge: Anyone familiar with the informal competition among state governors for one another’s workforce understands how intense interstate government rivalry can be.⁷⁶ The “solarize” model has been tremendously successful at harnessing the same spirit of competition among residential solar installers in states like Connecticut, where it helped the number of solar installations in 2013-2014 eclipse that of the previous eight years combined (see Figure 9).⁷⁷ Solarize relies upon municipal governments and local relationships to create demand for residential solar, while initiating a competition among local installers to offer the lowest viable \$/watt installation cost in order to have exclusive rights to supply the town’s solarize campaign. The White House should harness this energy by directing the DOE to **announce a National Solarize Contest among the states**. To further incentivize participation, the DOE should offer awards to the states in funding

proportional to how much growth each state’s solarize program drove in residential solar adoption per capita. These awards would be earmarked for renewable energy generation, storage, energy efficiency or electric vehicles, thereby creating a pool of funding within each state to continue driving growth beyond the solarize contest. Using the National Renewable Energy Labs (NREL) Solarize Guidebook as a foundation, the DOE could initiate the contest by holding a conference for municipal and state leaders interested in creating solarize programs in their own towns. For those who commit to participating in the national contest, the DOE could then work with NREL to offer a follow-up training session to prepare participating municipalities for the administrative responsibilities of a contest. Standouts on the high school AP Energy tests could even be offered a small stipend to intern as aides to the municipal leaders running the Solarize programs.

The Energy Bill of Rights: Solarize Comes to the Constitution State

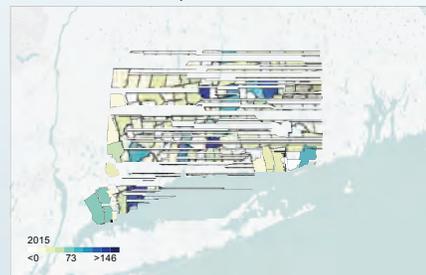
Figure 9

Number of cumulative residential solar installations in Connecticut, segmented by town.⁷⁸ Annual installations increased nearly 500 percent between 2012 and 2015.⁷⁹

BEFORE SOLARIZE, 2012



AFTER SOLARIZE, 2015



Sources: TrendCT and the Connecticut Green Bank “It’s Always Sunny in Connecticut”

CONCLUSION

Whoever is sworn in on the 20th of January 2017 will have a mammoth task ahead of her or him. While the world rejoiced upon hearing the news of the Paris Climate Accords, the agreement means little without action. Without action, global temperature increases will exceed 2 degrees Celsius within the century. Without action, sea levels will rise, weather patterns will change, and climate refugees will flood national borders. The next president will have an opportunity like no other. The world will look to the United States for leadership on meeting the challenge of climate change with solutions that build innovation, jobs and economic growth.

With energy-related emissions accounting for 80 percent of U.S. greenhouse gas emissions, the energy industry should be the primary target for a president seeking to reduce our climate impact. Moreover, public interest is on the rise as our youngest generations are increasingly concerned about the environmental ramifications of their energy sources.⁸⁰ Fortunately, solar and wind technology is increasingly cost competitive with conventional generation⁸¹ and

the renewable energy industry is now a significant economic engine running on the fuel of solar job creation.⁸² The energy industry that we have lived with for over 100 years is on the precipice of transformation – the next president just needs to give it an intelligent push.

Nationwide consumer demand, investment and energy literacy – each is entirely critical to the existence of the others. Without energy literacy, consumers will not have the understanding or the interest to adopt new technologies. Without consumer demand, investors will see no potential for returns on cleantech investment. Without investment, prices will remain high, demand will remain low, and interest in energy literacy will wane as new clean technology becomes slower to market. Yet by balancing demand, investment, and energy literacy the next president can realize this moment's potential and empower America to become the leader the world needs it to be – our 21st century clean energy nation.

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SETTING THE CLIMATE AGENDA FOR THE NEXT PRESIDENT

Toward a More Effective Federal Clean Energy Toolkit

Author

Dan Reicher is the Executive Director of the Steyer-Taylor Center for Energy Policy and Finance at Stanford University.

Contact

Steyer-Taylor Center for Energy Policy and Finance

Stanford University

559 Nathan Abbott Way

Stanford, CA 94305

<https://law.stanford.edu/steyer-taylor-center-for-energy-policy-and-finance/>

dreicher@stanford.edu

Abstract

The climate crisis requires a multifaceted response involving low-cost, low-carbon energy technologies, smart and aggressive public policies, and cheap and abundant financing. But today's policy and finance tools are not up to the task of getting key energy technologies developed and deployed – rapidly, cost effectively and at scale. The next president will need to take a thorough inventory of the tools in the federal clean energy toolkit and the proposed new ones. The toolkit is a messy one – and in need of a major upgrade. It was assembled in a haphazard manner often based more on political expediency than long-term cost-effective impact. It lacks analysis about how each tool relates to the others, what new tools are needed and how they all might be better integrated, and ultimately more effective, in addressing climate change.

This paper briefly analyzes federal clean energy policy and finance tools. It first looks at an array of federal clean energy incentives related private sources of capital and the “big three” clean energy standards. It highlights two critical enabling technologies for renewable electricity – transmission and storage – and then provides a brief case study of federal incentives and standards for carbon capture and storage (CCS). Finally, it discusses the next president's not-so-secret weapon – the federal government's own energy footprint and related authorities and resources.

Current federal clean energy incentives, like grants, loan guarantees and tax credits, need to be tuned up while we also extend federally authorized tax-advantaged investment vehicles like master limited partnerships (MLPs) and real estate investment trusts (REITs) to renewables, efficiency, storage and beyond. Government support is essential, but the big money for clean energy – tens of trillions of dollars globally over the next few decades – will have to come from the private sector, particularly major long-term investors like pension funds, insurance companies, sovereign wealth funds, endowments and more. The next administration needs to build aggressively on work to date to help attract these investors to the clean energy table.

Beyond public and private capital, the big three clean energy standards – Environmental Protection Agency (EPA)'s Clean Power Plan (CPP), Corporate Average Fuel Economy (CAFE) rules for cars and light trucks, and the Department of Energy (DOE) efficiency standards for appliances and equipment – are key to progress on climate change. Each faces important opportunities – and challenges. At the same time, the two essential support mechanisms for renewable energy, transmission and storage, must address a host of issues from siting and cost allocation problems in building new power lines to the high cost of batteries and other electricity storage technologies.

One of the messiest parts of the federal clean energy tool kit involves CCS – a key technology for addressing carbon emissions from both the power and industrial sectors and critical to meeting the global 2 degree Centigrade climate target, according to the UN International Panel on Climate Change and the International Energy Agency. From grants, loan guarantees and tax credits to MLPs, Private Activity Bonds, price stabilization contracts and federal carbon emission standards, the federal approach to CCS – current and proposed – needs a major upgrade if we are going to get this climate technology deployed at large scale, and soon.

Finally, the U.S. government is the single largest energy user in the nation; it owns more than a quarter of all U.S. land, tens of thousands of miles of transmission lines, 400,000 nontactical vehicles and 350,000 buildings, and it has developed, hosted and purchased more renewable energy than any other single entity in the United States. As “CEO” of “USA Clean Energy Inc.,” the new president can do much to advance clean energy: demonstration and validation of new energy technologies at federal facilities, improved government procurement of renewable energy, expanded financing of federal facility efficiency retrofits, more effective federal permitting of clean energy projects, increased federal siting and financing of transmission lines and several other opportunities.

Introduction

The next president will have an unprecedented challenge – and opportunity – in addressing climate change. Climate science is increasingly well-established, and many of the initial steps, if not all the details, that the U.S. will need to take to do its part in addressing the climate crisis have been defined in the Paris Agreement, EPA’s Clean Power Plan (CCP), federal fuel economy and efficiency standards, state requirements and beyond.

The opportunity to do good – and do well – in deploying clean energy in the United States and globally is vast. There are a number of differing estimates, but in rough terms global clean energy deployment will require tens of trillions of dollars of investment over the next several decades in order to have a reasonable likelihood of staying within the 2 degree Centigrade rise that scientists tell us will be required to avoid the worst effects of climate change.

A key challenge is achieving this kind of investment, largely from the private sector, at a time when annual global investment in clean energy is measured in the billions not trillions of dollars and global energy use grows. The good news is that the new president will have a host of tools to help drive this kind of spending and meet our climate imperative: cutting carbon emissions deeply, rapidly and cost effectively. In the energy sphere, the largest source of U.S. and global emissions, these tools are

- **Technology:** energy efficiency and renewable energy; nuclear power and natural gas; carbon capture and storage (CCS) for an array of power and industrial emitters; storage and transmission; fuel-efficient vehicles; low-carbon industrial operations and more
- **Policy:** at the international, national, state and local levels, building on government standards, incentives, procurement and beyond
- **Finance:** from early-stage venture capital to technology commercialization investments to project finance

These tools will be brought to bear in different ways along the three steps of the clean energy pathway: innovation, commercialization and deployment.

The next president will need to take a thorough inventory of all the current tools in the toolbox and the many proposed new ones. The toolbox today is a messy one. It was assembled in a haphazard manner often based more on political expediency than long-term cost-effective impact. It lacks adequate analysis about how each tool relates to the others, what new ones make sense, and how they all might be better integrated and ultimately more effective.

This paper takes a brief look at an array of federal clean energy incentives, private sources of capital, and the big three clean energy standards. It highlights two critical enabling technologies for renewable electricity – transmission and storage – and then provides a brief case study of federal incentives and standards for CCS. Finally, it discusses the next president’s not-so-secret weapon – the federal government’s own energy footprint and related resources and authorities.

1. Federal Incentives for Clean Energy

The federal government plays an important role in moving energy technologies from initial ideas to full-scale cost-competitive reality, from civilian nuclear power in the 1950s to advanced energy storage technologies today. There are an array of federal incentives, some involving direct federal spending and others built on indirect expenditures through the federal tax code. Each mechanism has a number of current issues, and there are broader questions about their interrelationships.

a. Federal Energy Research and Development (R&D) Funding

U.S. federal energy R&D funding, largely from the Department of Energy (DOE), supports work at universities, government labs and in the private sector across the full range of energy technologies. The new president’s biggest R&D imperative will be to meet the commitment made by President Obama at the December 2015 Paris climate talks to double U.S. energy R&D funding from \$6.4 billion in 2016 to \$12.8 billion by 2021. This is part of the Mission Innovation partnership, under which 20 nations announced their intent to double public clean energy R&D spending over the next five years. This kind of growth is a heavy lift in a Congress where even maintaining level funding has been a challenge. There are, however, some funding bright spots, such as ARPA-e, which has enjoyed strong bipartisan support since its launch in 2007. Overall, R&D has been the least controversial form of government support for clean energy. Congressional debate over federal funding tends to increase the closer to market the particular government incentive.

b. Federal Grants

Federal grants have been the workhorse of federal support for energy technology commercialization for decades, helping to move technologies from small-scale demonstrations to full-scale commercial deployment. The federal government, for example, funded much of the cost of early civilian nuclear reactors. In recent years, DOE has made significant grants in a range of areas including small modular reactors, CCS, offshore wind and storage. Grant funding was particularly strong following the 2009 stimulus bill but has fallen since.

The new administration should assess the track record and effectiveness of federal clean energy grants across the entire energy spectrum – nuclear, fossil, renewables, efficiency and beyond. The record is a mixed one across multiple administrations with a number of lessons learned involving issues like research focus areas, requests for proposal, cost share, evaluation, impacts and more. It is also important to assess the relative merits of grants versus other government policy tools to stimulate clean energy development and deployment. Taking a thoughtful and comprehensive look is particularly important with lower grant-funding levels following the wind-down of the federal stimulus program.

c. Federal Loan Guarantees

Federal loan guarantees, a government support mechanism administered by DOE’s Loan Programs Office (LPO), are designed to facilitate the commercialization and early deployment of advanced energy and vehicle technologies. The program supports energy and transportation technologies that are ready for commercial deployment but face challenges raising capital in the debt markets. It has been the subject of significant controversy over the last few years, particularly with the bankruptcy of Solyndra, the recipient of a \$535 million DOE loan guarantee. Behind all the media swirl and Capitol Hill hearings, however, several important facts have been lost, pointing to the success of the program in helping to commercialize key technologies as Congress intended.

First, loan guarantees have enjoyed bipartisan support extending back to President George W. Bush, who signed bills creating two of the key loan guarantee programs, for energy technology commercialization under Title XVII of the 2005 Energy Policy Act and advanced technology vehicle manufacturing (ATVM) under the 2007 Energy Independence Security Act. President Obama signed a third bill in 2009, the American Recovery and Reinvestment Act (the “stimulus bill”), that both funded the Title XVII and ATVM programs and authorized a new deployment-oriented loan guarantee program to stimulate job creation during the financial crisis.

Second, the DOE program has been a financial success. To date, the LPO has issued loan guarantees for 30 projects. The \$32 billion portfolio of loans, loan guarantees and conditional commitments has been effectively managed by DOE with 98 percent of loans paying back and more than 90 percent of the \$10 billion loan loss reserve Congress set aside currently available.

Third, while Solyndra gets much of the attention, the program has provided critical support to key clean energy and advanced vehicle projects at key moments. One example: A \$465 million ATVM loan guarantee in 2010 backed Tesla’s purchase of an old General Motors auto assembly plant in Silicon Valley, helping to jumpstart this innovative new U.S. auto company on American soil. When the assembly plant was up and running, Tesla repaid its loan 10 years early. A second example: Prior to 2010, there were no utility-scale PV projects in the United States greater than 100 megawatts. LPO helped finance the first five utility-scale PV projects, and since then the private debt markets have taken over, financing many more.

Finally, while the LPO has used upward of half of the loan authority originally provided by Congress, the program currently has over \$40 billion in remaining authority to fund innovative clean energy projects and advanced vehicle technology projects: \$24 billion in loan authority for Title XVII projects and \$16 billion for the ATVM program.

The new administration will need to focus on next steps for the loan guarantee program, building on the successful work currently underway at DOE’s LPO. While the likely trajectory is to spend down the remaining funds, Congress, working with a new president, might authorize additional LPO loan authority to advance critical energy and transportation technologies vital to both U.S. competitiveness and international climate commitments. President Obama proposed this approach in his FY2017 budget, including another \$4 billion in new loan authority for advanced fossil, renewable energy and energy efficiency projects. Another option would be to transition existing loan authority from the LPO to an independent federal revolving fund. The LPO already has a successful program structure in place, including the needed staff and resources, to manage such a fund. This might be part of a larger independent federal entity with a broader set of tools, such as the Clean Energy Deployment Administration (CEDA), proposed by then Senate Energy Committee Chair Jeff Bingaman (D-NM), with bipartisan support.

d. Federal Tax Credits and Accelerated Depreciation

Federal tax credits and accelerated depreciation have been the key federal tools in incentivizing large-scale deployment of clean energy technologies. They are best known in the context of the Production Tax Credit (PTC) for wind and Investment Tax Credit (ITC) for solar, but credits have been available on and off for a number of technologies including CCS, geothermal, biomass and energy efficiency.

Accelerated depreciation receives less attention (and stimulates less controversy) but has provided a significant additional benefit to renewable energy projects through the Modified Accelerated Cost-Recovery System (MACRS). MACRS, first authorized in 1986 for certain technologies and since expanded, provides five- and seven-year accelerated depreciation schedules, depending on the particular clean energy technology. In addition, certain technologies qualify for a 50 percent bonus depreciation, allowing investors to deduct half of their qualifying investments in the first year and the remainder spread over the following four years. It was initially authorized under the Economic Stimulus Act of 2008 and extended most recently in 2015.

There are several matters that a new administration must address in the context of federal tax credits. First, while Congress recently extended the wind and solar tax credits, a number of other technologies seeking similar reauthorizations were left behind. This has thrown major uncertainty into the development of key projects deploying, for example, geothermal, biomass and energy efficiency.

Second, there are some key technologies that have not enjoyed the benefits of these incentives at all. Storage is principal among them. Bipartisan bills have been introduced in the current Congress that would create a storage tax credit and the Internal Revenue Service (IRS) is developing guidance that might allow the current solar tax credit to be extended to storage systems that are directly coupled with a specific solar project.

Third, a major problem with tax credits is that they have a very limited group of investors who can monetize them, i.e., large investors who have sufficient tax bills to use the tax credits and who have structured themselves as “tax equity” investors. This requirement for tax liability has sidelined many interested investors, such as tax-exempt pension funds, and millions of smaller investors who cannot meet the complicated terms required by tax equity. The small group of eligible investors, facing little competition, charge higher rates for their capital, causing real inefficiencies in tax credits as clean energy incentives. In the 2009 stimulus bill, the Congress authorized renewable energy developers to receive a cash grant in lieu of a tax credit, reducing the need for expensive and complicated tax equity. The authority expired in 2011, but there have been regular calls to reinstate it.

Finally, the tax credits for solar and wind will phase down over the next several years, with wind dropping to zero in 2021 and solar phasing down to 10 percent for commercial projects and zero for residential after 2023. Two key questions: Will a new administration push for a further reauthorization? Are there attractive alternatives? The next section briefly explores the second question.

e. Federal Tax-Advantaged Financing Mechanisms

In the mode of teaching old dogs new tricks, there has been a bipartisan effort over the last few years to open up long-standing Congressionally authorized investment vehicles to clean energy technologies. These vehicles are attractive because they are tax-advantaged – either eliminating the double taxation of common corporate investment structures or providing a full exemption from federal taxation. As such, they provide lower-cost financing to project developers, particularly as compared with tax equity investment using tax credits. There are three tax-advantaged structures currently in the mix.

i. Master Limited Partnerships (MLPs)

The first tax-advantaged structure involves MLPs, authorized by Congress in 1981 and used to provide tax-advantaged financing primarily to U.S. oil and gas pipelines and related infrastructure, with roughly \$500 billion worth of projects financed to date. MLPs are taxed as partnerships, but their ownership interests trade like corporate stock. As a result, they avoid the double taxation of corporate vehicles as the income of the partnership passes through directly to investors. At the same time, they enjoy the advantages of broad public stock issuance, thereby opening up energy investment opportunities for millions of U.S. retail investors. The MLP structure provides access to large amounts of low-cost capital for energy projects provided by a significant number of investors. However, MLPs, as currently authorized, do not extend to renewables, CCS, energy storage, efficiency and other clean energy technologies.²⁹³ The MLP Parity Act, an identical bipartisan bill in the Senate (S.1656) and the House (H.R.2883), would open up this vehicle to these and other technologies.

ii. Real Estate Investment Trusts (REITs)

The second tax-advantaged structure involves REITs. REITs, first authorized by Congress in 1960, have cost-effectively raised capital on public markets for commercial real estate, hospitals, hotels, natural gas pipelines, electricity distribution lines, cell towers and billboards. They boast a market capitalization of more than \$900 billion. Like MLPs, REITs avoid the double taxation of corporate vehicles and enjoy the advantages of public stock issuance, allowing smaller individual investors to invest in large diversified portfolios of income-producing properties.

293 F. Mormann and D. Reicher, “How to Make Renewable Energy Competitive,” *s*, June 1, 2012, <http://www.nytimes.com/2012/06/02/opinion/how-to-make-renewable-energy-competitive.html?smid=tw-share>.

A pending 2014 Treasury Department rulemaking would expand REIT eligibility to solar and potentially other renewables without the need for Congressional action. Access to the REIT structure could help renewable energy projects significantly reduce their financing costs and help move solar energy closer to grid parity and, ultimately, subsidy independence. In its current form, however, the proposed rule covers a limited segment of solar assets and, as a result, would not effectively support this growth industry. The Treasury Department received a number of comments in response to the proposed rulemaking that would improve its scope and implementation.

As the ITC and PTC phase down, both REITs and MLPs could phase in to provide a true level playing field via these tax-advantaged structures, open to the vast majority of energy projects and providing lower-cost financing than often available today.

iii. Private Activity Bonds (PABs)

The third tax-advantaged vehicle involves Private Activity Bonds (PABs). PABs were used in the 1970s and 1980s to finance tens of billions of dollars' worth of U.S. projects, capturing air pollutants like particulates and sulfur dioxide and deploying an array of then advanced technologies. Like municipal bonds, PABs are exempt from federal tax and support a public benefit, but they are used by private not public entities, (e.g., investor-owned utilities). However, the authority for PAB-financed air pollution control projects ended in tax legislation in 1986. A pending Senate bill introduced by Senators Bennet (D-CO) and Portman (R-OH) – The Carbon Capture Improvement Act (S. 2305) – would reinstate this authority for CCS projects. It would provide access to long-term, low-cost fixed-rate debt that has often been unavailable in developing U.S. CCS projects.

2. Private Sector Investment

Regardless of what form government support for clean energy assumes – through direct appropriations or indirect tax expenditures – vastly increasing private-sector investment is essential to deployment at scale. Following the end of stimulus funding, direct federal spending on clean energy innovation, commercialization and deployment in the United States currently amounts to less than \$10 billion annually (not including spending to power federal buildings and vehicles). Indirect spending – primarily through tax credits and accelerated depreciation rates – weighs in at a little over \$7 billion annually. Globally, the Green Climate Fund, the centerpiece of long-term clean energy financing under the UN Framework Convention on Climate Change has announced commitments totaling \$10.3 billion to date from governments around the world, with \$3 billion pledged by the United States.

In stark contrast, estimates of overall global energy spending required to address climate change are orders of a higher magnitude. In 2014, the International Energy Agency (IEA) projected that meeting the world's growing energy needs will require more than \$48 trillion in investment over the period to 2035.²⁹⁴ Under this scenario, IEA projects that spending on energy efficiency, renewable energy and nuclear power will total \$15 trillion over two decades. But the IEA stresses that the investments projected in this scenario fall “well short of reaching climate stabilization goals, as today's policies and market signals are not strong enough to switch investment to low-carbon sources and energy efficiency at the necessary scale and speed.”²⁹⁵ To stay within 2 degrees C, the IEA says that “consistent policy signals and innovative financing vehicles will be essential to see investment in low-carbon energy supply rise to almost \$900 billion and spending on energy efficiency to exceed \$1 trillion per year by 2035, double the respective amounts seen in 2035 in the main scenario.”²⁹⁶ And these amounts do not include the additional trillions needed to build out an adequate electricity transmission and distribution system to support clean energy deployment.

The good news is that there are vast sources of existing capital that can be harnessed to dramatically increase private investment in clean energy. These include pension funds, insurance companies, sovereign wealth funds, university endowments, family offices and more. Rough estimates place the current combined investable capital of these long-term investors (LTIs) at more than \$100

294 International Energy Agency, *World Energy Investment Outlook* (2014), <https://www.iea.org/publications/freepublications/publication/WEIO2014.pdf>.

295 *Ibid.*, 14.

296 *Ibid.*

trillion – an overall magnitude that aligns with the trillions that will be needed over the next few decades to build a low-carbon global energy system. Despite this scale of opportunity, little LTI investment has found its way to clean energy through third-party managed funds, direct investments in companies and projects or public market vehicles.

There are a number of barriers. First, clean energy tends to be a long-term and capital-intensive undertaking to move a single energy technology from lab to full-scale cost-competitive deployment, with time frames often measured in decades and capital requirements in the billions of dollars. Along the way, entrepreneurs and investors face what has come to be known as the “Valley of Death,” where promising energy technologies founder between the lab and full-scale deployment. The clean energy space is a complicated and risky one where entire investment sectors – like cleantech venture capital over the last decade – can stumble.

Second, once a technology has reached a point of commercial maturity, capital flows remain problematic. In the case of power generation, the product is essentially a commercial commodity – electricity – that can be generated from many energy sources. While technological, financial and regulatory innovations have helped drive down prices for wind, solar and other renewables over the last decade, they still cannot compete fully with traditional sources like natural gas and coal in many places. Additionally, critical enabling technologies, like storage, remain costly or, in the case of transmission, difficult to develop. These kinds of challenges are particularly problematic where emitters are not required to “internalize” the societal costs of carbon at an adequate level to address the costs of climate change. And even energy efficiency, our lowest-cost zero carbon resource, faces long-standing market and behavioral challenges finding significant uptake in the market.

Third, in the developing world where steeply rising energy consumption in the coming decades will require the vast proportion of clean energy investment to be made, domestic financing is generally scarce. Foreign investors, meanwhile, are often skittish about the various risks involved in investing in infrastructure projects and selling power to utilities that may not be able to honor the long-term contracts necessary to recover their high up-front investments. India, which committed to a massive scale-up of wind and solar in the Paris Agreement, faces many issues in this regard.²⁹⁷

Despite these challenges, LTIs are beginning to take a serious look at clean energy investing. Private equity firms and sovereign wealth funds that typically have focused on traditional fossil-oriented investments, if they invested in energy at all, are beginning to explore clean energy, largely through funds but also through some direct investments in companies and projects. Family offices, some of which have experience in environmental and energy-related investing, have banded together to build expertise and, in some cases, pursue joint investments. And insurance companies, some of which are already exposed to climate-related claims, are increasingly looking at investments that can mitigate climate disruptions and improve their bottom lines. As public market vehicles – MLPs, REITs, PABs, YieldCos – develop for clean energy, these may become attractive to LTIs.

But much more needs to be done to accelerate the speed and magnitude of LTI investment. There are a few recent bright spots. The Breakthrough Energy Coalition, led by Bill Gates, has brought 28 wealthy investors from 10 countries together to create an investment vehicle focused on early-stage energy innovation. In 2015, the White House launched the Clean Energy Investment Initiative to catalyze expanded private-sector investment in climate change solutions. Shortly thereafter, DOE launched the Clean Energy Investment Center to expand access to the department’s expertise and analytical capabilities to advance private investment in clean energy technologies. And in 2015, Stanford University helped launch the Aligned Intermediary, an investment advisory group created to help LTIs accelerate and increase the flow of private for-profit capital into climate infrastructure projects and companies in the areas of clean energy, water infrastructure and waste.²⁹⁸

297 See e.g. Sivaram, Shrimali and Reicher, “Reach for the Sun: How India’s Audacious Solar Commitments Could Make or Break Its Climate Ambitions” (Stanford, CA: Stanford University, 2015), <https://www-cdn.law.stanford.edu/wp-content/uploads/2015/12/Reach-for-the-Sun-High-Resolution-Version.pdf>.

298 Monk, Kearney, Seiger, and Donnelley, “Energizing the US Resource Innovation Ecosystem: The Case for an Aligned Intermediary to Accelerate GHG Emissions Reduction” (2015), <https://www-cdn.law.stanford.edu/wp-content/uploads/2015/07/SSRN-id2617816.pdf>.

The next president should take significant additional steps to help expand LTI investment in clean energy. The next few years will determine whether these investors – who are holding the purse strings to trillions of dollars – will see reasonable risk and attractive returns in the massive scale-up of clean energy globally and put their capital to work at an unprecedented scale.

3. The Big Three Federal Standards for Clean Energy

Driving both public and private investment in U.S. clean energy are the big three federal clean energy standards: the CPP governing carbon emissions from power plants, Corporate Average Fuel Economy (CAFE) rules for cars and light trucks, and energy efficiency standards for residential, commercial and industrial appliances and equipment. Each set of standards plays an important role in accelerating the transition to lower-carbon energy technologies – particularly in the absence of a meaningful economy-wide price on carbon emission – but each faces issues the new administration will need to address.

a. Clean Power Plan

Under the CPP, the EPA has set carbon dioxide emissions performance rates for existing fossil-fueled power plants but allows a “beyond-the-fence-line” approach. That is, the state that administers the CPP program can pursue a mix of responses that will lower overall CO₂ emissions, e.g., energy efficiency, renewables, nuclear and CCS, plus the shutdown of particular plants. For new power plants, the EPA has essentially set a limit on CO₂ emissions that mirrors the emissions of new combined-cycle natural gas-fired power units, without CCS. Assuming it survives current legal challenges, the next administration will face a number of CPP implementation issues. In the category of clean energy deployment, several industries are pushing hard for a bigger and more certain seat at the CPP table.

Energy efficiency advocates believe the EPA needs to provide states with a model rule that offers a straightforward approach to incentivizing investments in a variety of energy conservation measures. In their view, allowing efficiency to be used for CPP compliance is not enough, and instead the EPA needs to provide states with regulatory certainty and a mechanism to help overcome existing market and regulatory barriers that hinder the adoption of low-cost energy-efficient technologies and practices.

The nuclear power industry believes the final CPP is an improvement over the draft version, particularly recognizing the contribution of new reactors, but has concerns that the “best system of emission reduction” (BSER) in the final rule does not incorporate the carbon-abatement value of existing nuclear power plants. These plants are the largest current source of U.S. carbon-free electricity, but a number are facing premature shutdown. The industry also has concerns that the final rule does not give credit for license extensions of these current reactors.

Advocates for transmission development believe the CPP does not adequately address the critical role of transmission and the need for upgrades to the grid as it drives a massive shift in electric generation resources to curb greenhouse gas emissions. Proponents of electricity storage have raised a similar issue, as storage is not among the measures making up BSER.

Finally, the CPP is currently restricted to the power sector, but Section 111 of the Clean Air Act, under which the CPP has been promulgated, provides the EPA with authority to regulate greenhouse gases from other sectors. As discussed below regarding CCS, major industrial operations – oil refining, cement, steel, glass-making, ceramics, petrochemicals, fertilizer, aluminum smelting, etc. – are a major contributor to U.S. carbon emissions and the next administration will need to look carefully at options to cut emissions from this sector.

b. Automobile Fuel Economy Standards

CAFE standards have driven significant improvements in U.S. light-duty vehicle efficiency since first enacted in 1975 following the Arab oil embargo. 2017 is a pivotal year for CAFE standards because of a required mid-course review agreed to by the federal government and the automobile industry when the latest CAFE requirements were set in 2012. In rough terms, the current standards require a doubling of fuel economy to 54.5 miles per gallon by 2025.

The key issue in the joint DOT and EPA mid-course evaluation is whether to maintain or change the current fuel economy standards for the second half of the compliance period for automobile model years 2022–2025. Auto fuel economy improvements figure prominently in the U.S. carbon reduction commitments in the Paris climate agreement, but at the same time the auto industry points to low fuel prices' making it tougher to market fuel-efficient vehicles. Progress on fuel economy is essential to U.S. greenhouse gas (GHG) reductions and the mid-course decision will require rigorous standards. The determination regarding the standards will also need to be made promptly by the new administration given that DOT and EPA have already released a Technical Assessment Report providing updated information on the factors relevant to the decision.

The new administration will also need to consider the trajectory for light-duty fuel efficiency beyond 2025 – consistent with long-term objectives for the transportation sector. Finally, Phase 2 heavy-duty vehicle fuel economy rules, issued in August 2016, will deliver major fuel savings and GHG reductions for trucks and buses. If there are legal or legislative challenges to this rule, it will be important to resolve them quickly to allow the Phase 2 program to move forward.

c. Appliance Efficiency Standards

Federal appliance and equipment efficiency standards, set by Congress and the DOE since 1987, are the little engine that could when it comes to stimulating massive low-cost energy savings and carbon emission reductions. DOE estimates that existing efficiency standards completed through February 2016 will, on a cumulative basis between 1987 and 2030, save 132 quadrillion Btu (quads) of energy, save consumers nearly \$2 trillion on their utility bills and reduce CO₂ emissions by more than 7 billion metric tons. For comparison, the entire U.S. economy uses about 100 quads per year. While not without occasional controversy, the standards have long enjoyed strong bipartisan support. Standards for many types of residential, commercial and industrial equipment have been regularly updated as one set of standards helps drive technology advances that undergird the next. In this context, it is important to understand that federal efficiency standard-setting is constrained by federal law. To issue a new or updated standard, the Secretary of Energy must determine that it is both technologically feasible and economically justified. While there is often debate over these criteria, they do ensure rigorous technical and financial analyses in the standard-setting program.

Building on this success, the next administration should take steps to deliver further savings from the standard-setting program. In an August 2016 report, the Appliance Standards Awareness Project and the American Council for an Energy Efficiency Economy calculated that efficiency standards, updated within the next eight years, could achieve cumulative nationwide savings of 70 quads of energy and 3.5 billion metric tons of CO₂ by 2050, while cutting consumer and business utility bills by \$1.1 trillion.²⁹⁹ The organizations concluded that even greater savings may be achieved by improving data sources, test procedures and analysis techniques; increasing the way standards contribute to systems-level savings; and addressing products that are connected to the internet.

4. Two Essential Technologies for Renewables: Transmission and Storage

With the rapid expansion of renewable energy in the U.S., there has been increased focus on the two essential technologies for further growth: transmission and storage. Transmission is critical because resource-rich areas of generation tend to be located far from urban load centers, plus local variations in sun, wind and other renewables can be smoothed out with significant interregional transmission connections. Storage – using pumped hydro, batteries, thermal systems, compressed air, and beyond – is critical to dealing with the intermittency of solar and wind – both utility-scale and distributed. Storage shifts the use of electricity from when it is generated to when there is greater customer need and economic value – whether over an hour, day or month. Both these renewable energy enablers need significant and rapid attention by the next administration, Congress and the states and energy industry if we are to meet the commitments to clean energy made at the international, federal and state levels.

299 “Next Generation Standards: How the National Energy Efficiency Standards Program Can Continue to Drive Energy, Economic, and Environmental Benefits,” (Washington, DC: ACEEE2016), <http://aceee.org/research-report/a1604>.

a. Transmission

The Paris Agreement, the federal CPP, and increasingly stringent state renewable portfolio standards are driving a massive transition to renewable energy. This transition will only be fully realized – with the critical carbon benefits – with a robust transmission system that can help ensure that electricity can be delivered in the most cost-effective, reliable and safe manner. Transmission development in the U.S. is inadequate today largely because of conflicts at the federal, regional and state levels. While significant transmission has been built during the Obama administration (over \$10 billion per year invested recently versus approximately \$4 billion per year previously), much more is needed to support the growth of renewable energy. The transmission imperative is particularly acute because development of new power lines often takes double or triple the time compared to new large-scale renewable energy generating capacity. The next president should take a number of steps to address the key challenges of transmission development: planning, cost allocation and siting.

i. Planning

A recent Brattle Group report argues for a more comprehensive and long-term approach to transmission planning.³⁰⁰ This anticipatory approach would include a scenario-based analysis that explicitly considers the uncertainties faced by the electricity industry and is used to evaluate a broad range of options and transmission benefits. Such an approach would expand beyond customary five- to 10-year planning horizons and the usual focus on electricity reliability to help address the next generation of electricity supplies and consumption in a more cost-effective manner. Planning like this must look at not only regional but also interregional service given the need for flows of renewable electricity between regions to address variations in solar, wind and other renewables.

Importantly, the Federal Energy Regulatory Commission (FERC) can improve regional and interregional transmission planning through Order 1000, a 2011 rule that reformed the commission's electric transmission planning and cost allocation requirements. Success to date with FERC-led planning has been spotty, but the agency has recently geared up its efforts, including a recent proceeding that looked at various aspects of transmission planning with a specific focus on the lack of development of interregional transmission facilities and what steps the commission could take to facilitate such development. The DOE can also help facilitate regional and interregional planning through funding, technical assistance, studies, data and generally using its bully pulpit to support transmission development.

A key feature of Order 1000 is its requirement that transmission planning consider needs driven by public policy requirements established through state or federal law. FERC should ensure that key public policy requirements are addressed in regional and interregional transmission plans, e.g., the EPA's CPP and state renewable portfolio standards. The CPP itself does not adequately address the critical role of transmission and the need for upgrades to the grid, as it drives a major shift in electric generation resources to curb greenhouse gas emissions.

DOE and FERC transmission planning should also be better coupled with the Department of the Interior's development of federal renewable energy zones. There is a serious need to identify transmission routes and paths that align with renewable energy resources expected to be developed and prioritize permitting and agency coordination. Importantly, the new administration should also include transmission development prominently in any infrastructure initiatives.

300 "Well Planned Electric Transmission Saves Customer Costs: Improved Transmission Planning Is Key to the Transition to a Carbon-Constrained Future," The Brattle Group, Washington D.C. (2016), http://www.brattle.com/system/publications/pdfs/000/005/296/original/Well-Planned_Electric_Transmission_Saves_Customers_Costs_PPT.pdf?1465318671.

ii. Cost Allocation

Transmission planning and cost allocation are intimately tied in FERC Order 1000. In Order 1000, FERC expressed concern that the traditional approach – relying heavily on individual transmission providers – had prevented the development of necessary new transmission facilities, including those integrating renewable generation that is distant from load centers. Order 1000 sets out a number of requirements for transmission cost allocation. Key among them are six cost allocation principles. Taken together these principles direct that a region should transparently allocate costs for transmission improvements according to a “beneficiary pays” approach.

Importantly, Order 1000 also directs that the cost allocation method for new interregional transmission must also satisfy similar cost allocation principles. This concrete and transparent approach to regional and interregional cost allocation should help bring more certainty to renewable energy developers. In addition, this approach more accurately accounts for the various benefits of transmission expansion and upgrades: greater reliability, increased competition leading to lower prices, reduced congestion and compliance with public policy requirements.

The FERC took a major step in Order 1000 in resolving transmission cost allocation problems, but issues persist. The new administration should take stock of cost allocation issues in a broader review of U.S. transmission development. And FERC should be encouraged to do all it can to facilitate fair regional cost allocation agreements at the regional level and increasingly for critical interregional transmission capacity.

iii. Siting

Even with improved planning and cost allocation, siting and then permitting a transmission project is frequently the toughest part of developing new transmission capacity. Controversies over transmission siting have erupted regarding many transmission projects, for example the Rock Island Clean Line (from South Dakota to Chicago), the Plains and Eastern Clean Line (from the Plains states to the Southeast), the Northern Pass in New Hampshire (to carry Quebec hydro into New England) and the Great Northern transmission line (to bring Manitoba hydro to Minnesota).

In light of these and a number of other controversies, the next president should build on recent actions designed to improve transmission siting and permitting. President Obama recently signed the FAST/DRIVE Act (H.R. 22) that, in Subpart D (The Federal Permitting Improvement Act), aims to improve permitting for major infrastructure projects, including transmission. This authority should be used expeditiously to prioritize transmission permitting and build on the work of the Obama administration’s Interagency Rapid Response Team for Transmission. The next president should also support further legislative authority that would give FERC narrow “backstop” authority to approve and site new priority electric transmission lines in cases where local or state approval processes have been unsuccessful. Under 2015 legislation introduced by Senator Heinrichs (D-NM), FERC would have to first determine that the proposed regional project is in the public interest and advances key public policy goals. FERC would also be required to conduct a full public process, including that under the National Environmental Policy Act (NEPA) for the use of any federal lands. In this regard, NEPA review of clean energy transmission over federal lands should include the positive environmental benefits of the lines – e.g., supporting zero carbon electricity – when considering alternatives.

As discussed in Section 6, DOE also has another tool in the siting toolkit. The department’s Power Marketing Administrations (PMAs), e.g., Bonneville Power Administration (BPA) and Western Area Power Administration (WAPA), have significant existing resources and authority – a vast electricity transmission network as well as financing and eminent domain authority – to site and fund new transmission within the PMA’s multistate regions.

Finally, transmission siting increasingly has a North American dimension. Recently, President Obama, Canada’s Prime Minister Justin Trudeau and Mexico’s President Enrique Peña Nieto made a commitment to generate half the power in their respective nations from clean energy by 2025. To get there, they agreed they’d need, among other initiatives, 5,000 miles of cross-border transmission lines. The next president, in following up on this broader commitment, will need to focus on this cross-border

transmission capacity. As President Obama said at his meeting with the Canadian and Mexican leaders: “There may be some wonderful hydroelectric power that we’d like to get to the United States. The question is, are there enough transmission facilities for us to be able to buy it at a competitive price.”³⁰¹

b. Storage

Large-scale electricity storage, with the exception of pumped hydro, is relatively immature technologically, and the costs of a number of promising options are high. As a result, gas turbines often fill the gap when solar and wind are not available. It is important to emphasize that storage is needed at both utility scale (e.g., pumped hydro) and at distributed scale (e.g., behind-the-meter battery packs).

Key federal and state policies can stimulate the development and deployment of storage. The next president and the new Congress need to consider federal policy and finance tools to advance both utility-scale and distributed storage projects. These include grants, tax credits, loan guarantees, MLPs, REITs, Energy Savings Performance Contracts and other tools. In the near-term, the IRS is developing guidance on the extent to which energy storage integrated with a solar project can qualify for the 30 percent federal solar ITC. The IRS ruling will be limited in various respects and, in the face of this, bipartisan legislation was recently introduced in the House (H.R. 5350) that would extend the ITC to a range of distributed and utility-scale storage technologies. Bipartisan legislation (S. 1656 and H.R. 2883 discussed above) is also pending in the House and Senate that would open up MLPs to storage projects. Other federal policies include potential availability of R&D tax credits for early-stage storage companies, Department of Defense (DOD) and civilian agencies increasing the use of storage in grid resilience efforts, and increasing funding for storage R&D in various DOE programs. With regard to the last, a recent bill (H.R. 5640), the Electricity Storage Innovation Act, would authorize \$150 million annually for basic research into advanced batteries. It would, however, specifically prohibit spending funds for commercial application of energy technology and it does not authorize research regarding any other storage technology.

Beyond incentives, it is important to take account of wholesale rates and their potential impact on the deployment of storage. To this end, in April 2016, FERC initiated Docket No. AD16-20-000 to examine whether barriers exist to the participation of electric storage resources in the capacity, energy and ancillary service markets, potentially leading to unjust and unreasonable wholesale rates, and whether any tariff changes are warranted.

Storage is part of a larger package of options – efficiency, demand response, grid management, fast-firing gas turbines, broader regional electricity markets and faster dispatch – to deal with intermittent renewables. The next administration and the new Congress should consider the federal policy options, and associated investment vehicles, that can ensure smart and cost-effective integration of these approaches. The states also have a major role to play.

There is also an important dimension in the relationship between storage and transmission. The recent Brattle report makes an important point: The need for transmission does not necessarily decline with greater reliance on distributed renewables. Brattle looked at the European experience that demonstrated that the choice between centralized, utility-scale generation and distributed generation does not have a direct impact on transmission needs. Instead, in Europe at least, transmission needs have been driven mainly by the type and regional distribution of renewable generation resources on a European-wide level, rather than the choice between centralized and distributed generation within a given region. The U.S. is likely to see the same dynamic, particularly as we look to interregional flows of renewable electricity to smooth out local variations in renewable resources. We will need both distributed and utility-scale renewables and the associated enabling technologies – storage and transmission – to meet the carbon reduction imperative.

301 Remarks by President Obama at the North American Leaders’ Summit Press Conference, Ottawa, Canada, June 29, 2016, <https://www.whitehouse.gov/the-press-office/2016/06/30/remarks-president-obama-prime-minister-trudeau-canada-and-president-pe%C3%B1a>.

5. Case Study – Incentives and Standards for Carbon Capture and Storage

The good news is that there are an array of tools – federal grants, loans, incentives, standards and beyond – at the president’s disposal to drive clean energy innovation, commercialization and deployment. The not-so-good news is that the tool kit was assembled in a haphazard manner without enough consideration of how each tool relates to the others, what new ones are needed and how they all might be better integrated. The federal approach to CCS is an example of this approach. CCS scrubs carbon emissions from power plant and industrial exhausts and then pipes and stores (sequesters) them thousands of feet underground in geologic formations already proven capable of holding saline water or oil and gas for long periods of time. Increasingly, we are also developing innovative ways to utilize captured CO₂ in commercial products, including plastics, cement, chemicals and agricultural products. At the January 2016 World Economic Forum meeting in Davos, Switzerland, the Global CO₂ Initiative was launched to accelerate development of these innovative “CCUS” approaches.

a. Background on CCS

As an emission reduction approach, CCS has broad application across the energy spectrum, from coal, natural gas and biomass-fired powered plants to industrial operations like oil refineries, ethanol facilities, cement plants, natural gas processing operations and fertilizer production. The International Panel on Climate Change Fifth Assessment Synthesis Report concluded that CCS will be essential in keeping global temperature rise within 2 degrees Centigrade. Similarly, the IEA projects CCS’s contributing one-sixth of total CO₂ emission reductions required in 2050 from the power sector as well as industrial operations (which themselves produce about one-fifth of global carbon emissions). This is a massive contribution built on the back of various CCS technologies that, while in operation in various industries, have generally not been deployed at the scale or cost required for meaningful climate-related carbon controls.

In past decades when faced with cutting emissions from power and industrial operations, the EPA has set specific pollution limits (e.g., for particulates, NO_x, SO_x and mercury) that must be met on a plant-by-plant basis. In contrast, and as discussed in Section 3, federal carbon controls for existing power plants allow for a broad array of options on a state-by-state basis – efficiency, renewables, CCS, nuclear and the shutdown of existing plants. For new plants, the EPA has essentially set a limit on carbon emissions that mirrors the current emissions of new combined-cycle natural gas-fired power units, without CCS. And for the most part, the EPA has not set carbon emission limits for large industrial GHG emitters. At the same time, state Renewable Portfolio Standards and Clean Energy Standards do not typically establish targets for CCS use.

Paradoxically, while the above-described U.S. federal carbon regulation has started with the power sector and has not yet expanded scope to the industrial sector, the evolution of CCS technology has marched in the opposite direction. CCS technologies have generally been used in industrial processes that demand the separation of CO₂ in order to make particular products rather than as a pollution control technique per se. As an example, raw natural gas is frequently contaminated with CO₂, and natural gas processing plants must capture CO₂ in order to meet gas pipeline specifications. For the most part, CO₂ capture for pollution control seeks to apply the same industrially derived CO₂ removal processes to new environments, such as the power sector. For instance, the carbon scrubbing system used at a CCS project under construction at a Texas coal plant owned by independent power producer NRG is similar to the solvent-based system used in natural gas processing plants.

However, as existing technology is applied to new industries, there are inevitable technical problems and financial challenges. Projects deploying CCS must take on extra capital costs and operating expenses to capture a pollutant for which there is currently no direct regulatory penalty or market price. The lone exception on the market side is the long-standing use of CO₂ for Enhanced Oil Recovery (EOR). For several decades, CO₂ has been pumped into old oil fields to enhance production. While this creates an economic use for CO₂, its value is tied to the price of oil, and with falling hydrocarbon markets, CO₂ prices have fallen as well. As a result, in most cases EOR revenues cannot cover the full capital and operating expenses of CCS.

b. Federal Support for CCS

In sum, CCS does not have the traditional regulatory requirements for control of CO₂ or a revenue model robust enough to pay for CCS. CCS deployment for power and industrial pollution control is instead looking to a mix of current and potential federal incentives and tax-advantaged financing mechanisms plus the volatile market for CO₂ in EOR. The federal approach to date has been inadequate, with an array of tools on the books or proposed but no integrated approach that will really drive CCS to a point where private sector investment can take it to scale in both the power and industrial sectors.

These tools include

- Grants
- Investment Tax Credits
- Sequestration Tax Credits
- Loan Guarantees
- Master Limited Partnerships
- Private Activity Bonds
- Price Stabilization Contracts
- EPA Clean Power Plan

DOE grants have helped push some CCS demonstration projects over the finish line (e.g., at an oil refinery in Texas and an ethanol plant in Illinois), but they were largely creatures of stimulus funding. Federal funding is now more limited and several of the projects identified for federal funding have failed. In addition, FY2014 and FY2015 appropriations language limited use of these funds exclusively for coal-fired power plants.

There are current federal CCS tax credits designed to stimulate both projects that capture carbon dioxide (IRC Section 48A and 48B) and others that sequester it (IRC Section 45Q). However, these credits have proven problematic given limitations in terms of amount, scope and duration. A significantly improved approach to the current CO₂ sequestration tax credit is pending in bipartisan bills in the Senate and House; these bills would both increase the value of the credit and uncap the total credits available. However, it is not clear whether or when Congress might enact this incentive. Furthermore, neither bill provides an improved incentive for CO₂ capture, and both rely on the same problematic “tax equity” approach, discussed in Section 1, which severely limits eligible investors and drives up financing costs. Recent Obama administration budgets (FY2016 and FY2017) have proposed an alternative approach that would create a new set of more effective CCS incentives, but this approach has not been proposed in either the Senate or House.

As discussed in Section 1, CCS is also included in pending Senate and House bills to open up MLPs to financing clean energy projects but, while they enjoy strong bipartisan support, the bills have been stalled for several years. Also as discussed above, extending Private Activity Bond authority to CCS projects would provide an attractive incentive modeled on pollution capture projects financed using this mechanism in the 1970s and 1980s. But again, the fate of a bipartisan Senate bill is uncertain.

There is also discussion of creating a CO₂ sales revenue stabilization mechanism for CO₂ capture projects to address the volatility of CO₂ sales revenue for EOR. This approach could authorize DOE to enter into “price stabilization contracts,” also known as “Contracts for Differences.” The UK uses this type of contract to stabilize electricity price revenues for renewable energy projects that dispatch into the volatile UK power markets. A provision directing the U.S. DOE to study such a mechanism is included in the pending Senate energy bill.

Finally, as discussed above, industrial carbon emissions, as opposed to ones from the power sector, are not controlled in the U.S., with the exception of methane emissions in the oil and gas industry (but not oil refining). This is problematic because heavy industry in the U.S. represents a significant portion of U.S. GHG emissions and could result in overshooting carbon limits. One obvious step

would be for the EPA to accelerate development of carbon emission standards and low-carbon feedstock requirements for U.S. industrial operations. Like CAFE standards for fleet efficiency or efficiency standards for appliances, GHG standards for industrial operations would stimulate investment in advanced technology for commercial projects and R&D for new projects.

Overall, the new administration should take a thorough look at CCS: analyzing existing and proposed policy mechanisms as well as current and potential revenue models and the interactions between them and developing an integrated and effective approach to accelerating CCS deployment. As an example, CCS tax credits, properly structured, could incentivize equity investment in projects, while PABs could stimulate the availability of low-cost debt and MLPs could provide a “liquidity event” for the initial equity investors and mitigate a large risk these projects otherwise face. Importantly, any consideration of CCS should look at both power and industrial emissions and involve both underground CO₂ storage and alternative uses such as cement, chemicals, plastics and beyond. The new administration should also consider the international dimensions of CCS. Ten countries, including the United States and China have explicitly declared CCS as part of their commitments under the Paris Agreement, and many key countries accept CCS as a compliance mechanism.

6. The President’s Not-So-Secret Weapon: Federal Energy Management

The U.S. government is the single largest energy user in the nation; it owns more than a quarter of all U.S. land, tens of thousands of miles of transmission lines, 400,000 nontactical vehicles and 350,000 buildings, and in recent years it has developed, hosted and procured more renewable energy more than any other entity in the United States. The new president can do much to advance clean energy as “CEO” of “USA Clean Energy Inc.” There are a number of opportunities explored in detail in a forthcoming report by a task force of the Secretary of Energy Advisory Board to the Secretary of Energy (co-chaired by this author with former U.S. Representative Ellen Tauscher) that could both green up the federal government’s own energy use and accelerate the development and deployment of clean energy more broadly. Some brief examples from the upcoming report and one other idea follow:

a. The Federal Government as Technology Test Bed

The DOD and the General Services Administration (GSA) in recent years have used their many buildings and related power infrastructure to demonstrate and evaluate next generation energy technologies important to DOD’s defense mission and GSA’s function as the nation’s largest landlord. With 150 demonstrations completed or underway, these “technology test beds” – GSA’s Green Proving Ground and DOD’s Installation Energy Test Bed – have helped advance an array of energy technologies including microgrids, new building controls, condensing boilers and advanced chillers. The next president should build on this success. There are, however, two challenges. First, these programs are not well coordinated with the DOE’s energy technology programs, particularly those related to building technologies. The R&D “push” of DOE’s work must be better aligned with the demonstration and validation “pull” of the DOD and GSA test beds. Second, both test beds are oversubscribed and their already modest budgets are declining.

b. Cut the Federal Government’s Energy Bill

Congressional legislation and a series of executive orders going back decades have directed the federal government to cut its energy use and, in the process, reduce its energy bill, totaling more than \$21 billion in 2015. The next president can accelerate progress to date by expanding investment in energy efficiency upgrades in federal buildings through direct appropriations as well as a compelling alternative – Energy Savings Performance Contracts (ESPCs). ESPCs are an arrangement under which a private third-party invests in an energy conservation measure in a federal building and is repaid over time from a portion of the resulting energy savings. ESPCs have become a major tool for federal agencies, are an important alternative to appropriated funds and enjoy strong bipartisan support. The White House and DOE need to resolve several outstanding issues concerning ESPC scope and implementation, quickly adopt new dollar- denominated goals for 2016–2018 and improve systems to track progress. The federal government can also help accelerate use of ESPCs in energy upgrades of state and local public buildings as well as private facilities.

c. Reduce the Federal Real Estate Footprint

The next administration should consider what may be the most compelling way to reduce the federal government's energy footprint and that is by reducing its real estate footprint. There is an important opportunity to cut energy consumption through a modest decrease in the federal facility footprint – at both DOD and civilian facilities – a reduction that federal agencies themselves favor. Previous federal downsizing has demonstrated the direct and significant connection between cutting square footage and reducing energy use. Thus the DOD, between 1988 and 2001, cut its real estate footprint by 35 percent, and its facility energy consumption decreased by a corresponding 36 percent, saving billions of dollars in the process. The challenge is the reluctance of the U.S. Congress to authorize new cuts in federal facility space, especially at the DOD. Congress has turned down a series of administration requests since 2012 for authority to further downsize DOD facilities through the Base Realignment and Closure (BRAC) process. But additional BRAC authority is something a new administration and Congress might come to terms on in the interest of greater DOD efficiency and effectiveness – and the civilian side might be addressed at the same time as part of a comprehensive deal. Meanwhile, there are innovative ways to tackle the up-front cost of federal facility downsizing, including a “space-saving performance contract” analogous to an ESPC, as discussed above.

d. Improve Federal Procurement of Renewable Energy

The federal government is a major purchaser of renewable energy, but it could be doing a great deal more both to green up its own operations and accelerate cost reductions in clean energy technologies and to improve financing mechanisms more generally. The key mechanism by which federal agencies – and the private sector – procure renewables is a power purchase agreement (PPA), which allows a developer to finance an energy project in exchange for a federal agency's long-term commitment to buy the power at an established price. Despite the benefits of PPAs and PPA-like mechanisms, agencies face major impediments to their use, including statutory limitations and the complexity of the federal procurement process. The DOD – with its aggressive goal to deploy 3 gigawatts of renewables – and civilian agencies have had a range of challenges using PPAs that have complicated and slowed federal procurement of renewable energy. For example, under federal law, civilian agencies can typically only enter into PPAs with a maximum duration of 10 years, while power developers typically need commitments of at least 20 years in order to finance a project. The recent report to Secretary Moniz makes a set of recommendations aimed at removing such impediments to the use of PPAs and expanding the use of alternatives.

e. Increase the Role of the Power Marketing Administrations in Renewable Energy Deployment and Transmission Development

The PMAs – Bonneville Power Administration (BPA), Western Area Power Administration (WAPA), Southwestern Power Administration (SWPA) and Southeastern Power Administration (SEPA) – are an arm of DOE that markets electricity generated at federal hydropower facilities primarily to “preference customers,” municipally-owned electric utilities and rural electric cooperatives. There are multiple ways the next president could make greater use of the PMAs in advancing clean energy development while being mindful of the PMAs' core obligations to their preference customers. The PMAs own tens of thousands of miles of transmission lines and have financing and eminent domain authority that could be used to both upgrade existing lines and build new ones – both essential to the large-scale and rapid build-out of U.S. renewables. The PMAs also have authority to purchase non-hydro power to supplement their hydroelectricity resources when necessary. Some of these purchases should come from other renewable resources, particularly as these technologies are increasingly cost competitive. Finally, the PMAs can also take more active roles in operational activities vital to clean energy and transmission: Regional Transmission Organizations, Energy Imbalance Markets, and, as discussed above, transmission planning under FERC Order 1000.

f. Address Barriers to Expanding Clean Energy Development on Federal Lands

There is extraordinary potential for renewable energy development on federal lands – making up more than one-quarter of all U.S.

territory – but a number of issues, including a cumbersome permitting process and concerns about wildlife impacts, have limited the deployment of wind, solar and other renewables. The next administration, led by the Department of the Interior, needs to reduce uncertainty and delay surrounding the assessment of potential wildlife impacts, formulate a new and improved permitting approach for future energy development on federal lands and increase research on technology that can improve species conservation. The Obama administration has made good progress on this front, but there is much that needs to be done, particularly to ensure large-scale access to federal property for both utility-scale renewables and transmission development while being mindful of important conservation values.

g. Increase Federal Deployment of Alternative Fuel Vehicles

The U.S. government has the single largest vehicle fleet in the nation – currently some 400,000 nontactical vehicles. Three departments largely control the fleet: the General Services Administration (39 percent), the U.S. Postal Service (33 percent), and the Department of Defense (28 percent). The bad news is that multiple administrations have made little progress in greening up this fleet through the use of alternative fuels – including biofuels, electricity, natural gas and hydrogen – despite specific direction in an array of federal legislation and executive orders. As a result, although alternative fuel vehicle (AFV) acquisition rates have come close to meeting the requirements of the 1992 Energy Policy Act (which mandates that 75 percent of new acquisitions be AFVs), actual alternative fuel use in federal fleets was only 3.9 percent of total fleet fuel consumption in 2015. Federal fleet access to biofuels for “flex-fuel” vehicles has been one challenge. The other challenge involves plug-in electric cars and trucks where federal procurement has been miniscule because agencies have largely focused on the higher first cost rather than the lower life-cycle costs typical of these vehicles. There are a number of steps the next president can take to address this failure. Among these are to ensure that the federal government does a better job of accounting for the full life-cycle cost of vehicle acquisitions, that it takes advantage of innovative financing mechanisms to cut the up-front cost of AFVs and that the U.S. Postal Service use its current need to replace its 180,000 light-duty vehicle fleet to maximize the deployment of AFVs.

h. Power the 100 Largest Non-Powered U.S. Dams

Hydropower is the largest source of U.S. renewable energy. There are presently more than 80,000 dams in the United States, of which only roughly 2,500 generate electricity. A 2012 DOE/Oak Ridge National Lab study identifies 54,000 existing dams in the United States that could supply 12 GW of hydropower, enough to power about 4.5 million U.S. homes.³⁰² According to the Oak Ridge study, powering the top 100 Non-Powered Dams (NPD) in the U.S. could generate 8 GW. Eighty-one of the top 100 NPDs are owned by the United States Army Corps of Engineers (USACE). The next president should direct the USACE, in consultation with DOE and FERC, to explore power development of its large NPDs, including potential public/private partnerships to finance these projects. Any future analysis should take account of DOE’s recent Hydropower Vision that explores this opportunity in some depth but reduced the Oak Ridge estimate.

Conclusion

The next president takes office with an extensive but inadequate federal clean energy toolkit. A thorough inventory and upgrade is in order. An improved set of policy and finance tools, involving both the public and private sectors, will put the U.S. on a better path to develop and deploy critical clean energy technologies – rapidly, cost effectively and at scale. With that, our nation will be in a stronger position to confront the climate crisis at home and carry out its critical leadership role globally.

302 Hadjerioua, Wei, and Kao, “An Assessment of Energy Potential at Non-Powered Dams in the United States,” GPO DOE/EE-0711 (2012), http://www1.eere.energy.gov/water/pdfs/npd_report.pdf.

FINANCING THE PARIS COMMITMENTS

The Urgent Need for Leadership

Author

William Reilly is the Senior Advisor to TPG Capital, LP, and the former Administrator of the Environmental Protection Agency.

Contact

TPG Capital
345 California Street
Suite 3300
San Francisco, CA 94104
<http://www.tpg.com/>
wreilly@advisorstpg.com

Abstract

Commitments to reducing greenhouse gases that 195 nations made in Paris are dependent on two contingencies. First, countries must identify the specific sectors where greenhouse gas reductions must be made. Even the United States has yet to identify precisely where it will achieve a third of its promised reductions. For the major developing countries, a greater portion of specific committed reductions is yet to be determined. The second contingency is financing. India, Brazil, Indonesia and South Africa made their Paris promises dependent on receiving sufficient foreign investment. Much of this investment will necessarily come from private sources. However, the significant new source of capital, and also potential leadership, is the Asian Development Bank. I urge the president to apply to join the bank America so recently lobbied its allies to spurn, to ask for a seat on the board, and to urge the bank to lead the efforts to help Asian and African countries build renewables on the scale of the plans they announced in Paris. Part of that leadership should be the mobilization of private capital paired with bank funds. Backed by China's significant resources and recognizing the important role China played in making Paris a success, the expectation is reasonable that China's impressive new institution will commit to making climate history.

Financing the Paris Commitments

People the world over cheered the news that 195 nations had seriously engaged the challenge of climate change in Paris and that most had committed to reducing their greenhouse gas emissions. Experts noted at the time that even if the commitments were to be achieved, they would not keep world temperatures below 2 degrees Celsius. In fact, estimates indicate the agreed-upon policies would likely accommodate twice the 2-degree target, considered the maximum that can be tolerated without catastrophic consequences of droughts and floods and violent storms. Preventing significant sea-level rise looks daunting under any practically plausible scenario.

Nevertheless, the Paris commitments are not the last word, nor were they intended to be. The most successful international environmental agreement of recent history, the Montreal Protocol to Protect the Ozone Layer, began with developed countries obligating to reduce by half their emissions from ozone-depleting substances. Just five years later, and with a better appreciation for replacement technology and ample substitutes, parties to the agreement scheduled full phaseout. The Paris agreements are similarly set to be reviewed in five years.

Paris commitments include both hard promises and aspirational objectives. Although the United States promised to reduce its greenhouse gas emissions 28 to 30 percent by 2030, fully one-third of the reductions are as yet unspecified. Even the United States has work to do to identify and then realize a major part of its commitment. For several developing countries, the identification of promised reductions and the means by which they will meet them is even more uncertain. So what the governments achieved in Paris, important as it was, will require sustained work to achieve.

A second caveat looms larger over the commitments, and that is the money necessary to achieve them: to build the new energy economy of renewable wind and solar, to make the grid improvements, to complete the efficiency investments that are implicit in the goals countries have set themselves. The most important pillars of the U.S. strategy for reducing greenhouse gas emissions are essentially assured of sufficient financing by the electric utility industry in the case of the Clean Power Rule for existing power plants and New Source Performance standards as applied to new coal-fired power plant proposals and by the automobile industry for the 54.5 mpg requirement for new autos manufactured starting in 2025. These rules are susceptible to political reconsideration, and thus the disposition of each presidential administration will need to be supportive. But if the regulations hold, one can be reasonably confident that at two-thirds of the commitment, reductions will be achieved.

The U.S. record regarding the commitments made at the international Conference of the Parties prior to the Paris meeting should inspire confidence. Although they receive little recognition, the greenhouse gas reductions promised by President Obama in Copenhagen are on their way to being met. The volumes of low-priced natural gas produced by the oil and gas industry created a lower cost fuel competitor for coal, and one which also has the advantage of producing significantly less carbon dioxide. Thus, the displacement of coal pursued by the policies of the Obama Administration has been reinforced by the market. This experience is one critics of the oil industry might learn from; the industry has resources in technology, geology, engineering and subsurface characterization and exploration that may well lend themselves to a constructive role in addressing climate change.

If the prospects for the developed countries are at least directionally correct, in Europe where automobile efficiency requirements also are leading to reduced oil consumption, along with incentives to renewables for electricity, key developing countries face more daunting obstacles. Several of the major developing countries accounting for the most emissions growth now and in the future – India, Brazil, Indonesia and South Africa – made serious and respectable promises in Paris. They submitted ambitious plans to meet much of their expected growth in electricity demand with wind and solar energy installations. However, the gap between their goals and the identification of specific means to reach them is very large. And these are the countries where the greatest reductions must be made. According to the report, “Shaping Energy Transitions,” endorsed by some of the most-respected energy executives and authorities, the investment necessary to finance the construction of the massive new renewables promised is two trillion dollars over the next 15 years. And most of the plans put forward by developing countries explicitly state that keeping their commitments will be dependent on financing, most of which is assumed to be from foreign investment. Currently, the resources of international aid and lending institutions do not begin to approach the levels necessary to finance the needed energy transformation. Could private capital fill that role?

There are in the range of \$70 trillion in capital invested in pension funds, endowments, hedge funds, private equity and similar institutions in the world. Such funds could be invested systematically in the new energy economies of the high-emission countries. Foreign direct investment dwarfs the annual transfers of funds from public institutions. However, recipient countries and their private sectors would have to design investment vehicles with characteristics not always offered in the developing world and with return prospects at a level that compensates for risks in a relatively new and growing industry in countries that, even though they may be growing, are also poor and the governance of which is distracted by more pressing concerns. Think of the political crisis in Brazil, the commodities downturn in South Africa, the endemic transparency challenges in Indonesia, the severe two-year drought in India. How much initiative will such countries mount to keep their Paris pledges? The initiative to design new incentives to secure private sector financial institutions will very likely have to come from the financial sector itself. Is that a realistic possibility?

The newly established Asian Infrastructure Bank (AIB) is one of the few new sources of capital mobilized to meet pressing demands in Asian countries. Its capital subscription, and even its membership, is still being added to. Some informed observers believe that the United States, which unsuccessfully lobbied its allies against joining, will eventually join the membership in hopes of influencing the AIB's priorities and investment projects. One might foresee the bank's carving out renewable energy as the object of a major portion of its investments. The AIB might also innovate new partnerships with private investment groups whereby the bank would offer one-third participation in various project commitments, much as the U.S. Overseas Private Investment Corporation has long done with private equity institutions. The potentially substantial financial resources available from Chinese reserves could change the renewables game in Asian countries. AIB has stated its intention to be open eventually to investing in Africa. However, the AIB CEO, in a dinner conversation with me in June in Beijing, said that he was not open to designating climate as a priority for AIB investment. He said that if renewable investments were proposed, the bank would consider them, and if the investments met standard investment criteria, they could be financed by the bank. But he ruled out a major funding priority aimed at helping countries realize their Paris commitments.

The challenge of financing the Paris commitments should be a major priority, especially of China, which along with the United States played such a critical collaborative role in making the Paris meeting successful. The burden is not simply one China need bear alone. Leadership on the part of governments and also private financial institutions will be required. The practice of waiting for developers to come forward and propose promising new projects will not meet the need in scale, timing and number of investments. One must ask for a different and more activist brand of leadership from private financiers, many unaccustomed to engaging in driving developers to initiate large projects, as from the development banks. Significant new funds must be found to scale up the installation of clean energy in order to realize fully the promises of Paris. But the Asian Infrastructure Bank, with its backing of China and with significant new multination funding, is the major new player on the scene of world development, and its priorities remain to be determined. Asia and Africa, of course, need infrastructure, and the bank has been conceived as an important new source of funding for it, but the opportunity is to focus first on energy infrastructure. If the bank were to do so, it could lead the drive to make good on the Paris promises.

I recommend that the president make a priority to obtain commitments from public and private sources to finance renewable energy and energy efficiency. And I propose the president start by applying to join the Asian Infrastructure Bank, acquiring a place on the board, and pressing major investor and donor countries to make the achievement of the Paris commitments a major thrust of the bank's investments. Many institutions will have to become engaged along with the AIB. But the partnership of the United States and China, together with an important well-capitalized new international funding institution, could accomplish several goals. It could ensure China remains engaged in reducing its own and other countries' greenhouse gases; it could marshal very significant funds; and as both the biggest polluter and a developing country, it could use its vast capital reserves to set an example to other fast-growing developing countries. The U.S. president, by swallowing some pride and proposing to join the enterprise America tried to thwart, could make clear that the Paris commitments are worth a change of heart.

RECOMMENDATIONS FOR THE NEXT PRESIDENT

Author

The Hon. George P. Shultz is the Thomas W. and Susan B. Ford Distinguished Fellow at the Hoover Institution and advisory council chair of the Precourt Institute for Energy at Stanford University.

Contact

Precourt Institute for Energy

Stanford University

473 Via Ortega

Stanford, CA 94305

<https://energy.stanford.edu/people/george-shultz>

<http://www.hoover.org/profiles/george-p-shultz>

precourt_institute@stanford.edu

Recommendations for the Next President

In my talk at Stanford University on May 6, 2016, I offered several observations and recommendations regarding how the next President of the United States should address climate change. My presentation included the following key points:

Climate Change Must be Depoliticized

Climate change clearly is a serious issue that could have a profound effect on everyone in the world.

Climate change should not be partisan. Scientific uncertainty should not be used as an excuse for inaction. We should learn from the approach that President Reagan took with regard to concerns that certain chemical releases might be creating a hole in the earth's ozone layer. Given the stakes involved, President Reagan agreed to move forward with an international initiative, the Montreal Protocol, to reduce ozone-depleting chemicals. He viewed it as an insurance policy. We should take the same approach with climate change.

Similarly, concerns about the sources and impacts of acid rain on lakes and forests in the eastern United States were ultimately addressed in a nonpartisan fashion. Scientific uncertainty did not stand in the way of taking action – led by President George Bush – through a cap-and-trade program with the utility industry that has been very successful.

The U.S. Should Adopt a Carbon Tax

As an economist, I believe in the power of the market to address important issues. When goods and services are priced correctly, the market provides opportunities for competition and innovation.

Currently, energy sources that generate greenhouse gases are not priced to account for the true cost of their products. If there's a form of energy that produces a lot of carbon, we should be paying for that.

Accordingly, I believe that the U.S. should put a carbon tax in place to create a level playing field for competition among energy sources. The tax should be revenue neutral in order to avoid a fiscal drag on the economy and to avoid debates over how the money generated is used.

I note that the world is already moving in this direction. More and more businesses are incorporating a carbon price when making their long-term investment plans. The World Bank and the IMF also have joined in advocating a revenue-neutral carbon tax.

We Should Continue to Invest Heavily in Clean Energy Research and Development with the Active Participation of the Business Sector

Republicans and Democrats alike are excited by research and advancements being made at places like Stanford and MIT. New breakthroughs such as large-scale electricity storage present important opportunities to scale up clean energy because they address the intermittency issues associated with wind and solar energy and potentially help to protect the integrity of the grid from cyber attack. Stanford University's highly efficient new power system – Stanford Energy System Innovations (SESI) – exemplifies the type of innovative clean energy solutions of which the private sector is capable.

The business sector needs to be actively involved in both clean energy research and development and in scaling up new energy solutions. The government and universities should not shy away from working with the private sector on energy R&D and deployment.

Energy Efficiency Must Play a Key Role

The least expensive and cleanest energy is the energy that you do not use. During the Arab Oil Boycott, when I was the Secretary of Treasury, we learned as a nation how much energy could be saved. In addition, when I led the Bechtel Corporation, we were able to have an immediate, positive impact on reducing our energy use by putting in place common-sense energy efficiency measures.

Professor Jim Sweeney, Director of the Precourt Energy Efficiency Center at Stanford, has written a new book on this subject, *Energy Efficiency: Building a Clean, Secure Economy* (Hoover Press, 2016), that everyone should read.

Learning from the States

The Hoover Institution's energy team worked with Senator Jeff Bingaman, Stanford Professor Dan Reicher, and the Steyer-Taylor Center for Energy Policy and Finance on an analysis of energy innovations that are occurring at the state level. We identified a large number of important energy innovations that are under way in both red and blue states. Our states truly are "laboratories of democracy." We should continue to encourage state-based innovations and help spread the word of their successes so that they may be adopted more broadly. I encourage the next President to review the report that we prepared on this subject, *The State Clean Energy Cookbook: A Dozen Recipes for State Action on Energy Efficiency and Renewable Energy* (Stanford University and Hoover Press, 2014).

Governance Issues

The question of how the President should organize his or her administration to effectively address climate change and energy issues is an important one. I believe that the White House should work through well-established processes – such as the National Security Council – when making important policy determinations. The Cabinet needs to be actively involved in policy making, perhaps by bringing together key departmental leaders into an "energy cabinet" that develops strategic directions for the Administration.

When it comes to implementation, I have an old-school view that the President-elect should treat both the White House and the Cabinet as "staff" with a responsibility to execute on policy. In that regard, it is important that the President, the White House, and the Cabinet lean on the career staff to implement policy. Career civil servants are a tremendous resource, and they will be eager to work with the new President, particularly in an exciting and important field like energy.

I also recommend that the next President get the "A" players in the government involved in addressing our nation's energy and climate change needs. This includes, in particular, the Department of Defense.

In order for the next President to build a strong team to work on these serious issues, the current confirmation process must be repaired. Nominees should not be forced by the Congress to languish, awaiting confirmation for months at a time, but should be given a prompt up-or-down vote.

COMPETITION AT THE GRID EDGE

A New Role for the Federal Government in Overseeing Competition Between Utilities and Distributed Energy Resources

Author

Michael Wara is Associate Professor and Justin M. Roach, Jr. Faculty Scholar at Stanford Law School.

Contact

Stanford Law School
559 Nathan Abbott Way
Stanford, CA 94305-8610

<https://law.stanford.edu/directory/michael-wara/>
mwara@stanford.edu

Abstract

The next eight years will bring transformative technological and economic change to the electric power sector. These changes will involve the consumer's playing a much more active role in shaping the electricity system. The next administration needs to position U.S. sectors, both within electricity and around it, to take advantage of these changes. Doing so will require a shift in how the grid edge, where customers interact with the electricity system, is conceived of and regulated. More than an energy regulatory problem, this is a competition law problem. The next administration should thus extend the work begun under the Obama administration to clarify and articulate the boundary between structurally competitive markets and regulated monopoly in the electricity sector. It should also act through its antitrust merger review authority to push for a level playing field for distributed energy technologies. By clarifying where antitrust law applies and conditioning merger approval on fair treatment of competitors, the next president can do much to spur action by state utility commissions to better take account of competition issues in their decisions. Developing a fair and level playing field for distributed energy will require careful attention both to the unique complexities of electricity and to the limits of antitrust remedies. But by embracing the challenge, the next president will position the United States as the leader in clean energy technologies for the 21st century.

I. Introduction

Open, fair and competitive markets are in the national interest – this is especially true when technological innovation creates the prospect of competition where natural monopoly has prevailed in the past. Rate regulation of industries is essential to constrain monopoly rents if a single firm can most efficiently serve all customers. But rate regulation in industries that do not require it tends to produce suboptimal outcomes because of the incentives and information challenges of the rate-setting process.³⁰³ Competition in the power sector, as in other sectors – most notably telecoms – incentivizes innovation, productivity growth, consumer choice and consumer value.

303 See Stephen Breyer, *Regulation and Its Reform* (Cambridge, MA: Harvard University Press, 1982); Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions, Vol. 1* (Cambridge, MA: MIT Press, 1988).

Today's electric power sector is at a turning point. Over the past decade, due to technological innovations and cost declines and fostered by long-term government support and sponsored research, a significant number of technologies that fundamentally change the consumer relationship with electricity have seen very large cost declines. The most important of these technologies today is solar PV – where continued declines in prices have led to a dramatic increase in deployment at the household level. But other technologies, most notably battery storage and energy sensor and control technology, are also experiencing dramatic changes in affordability, ease of deployment and adoption.

The greatest challenge for the next administration in the electricity space will be to continue and substantially expand the efforts the Obama administration has made to foster development of a vibrant, competitive marketplace for consumer energy services. By doing so, the administration will do much to create a national market for consumer energy services that will further drive down costs and increase the rate of innovation. Failure to do so is likely to result in balkanized consumer markets, higher costs and much less innovation in service offerings. Given the current magnitude of distributed solar deployment and the rapid growth of energy storage, the difference between these two outcomes has real implications for the achievement of productivity gains and job creation as well as air quality and climate goals.

II. The Current State of Competition at the Grid Edge

To date, rooftop solar and net metering have been the technologies for which competition issues are most acute in the power sector. Net metering, especially when combined with rates that bill for grid capital costs based on customer usage, have led to some erosion of revenues for a small number of utilities and have created deep-seated concern in the boardrooms of many others.³⁰⁴ The response has been a widespread move by utilities to change rate structures in ways that lower or even remove incentives to deploy customer-sited solar. Some of these efforts have borne fruit, most notably in Nevada and Wisconsin, while others have been less successful, such as in California.

My work and the work of other academics questions the extent to which these rate cases raise novel antitrust issues.³⁰⁵ We argue that changes in utility retail rate structures that erect or increase existing barriers to entry for competitors may not be immune from antitrust scrutiny. Further, I have argued that these concerns and their potential impacts on innovation should factor into the review of proposed utility mergers by antitrust regulators.³⁰⁶

At the outset, it must be emphasized that the real issues for the electricity industry are not limited to any particular technology. The competition issue is not (just) about solar net metering, although it might seem like that right now. The real issue is customer-side energy services more generally. Energy storage is the next big thing with large year-on-year cost declines and a proliferation of consumer-facing products. Smart homes and businesses are not far behind. Both energy storage and smart homes will become only more valuable as the challenge of integrating ever greater amounts of solar energy into the electricity system becomes more acute.

An all-out focus on solar and net metering risks missing the bigger and much more important question of what to do to (1) avoid erecting barriers to and to (2) perhaps even enable the dynamic innovation that is unfolding on the customer side of the meter. And to be clear, this evolution is occurring at a much more rapid pace than the utility industry can compete with. The most important aspect of this unfolding dynamic is probably the very different product cycles that occur in utility scale power generation relative to Distributed Energy Resources (DER). DER product cycles are annual or shorter. Utility scale product cycles are decadal. This has important

304 See Peter Kind, *Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business* (Washington, DC: Edison Electric Institute, 2013).

305 See Michael Wara, "Competition at the Grid Edge: Innovation and Antitrust Law in the Electricity Sector," http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2765502. Amy Stein of the University of Florida Levin School of Law and Ari Peskoe of Harvard Law School have made related claims. See, Ari Peskoe, "Unjust, Unreasonable, and Unduly Discriminatory: Electric Utility Rates and the Campaign Against Rooftop Solar," *Texas Journal of Oil Gas and Energy Law* (forthcoming).

306 See Michael Wara, "Fostering Competition in the 21st Century Electricity Industry," *Harvard Environmental Law Review* 40 (2016): 41.

implications for rates of innovation, particularly as energy evolves toward a service offering as opposed to a commodity product. As significant, it means that the competitive situation today is unlikely to be representative of where things will be in a decade.

The Obama administration has also shown an increasing willingness to take a position in competition disputes regarding distributed energy. SolarCity, the largest home solar installer in the country, brought an antitrust claim against a utility, Salt River Project, that enacted particularly onerous changes in its rates for rooftop solar customers. In a surprising move, the Department of Justice (DOJ) intervened in the case earlier this year. DOJ Antitrust argues in its brief in support of SolarCity's contention that Salt River Project, even though it operates a state-chartered monopoly and so would normally be immune from antitrust claims, should nevertheless be held to account for any actions it takes that are anticompetitive with respect to rooftop solar.³⁰⁷

In another signal of federal competition regulators' interest in grid edge energy services, the Federal Trade Commission (FTC) has intervened in important regulatory proceedings, ongoing in New York State, known as the *Reforming the Energy Vision or REV* process. The REV process is intended to result, ultimately, in competitive markets for energy services at the customer level. The FTC filed comments early on and has continued to stay engaged in this process as it unfolds. In its comments, the FTC has emphasized the need to create open access for all energy service providers in the new markets that REV would create and has warned against allowing regulated utilities to serve in roles where they can leverage their monopolies in the grid to gain unfair advantages over other competitors.³⁰⁸ Federal regulatory intervention in state utility proceedings is exceedingly rare, increasing the perceived significance of FTC participation in the REV proceedings.

Finally, in June of 2016, the Federal Trade Commission convened a workshop on distributed energy, in part to understand whether competition between DER providers and electric utilities raises a novel antitrust enforcement concern.³⁰⁹ A diversity of views were expressed on the panel – especially as to whether and how antitrust law could be used in practice to govern the conduct of state-regulated electric utilities. A diversity of views were evident at the forum, ranging from those who felt that while the competition issues were real and important, the use of antitrust authority would be impractical to those who argued for a more vigorous role for antitrust enforcement.

To be clear, electric utilities deserve a fair shake, too. They have made and continue to be required to make investments predicated on a business model that assumes no competition and focuses on cost minimization, not customer value. Cost minimization is a very limiting box to be in when exposed to firms that are willing to take risks because they can enjoy high future returns. Regulated utilities provide an incredibly valuable service to American consumers at relatively low cost and are obligated to serve all comers – unlike their would-be disrupters. They are also required, unlike their competitors, to provide very high levels of reliability. The interests of these firms and their shareholders deserve consideration in evaluating how and where a role for antitrust law should or should not exist in policing competition at the grid edge.

307 See Brief for the United States of America as Amicus Curiae supporting Plaintiff-Appellee, *SolarCity v. Salt River Project*, 9th Cir. No. 15-17302 (June 7, 2016).

308 See Federal Trade Commission, Reply Comment of the Staff of the Federal Trade Commission, Proceeding on the Motion of the Commission in Regard to Reforming the Energy Vision, Staff White Paper on Ratemaking and Utility Business Models, Case 14-M-0101 (Nov. 23, 2015).

309 See Federal Trade Commission, "Something New Under the Sun: Competition and Consumer Protection Issues in Solar Energy," June 21, 2016, <https://www.ftc.gov/news-events/events-calendar/2016/06/something-new-under-sun-competition-consumer-protection-issues>.

III. Shaping A New Role for Competition in Electricity

So how should antitrust enforcement agencies respond to this nascent competition? Basic principles are straightforward. First, create a level playing field for consumer energy services. Second, resist attempts by utilities, abetted wittingly or unwittingly by utility commissions, to create or raise barriers to entry for new technologies or service offerings. But detailed strategies to accomplish these goals bring antitrust regulators into unfamiliar and complex territory.

Courts and antitrust regulators are averse, and with good reason, to playing the role of rate regulator.³¹⁰ In general terms, these goals will be effectuated by differentiating between rate structures or practices that discourage competition from those that allow for and reward it. Applying these general concepts to specific contexts is a daunting challenge. How should antitrust enforcement intervene where prices are set by application to a commission, where cross-subsidization between different types of customers has been common practice for decades and where the regulatory context and industry structure vary substantially between states? This is a daunting challenge.

Before this challenge can even be addressed, the role of antitrust law in the electricity industry of the future needs to be clarified. This should be an important energy policy goal of the next president. Today, electric utilities and public utility commissions do not believe antitrust enforcement has any role to play in their activities due to what is known as the State Action Immunity doctrine. This area of law creates an exception to the antitrust laws where a state authorizes anticompetitive conduct by a party and then actively supervises the conduct as it occurs. *State Action Immunity* has long protected state-chartered and supervised monopolies from the application of the antitrust laws – and for good reason. Utilities rely upon this doctrine for antitrust immunity for their regulated business. And for much of that business, they are absolutely right to do so. It would be manifestly unfair to both require a utility to provide monopoly service at prices regulated by the state and yet to then impose liability for being a monopoly.

But whether utilities should be shielded from competition in provision of distributed energy services is a much closer question. Why should the doctrine shield utilities when they take actions that erect barriers to entry of otherwise unregulated DER providers that want to provide energy services to homeowners or businesses? The next administration should act to create a policy and a set of legal precedents that define clear limits to the reach of this doctrine, consistent with the new technological realities in the energy space. Initial advocacy by the antitrust agencies needs to focus on the two legal prongs of the State Action Immunity doctrine, authorization and supervision.

The first question a new administration's antitrust lawyers should be asking is whether utilities across the country have been clearly authorized by the states to act anticompetitively toward distributed energy. In large parts of the country, retail competition of some sort exists under state law for electricity customers. As electric utilities in these jurisdictions act to change rates in ways that discourage rooftop solar or other technologies, antitrust enforcement has a role to play in questioning whether states have clearly authorized displacement of this new type of competition. Where there is authorization for grid-based retail competition, why not competition from distributed energy? This argument has been made in the *SolarCity v. SRP* case by DOJ Antitrust but needs to be made to utility commissions across the United States as they are considering proposals by utilities that would harm competition.

In addition, many of the actions being taken by utilities across the country to change rate structures are focused solely on rooftop solar rather than on rates in general. For example, many proposed rate structures would impose minimum bills or demand charges on net metering customers but not on other customers. Should the utility be free from immunity when it modifies its rate structures to single out competition from rooftop solar? Absent specific statutory authorization, the answer is probably not. Modifications to rate structures should focus on creating a level playing field for all technologies on either side of the meter rather than singling PV out for special treatment, absent specific authorization by state legislatures to do so.

310 See *FPC v. Hope Natural Gas Co.*, 320 U.S. 591 (1944).

A second line of inquiry that a new administration's competition lawyers should pursue is whether utilities anticompetitive conduct, where it exists, is sufficiently supervised by public service commissions that oversee and approve rates. It might seem odd to suggest that a public utility commission (PUC) does not actively supervise retail rates. Most utilities, faced with the burden of supervision by utility commissions, would beg to differ. But the key question is the content of "supervision" that occurs and whether it is sufficient to relieve utilities of antitrust liability. Is the supervision concerned with utility cost recovery? Is it concerned with bill impacts to ratepayers? Or is it concerned with competitive impacts to DER providers? A new administration's lawyers should argue that courts need to clarify that the last is the most important criterion in assessing whether supervision is active in the context of a structurally competitive but indirectly rate-regulated market such as that for distributed energy.

The truth is, we don't really know how courts will respond to the issue of what counts as active supervision. The Supreme Court and circuit courts have been quite vague on the content of active supervision that must occur to confer State Action Immunity. What the history and evolution of antitrust law does teach is that enforcement is highly fact and context specific. A new administration should make the case that there are a new set of facts and a very new context in the electricity sector and that the national interest lies in fostering this evolution.

This strategy is not without risk: Courts allow the use of antitrust authority in new ways only reluctantly for fear of too much enforcement unfairly clipping the wings of successful enterprises. But right now, utilities feel free to propose new rate structures and commissions to review and approve them, with no consideration to the broader impacts on the developing ecosystem of distributed energy providers and the customers they serve. One recent example of this attitude was the decision by the Nevada Public Utility Commission, at the behest of its largest utility, to exclude SolarCity from full participation in negotiations on future rates for existing rooftop solar customers.³¹¹ The idea that SolarCity has no interest in the outcome of this proceeding, given the impact of changes to the grandfathering rules on its ability to procure financing on future projects, does not withstand scrutiny. The new administration should pursue the policy that utilities will not be immune for anticompetitive conduct against DER providers unless supervision by utility commissions takes these stakeholders' interests fully into account in setting the rules by which all parties compete for customers.

The Federal Trade Commission has taken some tentative steps into the area of state utility commission regulation of the power sector. In the FTC's comments in the NY REV proceeding, where it opposed allowing utilities to both own the transmission and distribution system and to operate as the distribution system operator, it essentially staked out a position on a structural remedy for competition in retail electricity. This suggestion by the FTC regarding how a new industry – the market for energy services operated in the distribution system – should be structured contains important pieces of how a new administration might flesh out the details of a new competition policy for consumer energy services.

The end goal should be creation of a national market for DER that allows for full exploitation of the potential productivity gains created by technological innovations. The best way forward in the numerous contexts across the country is for utility commissions to take a much more active role in oversight of the competition impacts of proposed changes to retail rates. By evaluating not just how retail rates will impact utilities and ratepayers but also how rate-structure changes will affect competition, PUCs and their regulated utilities can do much to avoid a highly disruptive private or public antitrust challenge to a rate case. The DOJ Antitrust involvement in the SolarCity–SRP case and FTC engagement in NY REV are important first steps in this direction. But a new administration needs to signal that this should be the rule for commissions moving forward. Commissions will not adopt this new responsibility unless antitrust regulators insist that they do so.

311 See Krysti Shallenberger, "Nevada Regulator Blocks SolarCity from Grandfathering Proceedings," *UtilityDive*, Sep. 1, 2016, <http://www.utilitydive.com/news/nevada-regulator-blocks-solarcity-from-grandfathering-proceedings/425578/>.

A new administration need not stop there in fostering a new era of competition and value creation for electricity customers. Federal competition regulators can and should be taking a more active stance in their horizontal merger reviews of major utilities. A new administration should be asking for disclosure during merger review of current retail rate structures and the competitive impacts on DER of the spread of one set of practices to the merged entity's full territory. It should also be soliciting input from the merging utility's DER competitors. By doing so, the new administration's competition regulators would do much to encourage the spread of best practices as utilities continue the consolidation wave brought on by stagnant electricity demand and shareholders' growth expectations. The next administration can and should act to ensure that the multistate utilities that emerge from the next wave of mergers are champions of DER and are well-positioned to make the transformation from regulated entities to competitive service providers, much the way the predecessors to AT&T and Verizon did over the last two decades.

Finally, the next administration should take heart in the fact that the law governing what counts as acceptable rate recovery already recognizes this inherent complexity. For 72 years, the law of the land has been that rate cases will not be overturned by courts as long as their impact is reasonable – not because there are technical defects in their accounting methods.³¹² Perfection is not required. For 48 years, Supreme Court doctrine has held that as long as a commission's decision is "within the zone of reasonableness" it will not be disturbed.³¹³ In other words, rough justice is acceptable in the rate-setting context. Antitrust remedies need do no better or worse than what courts will require of utility commissions.

Likewise, regulators should reassure themselves that there is no question that utilities should not be free to charge a rate that allows them a fair recovery on their invested capital. The only issue a new administration's competition regulators are concerned with is in regard to how that rate is distributed across customers and the consequent impacts of that structure on innovation in consumer energy services.

IV. Conclusions

Managing the new competition issues in the electricity sector is hard but essential work for the next administration. The next president should set as his or her goal nothing less than the creation of a national market for consumer energy services. Accomplishing this objective would unleash enormous productivity gains and lead to the creation of large numbers of high-quality jobs that cannot be outsourced. It would also position the United States as a leader in the energy transformation that is occurring across the globe.

Getting to that outcome will, of course, be enormously complex given the nature of the electricity system and its regulatory structure. But antitrust agencies should not shy away from their critical role. The purpose of antitrust engagement early in the next administration should be to avoid a situation where competition and innovation are stifled or where the issues are left unaddressed until they are so acute that private antitrust litigation leads to a wave of settlements that will prove highly disruptive to the utility industry.

The next president's antitrust agencies, in collaboration with both PUCs and regulated firms, should play a more active role in ensuring that the electricity landscape is fair for all participants. Ensuring this will further the interests of consumers, regulated utilities, DER providers, state governments and the nation as a whole over the next eight years. The federal government has an important role to play in helping to guide the grid edge ecosystem from one dominated by regulated utility monopolies toward a diverse, creative and value-creating sector that generates jobs, wealth and economic growth while at the same time improving local air quality and reducing the harms from climate change.

312 See *FPC v. Hope Natural Gas Co.*, 320 U.S. 591 (1944).

313 See *Permian Basin Area Rate Cases*, 390 U.S. 747 (1968).



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Stanford, CA 94305

environment@stanford.edu

woods.stanford.edu