The Costs of Building Decarbonization Policy Proposals for California Natural Gas Ratepayers: Identifying Cost-effective Paths to a Zero Carbon Building Fleet Supporting Information
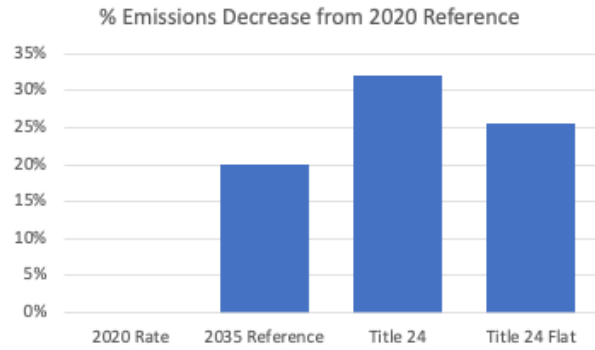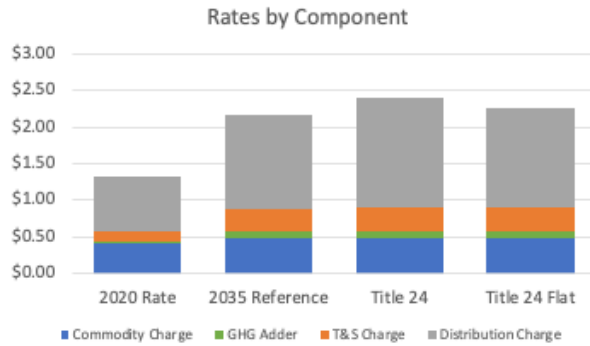
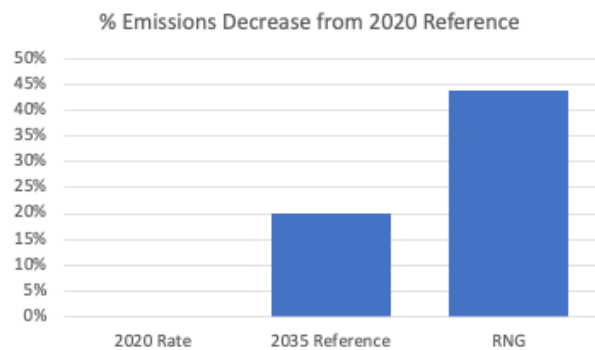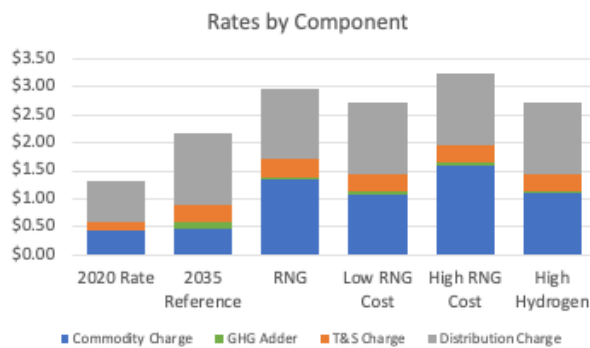## Alison Ong, Michael Mastrandrea, and Michael Wara

<u>Sensitivity Analysis</u>

The table below defines all scenarios used in our analysis, divided into Main Scenarios (presented in the main text) and Sensitivities (illustrated in the subsequent charts). A spreadsheet with full results and a visualizer for scenario comparison is available upon request.

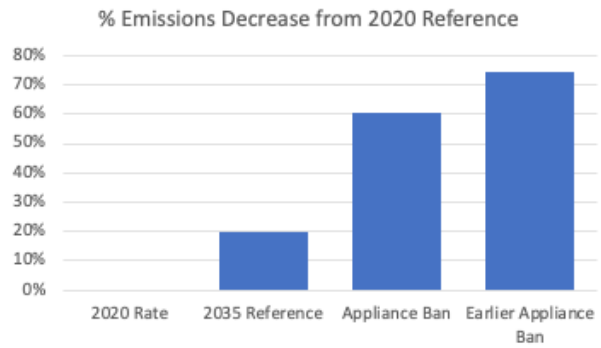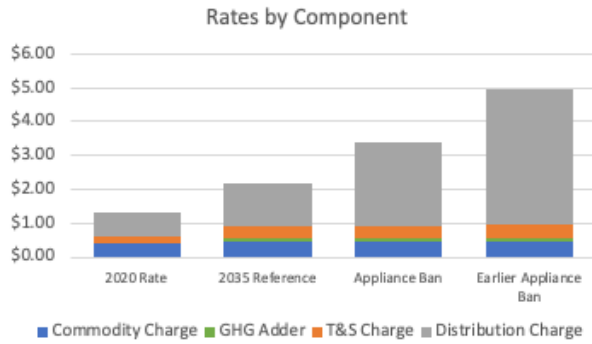| Scenario Type	Scenario Name	Policy Description	Rate Increase (%)	Emissions Decrease (%)
Main	Reference	No specific additional policy is undertaken to reduce natural gas usage or emissions.		
Main	Title 24	Electrification incentives curb consumption from 2023–2026, a statewide moratorium on natural gas hookups in all new construction takes effect from 2026 onwards.	11%	15%
Main	RNG	The concentration of Renewable Natural Gas is increased by 2% per year beginning in 2021, reaching 20% RNG by 2030.	37%	30%
Main	Appliance Ban	Beginning in 2026, the sale of new gas-fueled appliances is prohibited, resulting in phase-in of electric equivalents.	56%	51%
Main	Branch Pruning	From 2023 onwards, strategic retirements of distribution infrastructure assets begin alongside targeted electrification.	12%	32%
Sensitivity	Title 24 Flat	Hold customer numbers and throughput per customer constant after 2026 instead of imposing a 1% decline	5%	7%
Sensitivity	Earlier Appliance Ban	Same logic as the main Appliance Ban case, but begin implementation in 2023 instead of in 2026	129%	68%
Sensitivity	Earlier Branch Pruning	Same logic as the main Branch Pruning case, but begin implementation in 2021 instead of in 2023	12%	37%
Sensitivity	Later Branch Pruning	Same logic as the main Branch Pruning case, but begin implementation in 2026 instead of in 2023	17%	31%
Sensitivity	Inexpensive Natural Gas	Update conventional natural gas price to reflect the 2021 AEO base forecast	-6%	0%
Sensitivity	Expensive Natural Gas	Update conventional natural gas price to reflect the 2021 AEO "low supply" forecast	3%	0%
Sensitivity	Low RNG Cost	Use optimistic (low) cost projections for biogas, hydrogen, and SNG instead of the average of the low and high costs used in the main RNG scenario	28%	30%
Sensitivity	High RNG Cost	Use conservative (high) cost projections for biogas, hydrogen, and SNG instead of the average of the low and high costs used in the main RNG scenario	52%	30%
Sensitivity	High Hydrogen	Assume 20% hydrogen can be injected into the pipeline, meaning no SNG is needed in 2035	29%	30%

We modeled one sensitivity to the Title 24 scenario. The Title 24 Flat sensitivity assumes that customer account numbers stay static after the implementation of a moratorium on natural gas in new construction, instead of declining at 1% per year.

Rates by Component (left chart) — categories: 2020 Rate, 2035 Reference, Title 24, Title 24 Flat; components: Commodity Charge, GHG Adder, T&S Charge, Distribution Charge

% Emissions Decrease from 2020 Reference (right chart) — categories: 2020 Rate, 2035 Reference, Title 24, Title 24 Flat
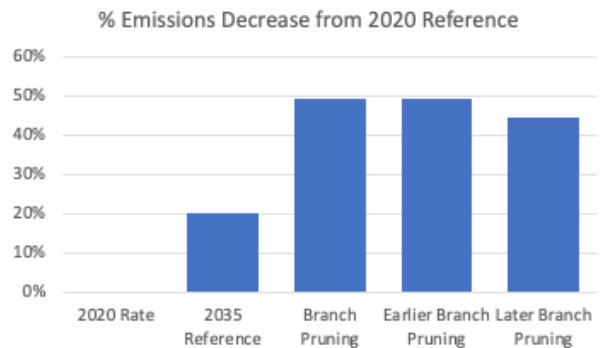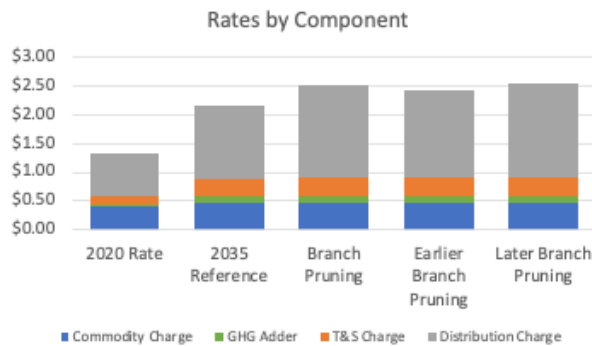
We modeled three sensitivities to the RNG scenario. The Low RNG Cost sensitivity assumes an optimistic projection of RNG costs, while the High RNG Cost sensitivity assumes a more conservative projection (the main RNG scenario reflects an average of these two trajectories). The High Hydrogen sensitivity assumes that up to 20% hydrogen can be incorporated into the pipeline, instead of 8%. Because all RNG is assumed to have an emissions rate of zero, the introduction of 30% RNG by 2035 simply results in a 30% emissions decrease relative to the 2035 Reference case, regardless of which types of RNG are used.

Rates by Component (left chart) — categories: 2020 Rate, 2035 Reference, RNG, Low RNG Cost, High RNG Cost, High Hydrogen; components: Commodity Charge, GHG Adder, T&S Charge, Distribution Charge

% Emissions Decrease from 2020 Reference (right chart) — categories: 2020 Rate, 2035 Reference, RNG

We modeled one sensitivity to the Appliance Ban scenario. The Earlier Appliance Ban sensitivity initiates the ban in 2023 instead of 2026, causing a more significant decline in throughput by 2035.

Rates by Component

Commodity Charge · GHG Adder · T&S Charge · Distribution Charge

% Emissions Decrease from 2020 Reference

We modeled two sensitivities to the Branch Pruning scenario. The Earlier Branch Pruning sensitivity begins pruning in 2021, while the Later Branch Pruning begins pruning in 2026.

Rates by Component

Commodity Charge · GHG Adder · T&S Charge · Distribution Charge

% Emissions Decrease from 2020 Reference

We modeled two sensitivities to the Reference scenario. The Inexpensive Natural Gas sensitivity updates conventional natural gas prices to reflect the 2021 EIA AEO Base Case, which predicts values lower than assumed in the original E3 model. The Expensive Natural Gas sensitivity uses prices based on the 2021 EIA AEO, Low Supply scenario.

Rates by Component

Commodity Charge · GHG Adder · T&S Charge · Distribution Charge
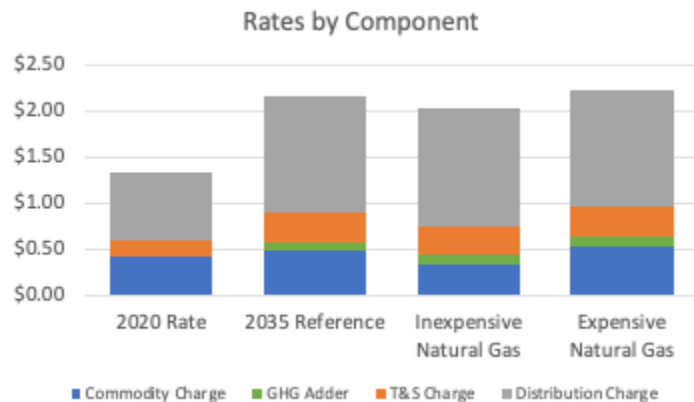
<u>Specific Modifications</u>

Our study generally follows the assumptions and model logic used in the E3 Revenue Requirement tool, with specific modifications as documented below.

- The GHG price adder was modified as described in the main text.
- For the Title 24 and Appliance Ban scenarios, we first developed a trajectory for total number of residential customers and residential throughput per year that reflected the scenario or sensitivity in question. These trajectories were then used as inputs to the E3 Revenue Requirement tool.
- For the RNG scenarios and sensitivities, we used the existing cost trajectories contained within the E3 Revenue Requirement tool and re-weighted them to reflect the desired RNG concentration and blend.
- For the Branch Pruning scenario and sensitivities, the Revenue Requirement model originally had a single value for the start year to decrease reinvestment across all network infrastructure (i.e., both Distribution and T&S). This parameter was changed to instead begin decreasing reinvestment for the initial year of Branch Pruning (2021, 2023, or 2026) for only the Distribution portion of infrastructure, leaving T&S untouched. The original model also had a single value for the percentage to reinvest. This was replaced by a ramp-down from 100% to 20% over a period of ten years. These two modifications produced a "pruned" version of the distribution system. Dividing cumulative unreplaced retirements by the original, unpruned size of the system yields the effective percentage of the system that has been retired. Combining this value with the percentage of prune-able customers in a given year (defined as linearly increasing from zero to 100% in 25 years) produces the desired Branch Pruning customer number/throughput trajectories, which are then fed back into the model to obtain rate results.