Building Electrification and the Future of Gas

One Size Does Not Fit All

April 21, 2022

Energy+Environmental Economics

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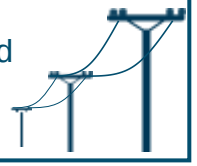
Overview of E3 Practice Areas

E3 has five defined working groups that create continual innovation from cutting edge projects and constant cross-fertilization of best practices across the groups

DERs & Rates

Analyzes distributed energy resources, emphasizing their costs and benefits now and in the future

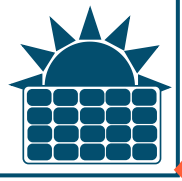
Supports rate design and distribution system planning



Climate Pathways

Provides market and policy analysis on clean energy technologies and climate change issues

Includes comprehensive and long-term GHG analysis



Asset Valuation

Determines asset values from multiple perspectives

Uses proprietary in-house models and in-depth knowledge of public policy, regulation and market institutions

Planning

Develops and deploys proprietary tools to aid resource planners

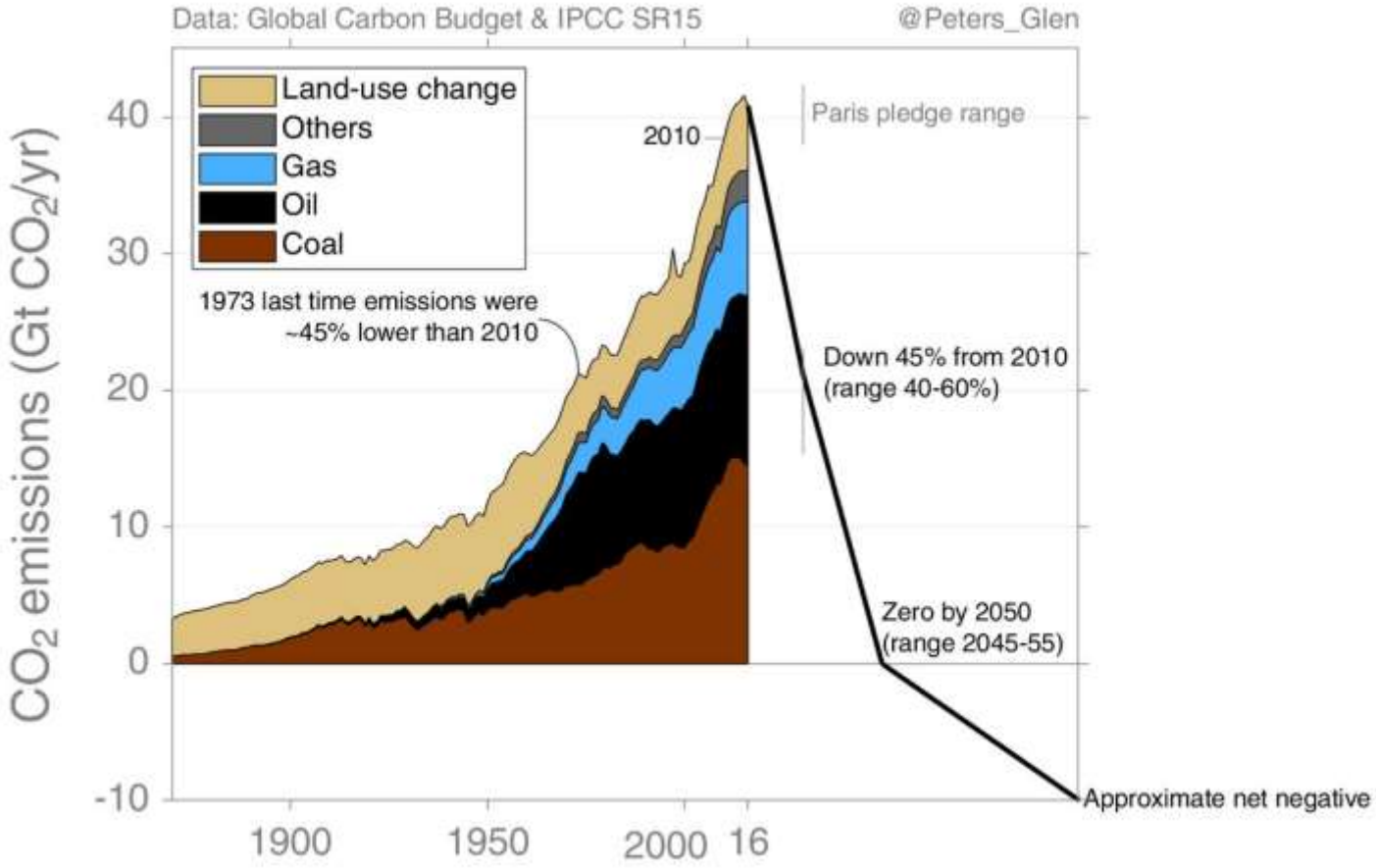
Informs longer-term system planning and forecasting

Market Analysis

Models wholesale energy markets both in isolation and as part of broader, more regional markets

Key insights to inform system operators and market participants

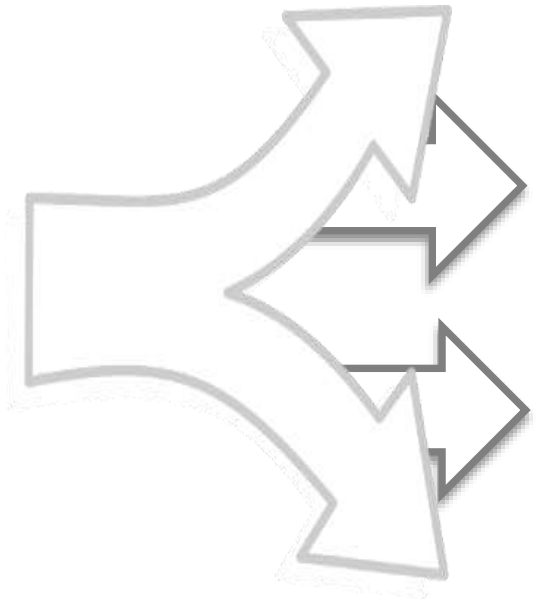
Motivation – 1.5C



Key Takeaways

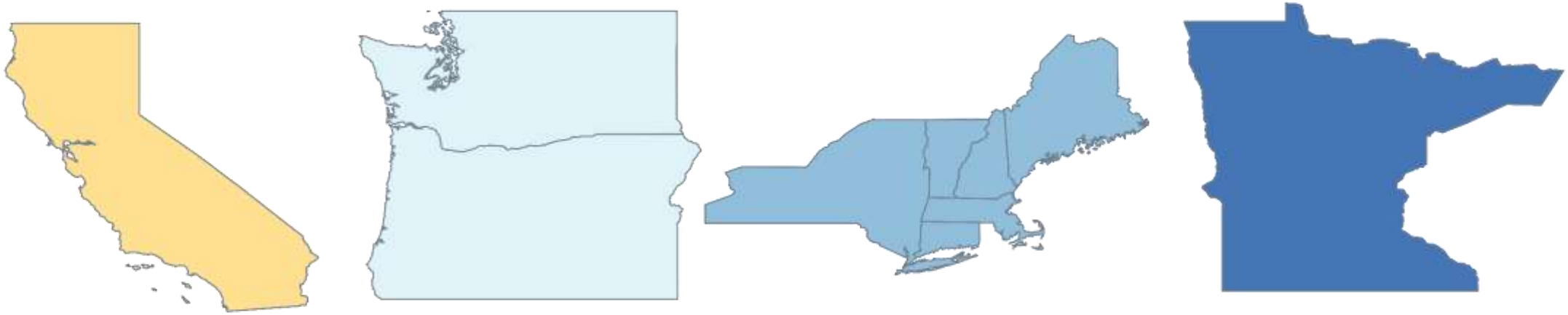
- **There are multiple strategies available to decarbonize buildings and natural gas systems.**
  The most appropriate portfolio of strategies will vary by jurisdiction.
- **Climate matters when determining which strategies are appropriate for which regions.**
  Electrification is key strategy across all climates, but there is a compelling case for dual energy systems in colder regions.
- **Customer costs and decision-making are pivotal issues.**
  Electrification is expected to be higher cost for many customers in the near-term
  In the longer-term, E3 expects upward pressure on gas rates.

A range of pathways has been studied throughout literature, each with advantages and drawbacks



	Potential advantages	Potential drawbacks
Renewable gas	Repurposes existing infrastructure with minimal consumer disruption, fuel diversity/reliability	High fuel costs, high feedstock needs, land-use constraints, not commercial at scale, potential methane leaks, criteria pollutants
Hybrid electrification	Commercially available, utilizes existing infrastructure, reduces demand for expensive gas, reduces electric grid impacts	Requires different utility rate structures, not well studied in the U.S., though an emerging strategy in Europe
Networked Geothermal	Higher efficiency due to sharing of heating and cooling loads across buildings, reduces electric grid impacts	Relatively new low-carbon strategy in the U.S., high infrastructure investment costs, not suitable for all locations
Electrification	Commercially available, complementary to decarbonized electricity, improves indoor & outdoor air quality	Requires customer investments (i.e. upfront equipment costs) and potential electric system investments, may result in stranded assets/high costs to remaining gas customers

E3 has examined building decarbonization and the future of gas in distinct settings, local context matters



	California	Northwest	Northeast	Minnesota
Cold Day Temp	35F	10F	-10F	-30F
Heating Fuels	Mostly Gas	Gas and Electric	Gas and Fuel Oil	Mostly Gas
Electric Peak	Summer	Winter	Summer	Summer

Example:
Electric System Impacts in California vs Minnesota




	California	Northwest	Northeast	Minnesota
Cold Day Temp	35F	10F	-10F	-30F
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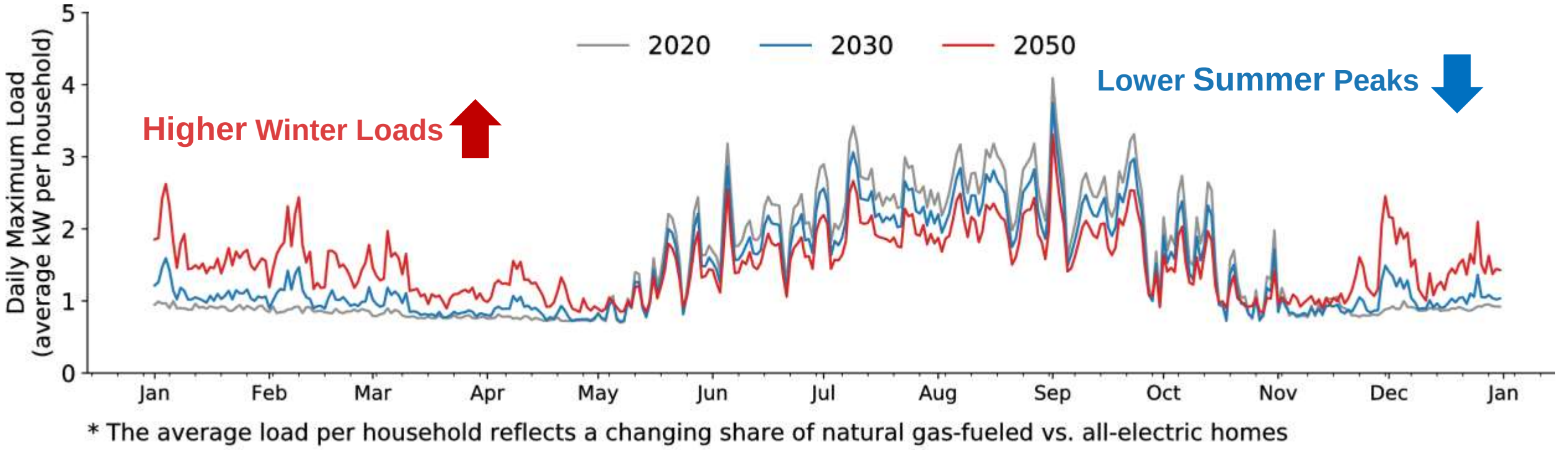
California's warm summers and mild winters mean that electric system impacts are unlikely to be a large issue

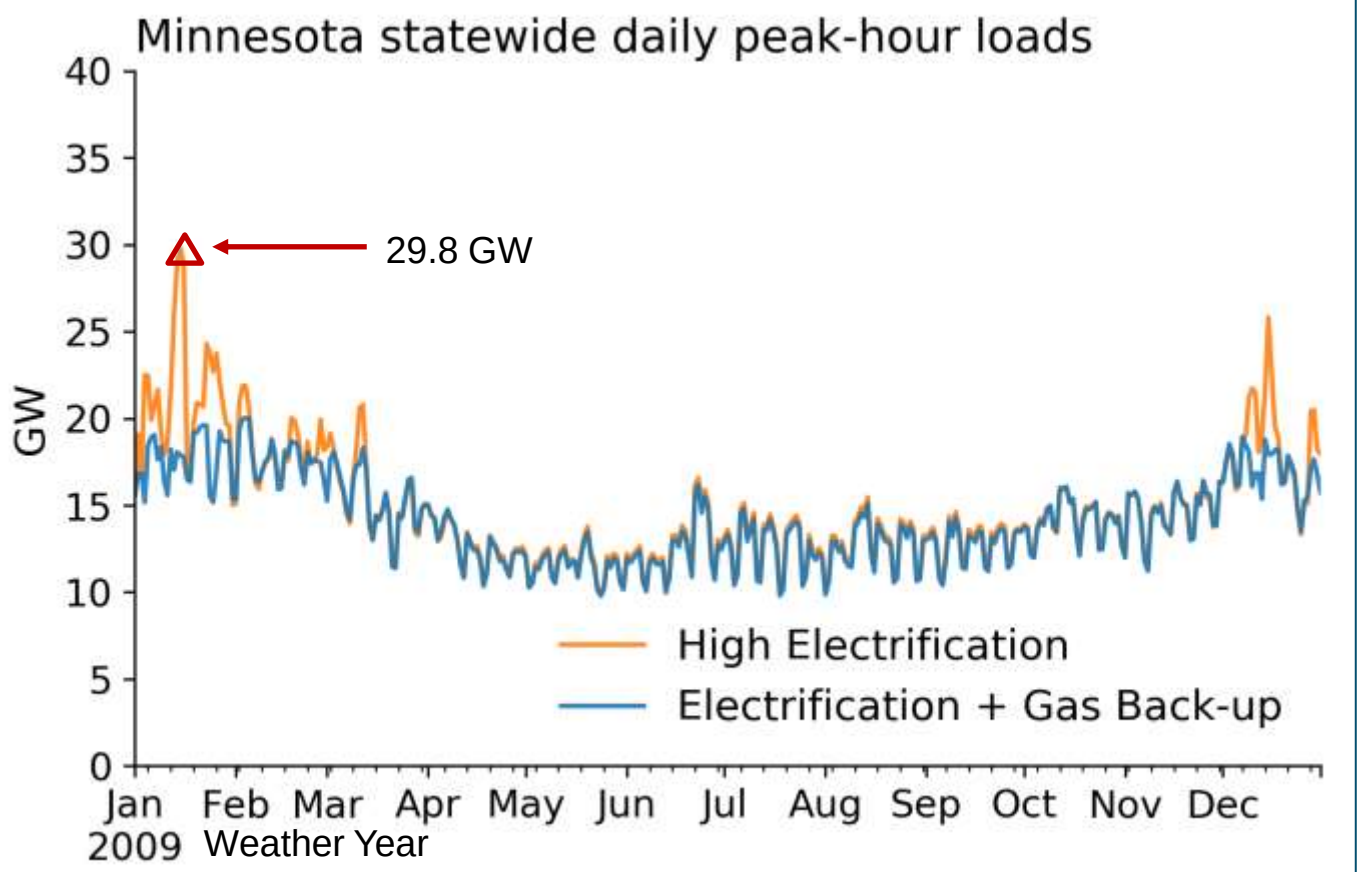
Per household daily peak demand impacts in California during a typical meteorological year



https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf

In Minnesota building electrification could lead to very large electric system impacts

MN load impacts in 2050: all-electric vs. hybrid



- **Under optimistic technology and energy efficiency assumptions electrification of all natural gas buildings in Minnesota would more than double electric peak demands.**
- **Those peak demands can be substantially mitigated using a hybrid strategy.**

https://e21initiative.org/wp-content/uploads/2021/07/Decarbonizing-NG-End-Uses-Stakeholder-Process-Summary.pdf

Example:
Customer Impacts in California vs Massachusetts

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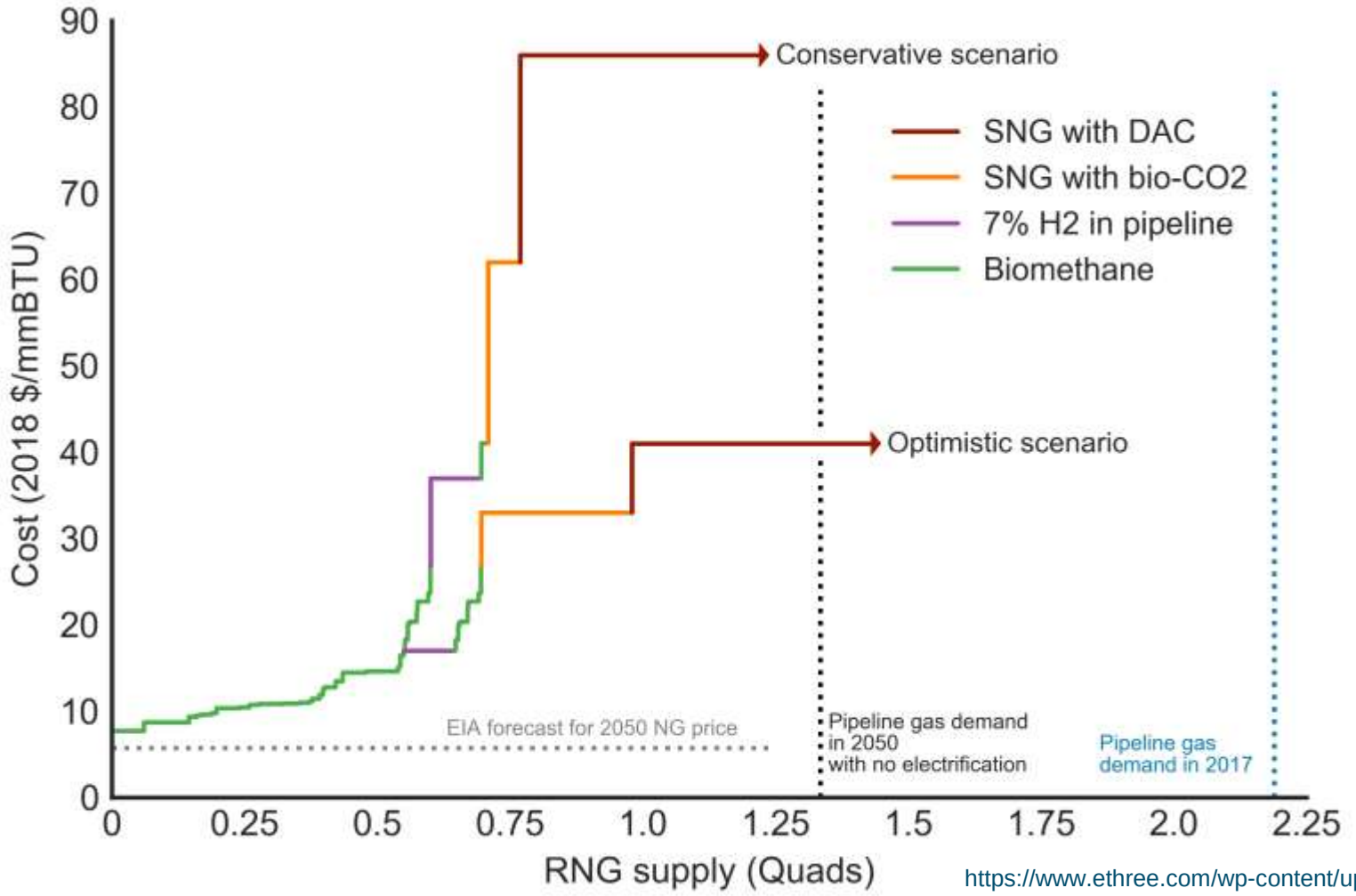
Renewable gasses are costly, limited in quantity and are not widely commercialized

California Renewable Natural Gas (RNG) Supply Curve, 2050

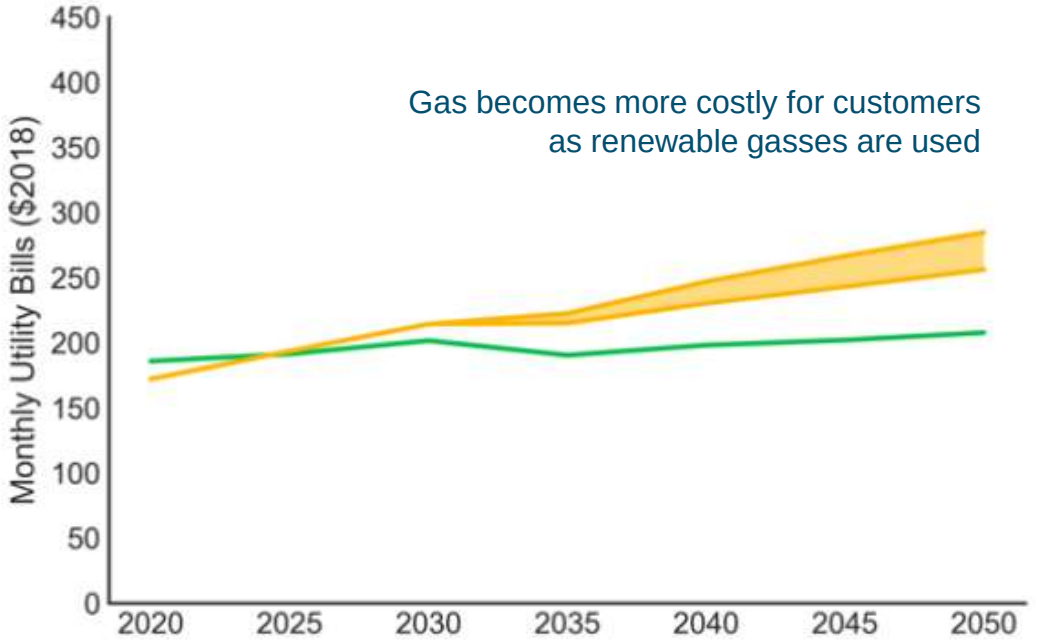


- The quantities of renewable gasses on the x-axis will be different in other states, but the relative proportions are likely to be similar
- The wide range of costs presented here reflects the substantial uncertainties associated with these fuels.

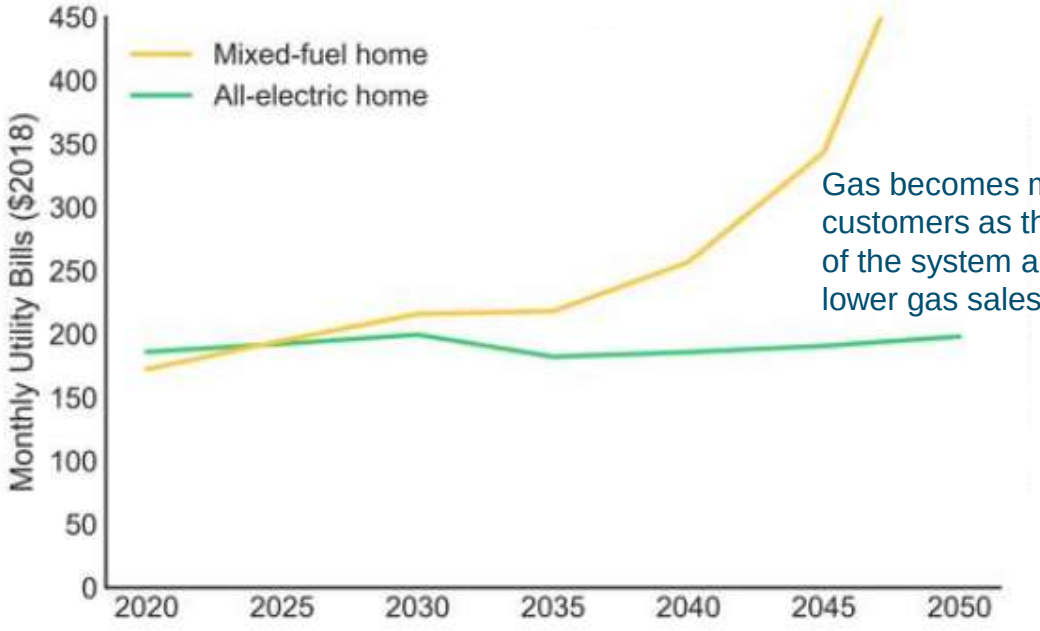
https://www.ethree.com/wp-content/uploads/2021/06/CEC-500-2019-055-F.pdf

E3 found that all-electric customers in California will see lower utility bills in policy-compliant scenarios

Residential Customer Bills
No Building Electrification w/ High Renewable Fuels

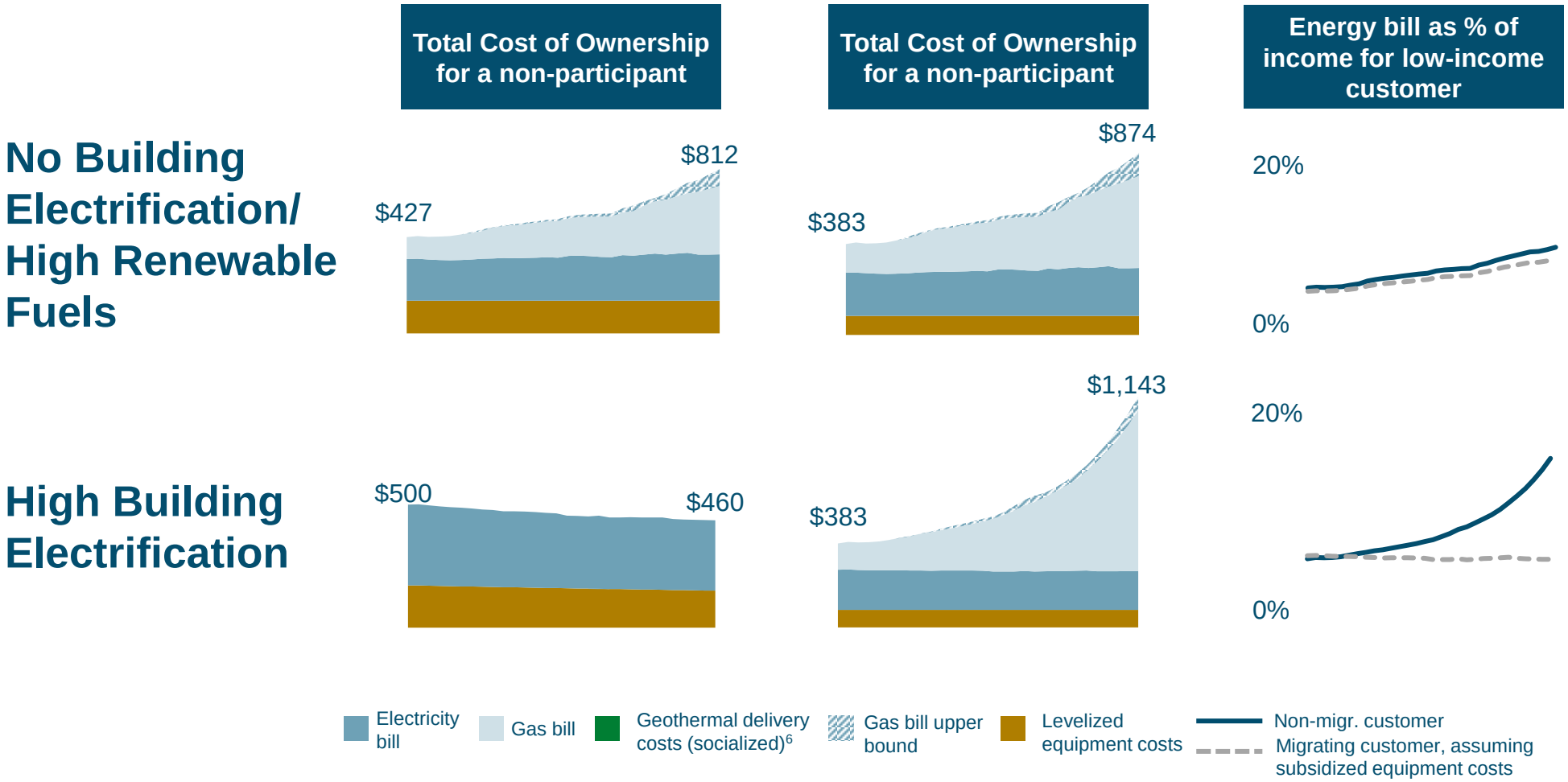


Residential Customer Bills
High Building Electrification



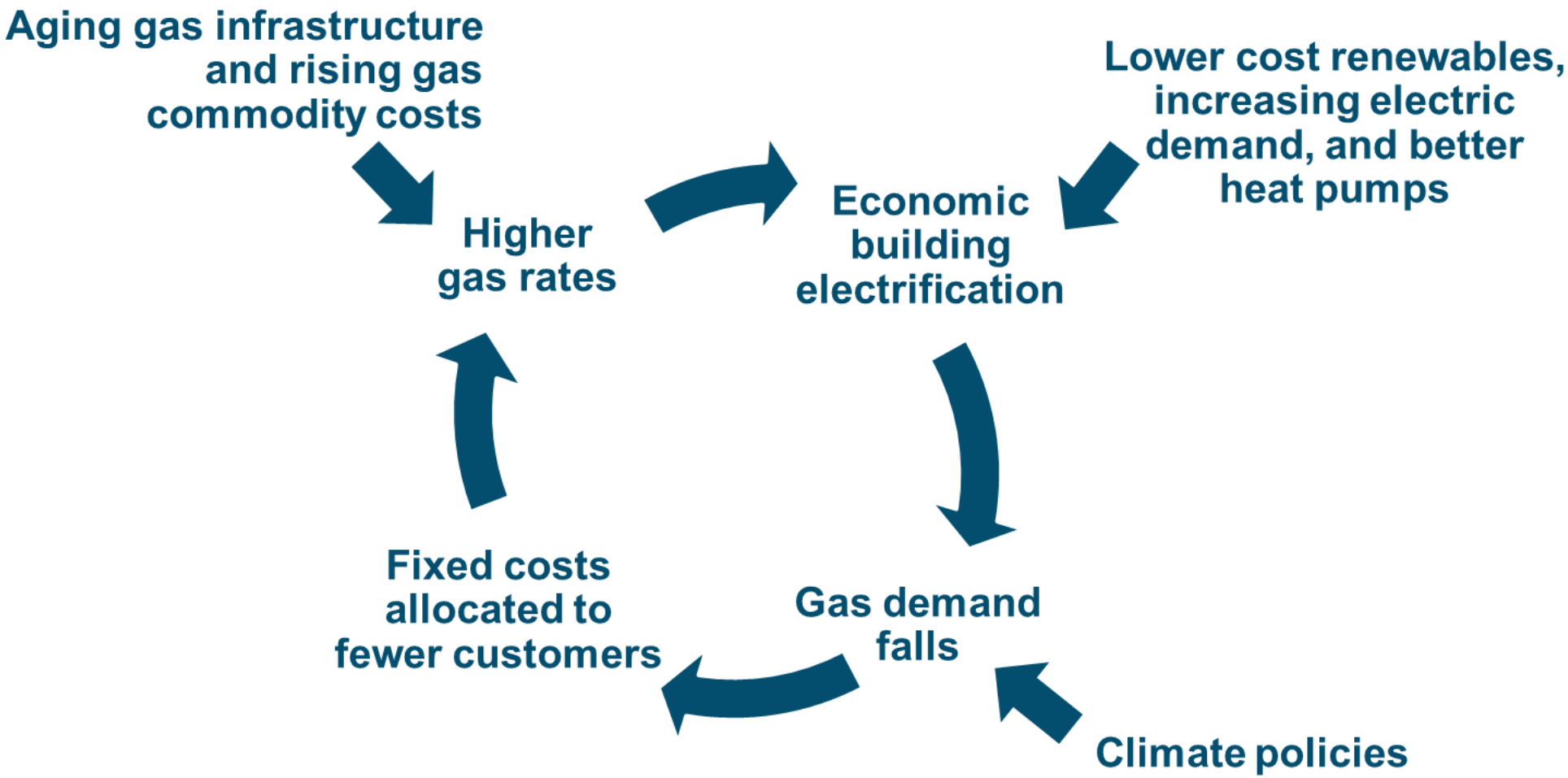
https://www.ethree.com/wp-content/uploads/2021/06/CEC-500-2019-055-F.pdf

E3 found a similar result for customer costs in Massachusetts

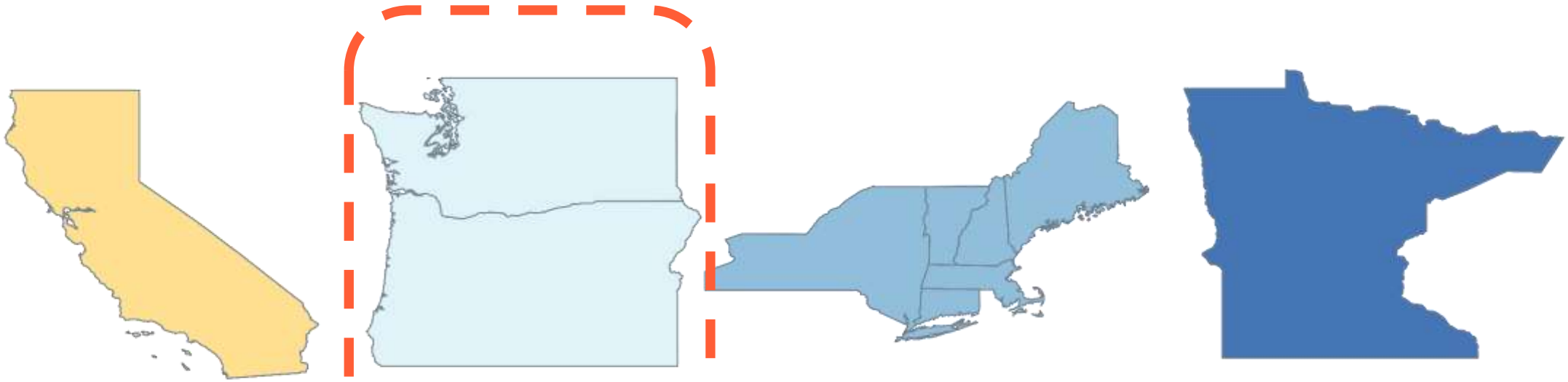


https://thefutureofgas.com/content/downloads/2022-03-21/3.18.22%20-%20Independent%20Consultant%20Report%20-%20Decarbonization%20Pathways.pdf

The fundamental challenge for gas utilities



What about the Northwest?



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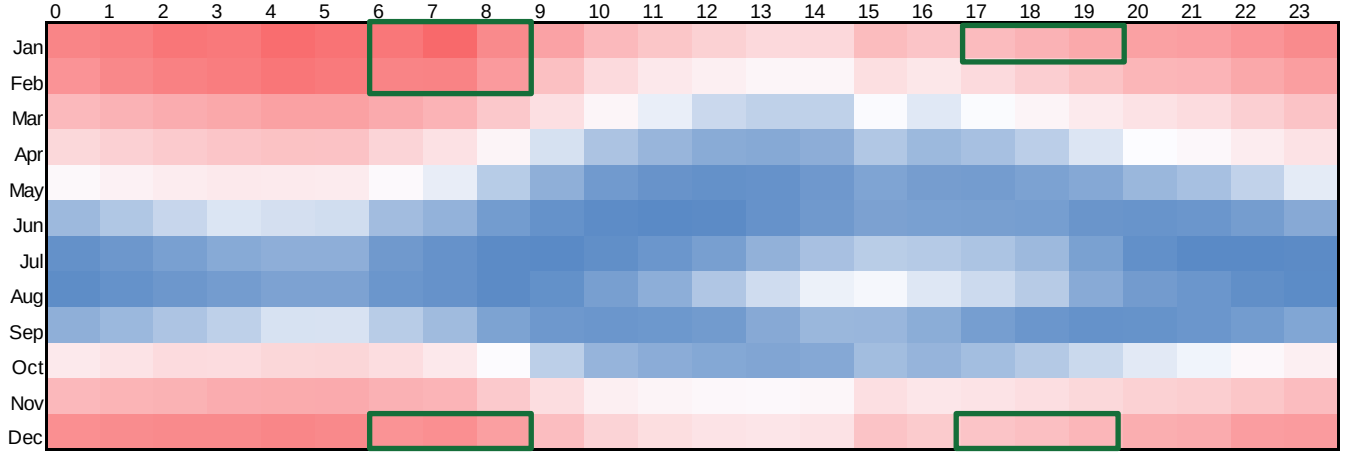
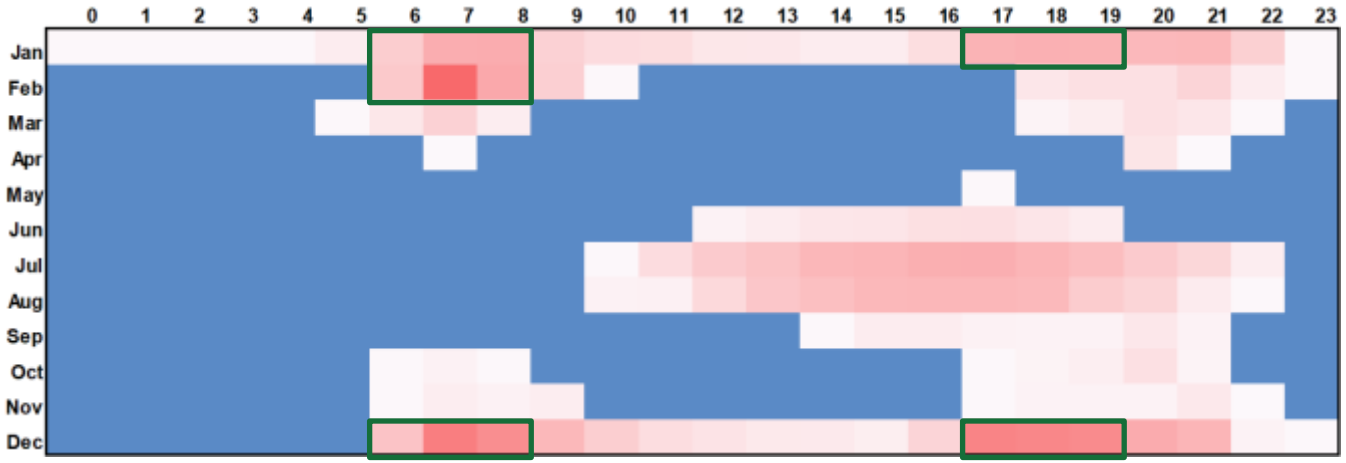
In the Northwest, heat pump HVAC loads are coincident with system peaks today

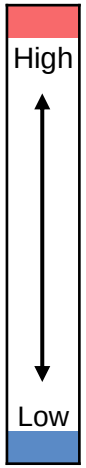
- Heat pump HVAC systems peak during winter morning and evenings.
- Those periods align with current system peak demands for many consumer owned utilities and the broader NW electricity system.
- Work by E3 has identified significant existing and projected resource adequacy challenges in the Northwest, particularly during cold-snaps.

Single-family Heat Pump HVAC in Eastern WA (kWh)



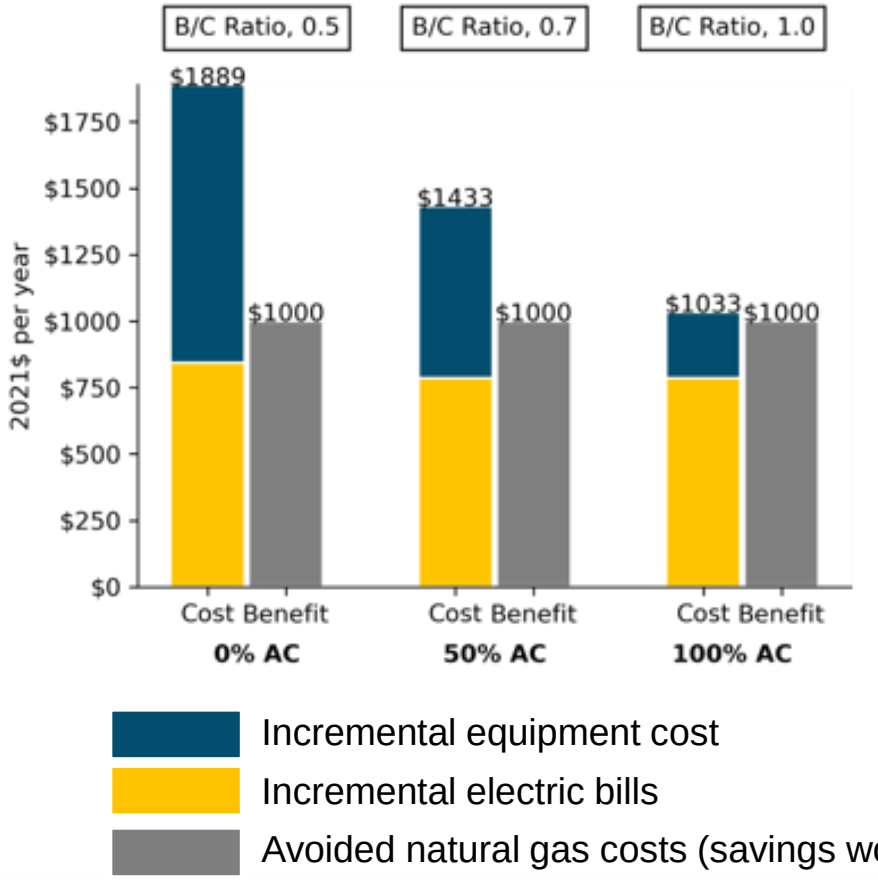
Marginal Capacity Cost ($)





Heat pump upfront costs represent a significant near-term challenge to scaling electrification in existing buildings

Participant cost-effectiveness of replacing a gas furnace with a heat pump HVAC system depending on AC Status



- Heat pump HVAC systems provide both heating and cooling services.
- Therefore, a heat pump replaces both a furnace and air conditioning equipment.
- E3 has found that heat pump HVAC systems are most cost-effective for customers who have, or want, AC.
- But many homes in the Northwest currently do not have air conditioning and the replacement cycles of furnaces and AC systems may not align.

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Thank You

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