ET Summit 2024

Presented by

Hybrid Electrification in California

Dual-Fuel/Hybrid Systems for Residential Heating Session

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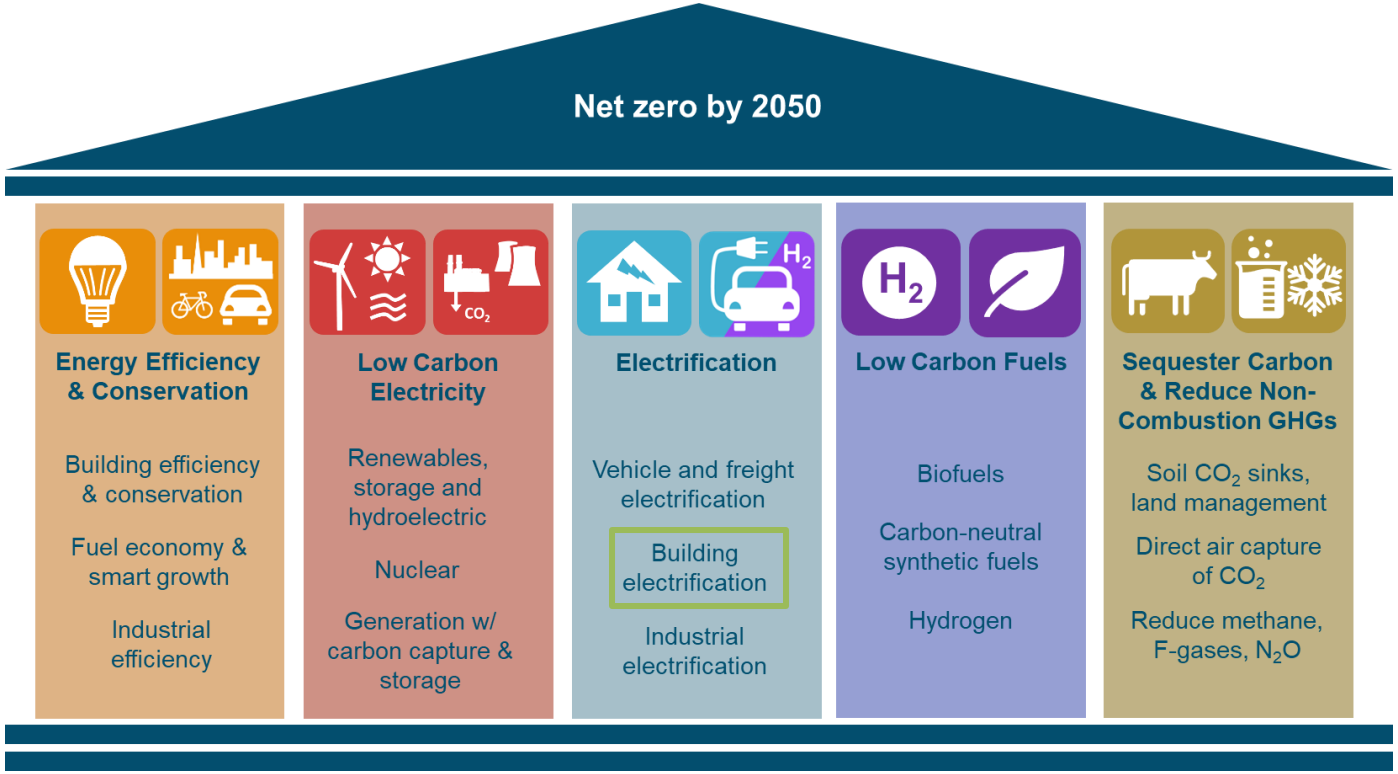
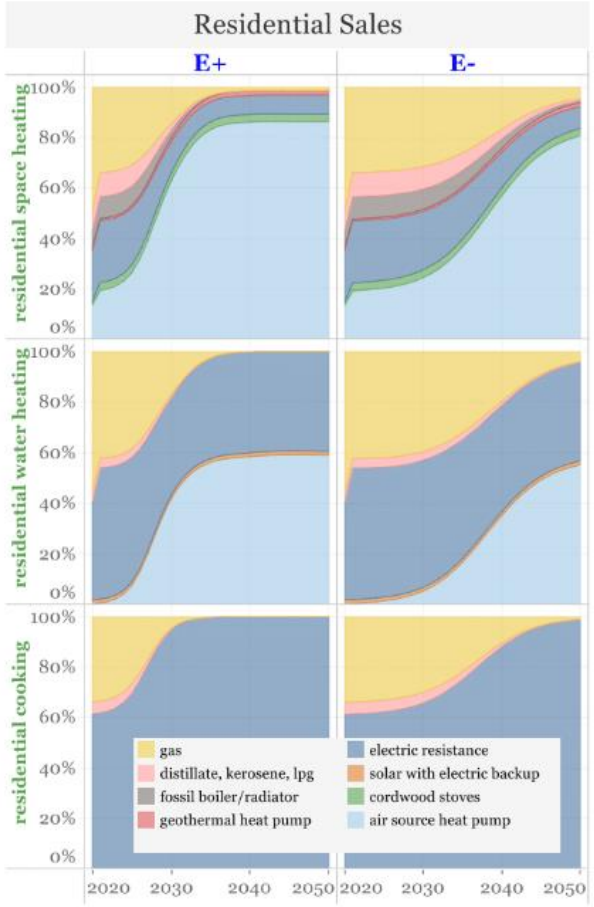
E3

The main takeaways

- A hybrid approach CAN help mitigate grid impacts from electrification and help alleviate surging gas rates in a high electrification future
- However, hybrid electrification is not an appropriate solution for much of California due to California's temperate climate, clean electric grid, expensive gas infrastructure, and existing and statewide codes & standards
- 100% decarbonization with hybrids will be near impossible due to limited supply of low-cost decarbonized fuels

Building electrification has proven to be a critical pathway towards achieving GHG reduction goals



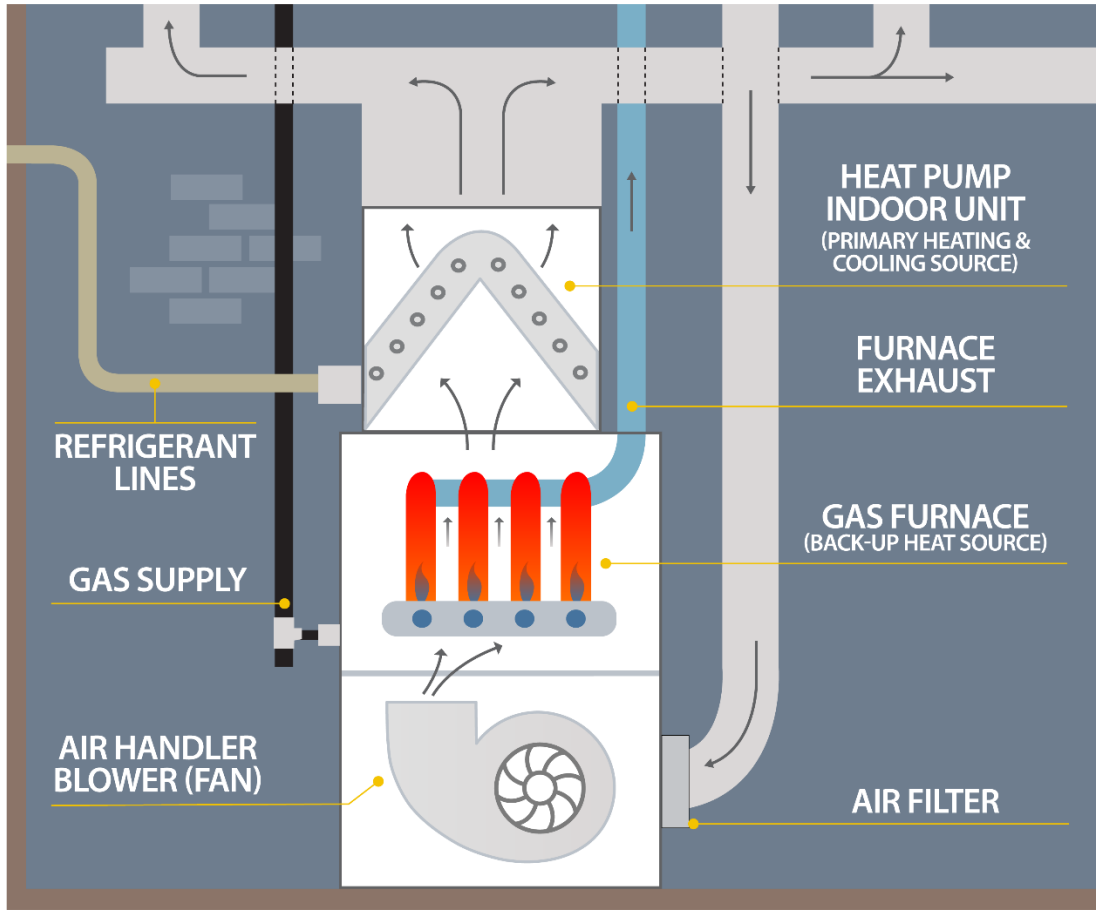


Net Zero America 2021 Report, Princeton University

Would a hybrid approach help achieve decarbonization faster and more economically in the colder parts of California?

Hybrid heating:

Pairing an all-electric heat pump with a building's existing fuel-based heating equipment, to operate during the coldest hours of the year



Hybrid heat pump schematic, Slipstream Inc.

Today we'll explore what role hybrid HPs should play in California building decarbonization

Benefits

- Emissions reduction
- Grid peak & annual load mitigation
- Reduce upfront appliance costs
- Alleviate customer bill impacts
- Ease long-term gas cost challenge
- Reach new customers through AC conversion

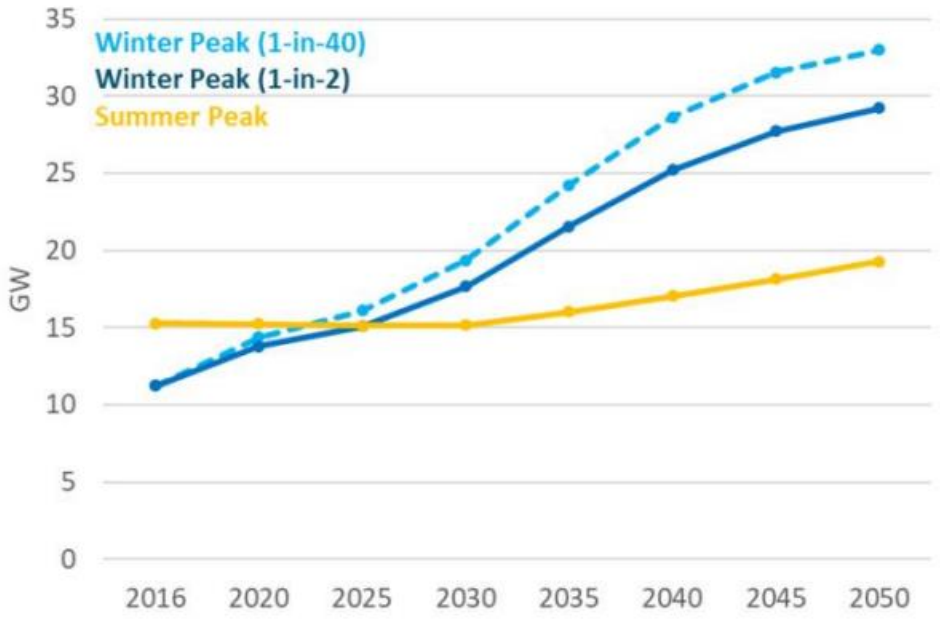
Challenges

- Curbed potential for emissions & NOx reduction
- Cutoff temperature confusion
- Interoperability concerns
- Reliance on RNG for complete decarbonization
- Limited access to incentives
- Continued gas infrastructure costs and maintenance

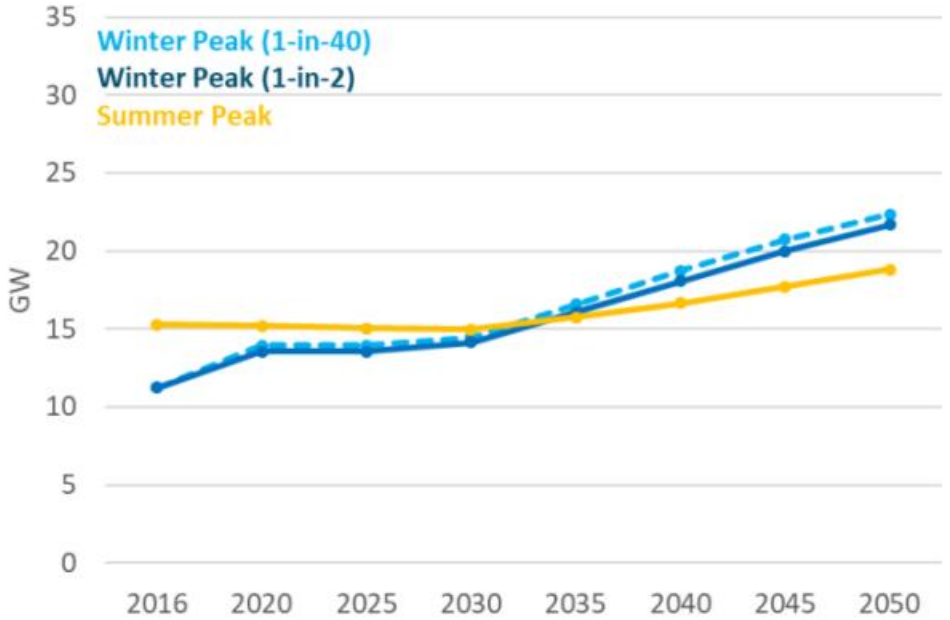
Hybrid heat pumps can…

Delay the switch to a winter peaking system in cold climates

High Electrification Scenario



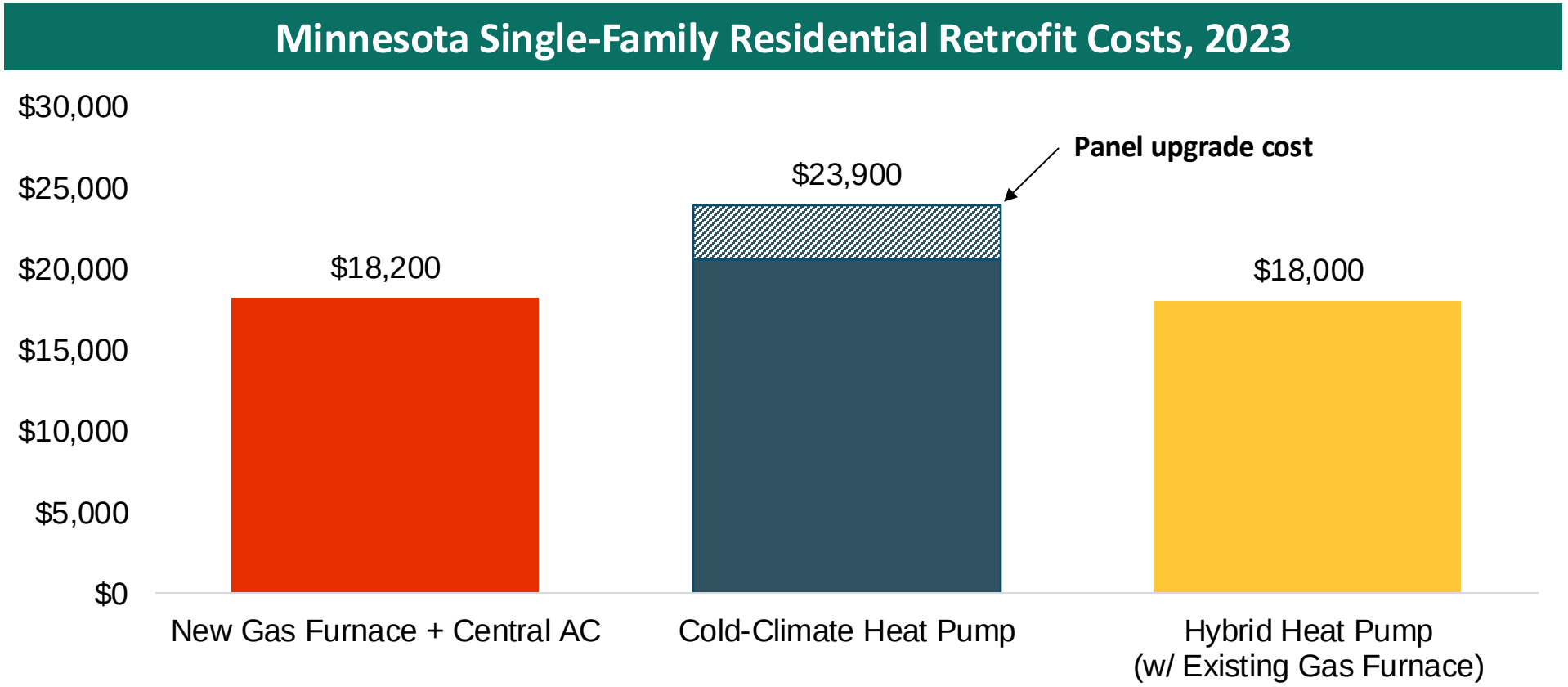
Hybrid Heating Scenario



Example load growth analysis from Minnesota building decarbonization study

Hybrid heat pumps can…

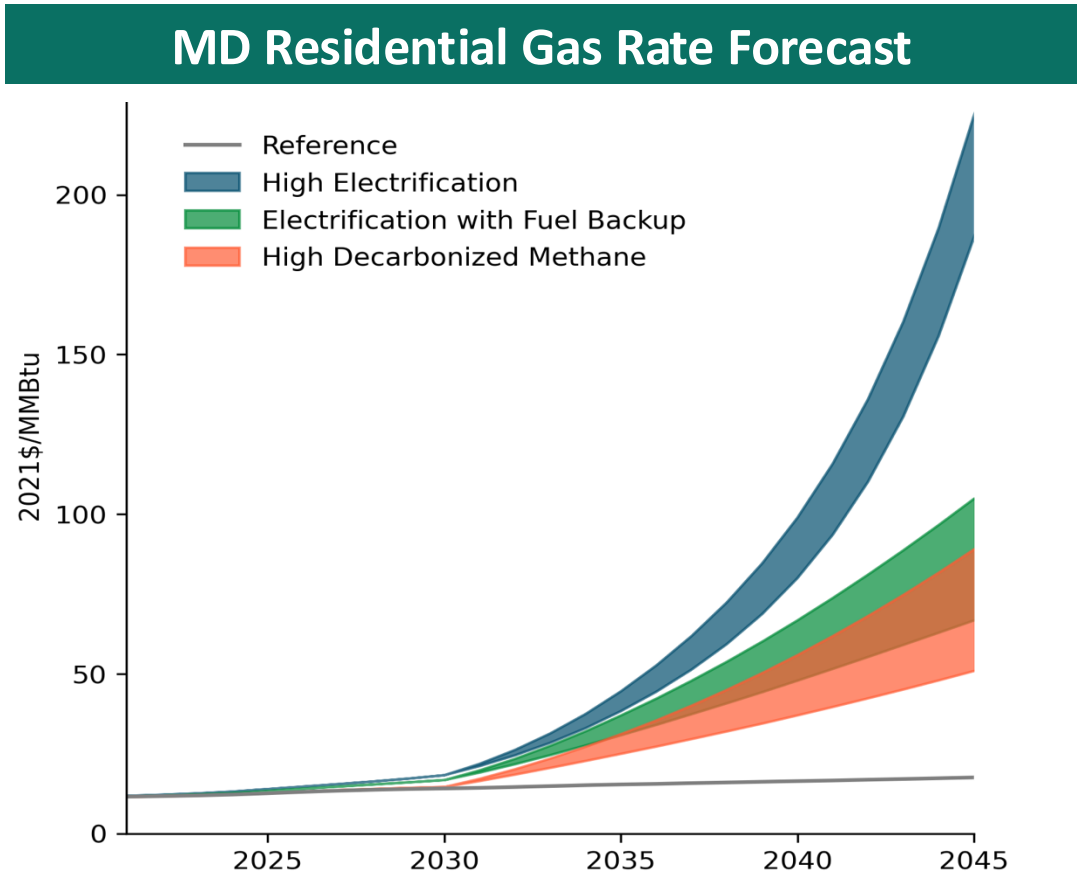
Eliminate the need for a panel upgrade



Example equipment installation cost analysis for Minnesota electrification retrofit

Hybrid heat pumps can…

Prevent the gas rate "death spiral"

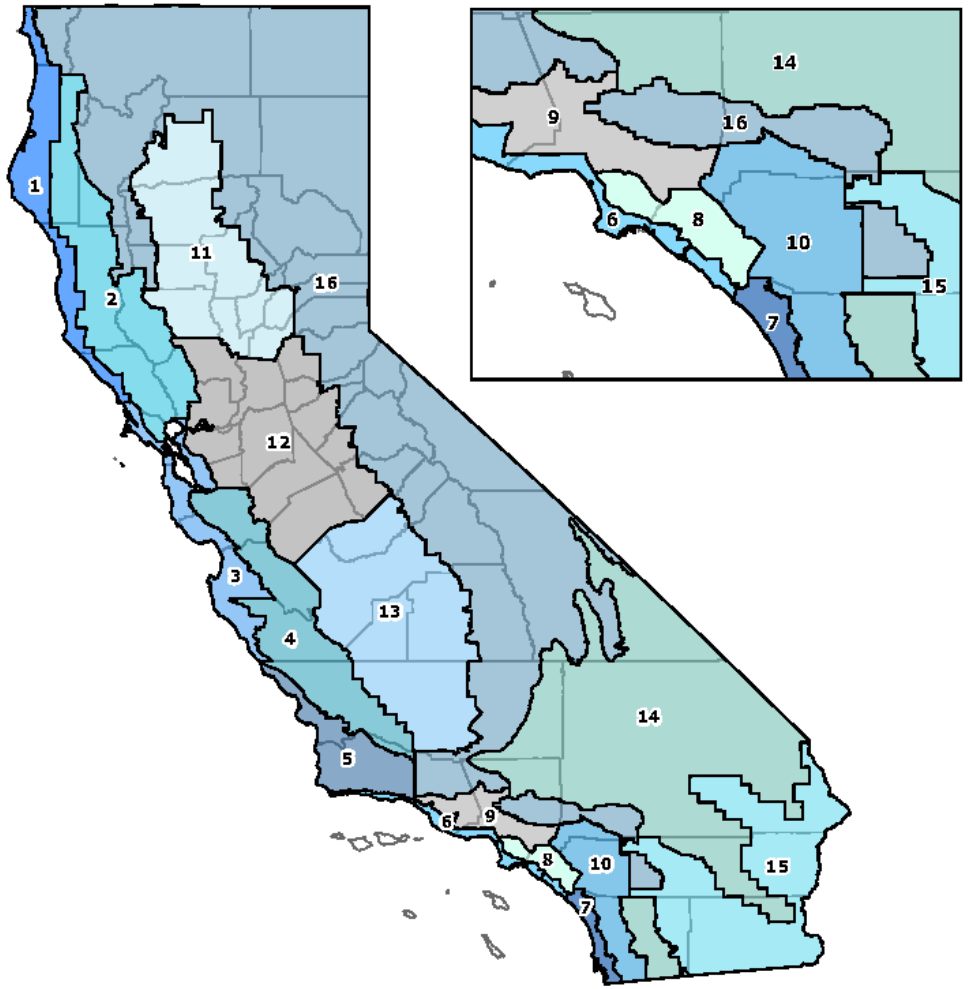


Example gas rate analysis from Maryland building decarbonization study

However, in California…

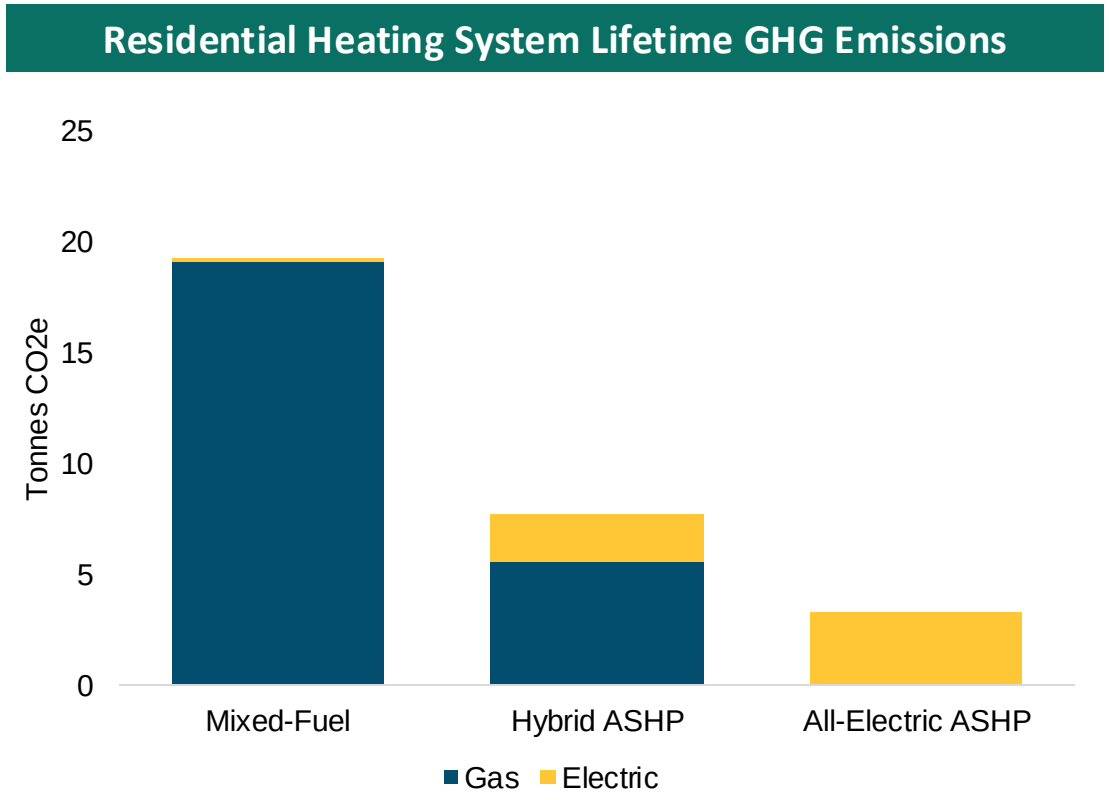
Most of the state has a mild climate

- Most of California has relatively mild climate
  - Lower heating loads justify full electrification over hybrid electrification
- Climate zones 1, 2 and 16 DO experience more severe heating loads
  - But these climate zones only account for 5% of the statewide households



However, in California…

Hybrids will curb the potential for emissions reduction



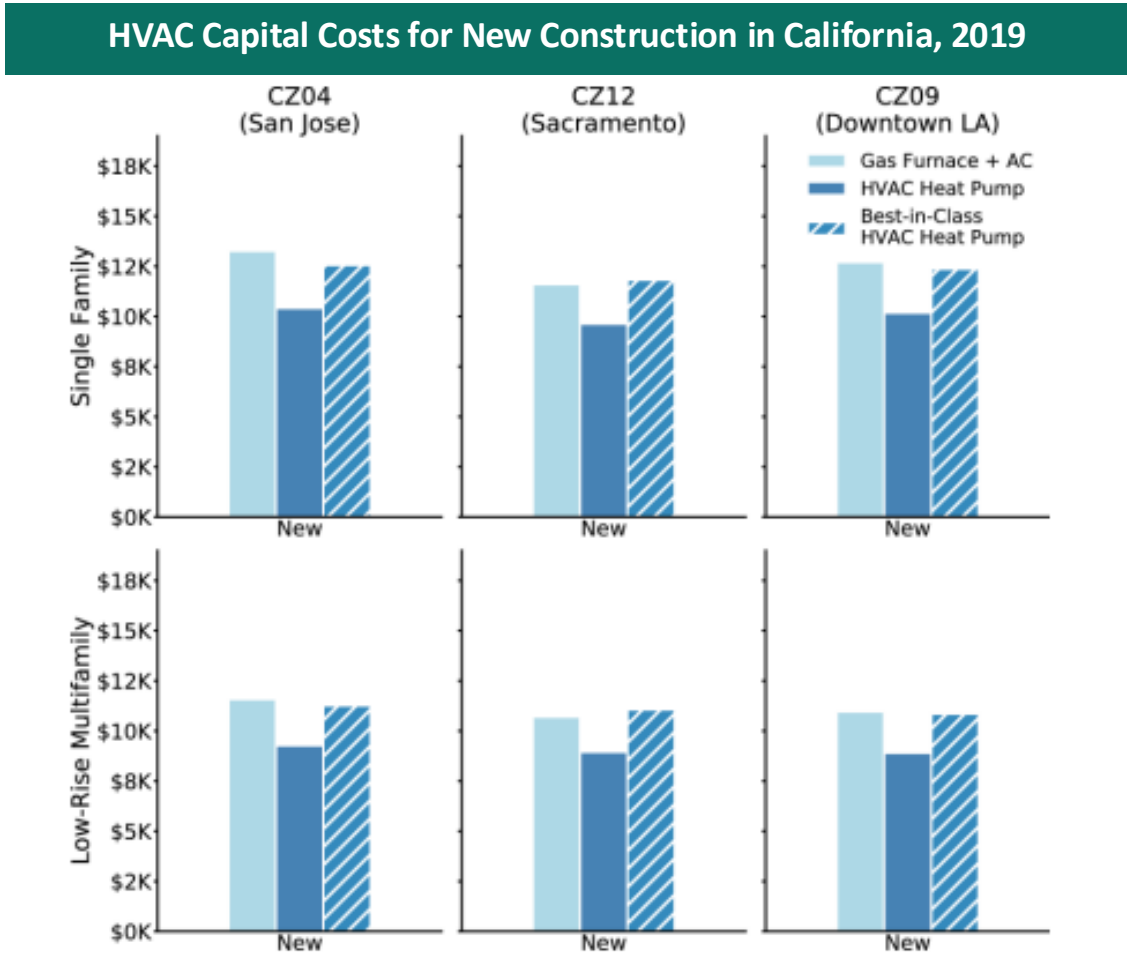
- California has a clean electric grid that is getting EVEN cleaner
  - SB100 requires zero-carbon resources supply 100% electric retail sales by 2045
  - Hybrid electrification WILL reduce emissions, but they will limit the emissions reduction possible through full electrification

Example emissions analysis for residential electrification retrofit in the East Bay

However, in California…

All-electric new construction is cheaper & (essentially) mandated

- All-electric options are particularly cost-effective for new construction
  - Avoided gas connection costs & lower upfront capital costs
- Title-24 has set an all-electric baseline for the 2025 code cycle
  - Very difficult to build mixed-fuel buildings starting in 2026



Example cost analysis new construction in California

However, in California…

Zero NOx standards are prohibiting the sale of new gas appliances

What is the timeline for compliance with these amendments?

- Ultra-low NO_x standard implementation date (applies to appliances manufactured after the noted date):
  - **Jan. 1, 2024** – For residential fan-type central furnaces. This standard matches existing standards in other large California air districts, and natural gas appliances are currently available to meet this standard.
- Zero NO_x standard implementation dates (applies to appliances manufactured after the noted date):
  - **Jan. 1, 2027** – Water heaters less than 75,000 BTU/hr (typically residential tank water heaters)
  - **Jan. 1, 2029** – Residential and commercial furnaces
  - **Jan. 1, 2031** – Water heaters between 75,000 and 2 million BTU/hr (commercial and multifamily)

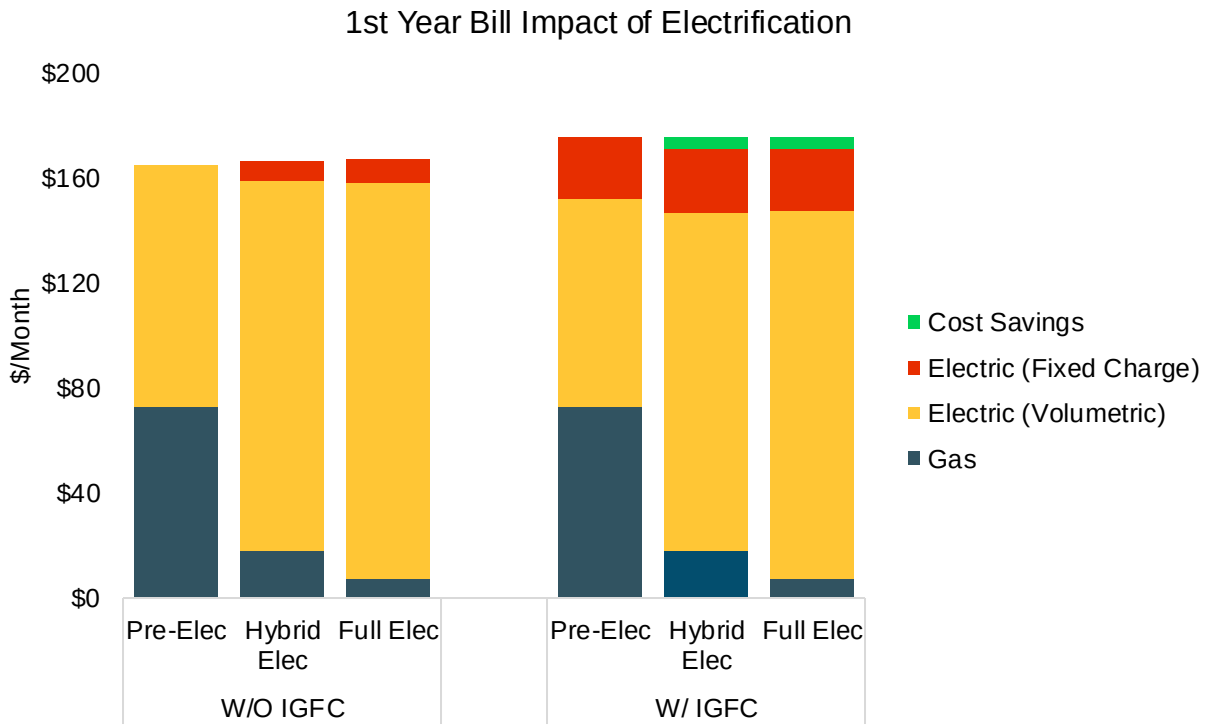
- BAAQMD and SCAQDM have recently passed Zero NOx standards
  - Essentially banning the sale of non-electric residential space and water heating appliances by 2030
- CARB is considering adopting a similar Zero Emissions standard

BAAQMD Zero NOx appliance standard FAQ

However, in California…

Hybrids don't solve the problem of high electric rates

- High electric rates in CA will pose affordability issues for full or hybrid electrification
- CA rate design is starting to move toward rates that benefit electrification: the Income Graduated Fixed Charge (IGFC) → monthly fixed charge w/ lower volumetric rates
  - Larger fixed charge will structurally benefit larger electricity users

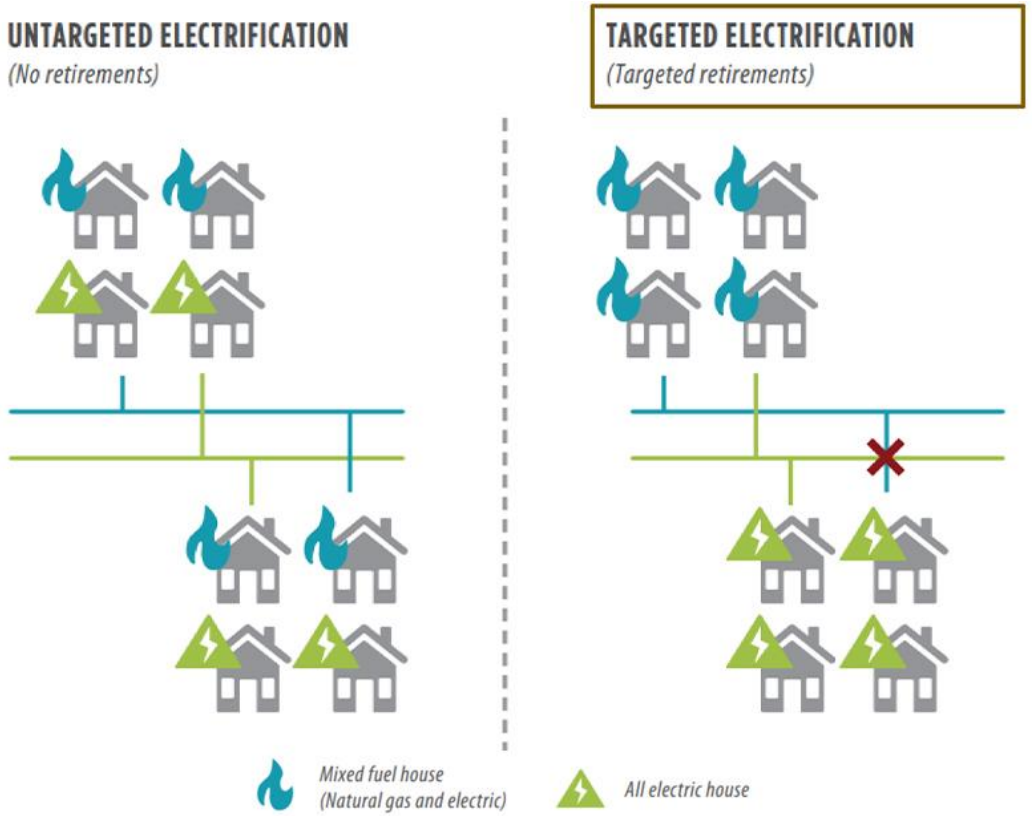


Example electrification bill impact analysis for low-usage Non-CARE residential customers in the East Bay

However, in California…

The gas system is expensive to maintain

Targeted Electrification & Gas Decommissioning Illustration, E3

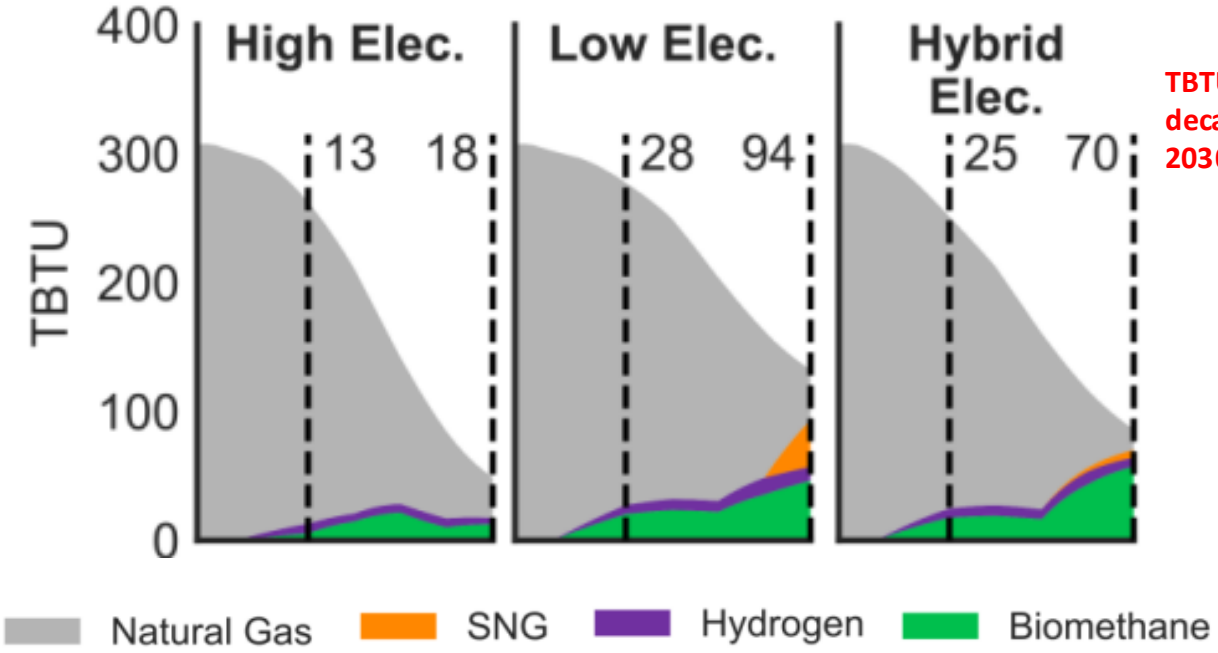


No matter where hybrids are deployed…

Full decarbonization through hybrids relies on speculative renewable fuels

- Renewable fuels are better saved for
  - Hard to electrify sectors of the economy OR
  - To power hybrid heat pumps in cold climates where all-electric is more challenging

MA Gas Throughput, 2020-2050



TBTU/year of decarbonized fuels, 2030 and 2050

Gas throughput and composition analysis from Massachusetts future of gas study

What you should take away from this presentation…

- Hybrid electrification DOES makes sense in certain circumstances, but for much of California, hybrid electrification is not the right solution
  - Temperate climate → low heating loads (exceptions for CZs 1, 2, & 16)
  - Clean electricity → curbed emissions reduction
  - Codes & standards → Legal barriers
  - High rates → Affordability issues
  - Expensive gas infrastructure → Targeted gas decommissioning
- The path to 100% decarbonization with hybrids is murky
  - Achieving full decarbonization with hybrids will require a large supply of decarbonized fuels, which will have a limited supply of low-cost options and will be in high demand from other sectors

Thank You!

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