Atlantic Canadian Conference on Energy System Modelling

JUNE 19 & 20, 2024 | MONCTON, NB

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Heating Up

How Heating Decarbonization Modelling Can Prepare Policymakers in Building a Resilient Future

Session 1: The Future Unveiled
June 19th, 2024, Moncton, NB

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ACCELERATING THE CLEAN ENERGY TRANSITION

ANALYSIS + STRATEGY

BUILDINGS | **MOBILITY** | **INDUSTRY** | **ENERGY**

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BUILDINGS — **MOBILITY** — **INDUSTRY** — **ENERGY**

GOVERNMENTS — UTILITIES — CORPORATE + NON-PROFIT

Reducing the use of fossil fuels in buildings is pivotal for achieving **decarbonization** in Atlantic Canada

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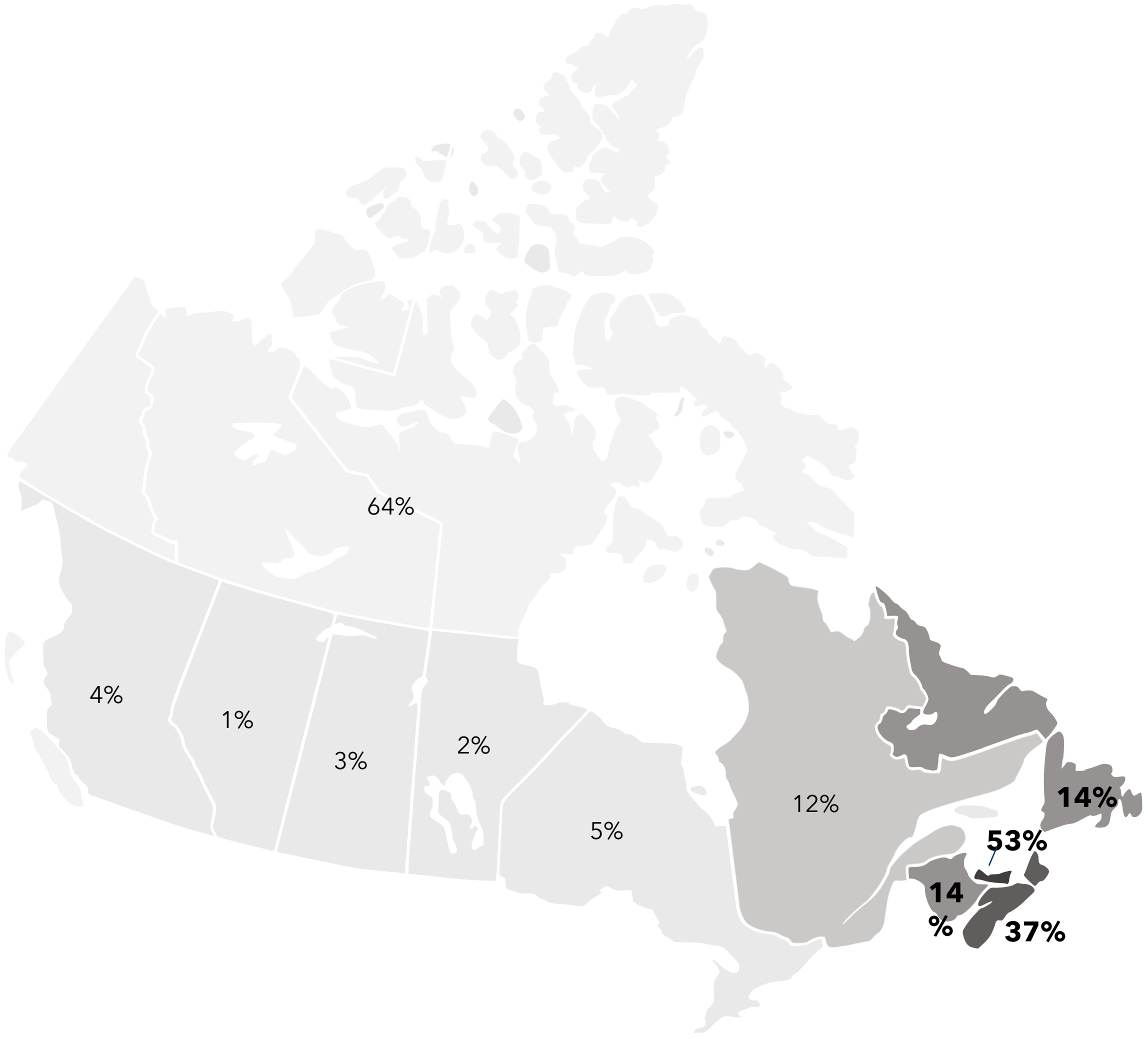
Fossil-based heating remains substantial in Atlantic Canada.

- As of 2020, **25%** of homes in Atlantic Canada were heated with fuel oil, compared to a **6%** national average.*
- The number of homes to upgrade to heat pumps remains large.

What are the implications for different stakeholders as the energy system decarbonizes?

- How can **heating electrification modelling** help to navigate the transition?



Percentage of homes that heat with fuel oil, 2020

*Natural Resources Canada. January 2024. _Enhancements to the Oil Heat Pump Affordability Program_.

Key drivers and considerations

Technologies

Selection & Configuration ➔ Costs and Load Impacts

Policies and Programs

Timing and Scope ➔ Adoption and Customer Bills

Load Impacts

Heating Electrification + Electric Vehicles + DERs + Demand Response + … = ?

Uncertainty

Politics, Programs Phase-Out, Technology Improvements

Equipment mapping – what are the options?

Baseline

- Furnace
- Boiler
- Unit Heater

Upgrade

- Central Ducted ASHP/GSHP
- Hydronic ASHP/GSHP
- Ductless Mini/Multi Splits

Configuration

- All-Electric
- Hybrid

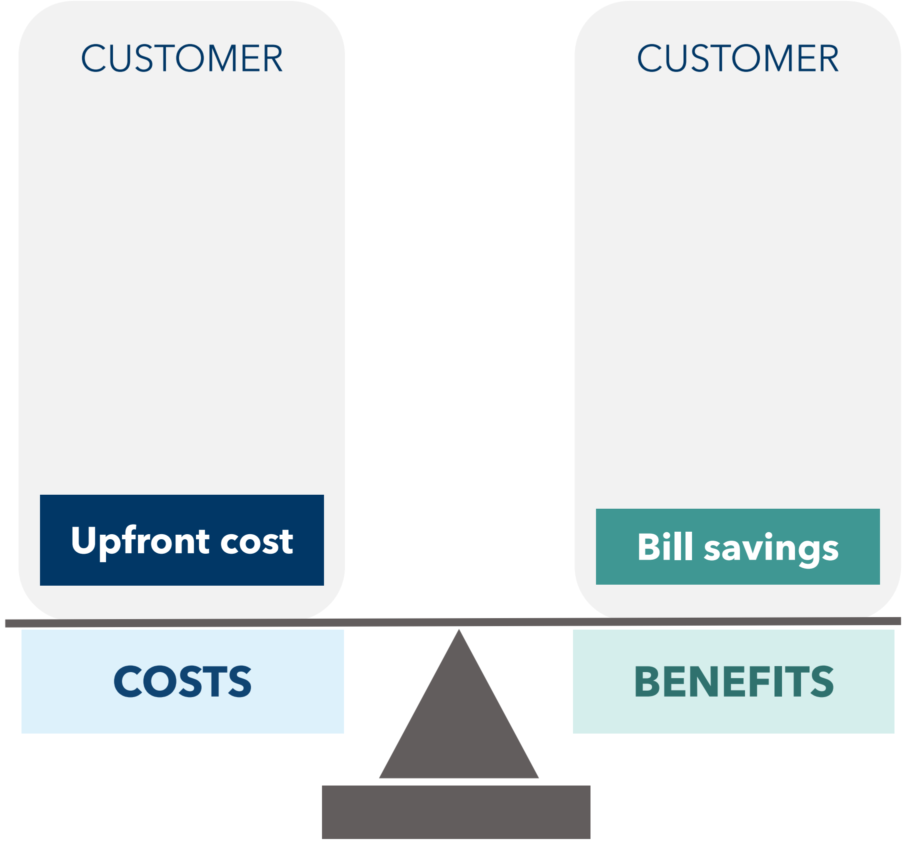
Configuration Deep Dive:

- **All-Electric:**
  - **Primary system: Heat pump**
  - **Back-up system: Electric resistance**
  - **Operation: Parallel** (when building load exceeds heat pump capacity)
- **Hybrid:**
  - **Primary system: Heat pump**
  - **Back-up system: Fuel-fired**
  - **Operation: Switch** (when temperature is below pre-set outdoor air temperature)

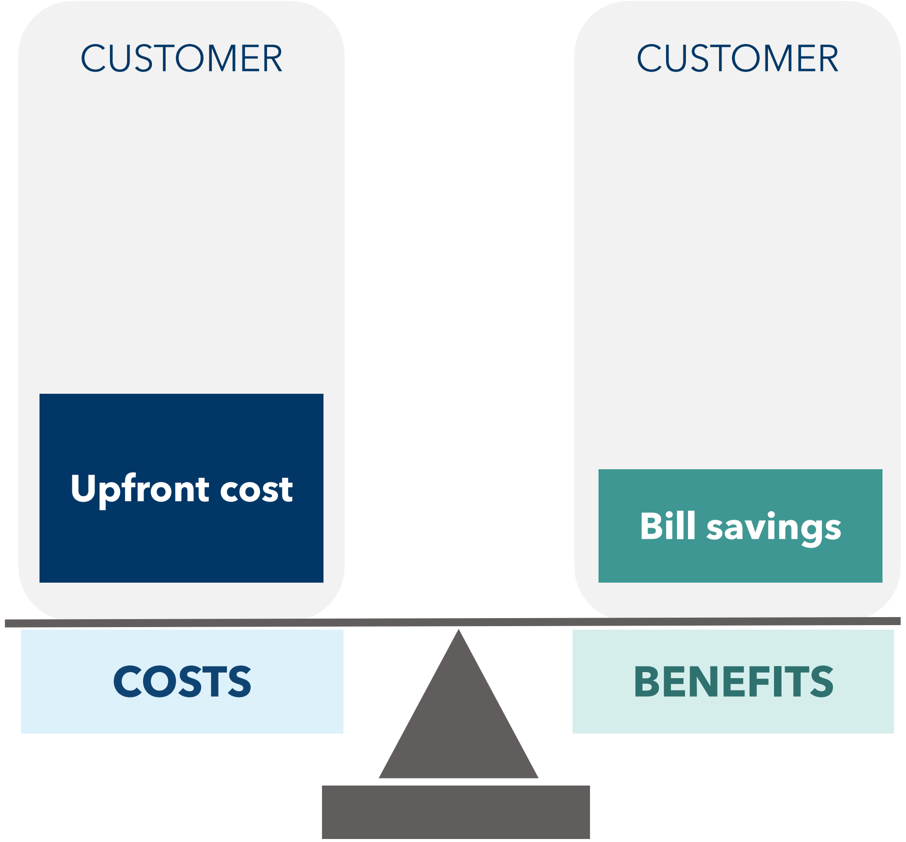
Technology Choice Matters

From the wallet: how do technologies compare?

Air source heat pump



Ground source heat pump



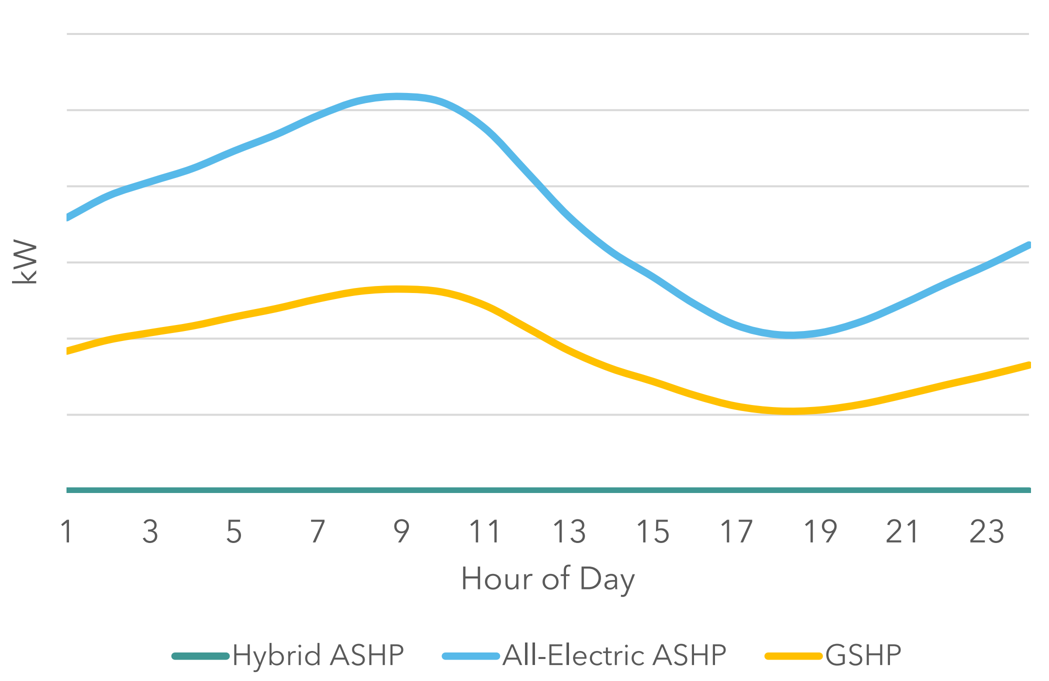
*Not to scale

From the utility: How is the grid impacted?

Peak impacts of heating electrification are limited by **hybrid heating systems**.

- **All-electric ASHPs** can operate at low OAT, but the impact is dominated by their electric resistance backup (100% efficiency).
- **GSHPs** maintain higher efficiency and capacity by leveraging warmer ground temperatures: 3x less impact than all-electric ASHPs.

Peak Winter Day – Space Heating Equipment Load Profiles

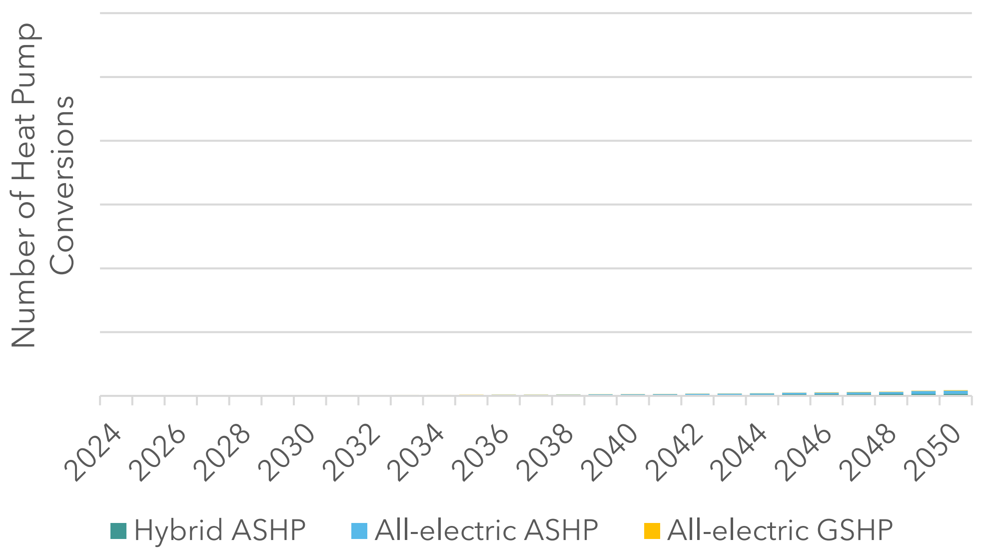


Programs – why do we **need** them?

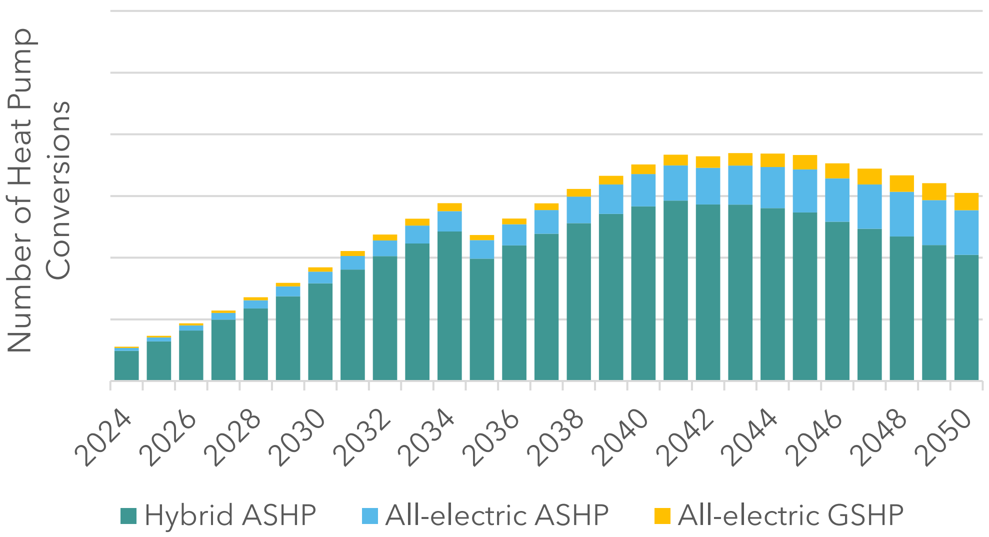
Programs can **spur technology adoption** by :

- Lowering **customer upfront costs**
- Improving **market conditions** (diffusion rates and barriers)
- Improving **technology factors** (performance & capital costs)

No Programs



Programs Available Until 2035



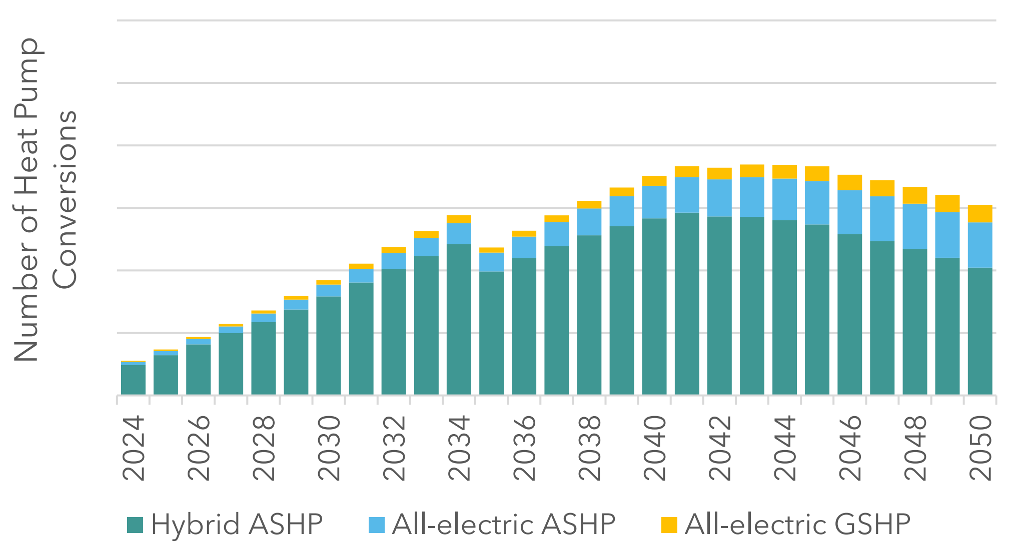
*Adoption is highly dependent upon commodity rates (baseline fuel cost vs. electricity rates).

Policies are important in a net-zero context

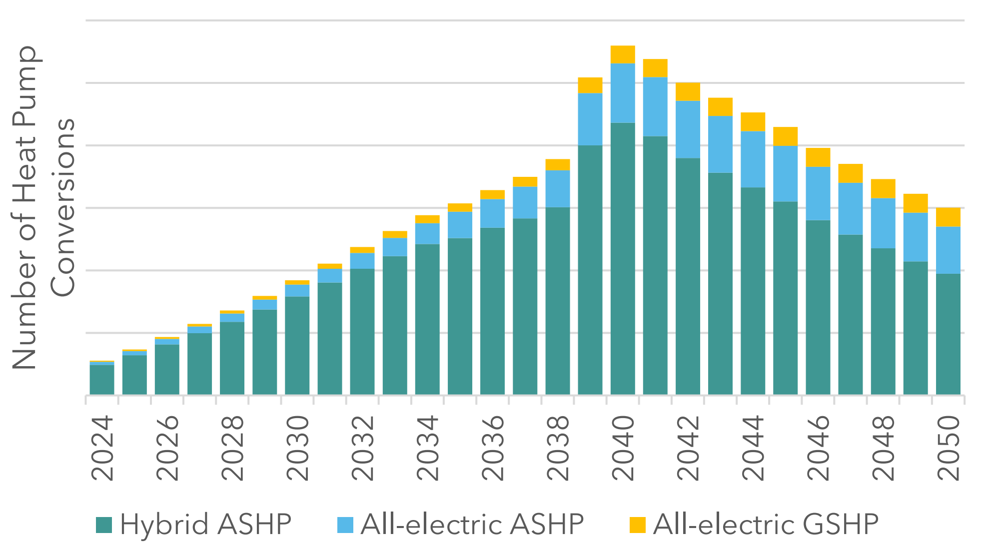
Programs alone can lead to high levels of adoption, but to reach an ambitious target such as net-zero, policies can take us to the **finish line** while:

- Having early adopters to be supported by programs
- Allowing the market to transform
- Phasing out all fossil-based heating

Programs Available Until 2035



Programs + Policy Phase-in 2035 to 2040



Policies & Programs as Levers

How can policies inform peak load forecasts?

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Programs Available Until 2035

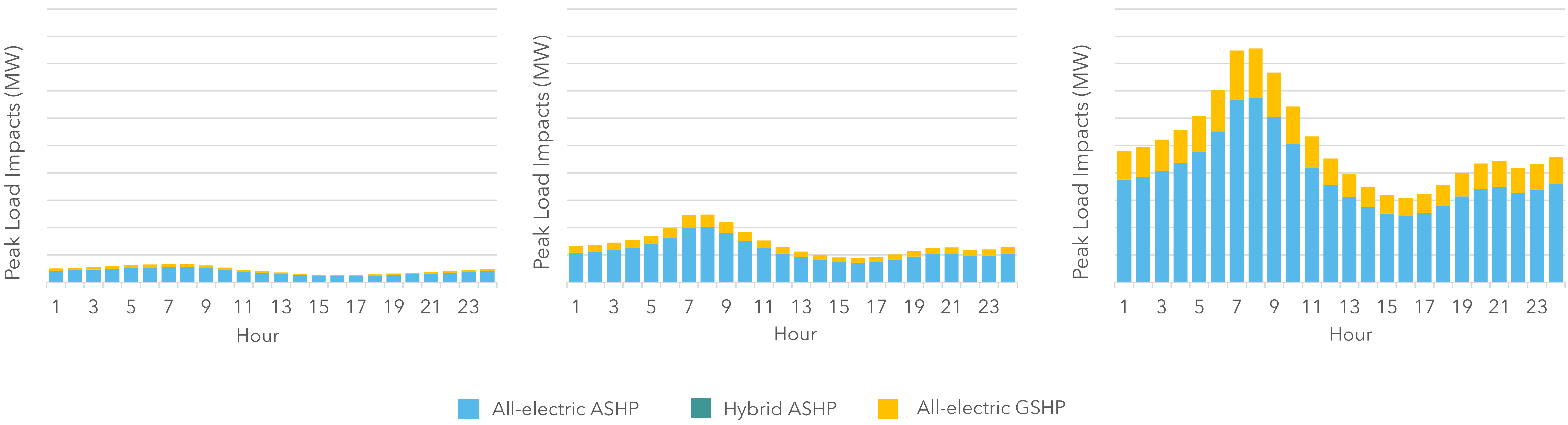
- Lower adoption
- Mostly hybrid systems -> no peak impact

Programs + Hybrid/Electric Policy

- Higher levels of adoption from policy
- Still mostly hybrid systems -> no peak impact

Programs + All-Electric Policy

- Very high levels of adoption cumulatively
- No hybrid systems -> electric resistance back-up (low efficiency)

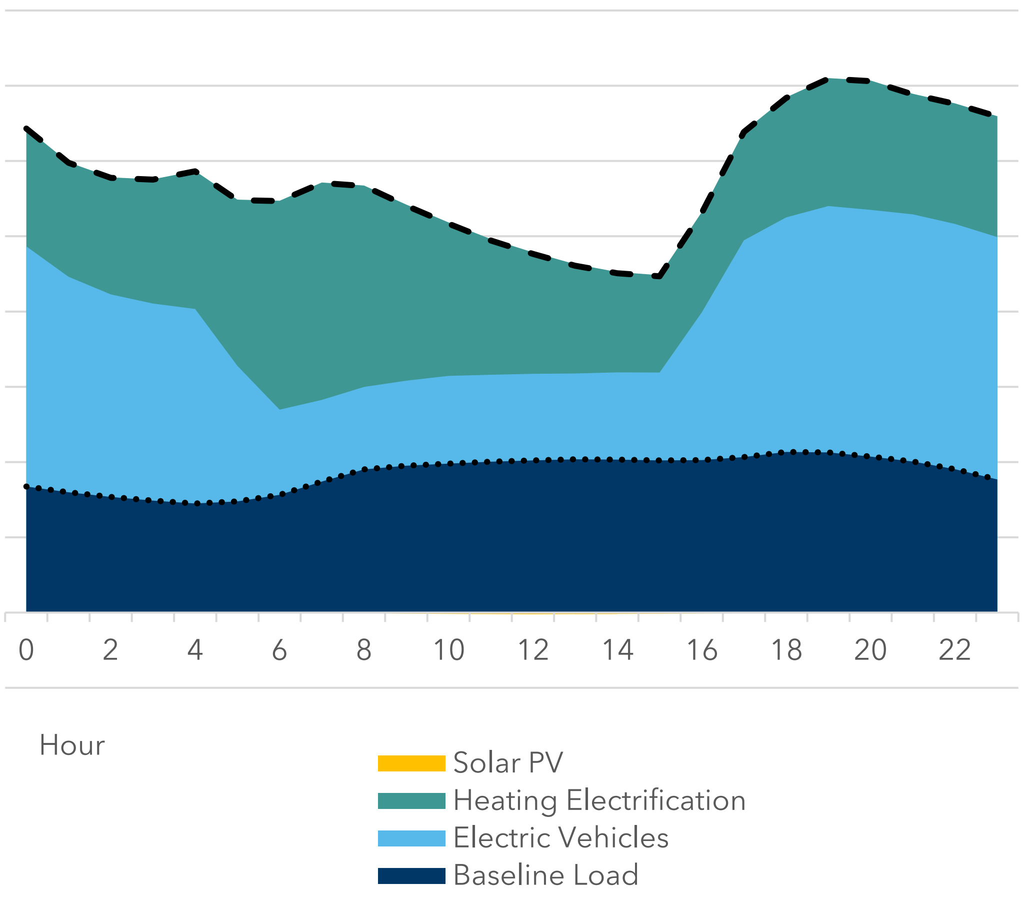


Load impacts assessment must be holistic

While heating electrification may have significant load impacts, **peak impacts must be viewed alongside other emerging loads** – i.e., coincident peak including:

- EV penetration
- DER (e.g., solar PV)
- Demand response measures
- Baseline load

Region-wide Impact of EVs, HE, and PV (2050)



Long-term modelling – how to navigate uncertainty?

Types of uncertainty:

Politics

- Carbon tax
- Programs and policies

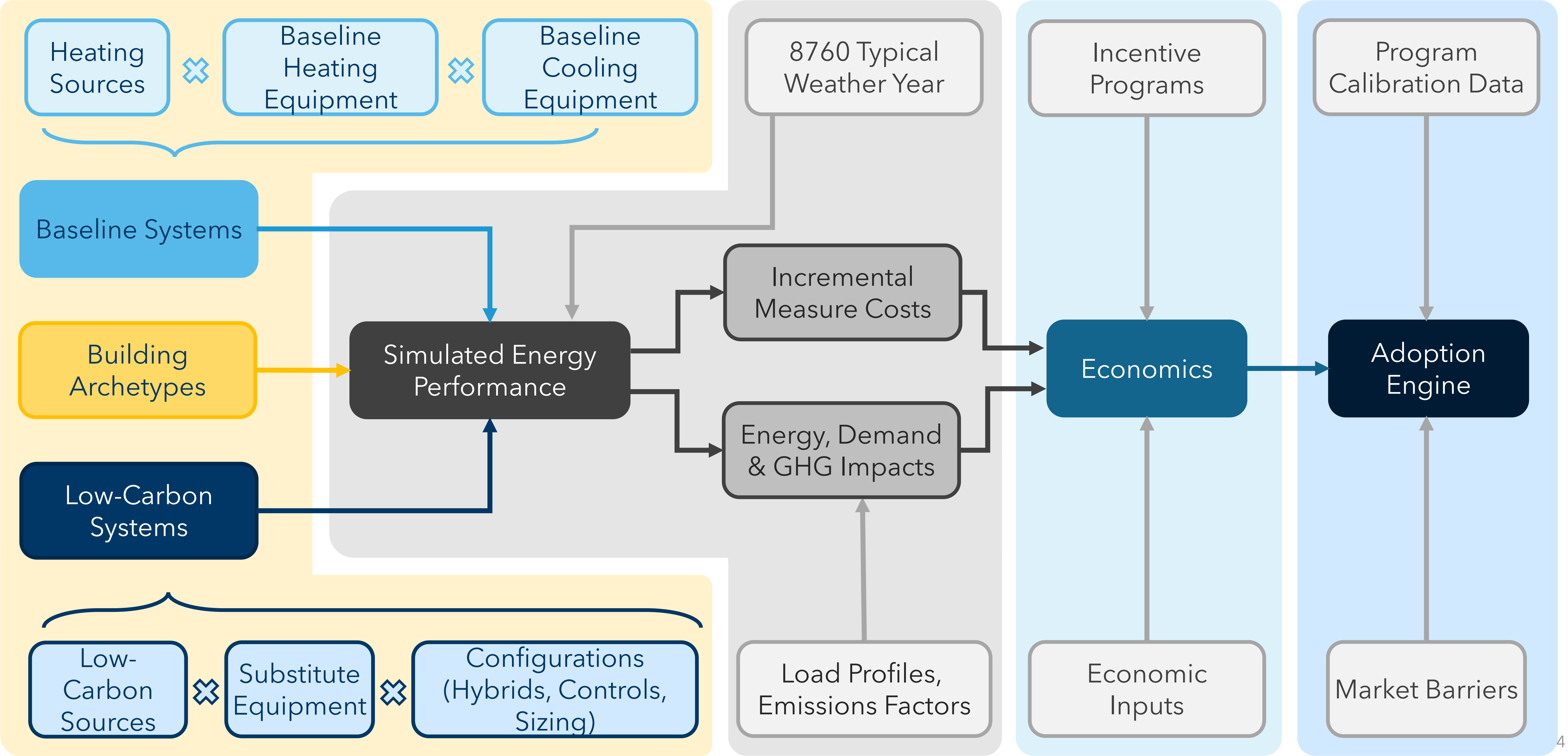
Commodity Rates

- Electricity
- Fossil fuels

Technology Evolution

- Capital costs
- Performance improvements

Dunsky's HEAT™ Model



Modelling is useful, but no one has a crystal ball

Heating electrification modelling can help policymakers and utilities navigate the energy transition**, but…**

1. The **future is uncertain** – modelling acknowledges this and explores pathways considering varying factors.

2. Modelling is not about getting it **"right"**, but rather **exploratory** work.

3. **Planning and policy goals/actions** will shape our future – leveraging models will help to inform action.

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