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Focus on Energy Quad V Planning Study

Second Stakeholder Meeting: Methodology

August 6, 2024

Agenda

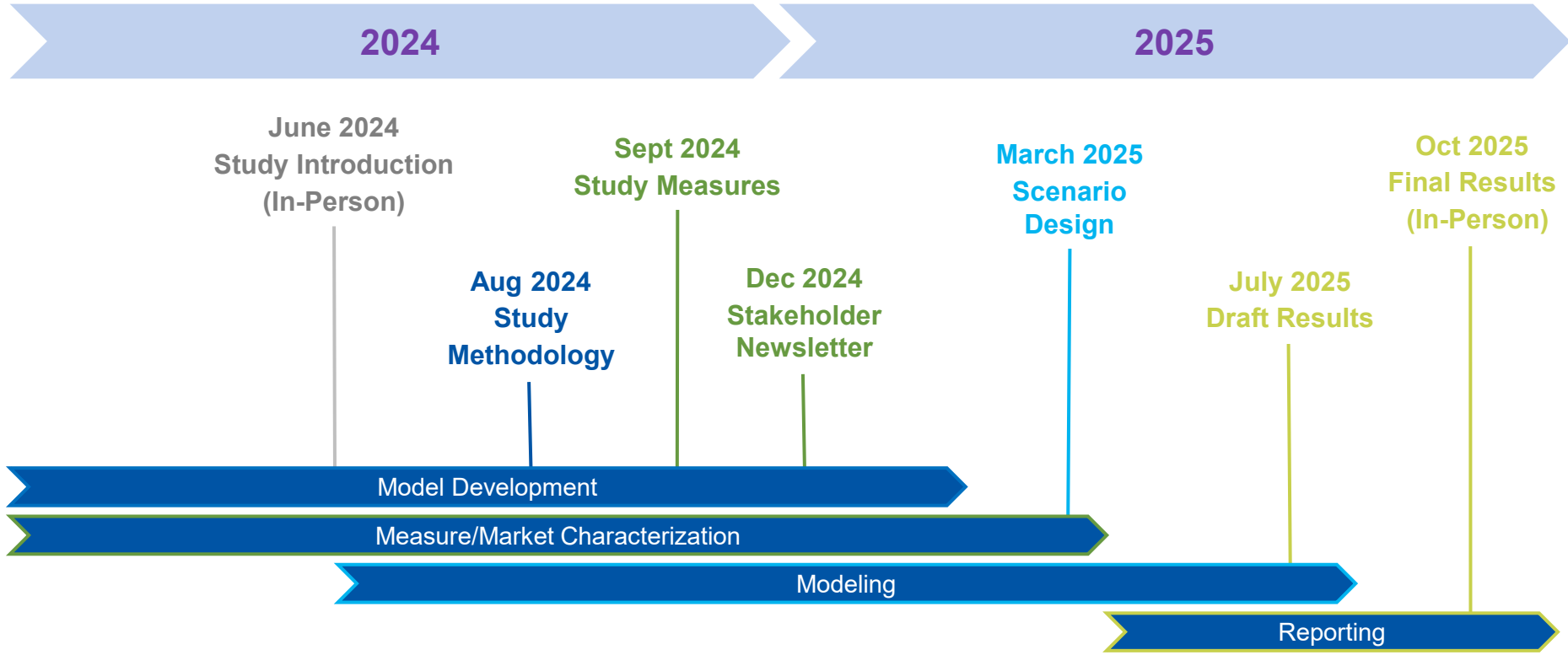
1. Overview
2. Model Mechanics
3. Electrification & Energy Efficiency Considerations
4. Peak Demand & Emissions Reduction Estimates
5. Participation in Program Design Scenarios



Overview

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Stakeholder Meetings



Evaluation Working Group, comprised of Wisconsin stakeholders with specific technical expertise, consulted throughout the study

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Study Themes and Objectives

Energy Efficiency: Electric & Natural Gas	Economic Potential	Program Scenarios	Electrification	Peak Impact and Emissions Reporting
Technical Potential	Adoption Simulation (Optimized Potential)	Scenario Analysis	Distributed Solar	Hourly 'Time-Value' Impacts

Consistent with the prior study

New to this study

Objectives:

Understand …

- how focusing on emissions reductions could impact energy savings
- the value of / tradeoffs between focusing on demand reduction versus energy savings
- potential energy, demand, and emission reductions in Wisconsin across customer segments, particularly for income-qualified households
- options for and potential benefits of policy and programmatic changes that promote further fuel switching
- how the Inflation Reduction Act (IRA) could impact programmatic uptake for Focus on Energy programs and the best path to complement its implementation

Contextualize study findings to inform program goals

Questions from Stakeholder Meeting 1

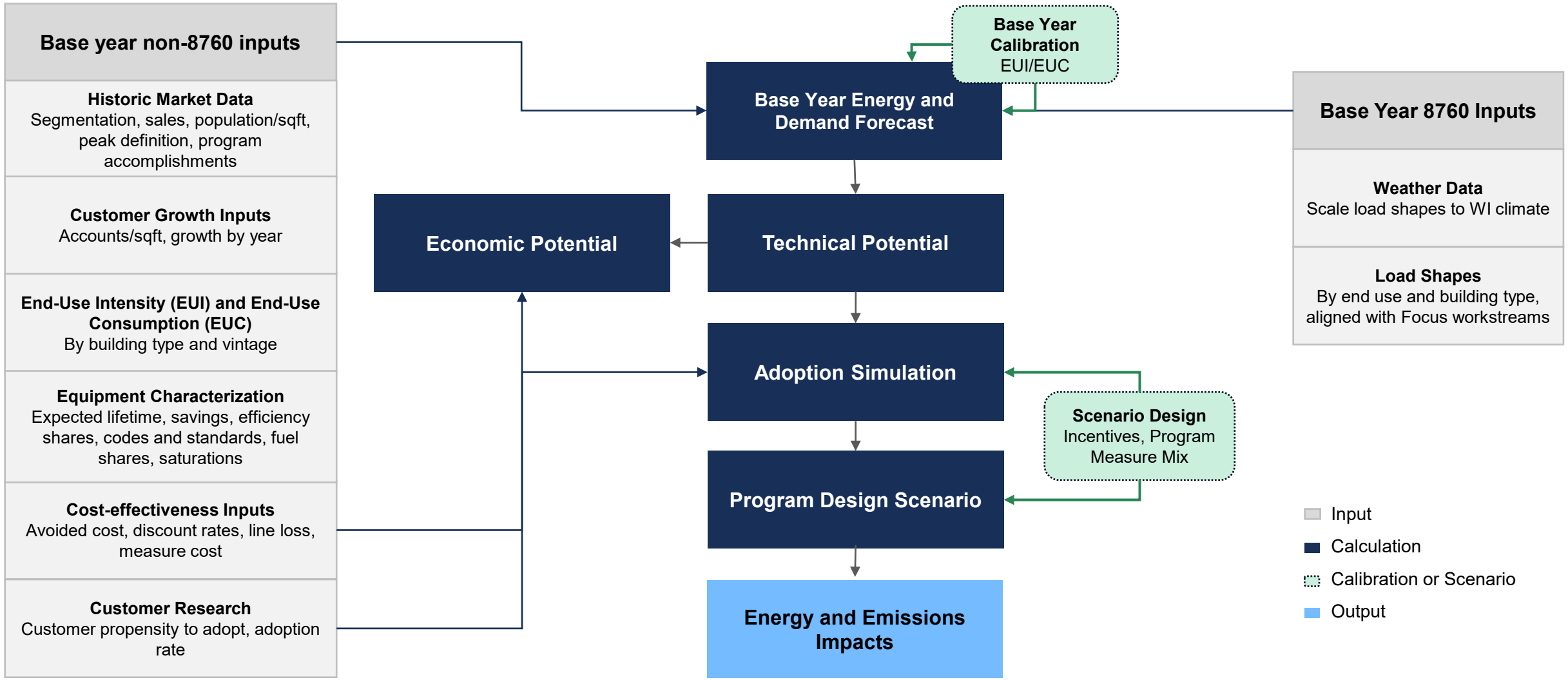
Questions	Response
To what extent will previous Focus activity inform projections of future potential?	Part of adoption and program participation modeling. Past program participation basis for future adoption trends (further details slide 19).
How will the demand impacts be calculated? And how will the planning study approach what constitutes demand reduction in terms of timing?	Electric demand calculated based on Focus on Energy peak period definitions. Peak demand impacts represent average impact over many hours, as compared to a maximum peak impact (single hour or day) (further details slide 22).
Is the intent to look at a typical energy efficiency scenario or to understand what a program trying to achieve emissions reduction looks like; and introduce new measures?	The study will design scenarios in consultation with stakeholders. One of the scenarios can be a typical energy efficiency program, and that can be compared to other scenarios. The study will start with existing measure list and expand it with emerging technology (further details slide 27).
Through the program scenarios, will the mix of measures change if focused on emissions reductions?	The measure mix can be adjusted, depending on the final scenarios (further details slide 27).
How will measure affordability be balanced with the cost of carbon, to ensure that measures will be financially possible for consumers? What will prevent the report from encouraging an emphasis on measures that are “efficient” or “high potential” in net energy/emissions impact (for electrification, emissions, and demand savings), but are not likely to deliver net energy bill savings for customers?	While the primary cost effectiveness screen for this study is the modified TRC test, which looks at cost and benefits wholistically, the adoption modeling takes the view of the consumer. The “customer view” includes utility bill impacts, capital and operational costs, utility and federal incentives – as well as non-economic considerations (further details slide 19).



Model Mechanics

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Planning Study Modeling Framework

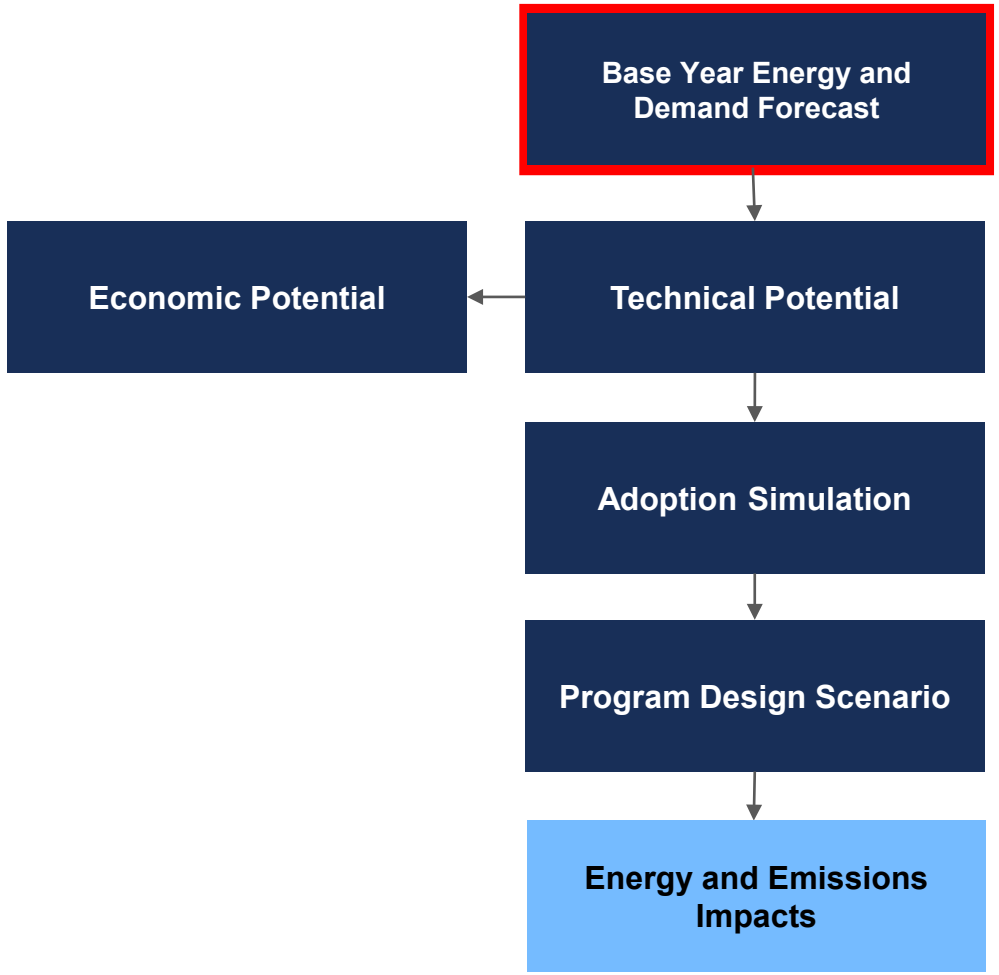


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Base Year Energy and Demand Forecast

Characteristics:

- Built up from customer accounts, end use saturations, end use fuel shares, end use equipment efficiency shares and end use consumptions
- Includes new construction and deconstruction rates by building type
- Includes adjustments from climate forecast
- Calibrated to utility load forecasts
- 8760 level results, built up from equipment load shapes

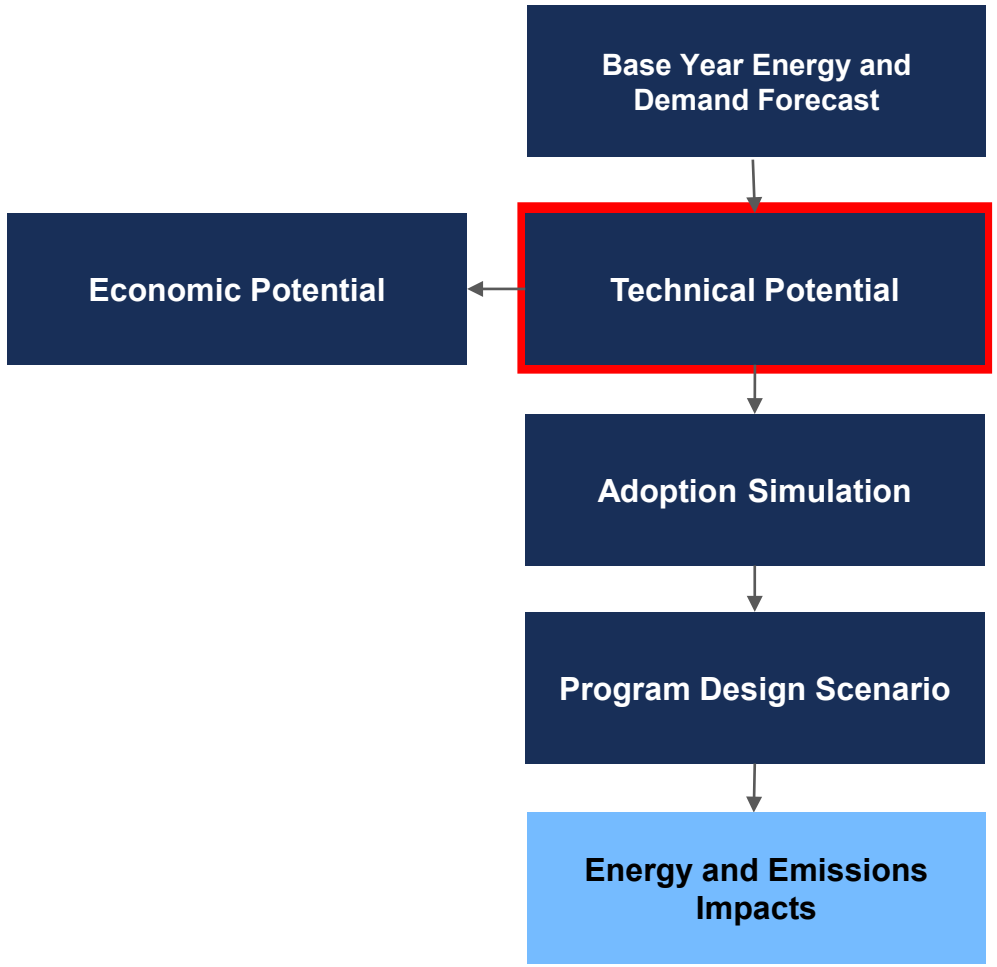


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Technical Potential

Characteristics:

- Represents the maximum energy and emissions impact from study measures, regardless of economics or customer choice
- Built up from equipment load shape
- Incorporates customer segmentation of all households and businesses in Focus on Energy territory
- Builds energy efficiency and electrification impacts separately due to downstream / interactive effects
- Develops database of measure-level impacts in WI
- Incorporates equipment turn-over assumptions, technical feasibility, and baseline code assumptions for impact measurement

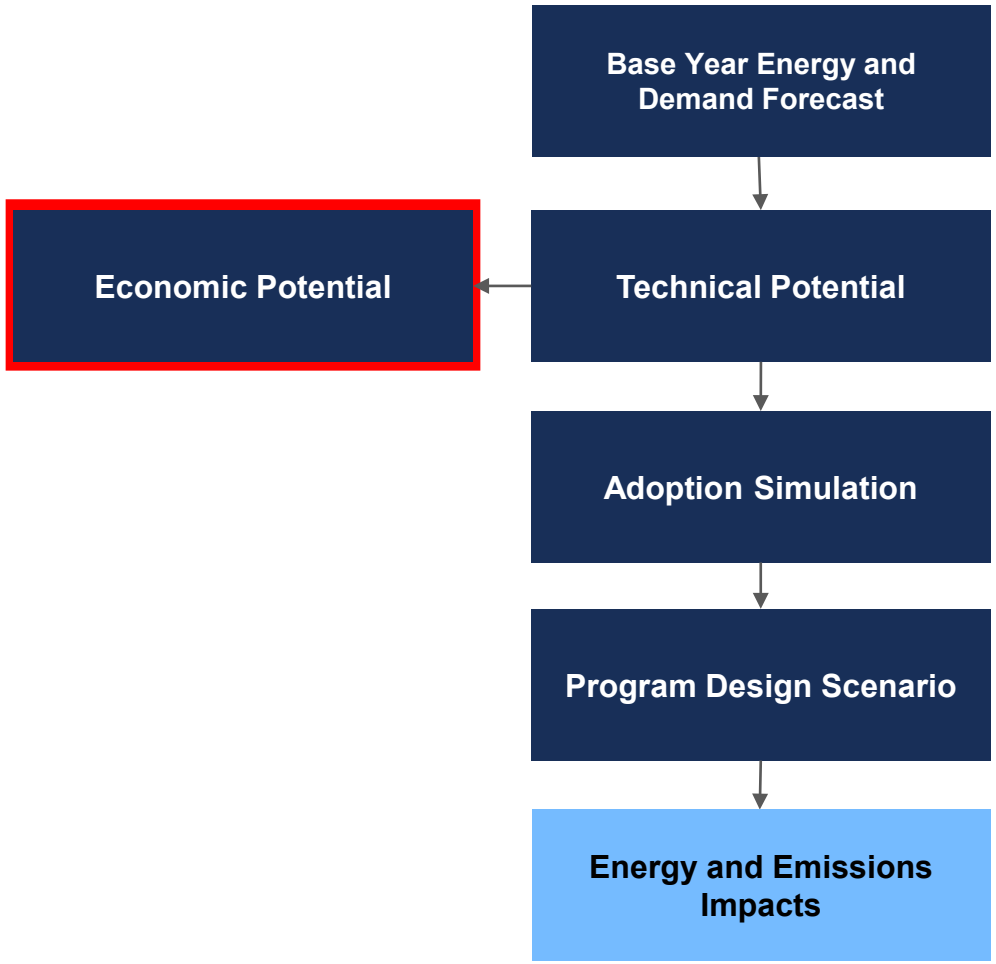


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Economic Potential

Characteristics:

- Subset of technical potential, representing measures in technical potential that pass the modified Total Resource Cost (mTRC) test
- Multiple cost test options and scenarios possible (fuel price, carbon cost, etc)
- Builds energy efficiency and electrification impacts separately due to downstream / interactive effect

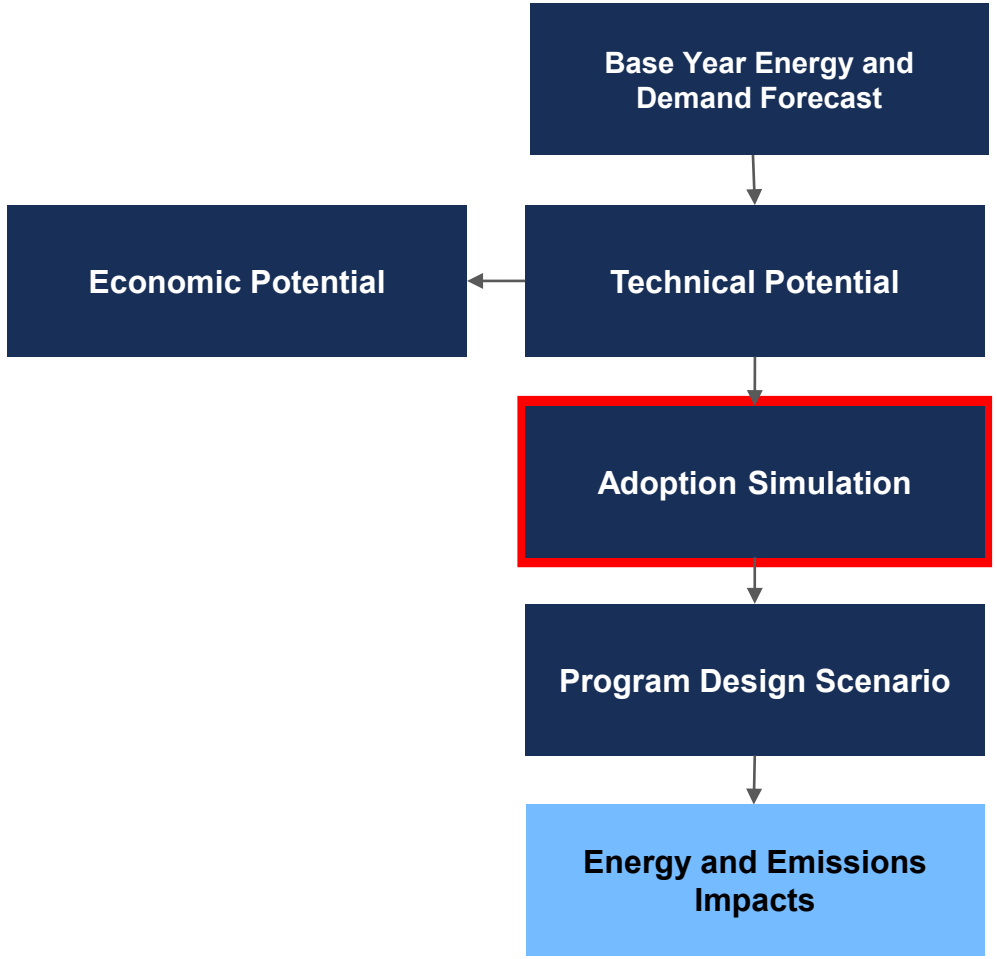


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Adoption Simulation

Characteristics:

- Annual adoption simulation of Focus on Energy measures by households and businesses based on past customer behavior, customer economics, and measure characteristics AND scenario design
- Scenario results reflect energy efficiency and electrification together
- Long-term impacts of program design and other market drivers
- Incorporates incentives
- Develops database of measures adopted under a variety of scenarios

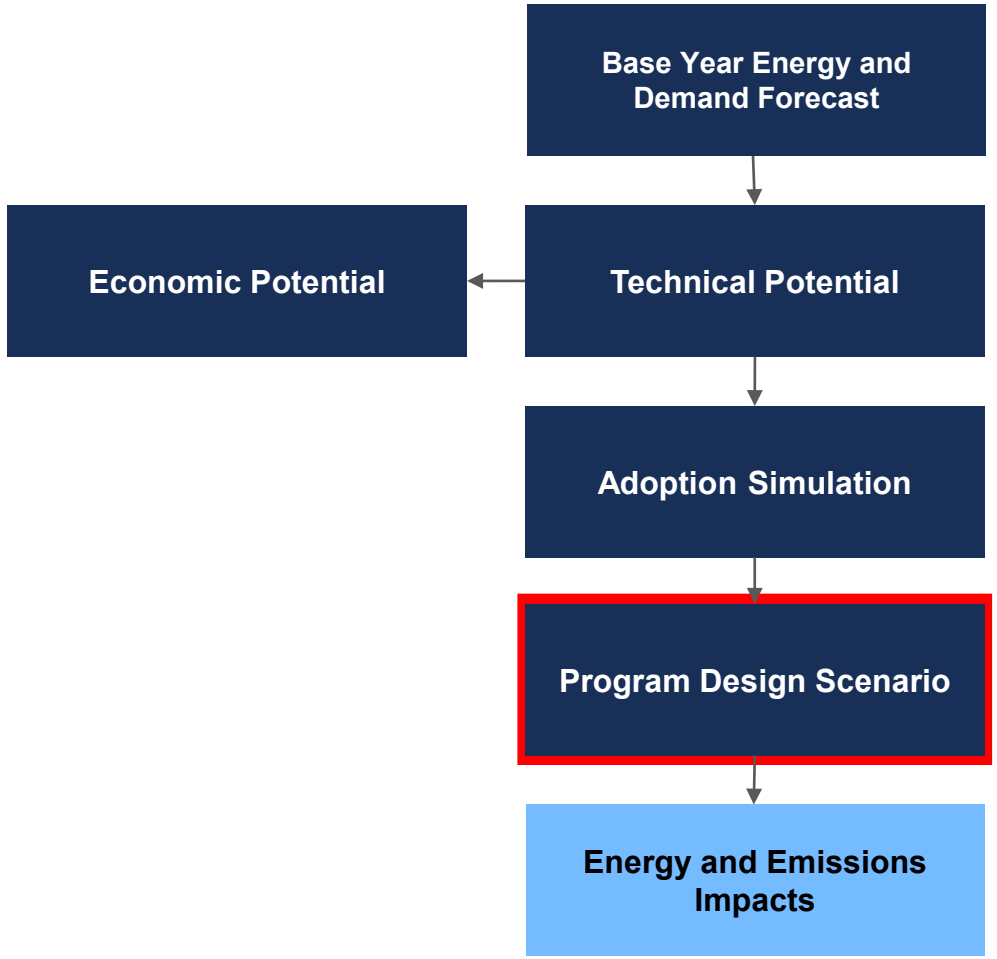


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Program Design Scenarios

Characteristics:

- Past measure performance informs participation
- 4-Year Program Scenarios
  - Six program planning scenarios with varying program parameters (measures incentives) and market conditions (measure costs, acceptance)
- Provides view into possible program design
  - Program budgets and cost effectiveness
- Bundles impacts by measure types, delivery mechanism
- Develop program configurations
- Estimate budgets, energy and emission impacts by program
- Develop portfolio and program cost effectiveness



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Electrification & Energy Efficiency Considerations

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Gas to Electric Fuel Switching Considerations

Study accounts for the **increases and decreases in electric load** and **decreases in gas load** in energy impact and emissions impact reporting and cost-effectiveness testing

Normalization of energy impacts necessary to compare impacts from fuel switching

Electric Energy Efficiency and Distributed Solar

- MMBtu & MWh, MW Winter / Summer Peak, GHG emissions, incentive and program budgets, units

Gas Energy Efficiency

- MMBtu & therms, therm-day Peak, GHG emissions, incentive and program budgets, units

Electrification (Gas to Electric Fuel Switiching)

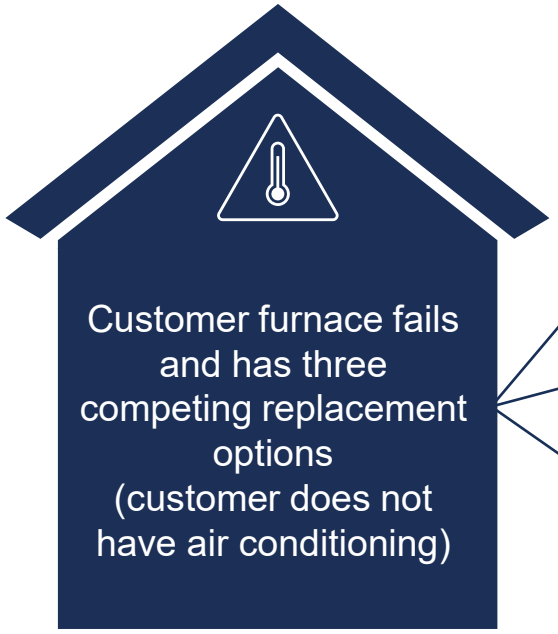
- MMBtu & MWh & therms, MW Winter / Summer Peak and therm-day Peak, GHG emissions, incentive and program budgets, units

Types of End Uses Compatible with Electrification

Gas End-Use Equipment	Electric End-Use Equipment
Gas Space Heat	Ducted Heat Pump
	Ductless Heat Pump
	Dual Fuel Heat Pump
Gas Water Heat	Electric Water Heat
Gas Dryer	Electric Dryer
Gas Pool Heat	Electric Pool Heat
Gas Cooking	Electric Cooking
Gas Process	Electric Process

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Electrification Impacts: Example



Customer furnace fails and has three competing replacement options (customer does not have air conditioning)

Baseline Option
Standard Gas Furnace

Energy Efficient Option
High-Efficient Gas Furnace

Electrification Option
Air Source Heat Pump

No System Impacts Compared to Baseline

Anticipated System Impacts	Gas
Load	▼
Summer and Winter Peak	▼

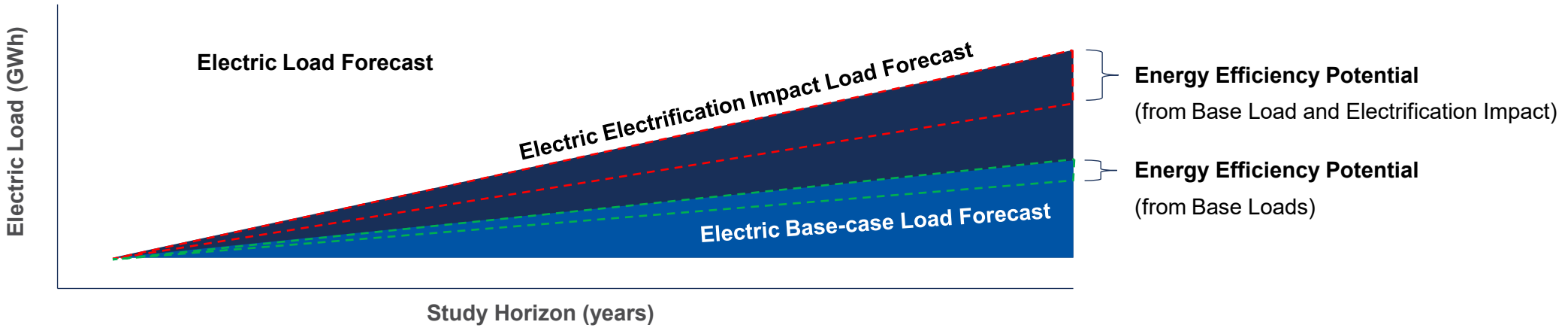
Anticipated System Impacts	Gas	Electric
Load	▼	▲
Summer and Winter Peak	▼	▲
Future EE Potential	▼	▲

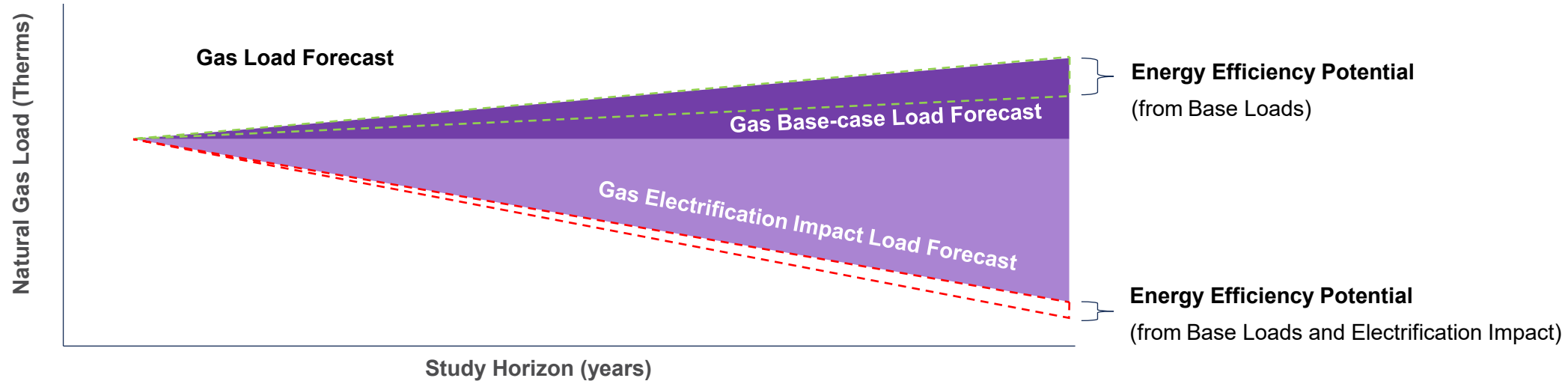
As electric space heating load converts from gas to electric use, energy efficiency potential for building retrofits moves from gas to electric impacts.

Factors for Competition
Customer Choice Efficient gas furnace is financially more affordable for customers than the heat pump. The economics of electrification can be more challenging. At the same time a heat pump can add cooling benefits.
Feasibility Some building designs are only compatible with certain types of appliance or system installations.

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Electrification vs Energy Efficiency





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Technical Electrification & Energy Efficiency Opportunities

Due to two (2) distinct pathways for equipment fuel choices (with downstream effects), 2 views of Technical and Economic opportunities needed

Electric & Gas Energy Efficiency Potential	Electrification Potential
No fuel switching	**Gas to Electric** fuel switching Convert all gas equipment to electric equipment where possible

Technical Potential

- Represents the maximum outcomes from electrification and energy efficiency options
- Captures the floor and ceiling of technical potential from electrification and energy efficiency
- Removes customer choice from estimates of what is technically possible
    - Technical electrification potential impacts represent 100% of failed gas equipment converting to electric equipment AND associated changes to energy efficiency potential
    - Technical energy efficiency without electrification represents theoretical maximum of energy efficiency

Economic Potential

- Since economic potential is a subset of technical potential, economic potential will similarly have two sets of results
- mTRC Screen

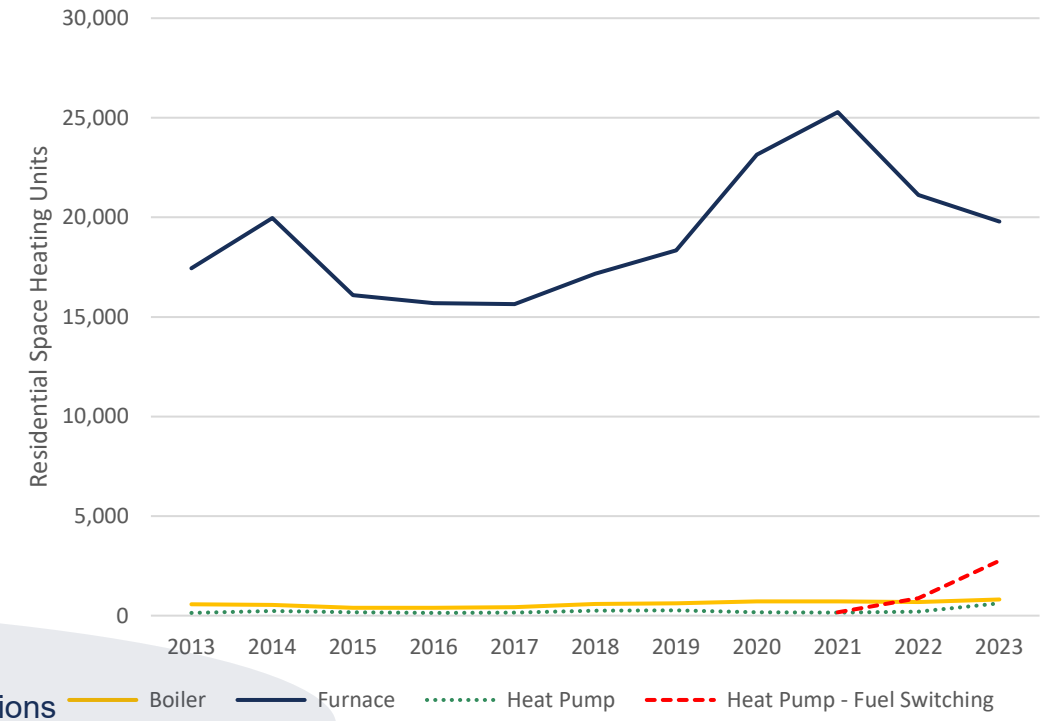
Simulating Equipment Adoption Choices

Adoption Simulation Methodology

"To what extent will previous Focus activity inform projections of future potential?"

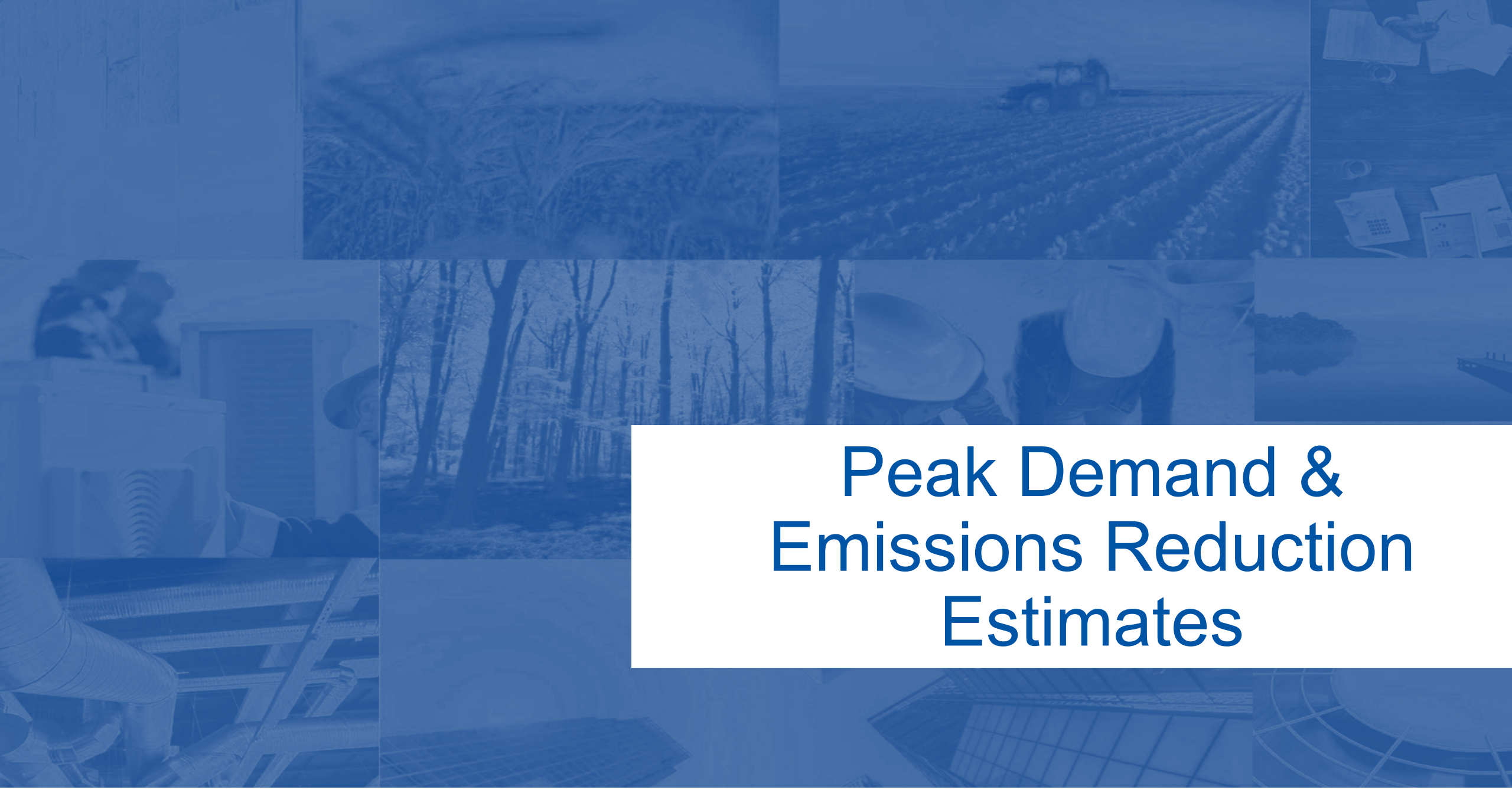
- Study develops adoption rates based on past consumer behavior / program participation
  - Past program participation provides baseline of 4-year adoption
- Study applies adoption rates AND survey data-driven customer economic and non-economic preferences to simulate adoption over 12 years
  - Economic considerations include utility bill impacts, incentives, and equipment costs
- Customer options for new equipment presented when existing equipment fails
  - Where two upgrade options compete for a new installation, study will develop a weighted relative share of adoptions

Historical data informs adoption trajectories (S-curves). Since 2014 participation in residential boiler and furnace offerings has been stable, while adoption of switching Heat Pumps has increased exponentially.



"What will prevent the report from encouraging an emphasis on measures that are "efficient" or "high potential" in net energy/emissions impact (for electrification, emissions, and demand savings), but are not likely to deliver net energy bill savings for customers?"

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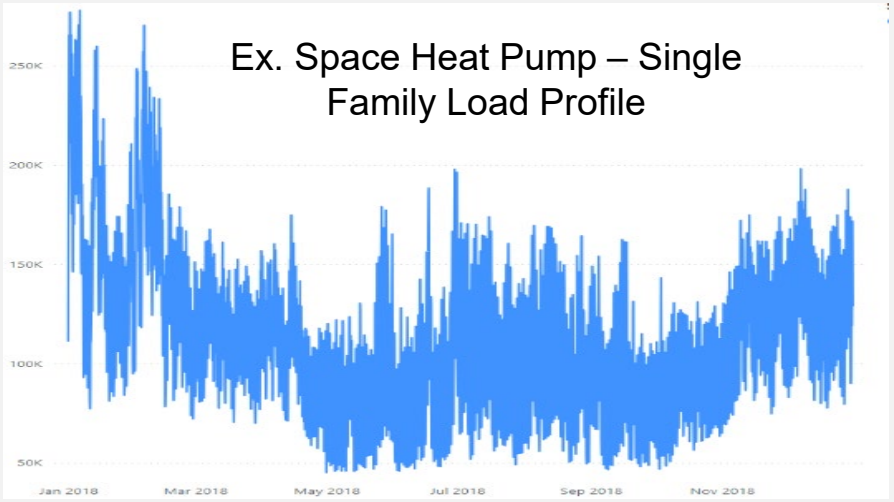


Peak Demand & Emissions Reduction Estimates

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Estimate Load Impacts at Hourly Basis

1. Develop technical, economic, and scenario annual hourly load impacts
   a) Develop end-use and measure load profiles based on Focus on Energy's load profile research (NREL's ResStock, ComStock, and other research)
   b) Apply hourly profiles to load annual impacts from study measures
2. Add hourly load impacts to hourly system load shapes to estimated total hourly load impacts from measure adoption
3. Compare system hourly load shapes to total hourly load impacts for peak and emissions impacts



NREL
NATIONAL RENEWABLE ENERGY LABORATORY
ResStock
ComStock

- NREL dataset contains approximately 900,000 (550,000 ResStock and 350,000 ComStock) building energy models
- Output of each building energy model is 1 year of energy consumption in 15-minute intervals

To develop total load impacts (technical, economic, adoption simulation) add hourly impacts for all measures in each year.

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Electric and Gas Peak Demand Impacts

"How will the planning study approach what constitutes demand reduction in terms of timing?"

Energy Efficiency and Electrification Peak Demand impact represents the average peak demand during the peak period, as defined by Focus on Energy

Hourly Impacts represent the difference between baseline and measure adoption impacts

The **average of the hourly impact during the peak period** (summer and winter) = the peak demand impacts for energy efficiency

The **net hourly impact** will be determined relative to the system load shape

- EE will decrease system demand
- Electrification will increase system demand

Natural Gas Peak Demand reported on a therm-day basis, following an approach similar to the electric demand calculation.

This approach estimates the average peak impact over many days (i.e. summer peak is the average impact from measuring system load changes over 4 hours, 5 days, 4 weeks, 4 months). Study does not estimate the maximum peak impact during the hour of highest system demand.

Study does not estimate changes to peak periods over study horizon.

STATEWIDE FOCUS ON ENERGY PEAK PERIOD DEFINITIONS

Summer Demand Peak: (Electric)

Weekdays 2PM-6PM (hour beginning 2:00PM-5:59PM)

June, July, August, and September

Winter Demand Peak: (Gas & Electric)

Weekdays 8AM-12PM (8:00-11:59AM) and 5PM-9PM (5:00PM-8:59PM)

December, January, and February

Electric Emissions Impact Modeling

1. Develop hourly generation profile for Wisconsin utilities
   - Determine current and future generator mix from the Wisconsin Strategic Energy Assessment (SEA)
   - Apply hourly generator profiles from EIA (MISO Local Resource Zone 1 & 2)

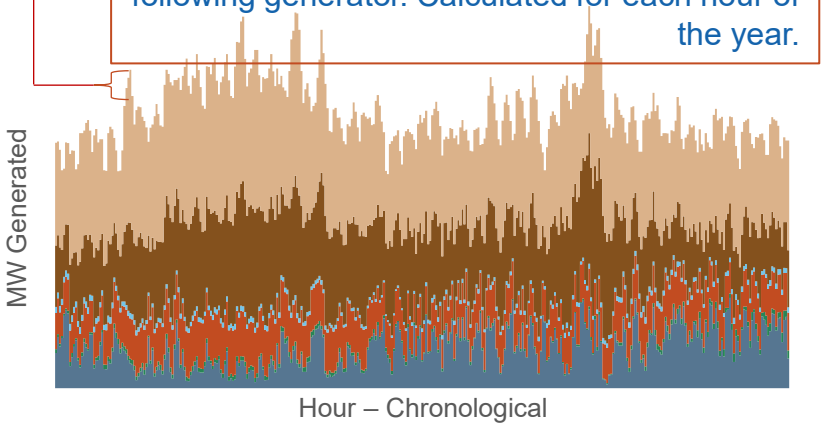
2. Identify hourly load impacts from study measure adoption
   - Hourly generation resources impacted are load following resources such as (combined cycle gas plants)

3. Apply emission factors from the SEA for generator load decreases and increases
   - Determine generator type ramped up or down from current or forecast generator mix*

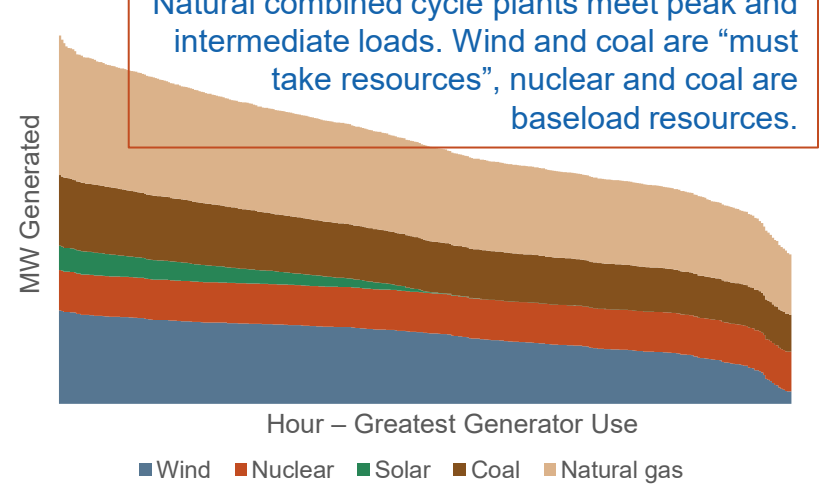
Changes in generation due to changes in loads occur in Wisconsin
- Utilities reduce generation rather than increase exports when demand decreases
- Utilities increase generation rather than increase imports when demand increases

* This study will not attempt to forecast resources needed to meet potential increased energy demand

Hourly emissions impact = hourly reduction in generator use * emissions factor for load following generator. Calculated for each hour of the year.



Natural combined cycle plants meet peak and intermediate loads. Wind and coal are “must take resources”, nuclear and coal are baseload resources.



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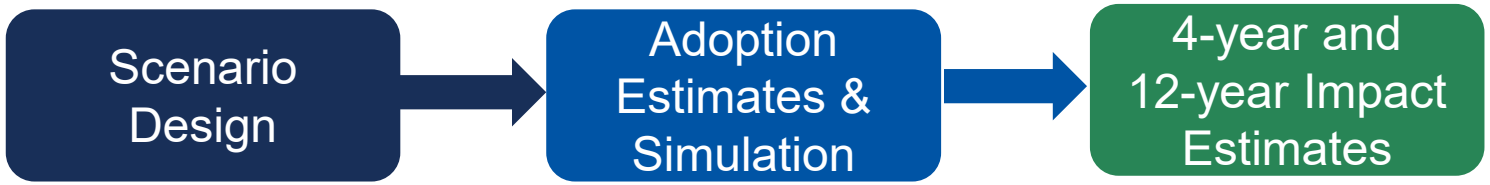


Participation in Program Design Scenarios

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Program Planning Scenarios Overview

"To what extent will previous Focus activity inform projections of future potential?"



Study will develop **six** program planning **scenarios** in consultation with stakeholders by **varying program parameters** (measures, incentives, budgets) and **market conditions** (measure costs, market conditions [gas prices])

Scenarios designed in consultation with stakeholders to address study research questions

4-Year Program Scenarios

Provides view into possible Quad program design

- MWh, therm, MMBtu, CO_2, MW and therm-day impacts from Focus on Energy program measures
- Program budgets and cost effectiveness

Measure adoption informed by historical participation trends and capped to any assumed program budgets

12-Year Adoption Simulation

Long-term impacts of program design and other market drivers

- Impacts from Focus on Energy measures **AND** adoption outside of the program

Adoption could include non-program uptake driven by market conditions or non-program incentives (tax credits)

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Participation in Program Design Scenarios

4 and 12-year adoption simulated through modeling mechanism leveraging primary research, past adoption data, and current and future market trends



Adoption Simulation

- Each scenario require re-running the adoption simulation

Benchmarking / Calibrating Adoption Results

- Prior to developing scenarios and simulating measure adoption study will:
  - Gather participation four years of focus participation data and program data (incentives) and macro economic factors
  - Simulate adoption using past measure mix and adoption assumptions
  - Compare results of simulation to actual program participation
  - Calibrate measure assumptions
  - Re-run adoption simulation and repeat until simulation results match historical measure adoption
  - Apply calibration factors to subsequent model runs

Program Planning Scenarios

Variation Options in Program Scenarios

Incentive Level

Incentive amounts impacts the customer payback used in adoption uptake calculation

Gas or Electric Rates

Bill impacts incorporated into customer payback calculation

Measure Mix

Design program offerings to reflect potential priorities of Quad

Market Conditions

Simulate lower or higher adoption barriers

"Through the program scenarios, will the mix of measures change if focused on emissions reductions?"

"Is the intent to look at a typical energy efficiency scenario or to understand what a program trying to achieve emissions reduction looks like; and introduce new measures?"

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Thank You and Discussion

Next Steps:

Cadmus to post meeting slides, notes, and recording to study website (focusonenergy.com/about/quad-v-planning-study)

Next Stakeholder Meeting:

Study Measures (September)

Your input is important, please send us feedback

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