Gas Utility IRP

September 22, 2022

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Safety Moment

As we are heading into fall with raining season ahead, some safe driving tips:

- Follow S.A.F.E.R driving tips:
  - **S**pace - Allow enough space between cars.
  - **A**ttitude - Be patient and do not tailgate other cars.
  - **F**oresight - Ensure that you are seen by others by using turn signals, headlights and brakes lights are in good condition, and avoid others' blind spots.
  - **E**yesight – Stay focused, don't text and drive
  - **R**esponsibility – Always wear seat belts, and remind passenger to wear seat belts even in the back seat

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Welcome to the Webinar and Thank you for Participating!

If you **want to type a question regarding the presentation,** insert **"Slide X followed by your question"** in the chat box!

If you **have a technical issue or a general question**, please type it in the chat box.

Please **keep yourself on mute** unless you are speaking.

If you want to **ask a question verbally,** click the 'Reaction' button and click on the **'Raise Hand'** option and we will call on you.

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Facilitator Requests

- Engage constructively and courteously towards all participants
- Respect the role of the facilitator to guide the group process
- "Take space and make space"
- Avoid use of acronyms and explain the technical questions

Agenda

Time	Agenda Item	Presenter
1:00 – 1:10 p.m.	Opening	Sophie Glass, Triangle Associates
1:00 – 1:15 p.m.	Recap from August 24 Meeting	Phillip Popoff, PSE
1:15 – 1:20 p.m.	Inflation Reduction Act Impacts	Jennifer Coulson, PSE
1:20 – 1:40 p.m.	Final Gas Scenarios and Sensitivities	Jennifer Coulson, PSE
1:40 – 2:40 p.m.	Conservation Potential Assessment (CPA) Results	Gurvinder Singh, PSE Aquila Velonis, Cadmus Group
2:40 – 2:50 p.m.	Break	
2:50 – 3:55 p.m.	Final Climate Commitment Act (CCA) Pricing and Gas Alternatives	Gurvinder Singh, PSE Steve Schueneman, PSE Bill Donahue, WFD Consulting
3:55 – 4:00 p.m.	Next Steps	Sophie Glass, Triangle Associates
4:00 p.m.	Adjourn	Sophie Glass, Triangle Associates

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Today's Speakers

Phillip Popoff
Director, Resource Planning Analytics, PSE

Jennifer Coulson
Manager, Operations and Gas Analysis, PSE

Bill Donahue
WFD Consulting

Sophie Glass
Co-facilitator, Triangle Associates

Gurvinder Singh
Consulting Energy & Resource Planning Analyst, Resource Planning and Analysis, PSE

Aquila Velonis
Senior Associate, Cadmus Group

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Recap from August 24 Resource Adequacy Meeting

Phillip Popoff

Director, Resource Planning Analytics, PSE

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Themes Heard at the August 24 Meeting

Themes/ questions heard at August 24th Meeting (Resource Adequacy)	Answer
PSE needs to provide more context and clarity on the steps in which IRP stakeholders can have a role in conservation planning.	PSE prepares a Biennial Conservation Plan (BCP) consistent with RCW 19.285.040(1), WAC 480-109-120, and requirements outlined in Appendix A of the Commission Order 01 of Docket UE-190905. Stakeholder engagement related to the development of the BCP occurs at various steps of plan development, as described in the BCP. In addition, after the BCP is filed with the Washington Utilities and Transportation Commission by November 1st of every odd-numbered year, the public has opportunities to submit written comments on the BCP within 30 days of the utility's filing and participate at any WUTC meetings to review and consider the BCP.
Participation in the IRP process is critical to stakeholders.	PSE agrees that stakeholder engagement is critical to the IRP process. We are assessing the stakeholder process for the next IRP cycle in order to improve the process.
It is critical to include the most recent data in forecasting models.	PSE agrees. It is important to include the most recent data in forecasting models as feasible.
It is good to see that PSE is incorporating climate change into modeling and resource planning.	Thank you for your comment.
Concerns about PSE's commitment to meeting the 2030 CETA requirements.	PSE is committed to achieving the 2030 CETA requirements, as outlined in our 2021 Clean Energy Implementation Plan (CEIP).

More responses on unanswered questions from August 24 meeting and feedback form are addressed in Feedback Report.

Inflation Reduction Act Impacts

Jennifer Coulson

Manager, Operations and Gas Analysis, PSE

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Overview of IRA Impacts on the Gas Utility

2023 Gas Utility IRP

- The new Production Tax Credit (PTC) & Investment Tax Credit (ITC) are really focused on resources that would support the electric utility
- However, **the following impact the gas utility**
  - **2023 Gas Utility IRP**
    - **PTC for new technologies includes hydrogen** and hydrogen hubs, making this technology more cost effective. This will be included in PSE's analysis
  - **Future IRP cycle**
    - **Methane Emissions Reduction Program**: Beginning in 2025, the EPA will begin calculating and enforcing methane emissions fees from covered gas processing, transmission and storage facilities. Likely to impact wholesale gas prices in the future.
    - **Energy Efficiency Home Rebates:** The legislation establishes pair of consumer home energy rebate programs, focused on lower & moderate-income consumers, totaling $9 billion. One of the programs is exclusively focused on electrification rebates.
    - The **Alternative Fuel Tax Credit (AFTC)**, a $0.50/gal excise tax credit utilized by PSE customers for natural gas transportation uses, has been extended through 2024.

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Final Scenarios and Sensitivities

Jennifer Coulson

Manager, Resource Planning and Analysis

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How Does PSE Model Different Conditions to Get a Portfolio?

- IRP builds long-term portfolio – mix of resources to meet customer gas needs – based on demand, price and applicable laws
- IRP analysis will look forward to 2050; the exact combination of conditions and risks are unknown
- Uses scenarios and sensitivities to help model and understand potential outcomes based on various conditions

What are scenarios?

Scenarios **test how different sets of economic and policy conditions affect portfolio costs and risks**, followed by the inputs used to create those scenarios

What are sensitivities?

Sensitivities start with the optimized, least cost Reference Case Scenario portfolio produced in the scenario analysis and **change a resource, environmental regulation or other condition to examine the effect of that change on the portfolio.**

Example:

Scenario #	Scenario Name	Parameters		
		A	B	C
1	Reference Case	X	Y	Z
2	abc	A	B	C

	Sensitivity Name	Parameters		
		A	B	C
1	Reference Case	X	Y	Z
A	abc	X	Z	Z

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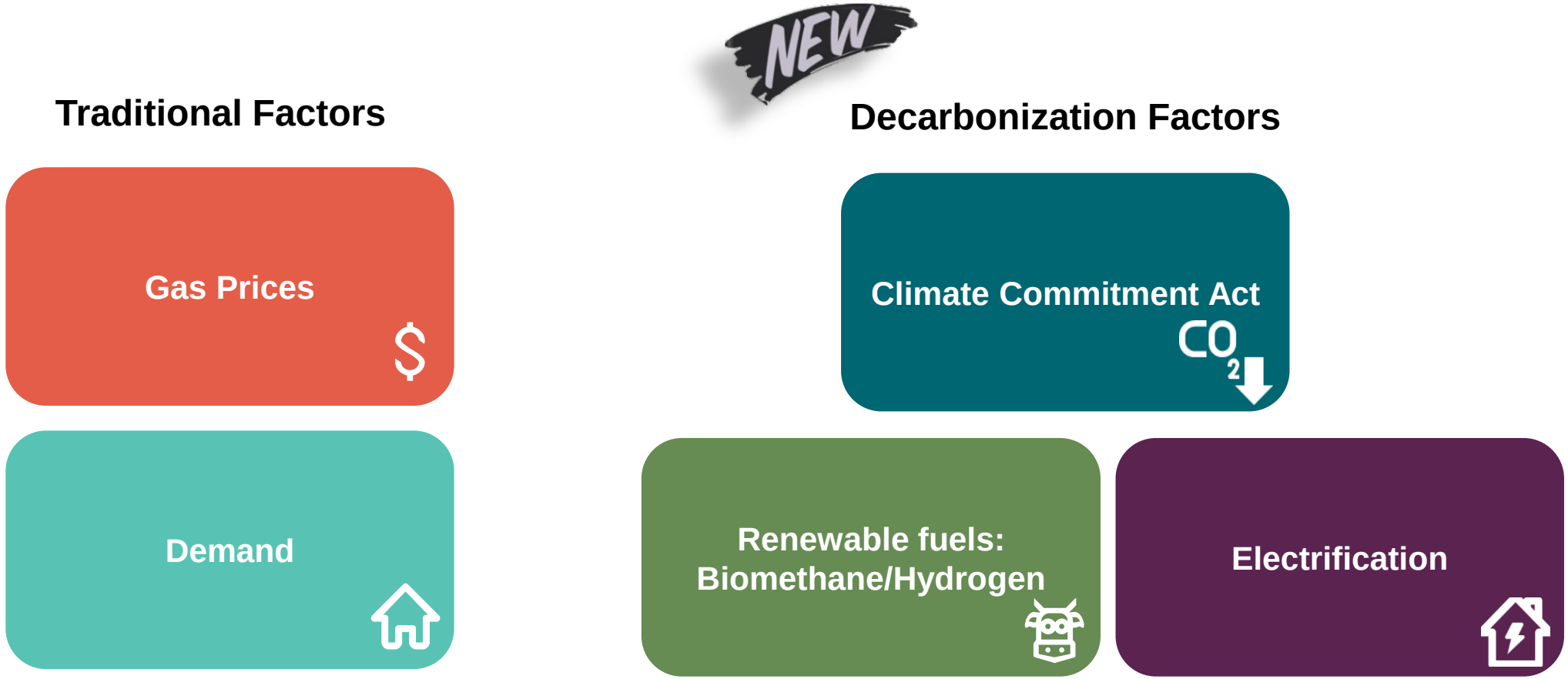
Input Components that were Considered in the Development of the Scenarios



Changes Since March 31st Stakeholder Meeting

Removal of some of the input components reduced the number of scenarios but increased the number of sensitivities:

- Clarifications
  - Hybrid heat pump treated as a conservation measure
  - Externality cost not applied to renewable fuels
  - Incorporating what we understand of the Inflation Reduction Act
- CCA Draft rules released
  - Consolidated carbon policies scenarios to a sensitivity
- Incorporation of stakeholder feedback
  - ✓ Will model State Energy Strategy as electrification scenario
  - ✓ Added no gas growth sensitivity
  - ✓ RNG sourced in WA only now a sensitivity, using North America for all other scenarios and sensitivities
  - ✓ Will include cold weather and ground source heat pumps along with hybrid heat pumps

2023 Gas IRP: Scenarios

	Scenario #	Scenario Name	CCA				Typical Gas IRP Parameters		
			Carbon Constraint Parameter	Allowance Price	Renewable Fuel Source Location	Heating Load Shift	Demand	Gas Growth?	Gas Price
★	1	Reference Case	Price	Expected	North America	Economic	Mid (F22)	yes	Mid
★	2	Electrification - State Energy Strategy (SES)	Follow SES line	Floor	North America	Force in Cadmus Electrification Results	Zero by 2050	no	Mid

★ Scenario will have an electric analysis modeled in Aurora

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2023 Gas IRP: Sensitivity

	Sensitivity Name	CCA		Renewable Fuel		Typical Gas IRP Parameters	
		Carbon Constraint Parameter	Allowance Price	Renewable fuel source location	SCGHG Added?	Demand	Gas Price
1	Reference Case	Price	Expected	North America	No	Mid (F22)	Mid
A	Allowance Price High	Price	Ceiling	North America	No	Mid (F22)	Mid
B	Allowance Price Low	Price	Floor	North America	No	Mid (F22)	Mid
C	Carbon Constraint	Free Allowance line	Expected	North America	No	Mid (F22)	Mid
D	Alternative Fuel Location WA	Price	Expected	WA	No	Mid (F22)	Mid
E	Alternative Fuel without SCGHG	Price	Expected	North America	Yes	Mid (F22)	Mid
★ F	HHP Policy	Price	Expected	North America	No	Mid (F22) - policy driven HHP adoption	Mid
G	No gas growth	Price	Expected	North America	No	Zero gas growth after 2026	Mid
H	High Gas Price	Price	Expected	North America	No	Mid (F22)	High

★ Sensitivity will have an electric analysis modeled in Aurora

Note: 'No' on SCGHG adder = no penalty

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Conservation Potential Assessment Results

Gurvinder Singh
Consulting Energy & Resource Planning Analyst, Resource Planning and Analysis, PSE

Aquila Velonis
Senior Associate, Cadmus Group

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2023 IRP: Conservation Potential Assessment – Natural Gas

September 22, 2022

Meeting Agenda

1. Scope Overview
2. Results
   a) Energy Efficiency
   b) Gas to Electric Conversion

Study Scope

Resources	Energy Efficiency (EE)

Fuels	Natural Gas – EE, Gas to Electric

Primary Objectives

- Produce updated forecasts of achievable technical potential
- 2024 – 2050
- Develop supply curve inputs

Updated Data

- Load and customer forecasts
- Updated customer segmentation
- PSE measure case
- Program accomplishments
- Updates based on codes and standards
- Climate change adjustments
- Non-Energy Impacts (NEIs)
- Named Communities & Equity

Natural Gas Energy Efficiency Potential Results

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Natural Gas Energy Efficiency Potential

2023 Achievable Technical Potential

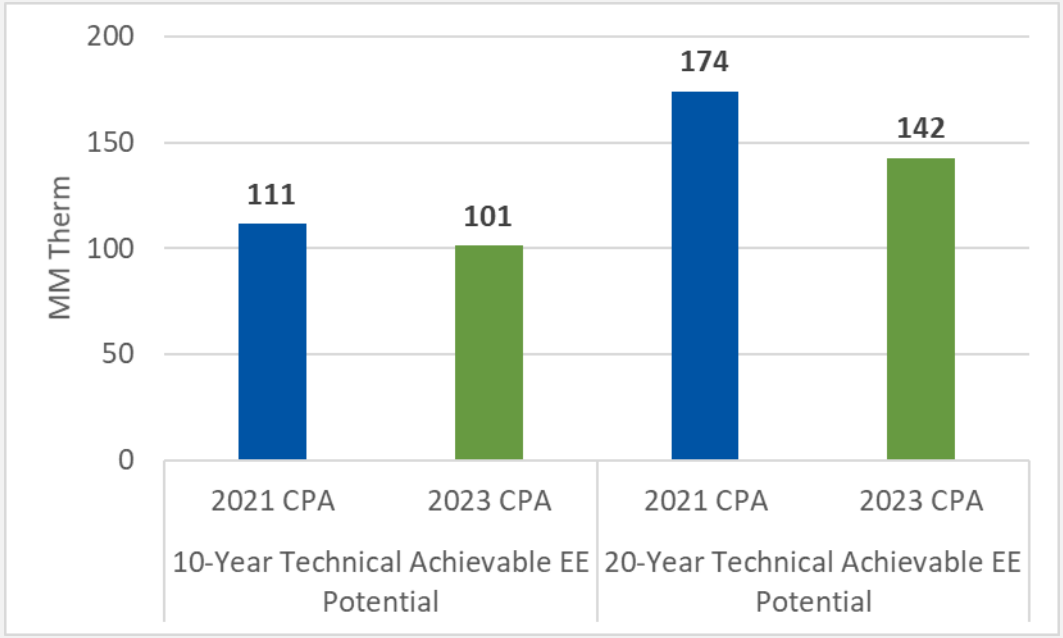
Sector	2-year (2025)	4-year (2027)	10-year (2033)	27-year (2050)
Cumulative Achievable Technical Potential (MMTherm)				
Residential	10	21	59	111
Commercial	7	14	39	51
Industrial	1	1	3	3
Total	18	37	101	165

Sector	2-year (2025)	4-year (2027)	10-year (2033)	27-year (2050)
Cumulative Achievable Technical Potential (MMTherm)				
Transport	4	9	23	26

Transport Customers:

- Less than 25k tons of CO_2 annual emissions - 309 small commercial and industrial sites
- Included in the CPA as a compliance requirement for the Climate Commitment Act (CCA)

Comparison to 2021 CPA



9% decrease in 10-year total potential

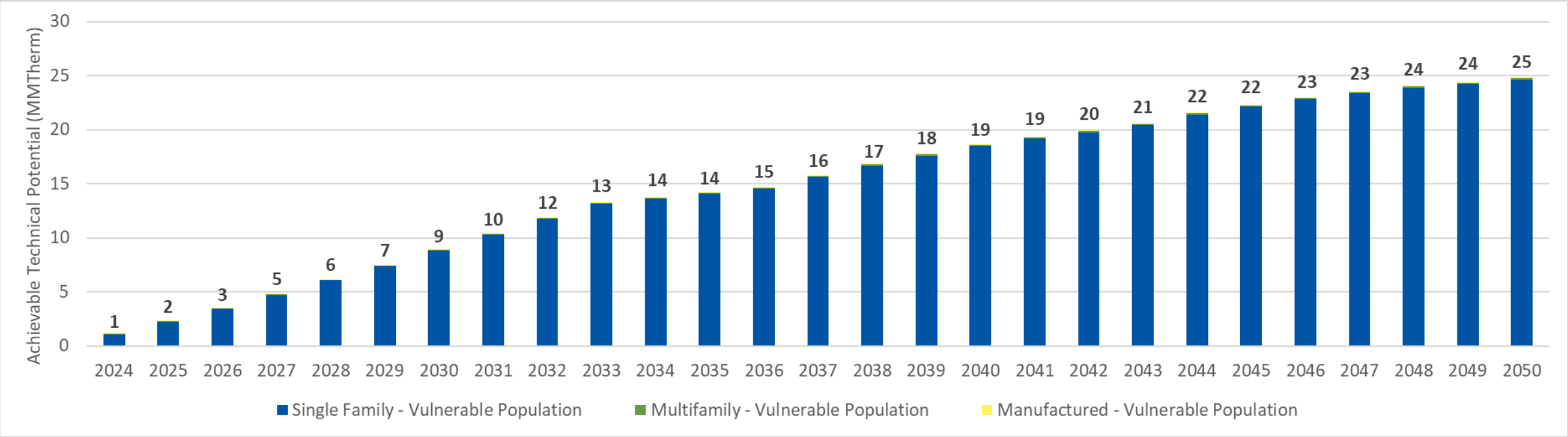
18% decrease in 20-year total potential

The 2023 IRP natural gas study period spans 27 years

The 2021 IRP spans 20 years

Figure shows only the first 20 years for comparison purposes

Natural Gas Energy Efficiency Potential for Vulnerable Populations



Vulnerable Population Potential:

- 22% of the residential potential (25 MMTherm) by 2050
- Levelized cost bundles are changed to 2/3 of TRC to reflect vulnerable populations on the supply curve

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Top Residential Measures

Cumulative Achievable Technical Potential (MMTherm)

Measure Name	10-Year	27-Year
Furnace - Premium Efficiency	8.6	26.3
Water Heater - ENERGY STAR Tankless	2.6	25.3
Smart Thermostat	10.6	11.3
Integrated Space and Water Heating	1.3	9.6
Duct Sealing	6.2	6.2
Window - Storm Window	5.2	5.2
Insulation - Attic	5.1	5.1
Insulation - Wall	4.8	4.8
Windows	2.7	2.8
Duct Insulation	1.8	1.8

Measure Changes from the Last CPA:

- Less potential for gas furnaces (lower UEC due climate change impacts lowering heating loads)
- Higher incremental costs for furnaces compared to the last CPA
- Lower showerhead potential (WA code)
- Added NEIs to more measures
- Updated to PSE Business as well new Council/RTF workbooks

Top C&I Measures

Cumulative Achievable Technical Potential (MMTherm)

Commercial

Measure Name	10-Year	27-Year
Re-Commissioning	7.6	7.6
Energy Management System	5.6	5.6
Space Heat - Gas Furnace	1.5	4.3
Window - Secondary Glazing	4.2	4.2
Weatherization - Attic/Roof Insulation	3.3	3.3
Pipe Insulation - Space Heat	3.0	3.0
Water Heat LE 55 Gal	0.3	3.0
Space Heat - Gas Boiler	1.2	2.8
Kitchen Hood - Demand Controlled Ventilation	2.0	2.0
Fryer	0.8	1.8

Industrial

Measure Name	10-Year	27-Year
Waste Heat From Hot Flue Gases To Preheat	0.37	0.37
Improve Combustion Control Capability And Air Flow	0.36	0.36
Process Improvements To Reduce Energy Requirements	0.32	0.32
Install Or Repair Insulation On Condensate Lines And Optimize Condensate	0.31	0.31
Heat Recovery And Waste Heat For Process	0.31	0.31
Optimize Heating System To Improve Burner Efficiency, Reduce Energy Requirements And Heat Treatment Process	0.18	0.18
Equipment Upgrade - Boiler Replacement	0.17	0.17
Thermal Systems Reduce Infiltration; Isolate Hot Or Cold Equipment	0.17	0.17
Equipment Upgrade - Replace Existing HVAC Unit With High Efficiency Model	0.15	0.15
Analyze Flue Gas For Proper Air/Fuel Ratio	0.15	0.15

Gas to Electric Conversion

Gas to Electric - Overview

RESIDENTIAL AND COMMERCIAL

- Incorporating EE impacts of replacing natural gas equipment with electric equipment within PSE's service area
  - Determine electric and natural gas baseline sales impact
  - Measure impacts and costs (levelized costs)
  - Associated electric and natural gas energy efficiency potential estimates

INDUSTRIAL

- An analysis that converted a portion (~30%) of natural gas loads based on prior analysis by Cadmus and E3.

PSE Service Area Impacts:

Electric only – natural gas equipment converts to electric (increases PSE electric load)

Natural gas only – converted to electric equipment (reduces PSE natural gas load)

Combination service – converted to electric equipment (increases PSE electric load and reduces PSE natural gas load

Study End-Uses	Residential	Commercial	Electric Only ▲	Natural Gas Only ▼	Combination Service ▲▼
Heat Pump	X	X	Electric		Electric
Hybrid Heat Pump/Gas Back-Up	X		Electric	Gas back-up	Electric/Gas back-up
Furnace	X	X		Gas	Gas
Boiler	X	X		Gas	Gas
Other Gas Heat	X			Gas	Gas
Dryer	X		Electric	Gas	Both
Cooking	X	X	Electric	Gas	Both
Water Heat	X	X	Electric	Gas	Both

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Gas to Electric Conversion Alternatives

Electrification supply curve based on three supply curves:

- **Market Hybrid Heat Pump/Gas Back-up**: Selection based on cost effectiveness in gas portfolio model and adoption capped based on customer survey
- **Policy Hybrid Heat Pump/Gas Back-up**: End of life replacement of gas equipment with hybrid heat pumps reaching 100% annual adoption within the study horizon
- **Policy Full Replacement**: End of life replacement of gas end uses with electric heat pumps (no gas back-up) reaching 100% annual adoption within the study horizon

In analyzing these alternatives, consider:

- Implementation ramp rates
- Interaction with energy efficiency savings – both gas and electric
- Total cost will include impacts on electric system
- Non-energy benefits of cooling from heat pumps

Heat Pump Research conducted to inform residential adoption for the market hybrid/back-up scenario and costs for all scenarios

- Customer survey results provided maximum adoption values for various heat pump applications
- Contractor/Builder interviews results provided cost data (equipment and conversion cost)

Gas to Electric – Technologies

Space/water heating systems, stoves/cooktops, and clothes dryers for existing customers and new constructions in the residential and commercial sectors

Sector	Electric Converted - Policy Full Scenario	Natural Gas Replaced - Policy Full Scenario
Residential	Ductless Heat Pump (DHP)	Furnace Full Replacement
Residential	Air Source Heat Pump (ASHP) - Market Average	Furnace Full Replacement
Residential	DHP	Boiler Full Replacement
Residential	DHP	Gas Wall Unit Full Replacement
Residential	Cooking (Electric) - Market Average	Cooking (Gas)
Residential	Dryer (Electric) - Non-Heat Pump	Dryer (Gas)
Residential	Water Heat - Market Average	Water Heat (Gas)
Commercial	Air Source Heat Pump - Market Average	Furnace/Boiler Full Replacement
Commercial	Cooking (Electric) - Market Average	Cooking (Gas)
Commercial	Water Heat - Market Average	Water Heat (Gas)
Industrial	Target Reduction Conversion of Natural Gas Load 30% Reduction	

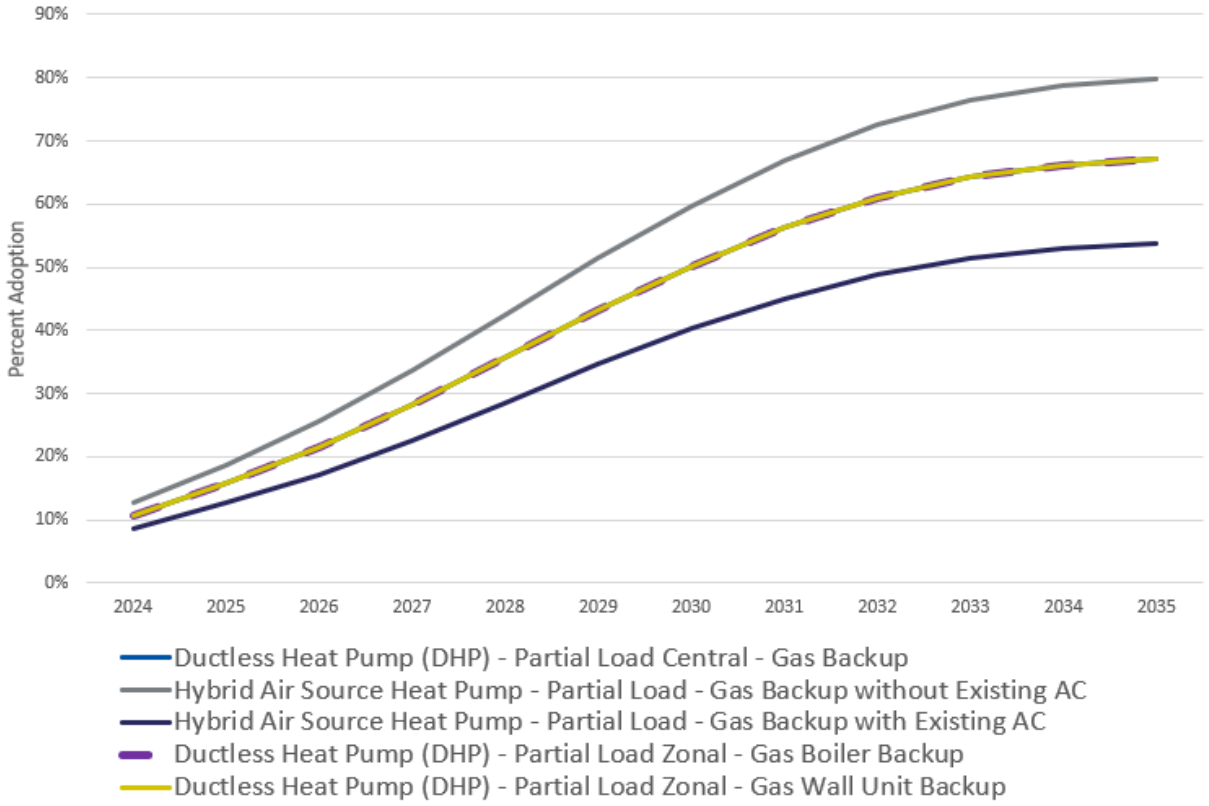
Sector	Electric Converted - Policy Hybrid and Market Hybrid Scenarios	Natural Gas Replaced - Policy Hybrid and Market Hybrid Scenarios
Residential	DHP with Furnace Back-up	
Residential	Hybrid ASHP with Furnace Back-up	
Residential	DHP with Boiler Back-up	
Residential	DHP with Gas Wall Unit Back-up	
Residential	Cooking (Electric) - Market Average	Cooking (Gas)
Residential	Dryer (Electric) - Non-Heat Pump	Dryer (Gas)
Residential	Water Heat - Market Average	Water Heat (Gas)
Commercial	Air Source Heat Pump - Market Average	Furnace/Boiler Full Replacement
Commercial	Cooking (Electric) - Market Average	Cooking (Gas)
Commercial	Water Heat - Market Average	Water Heat (Gas)
Industrial	Target Reduction Conversion of Natural Gas Load 30% Reduction	

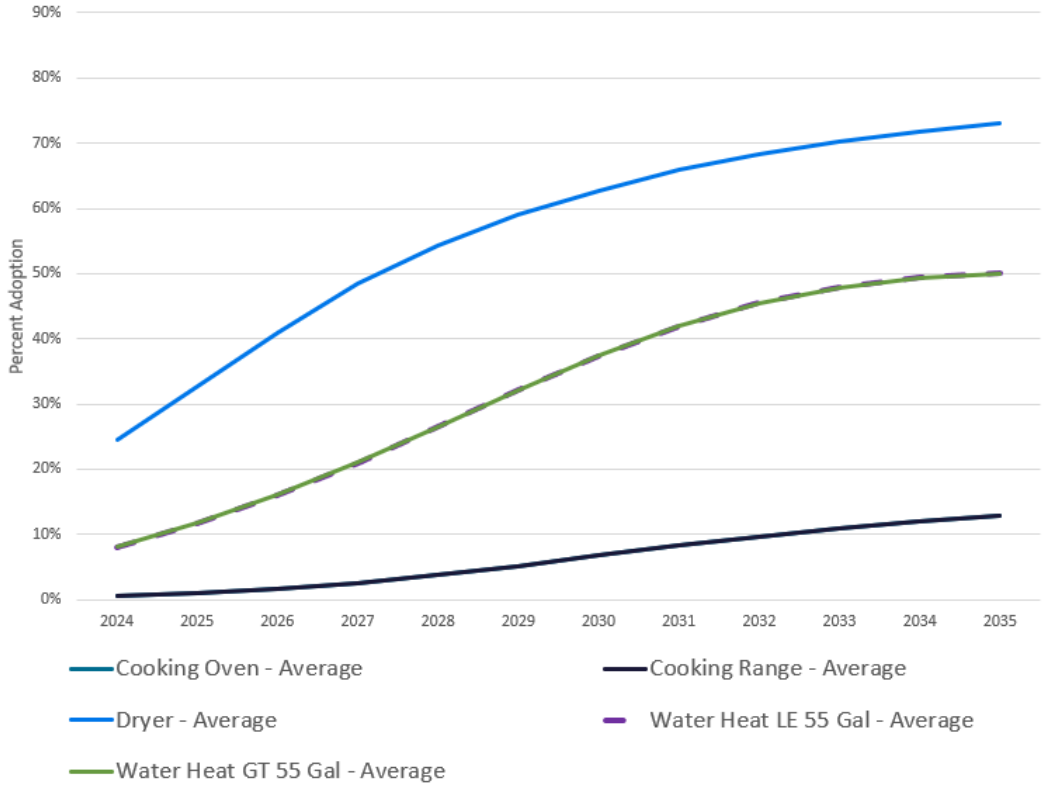
*Green lines highlights the residential difference from Policy Full to the Market Hybrid and Policy Hybrid scenarios

Hybrid/Back-up Assumptions:

- 88% electric consumption vs. 12% natural gas consumption based on BeOpt modeling using Seattle area weather data
- Assumed 35-degree setpoint cut-off

Adoption Curve: Residential Market Hybrid Heat Pump Scenario – (Single Family Example)





Heating Loads:

Adoption based on customer surveys (at 100% of incremental costs)

Ramp rate based on Council heat pump adoption (Lost Opportunity 5 Medium)

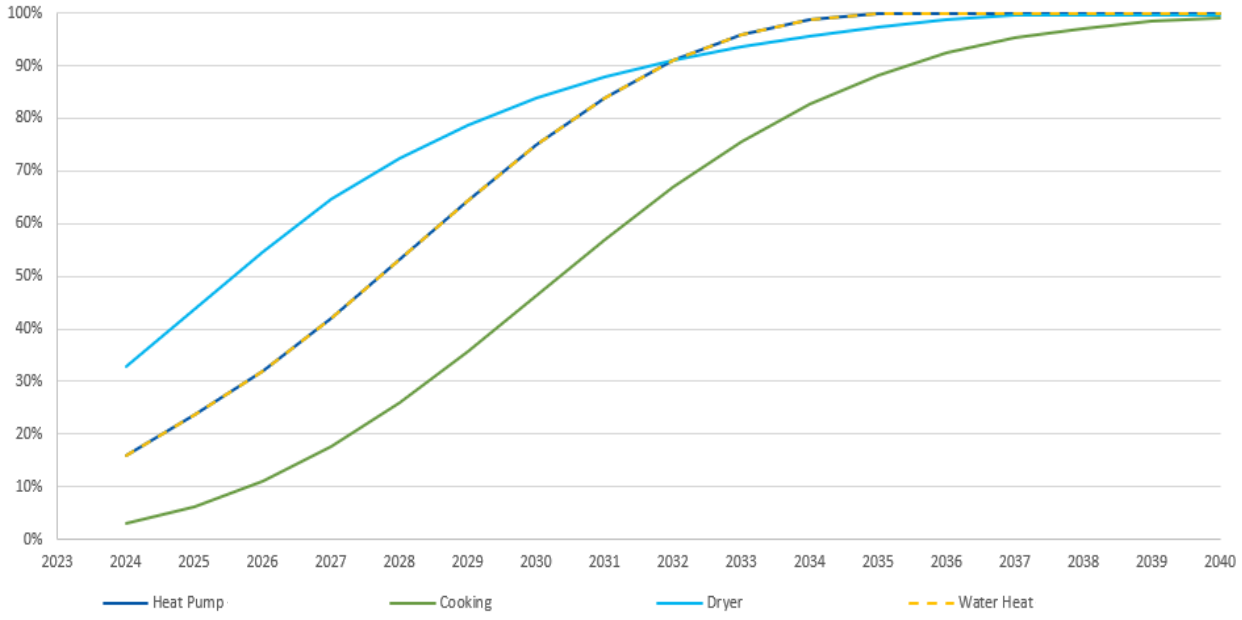
Other Loads:

- Dryer (75% max) - assume limited market barriers for dryers
- Water heat (50% max) - assume water heat has similar market adoption as ASHP
- Cooking (14% max) - based on customer survey (without incentives)

Ramp rates based on Council 2021 Power Plan

Adoption Curves (Continued)

Residential Policy Full Replacement and Policy Hybrid Heat Pump Scenarios Adoption Curves

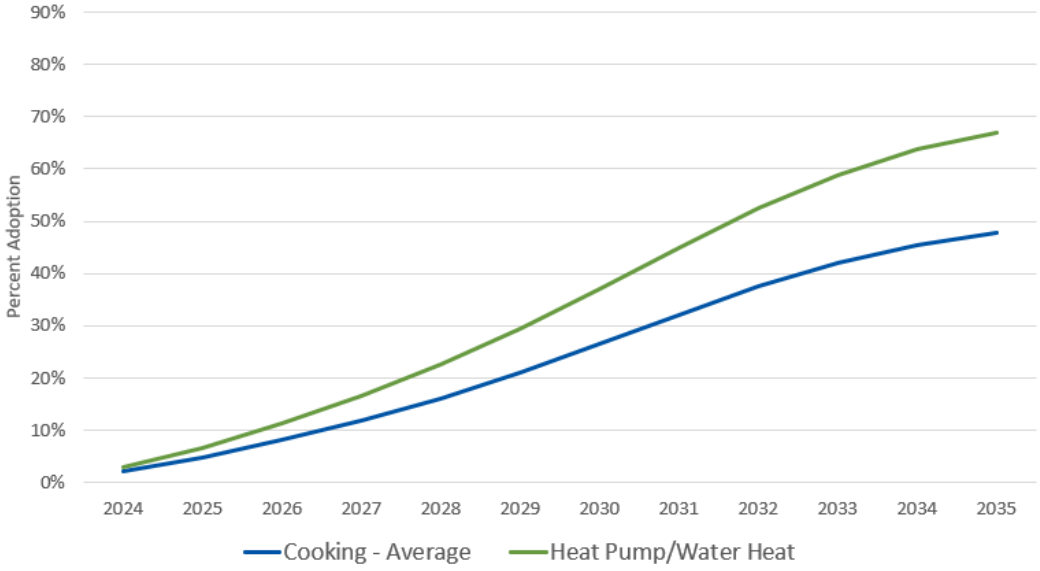


Residential Adoption Estimated:

- End of life equipment reaches maximum adoption of 100%

Ramp rates based on Council 2021 Power Plan

Commercial Adoption Curves

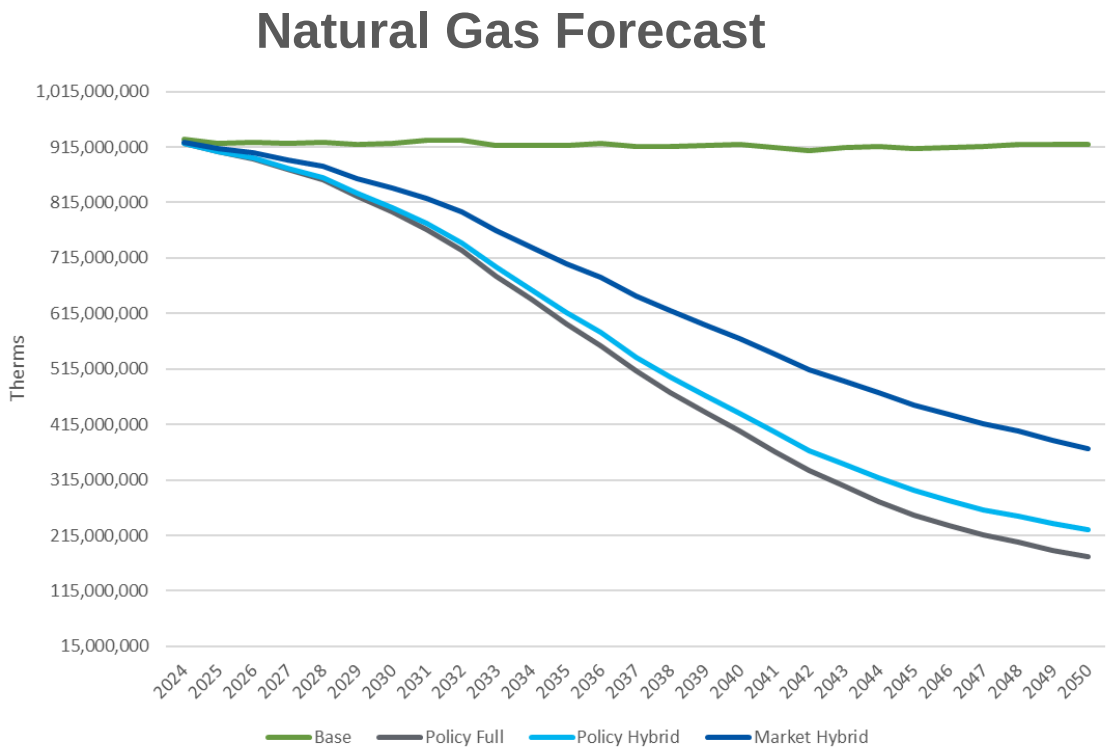


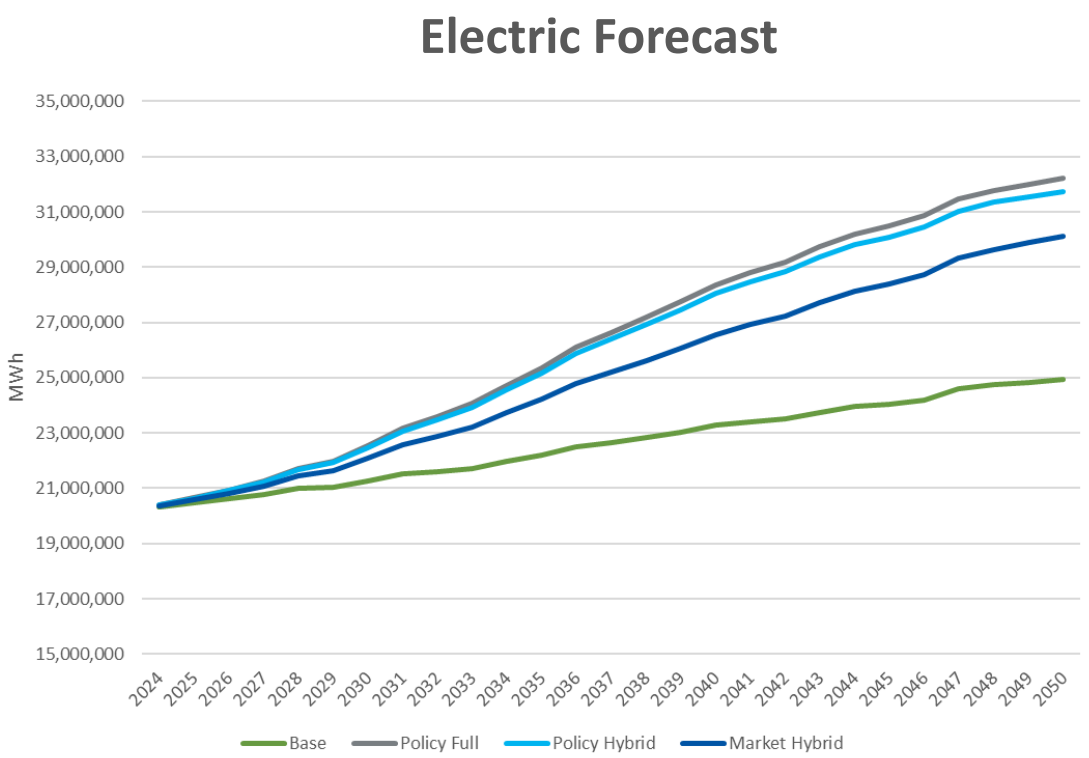
Commercial Adoption Estimated:

- Heat Pump and water heat (70% max) – based on ACEEE 2020 study "Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges"
- Cooking (50% max) - assume market barriers for converting some gas cooking equipment (estimated)

Ramp rates based on Council 2021 Power Plan

Impact on the Baseline Forecast (All Sectors)

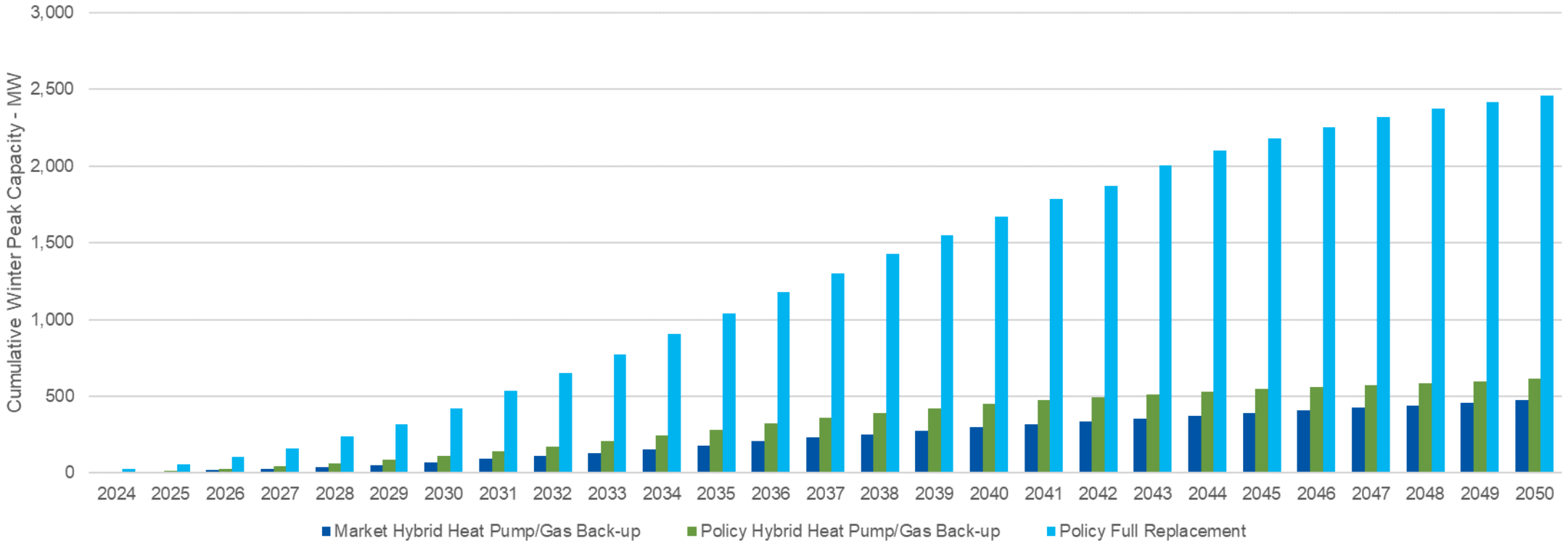




Gas to Electric Forecast Impact

- **Policy Full Replacement (Policy Full):** 29% electric increase and 81% gas decrease in 2050 from the base case forecast
- **Policy Hybrid Heat Pump (Policy Hybrid)**: 27% electric increase and 76% gas decrease in 2050 from the base case forecast
- **Market Hybrid Heat Pump (Market Hybrid):** 21% electric increase and 60% gas decrease in 2050 from the base case forecast

Added Peak Demand – By Scenario (All Sectors)



- Policy Full Replacement scenario shows 2,459 MW increase to the PSE system peak by 2050
- Policy Hybrid Heat Pump/Gas Back-up is roughly a quarter of the full replacement scenario (612 MW) by 2050
- Market Hybrid Heat Pump/Gas Back-up is 473 MW by 2050

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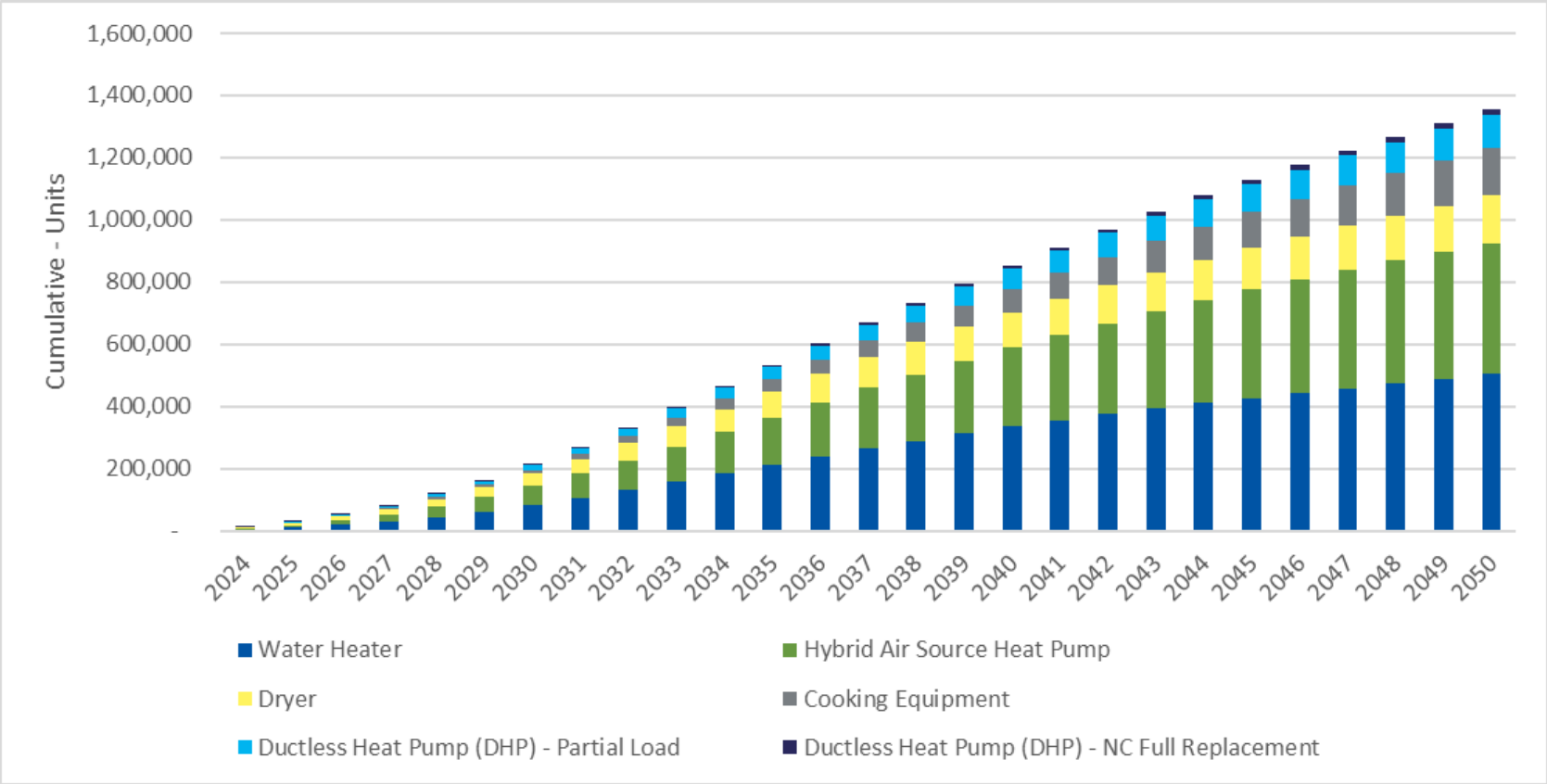
Residential Equipment Adoption – Market Hybrid Heat Pump Scenario



Units in 10-years:

- ~115k Hybrid air source heat pumps (includes existing and new construction)
- ~157k Water heaters
- ~64k Dryer equipment
- ~35k Ductless heat pumps
- ~26k Cooking equipment

Units in 27-years:

- ~419k Hybrid air source heat pumps
- ~506k Water heaters
- ~154k Dryer equipment
- ~124k Ductless heat pumps
- ~151k Cooking equipment

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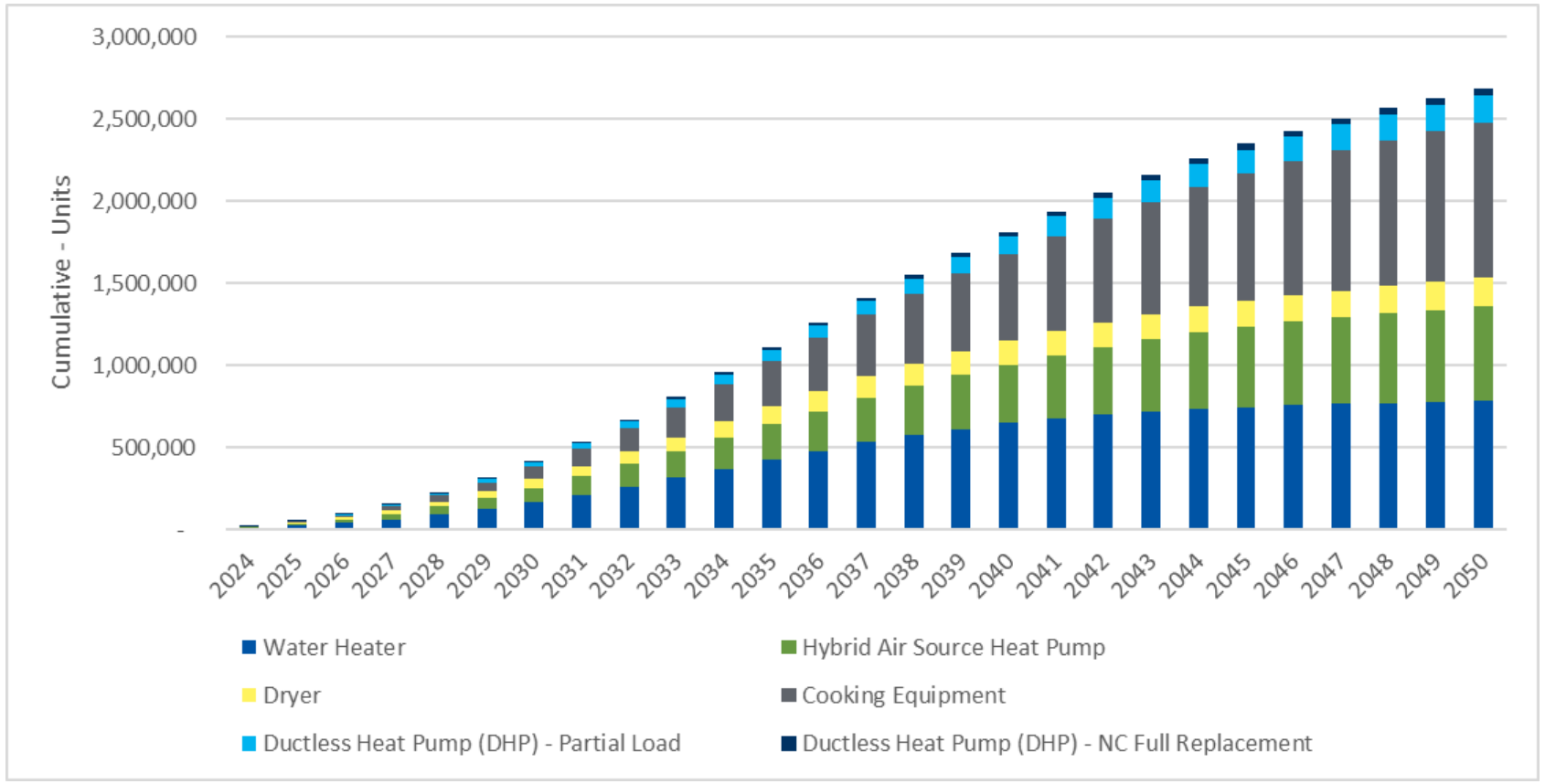
Residential Equipment Adoption – Policy Hybrid Heat Pump Scenario



Units in 10-years:

- ~162k Hybrid air source heat pumps (includes existing and new construction)
- ~315k Water heaters
- ~86k Dryer equipment
- ~62k Ductless heat pumps
- ~184k Cooking equipment

Units in 27-years:

- ~569k Hybrid air source heat pumps
- ~786k Water heaters
- ~179k Dryer equipment
- ~206k Ductless heat pumps
- ~945k Cooking equipment

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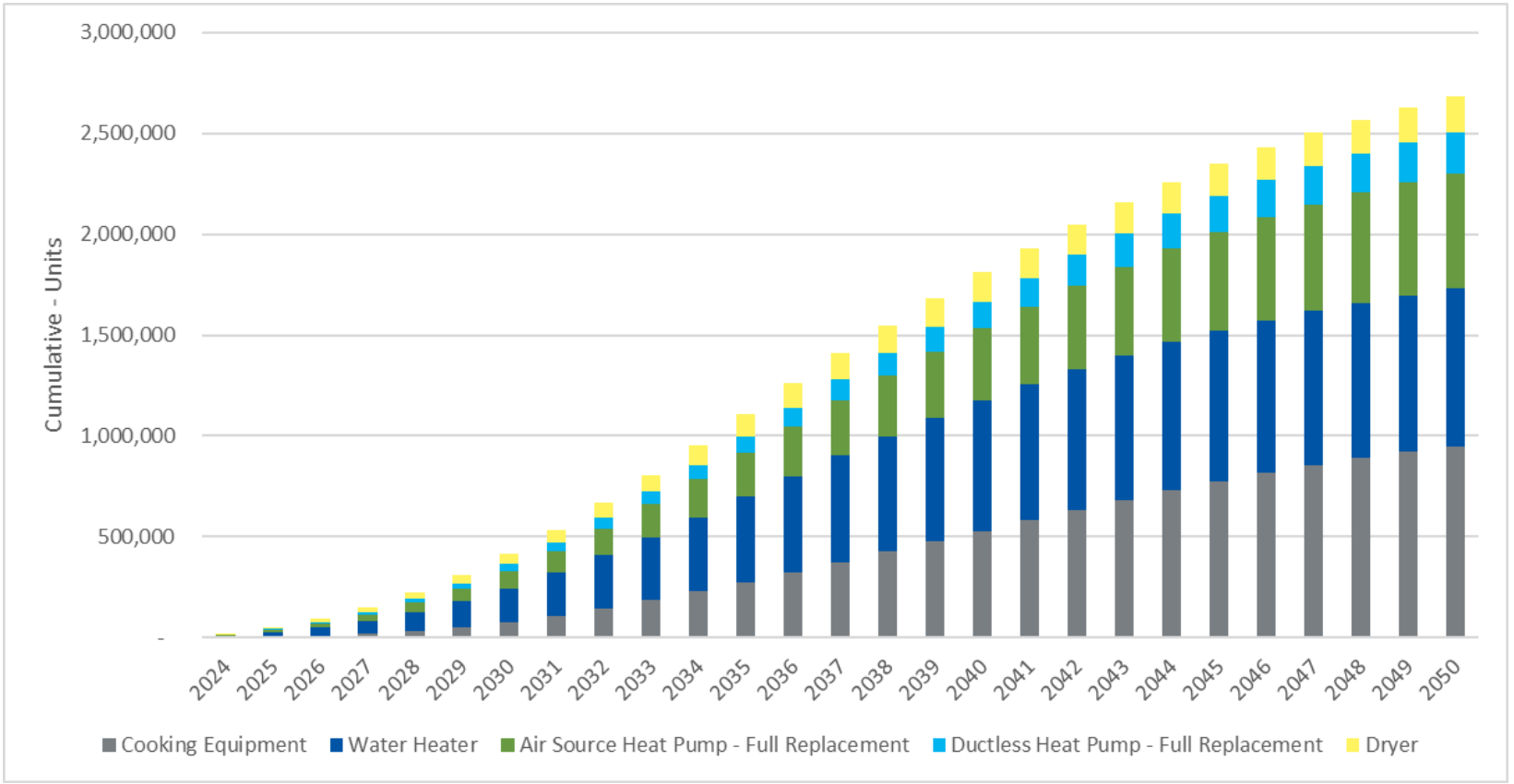
Residential Equipment Adoption – Policy Full Replacement Scenario



Units in 10-years:

- ~160k Air source heat pumps
- ~314k Water heaters
- ~85k Dryer equipment
- ~60k Ductless heat pumps
- ~184k Cooking equipment

Units in 27-years:

- ~569k Air source heat pumps
- ~786k Water heaters
- ~179k Dryer equipment
- ~206k Ductless heat pumps
- ~945k Cooking equipment

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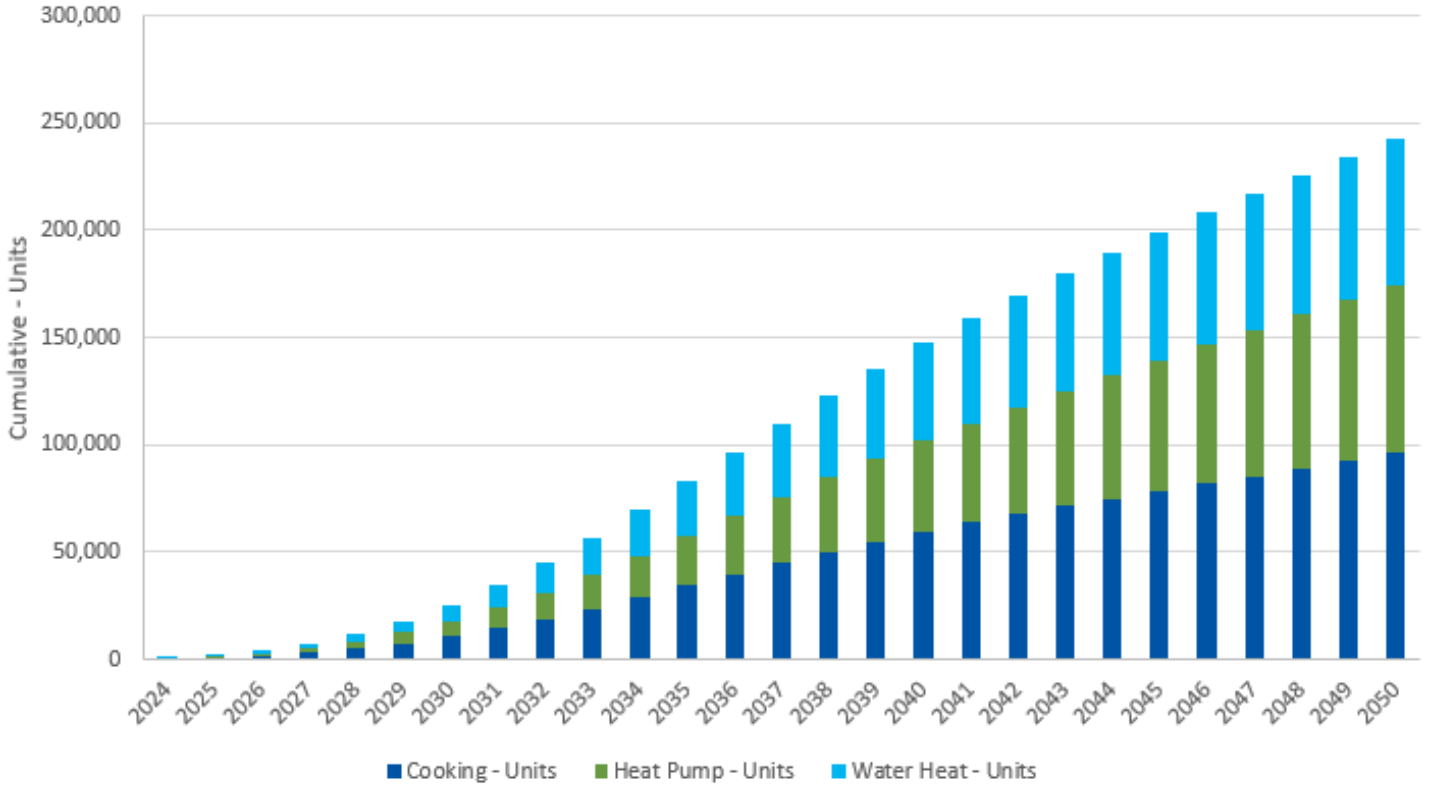
Commercial Equipment Adoption Forecast



Units in 10-years:

- ~15,800 Heat pump units
- ~17,400 Water heater units
- ~23,800 Buildings with cooking equipment

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Energy Efficiency Potential Impact

Sector	Achievable Technical Potential, Cumulative 2050			
	27-Year Base Energy Efficiency Potential	27-Year Policy Full Energy Efficiency Potential	27-Year Policy Hybrid Energy Efficiency Potential	27-Year Market Hybrid Energy Efficiency Potential
Electric (MWh)				
Residential	2,614,783	4,049,002	3,602,076	3,283,504
Commercial	2,020,415	2,303,609	2,303,609	2,303,609
Industrial	162,004	163,938	163,938	163,938
Total	**4,797,202**	**6,516,549**	**6,069,624**	**5,751,051**
Natural Gas (MMTherms)				
Residential	111	26	31	50
Commercial	51	19	19	19
Industrial	3	3	3	3
Total	**165**	**48**	**53**	**71**

*Table excludes transport customers

Policy Full scenario has the highest electric energy efficiency potential and lowest natural gas energy efficiency potential from equipment and retrofit measures

Policy Hybrid scenario has 27% higher electric energy efficiency potential than the base potential and 68% lower natural gas energy efficiency potential than the base potential

Market Hybrid scenario has 20% higher electric energy efficiency potential than the base potential and 57% lower natural gas energy efficiency potential than the base potential

Gas to Electric Levelized Cost Calculation

Costs Included	Benefits Netted Out
PV Capital Cost of Equipment Conversion	PV of Natural Gas Avoided
Program Cost (HVAC equipment program admin adder based on EE potential estimates, all other end-uses based on 21% of equipment conversion cost)	PV of Conservation Credit (10% of conserved natural gas energy)
Added Electric Energy Costs	PV of Non-Energy Impacts
Added Electric Generation Capacity Costs (for non-hybrid systems)	
Added Electric T&D Costs (for non-hybrid systems)	
Panel Upgrade Cost	

CADMUS

Questions

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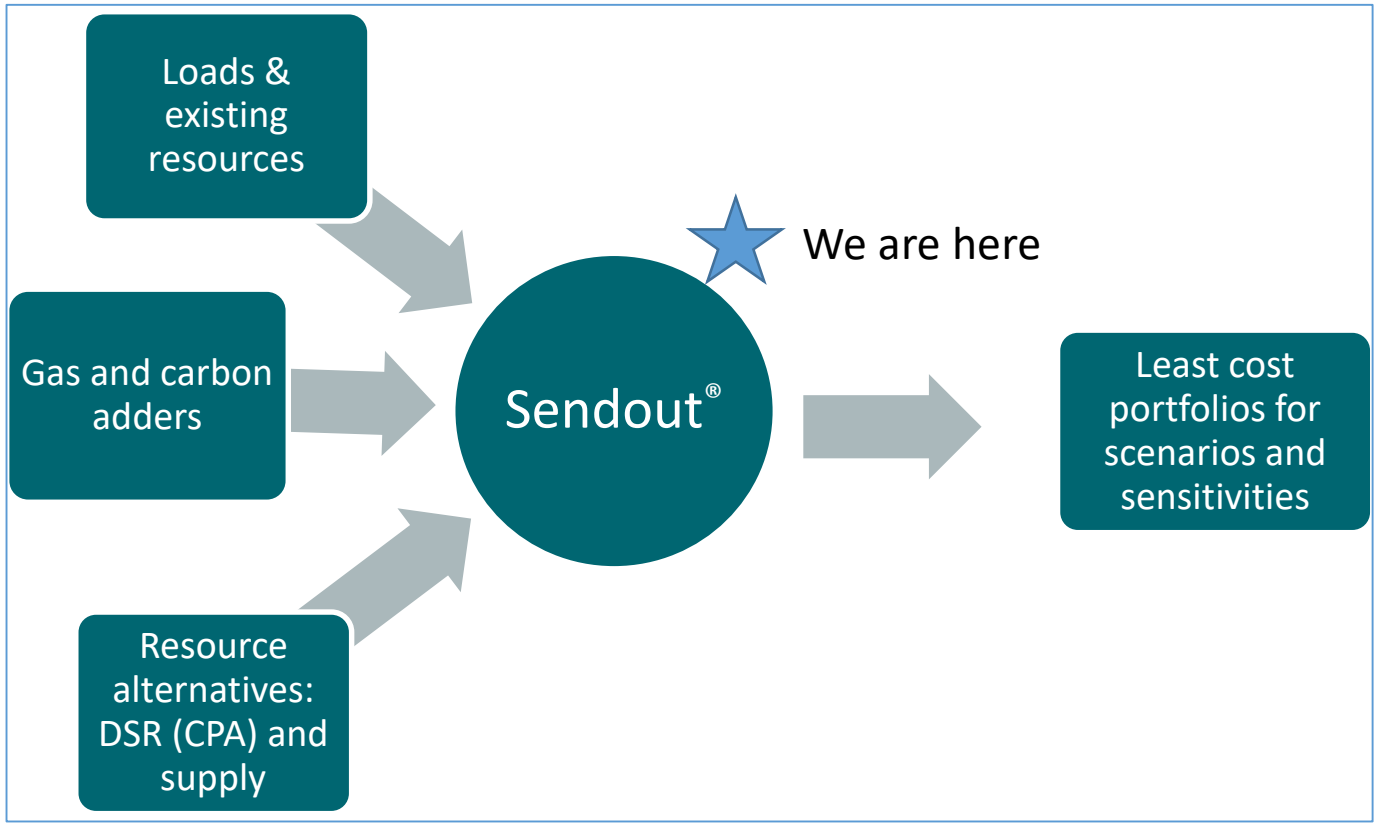
Next Steps



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Break

Please return in 10 minutes

Final CCA Pricing & Gas Alternatives

Gurvinder Singh
Consulting Energy & Resource Planning Analyst, Resource Planning and Analysis, PSE

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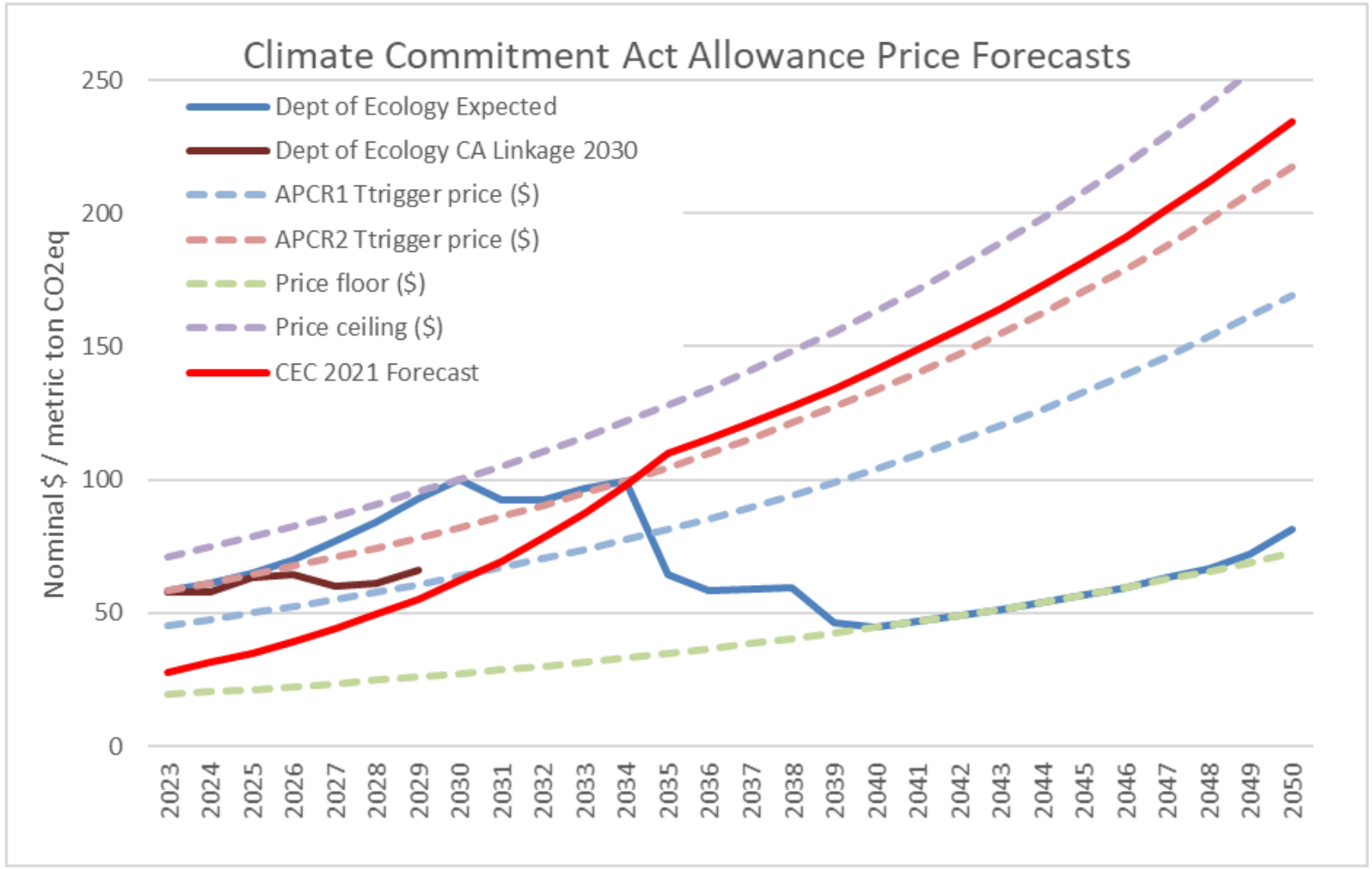
CCA Update: Allowance Pricing Forecast



- Dept. of Ecology (Ecology) expected price assumes no CA linkage
- Ecology looked at timing for linkage (forecast for 2030 linkage shown)
- PSE believes CA linkage is highly likely at some point
- 2023 IRP CCA allowance price assumption is the Ecology CA Linkage 2030, then transition to the CEC 2021 Forecast

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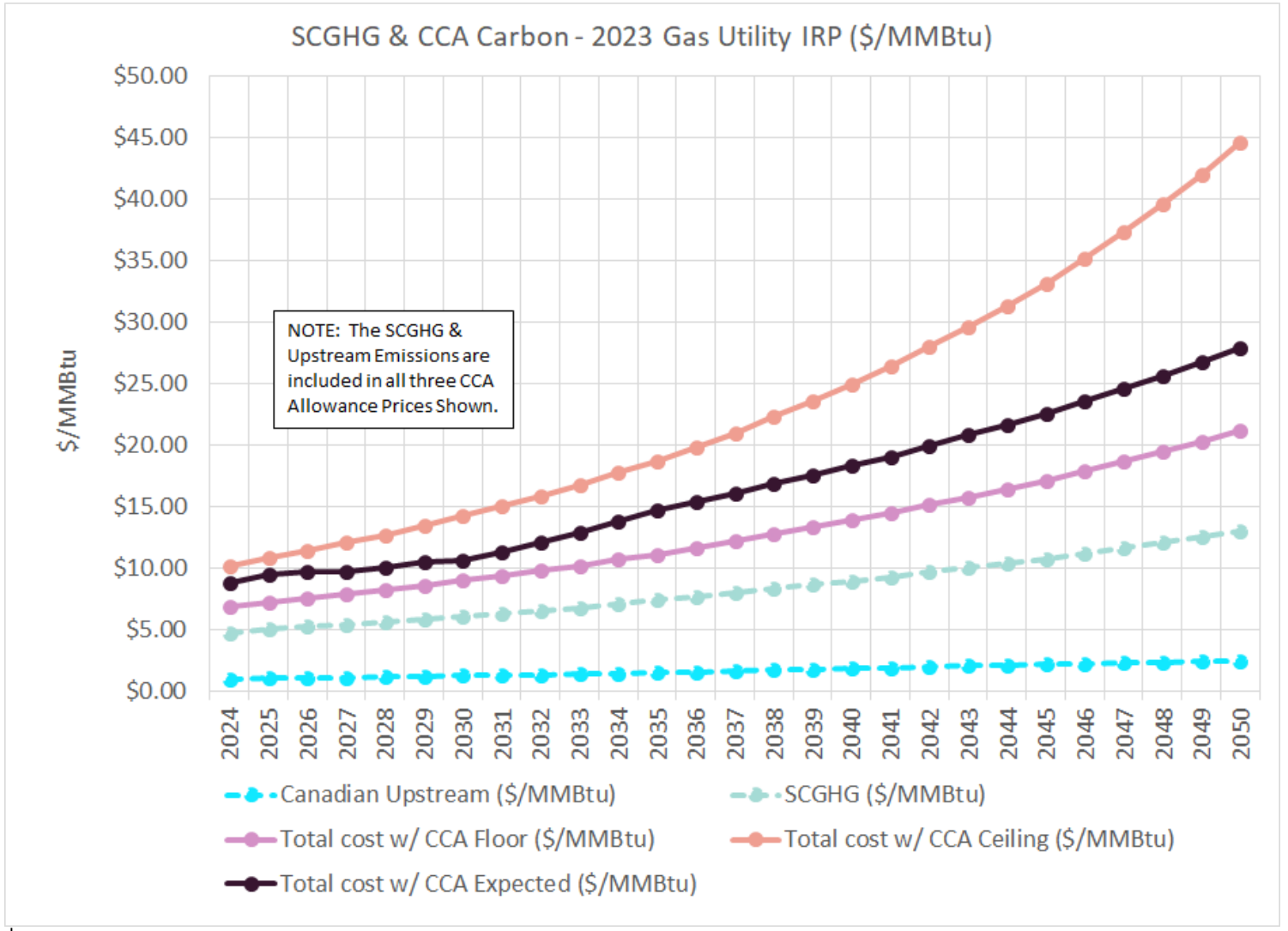
2023 Gas Utility IRP Annual Carbon Price Adders



- CCA expected carbon price is the hybrid
- CCA ceiling and floor prices shown for reference
- Used Ecology emissions rate to get from $/metric to $/MMBtu
- These will be added to natural gas price to get total conventional gas costs

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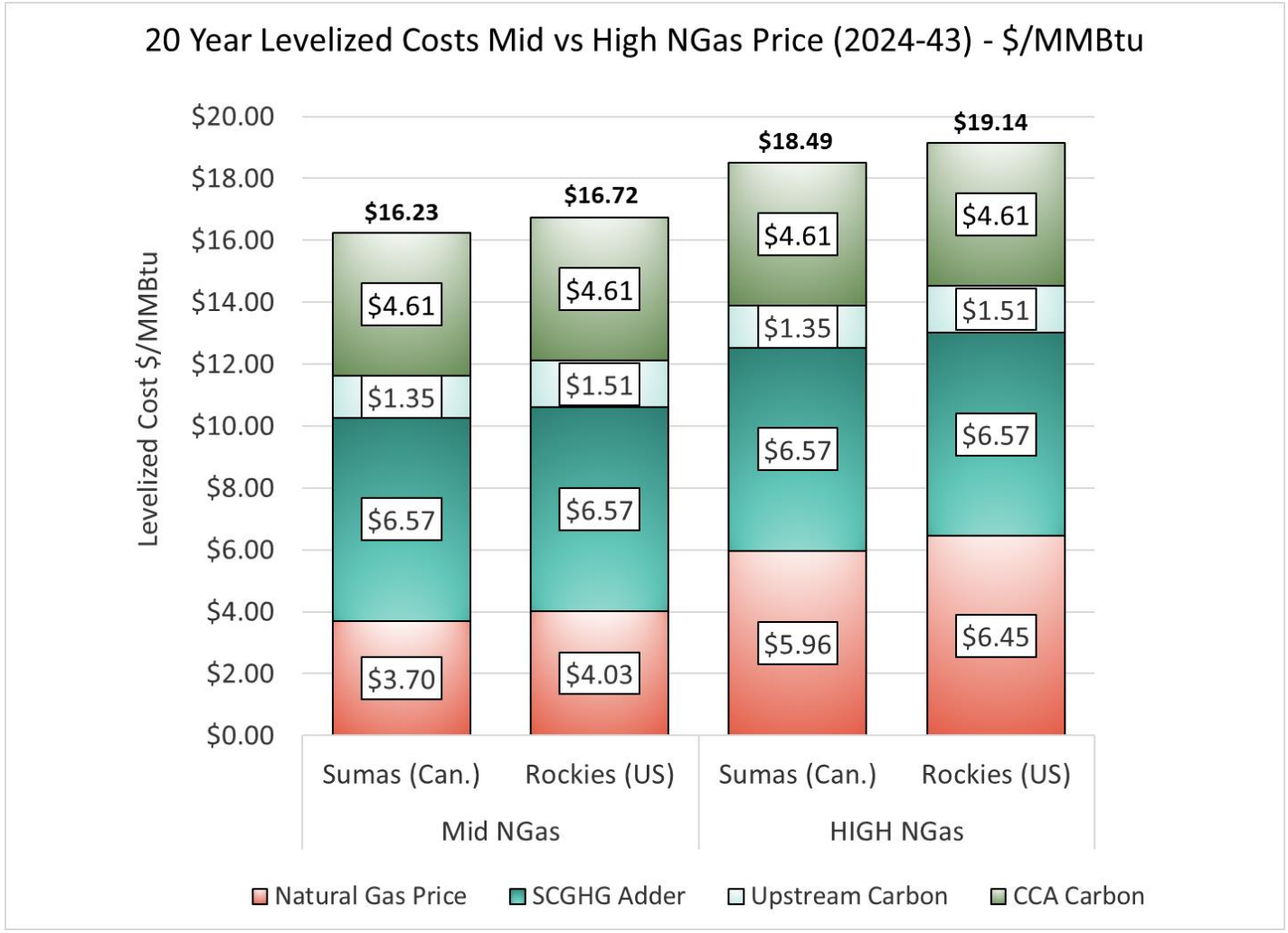
Natural Gas and Carbon Price Assumptions



- Mid natural gas price forecast consists of forward marks as of May 2022 and Wood Mackenzie's long-term outlook released spring 2022.
- Mid natural gas price forecast based on forward marks 2024-2028 and Wood Mackenzie from 2028-2050.
- High natural gas price forecast derived from Council's high gas forecast in 2021 Plan.
- SCGHG adder based on UTC forecast (May 26, 2022).
- Upstream carbon based on GHGenius and GREET models (updated emissions rate to align with CCA).
- CCA carbon price is hybrid: Ecology to 2030 and California Energy Commission after 2030.

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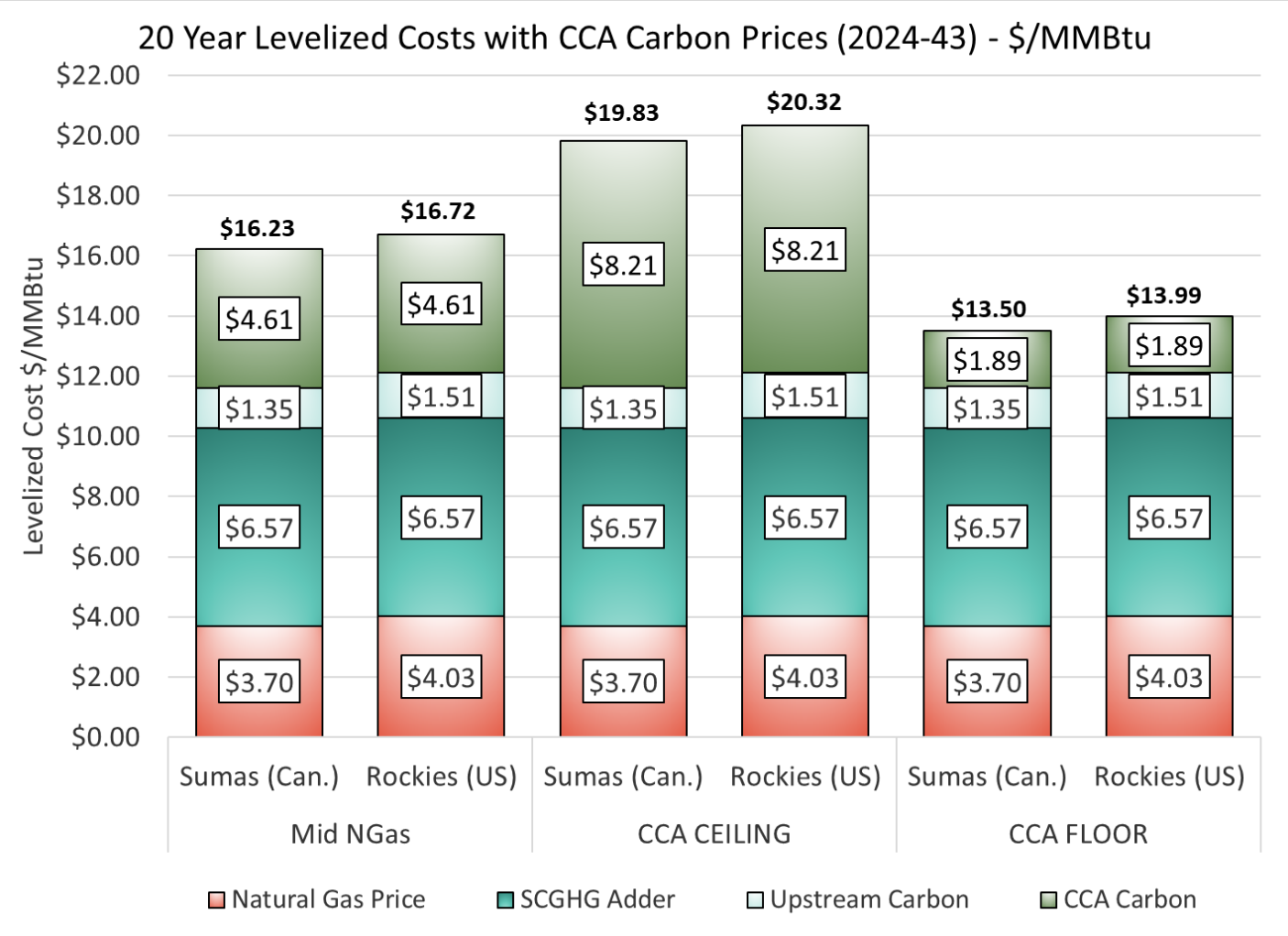
CCA Carbon Price Scenarios



- CCA expected price based on Ecology to 2030 and California Energy Commission after 2030.
- CCA ceiling price with Mid Natural Gas prices for all hubs (Sumas and Rockies shown).
- CCA Floor price with Mid Natural Gas prices for all hubs (Sumas and Rockies shown).
- SCGHG and upstream emissions are same as Mid or reference scenario.

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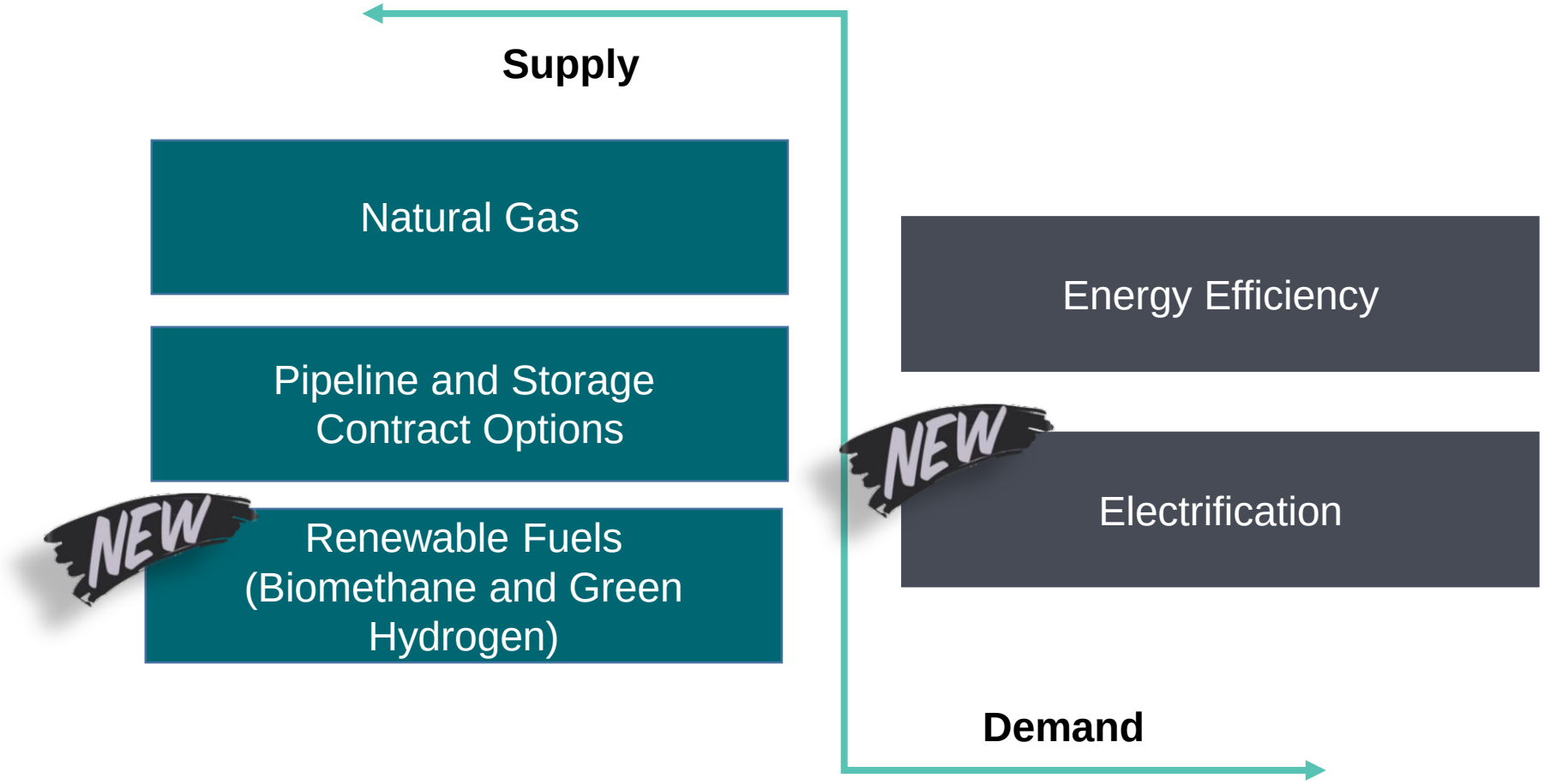
2023 Gas Utility IRP: Resource Alternatives



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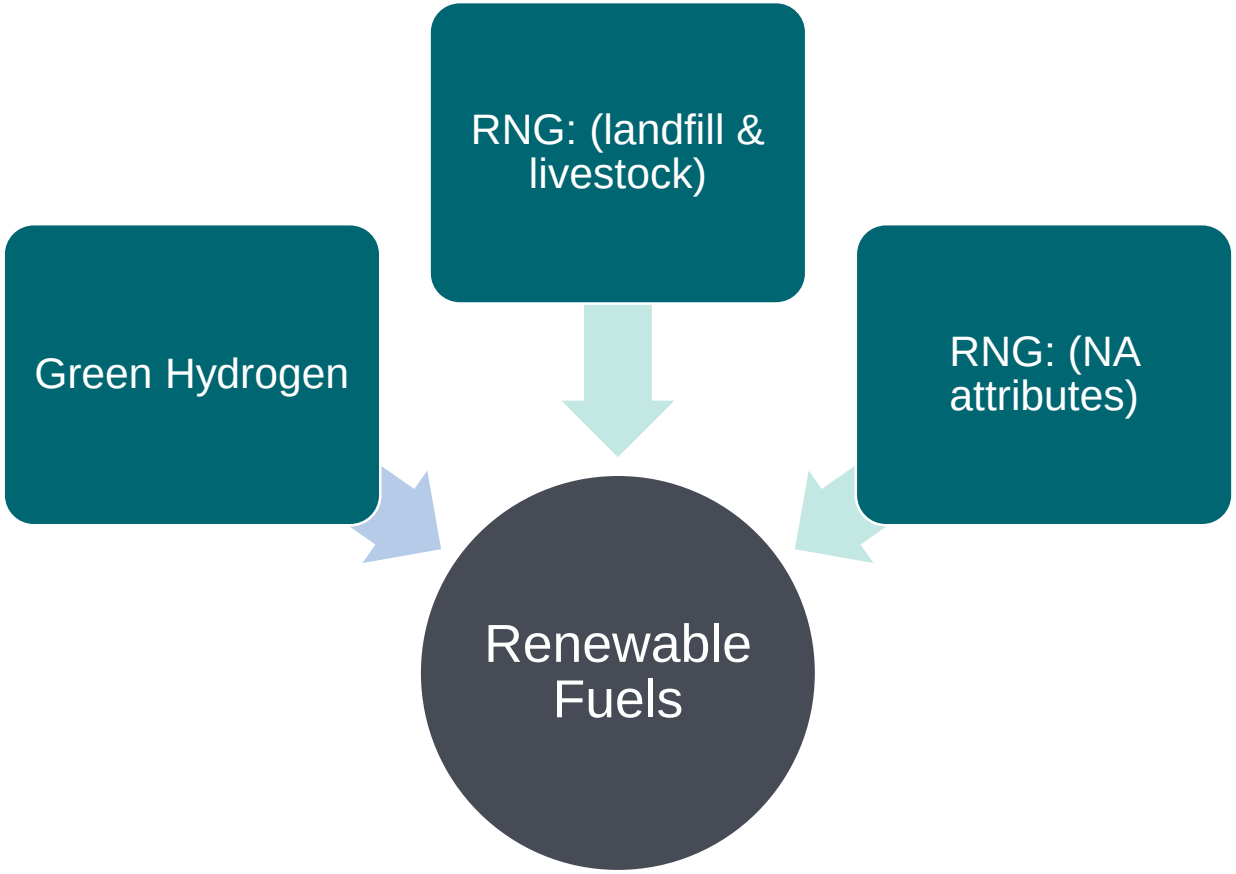
Emerging Renewable Fuel Options



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Green Hydrogen Overview

- **Hydrogen Hub**
  - PSE is engaged with multiple other entities in seeking DOE hydrogen hub grant funding. We are aiming to demonstrate the value of hydrogen in decarbonizing the gas and electric generation sectors.

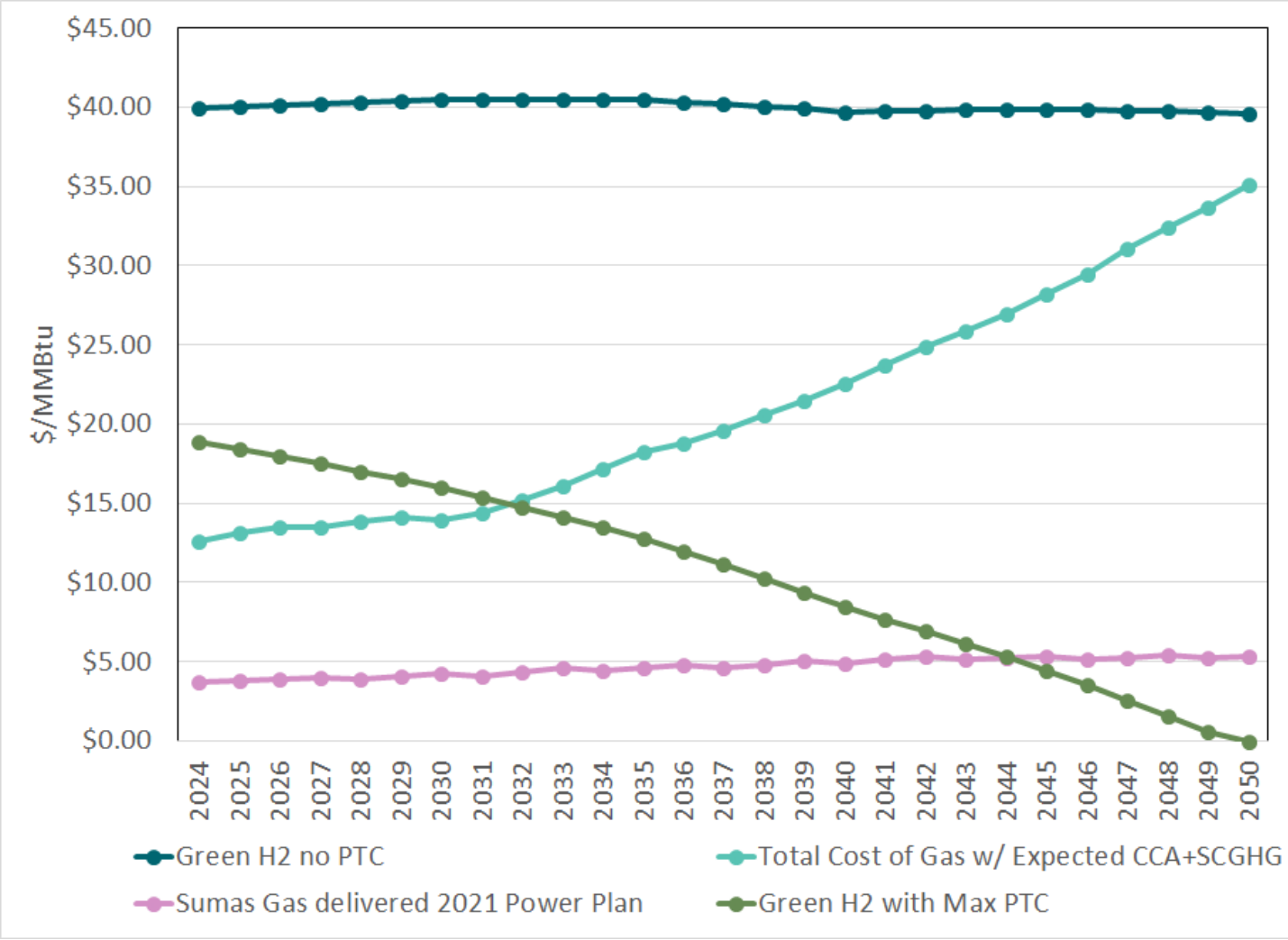
- **Inflation Reduction Act**
  - Production and investment tax credits have the potential to lower fuel costs in such a way that green hydrogen will be competitive with conventional natural gas in the early 2030s.
  - If a producer utilizes low carbon electricity and meets union labor and wage requirements, the production tax credit is up to $3 per kg.
  - The demand for green hydrogen will also create additional demand for green power, above and beyond regional demand for baseload requirements.

Green Hydrogen Overview

- **Pilot Projects**
  - PSE is planning the next stage of pilot projects to assess impacts of fuel blends on customer equipment. Our current plan is to install a solar powered electrolyzer at one of our operating bases, and assess the operational impact on furnaces, stoves, and fireplaces from blended fuel.

- **Research and Development**
  - PSE is engaging with Pacific Northwest National Laboratory (PNNL) and other agencies to evaluate the impacts of blended gas on underground storage facilities, and the gas distribution system.
  - PSE is looking to sponsor research into synthetic methane based on green hydrogen and captured carbon dioxide.

Green Hydrogen Price Assumptions



- Green H2 Cost curve based on electrolysis using renewable electricity input
- Assumes delivery on PSE distribution system
- Green H2 are levelized costs in nominal $
- Assumes PTC at $3.0/kg of Hydrogen & 10-year from production date.
- PTCs available over IRP study horizon

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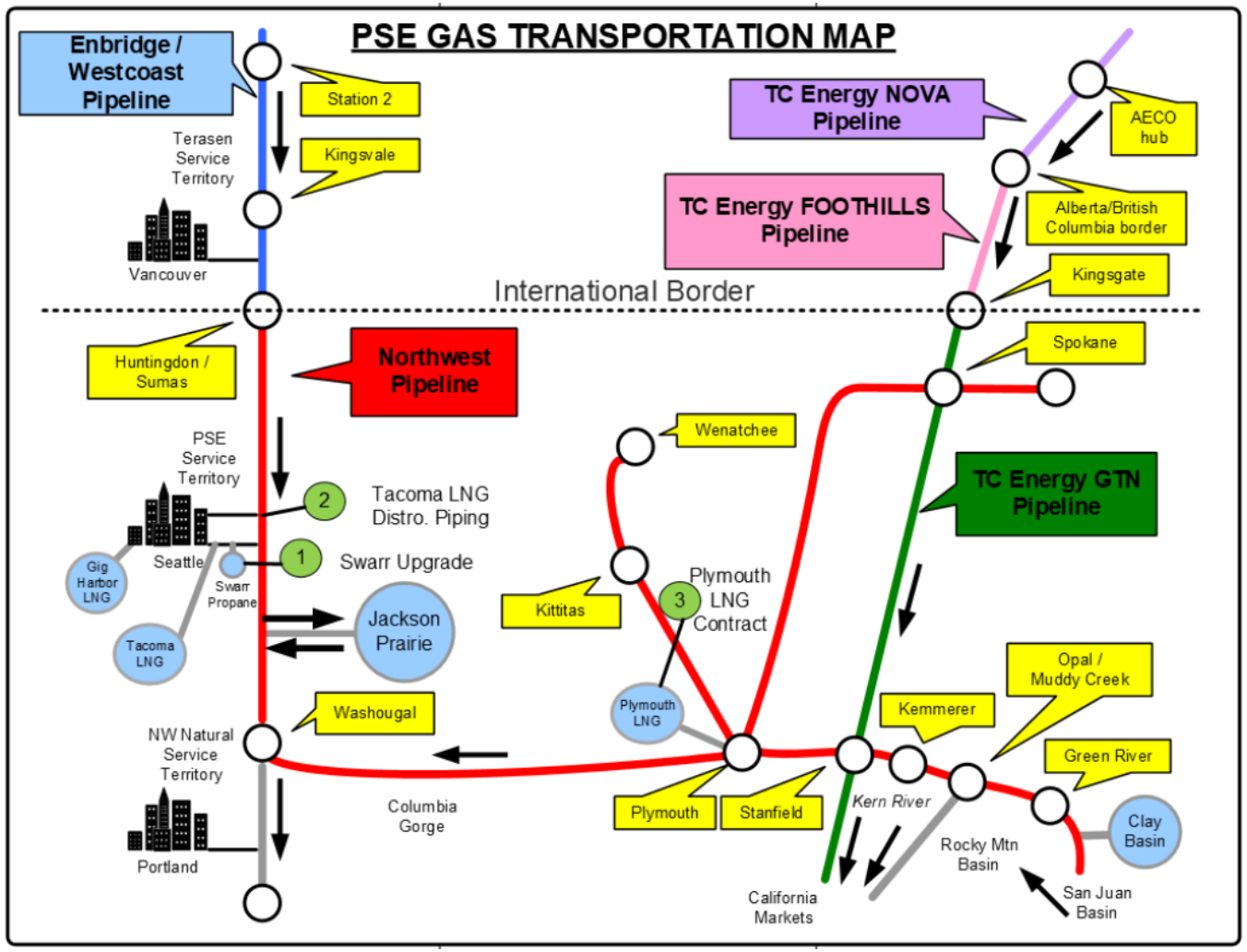
Resource Alternatives – Pipelines and Peaking Resources



1 - Swarr on-system peaking resource

2 - LNG distribution upgrade

3 - Plymouth LNG storage contracts with TF-1 on Northwest pipeline to deliver gas to PSE

Pipeline renewals

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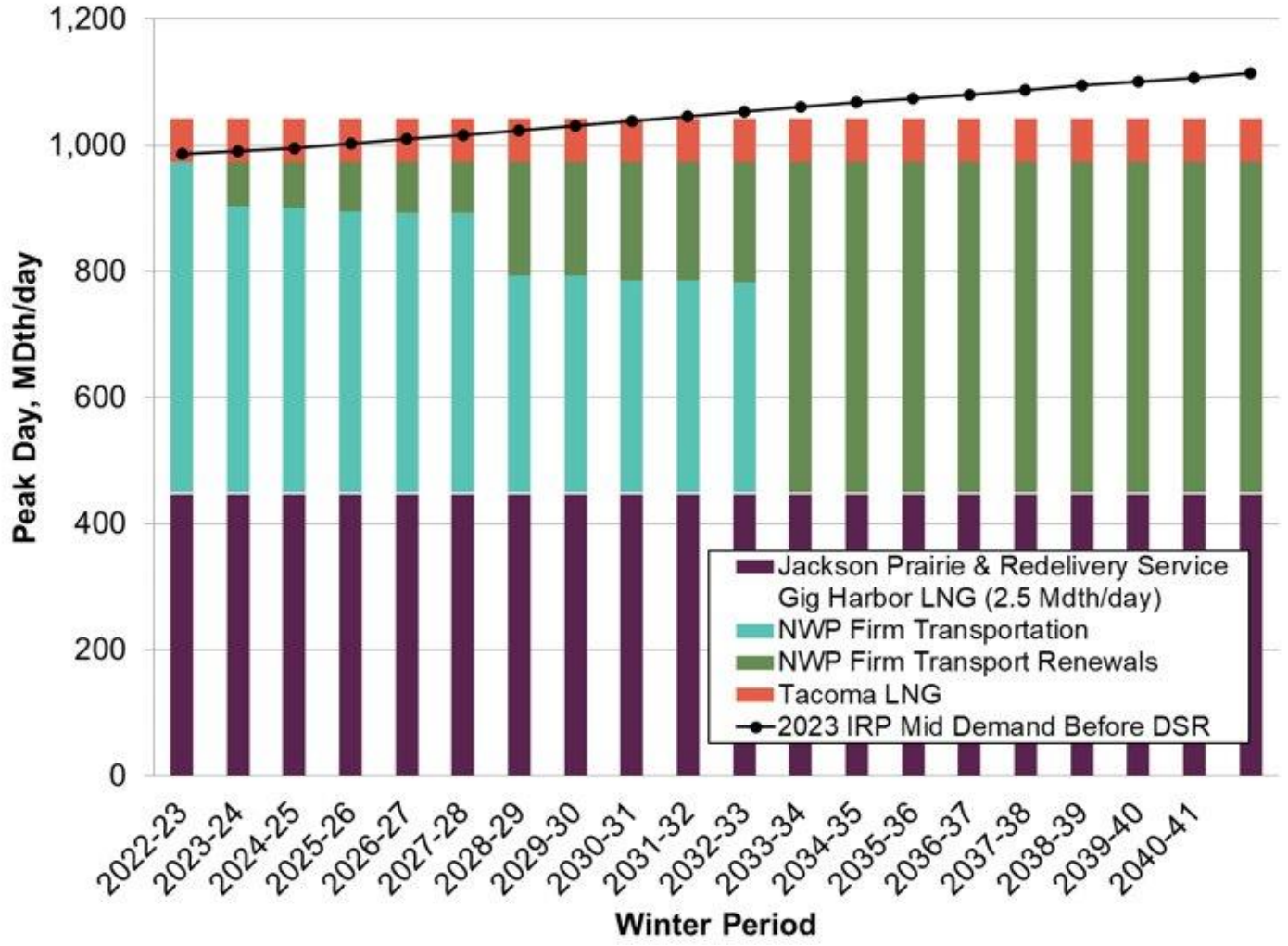
Pipeline Renewals and Energy Efficiency



- March 2022 meeting chart
- Being long, energy efficiency has no incremental benefit on the capacity value
- By letting the portfolio decide pipeline capacity renewals, this allows energy efficiency to compete with resource additions

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RNG in the 2023 Gas Utility IRP

Pending the Final CCA rules and the PSE IRP analysis, PSE is remaining engaged with several project developers

- Washington based RNG projects, both physical and attribute only
- North American RNG – attribute only from large portfolios of small projects
- Ensuring RNG sources are well-documented on accepted platforms (MRETS, etc.)

Advantage to LT RNG contract:

- Secures supply from “best” projects before demand rises
- Price may be higher than CCA price in near-term but secures ”fixed” price for LT
- Avoids uncertainty of CCA and Social Cost of Carbon prices in evolving compliance markets
- ….and that is currently the only way to buy RNG

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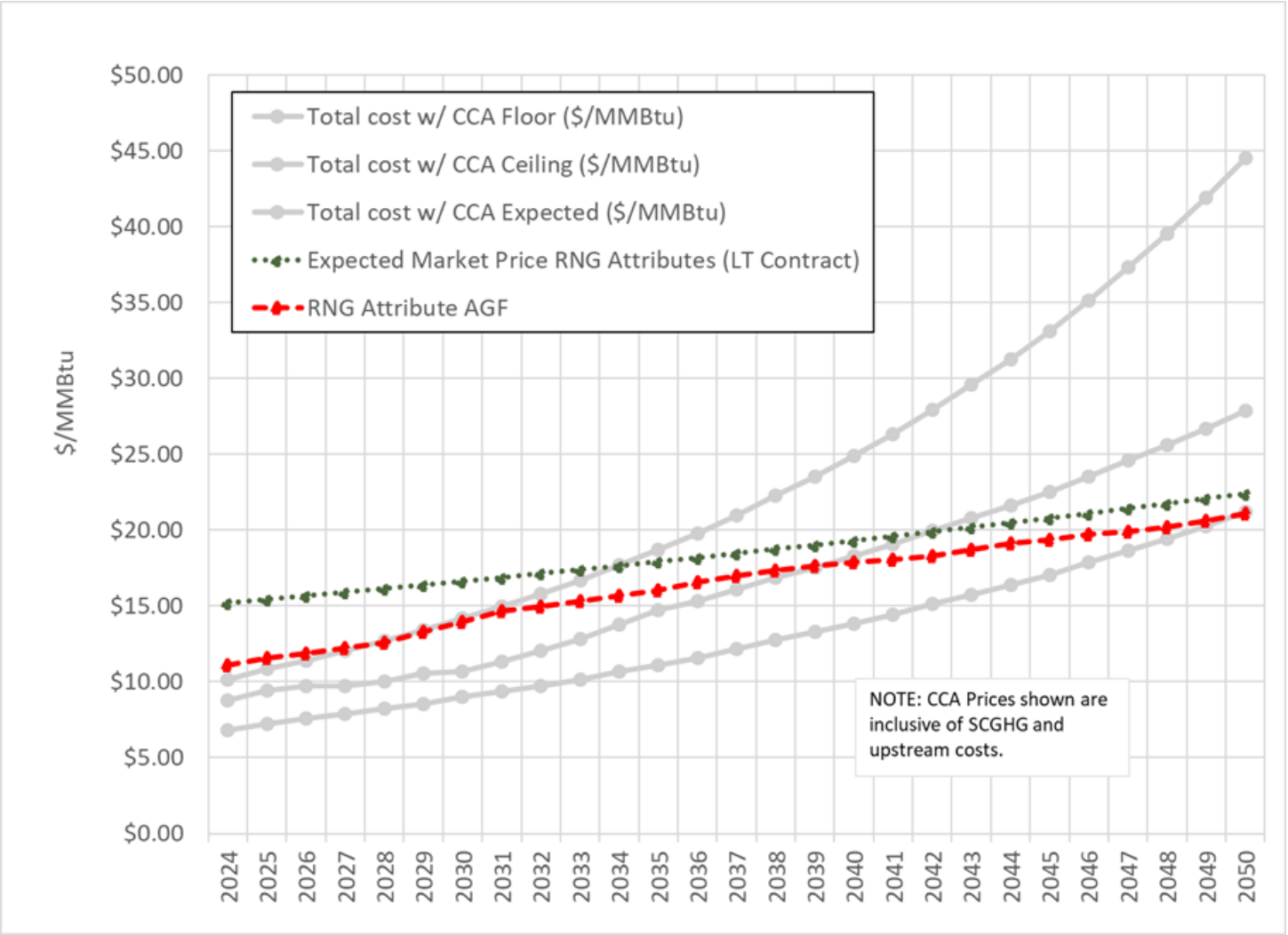
RNG Attributes



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Next Steps

Sophie Glass, Co-facilitator, Triangle Associates

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IRP Stakeholder Feedback Process

Feedback form:	PSE IRP - Feedback Form
Sept. 26	A recording of the webinar and the transcript of the chat will be posted to the IRP website so those who were unable to attend can review.
Sept. 29	Feedback forms are due. Feedback should focus on questions regarding the presentation.
Oct. 20	A feedback report of **questions** collected from the feedback form, along with PSE's responses, and a meeting summary will be shared with stakeholders and posted to pse.com/irp.

Next Steps and Stay in Touch

Next meetings with IRP stakeholders

- Sept. 28 and 30, 2022 – Portfolio Benefits Analysis Drop-In Sessions
- Nov. 17, 2022: Updates and feedback on draft results of electric and gas portfolio
- March 1, 2023: Updates and feedback on draft results of 2023 Electric Progress Report and Gas Utility IRP

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Appendix

PUGET SOUND ENERGY

Common Acronyms

Acronym	Meaning
BCP	Biennial Conservation Plan
CCA	Climate Commitment Act
CEIP	Clean Energy Implementation Plan
CETA	Clean Energy Transformation Act
CPA	Conservation Potential Assessment
DHP	Ductless heat pump
DSR	Demand-side resources
GHG	Greenhouse gas
EE	Energy efficiency
IRA	Inflation Reduction Act
ITC	Investment Tax Credit
LNG	Liquified natural gas
MMBtu	Metric Million British Thermal Unit
MMTherm	Million therms
PNNL	Pacific Northwest National Laboratory
PTC	Production Tax Credit
RNG	Renewable natural gas
SCGHG	Social cost of greenhouse gas