Resource Planning Advisory Group Meeting

2027 Integrated System Plan

June 24, 2025

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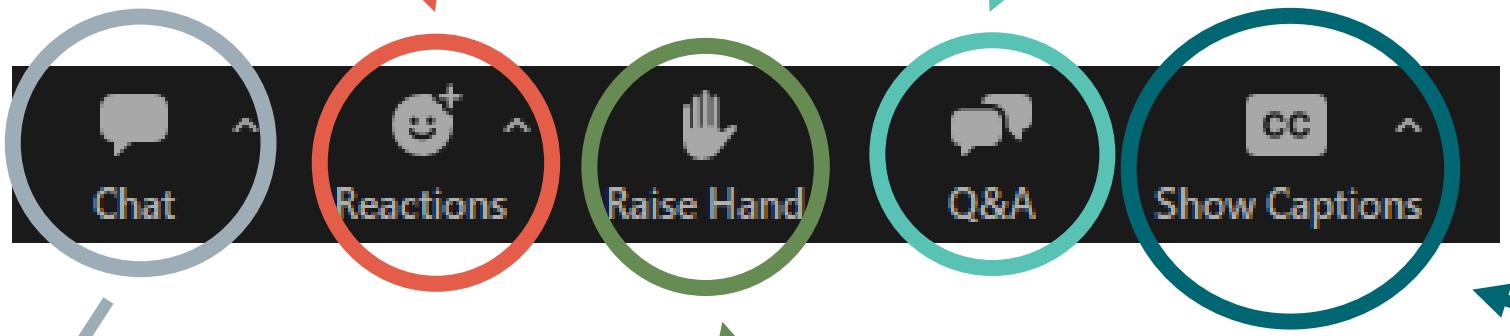
Welcome to the webinar!

Use the **Reactions** feature to respond to content with emojis

The **Q&A** tool will be turned off during the meeting



RPAG members and PSE staff are welcome to use the **Chat** feature

Use **Raise Hand** feature if you'd like to provide a comment or ask a question

Click **Show Captions** to see real-time closed captioning

Facilitator requests

- Engage constructively and courteously towards all participants
- Respect the role of the facilitator to guide the group process
- Avoid use of acronyms and explain technical questions
- Use the feedback form or email isp@pse.com for additional input to PSE
- Aim to focus on the webinar topic
- Public comments will occur after PSE's presentations

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Safety moment

Have a safe 4th of July!

- **Be safe with sparklers – nearly 25% of fireworks-related ER visits are due to sparklers, and half of those injuries are children under age 5**
- **Wear a U.S. Coast Guard approved life vest when operating or riding as a passenger on a watercraft**
- **Consider attending a professional fireworks display rather than setting them off yourself (check your local regulations to determine if it's legal)**
- **Double check your sunscreen to ensure it's not expired**

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Today's speakers

Annie Kilburg Smith

Facilitator, Triangle Associates

Elizabeth Hossner

Manager, Resource Planning and Analysis, PSE

Jennifer Coulson

Manager, Operations and Gas Analysis

Gurvinder Singh

Consulting Energy & Resource Planning Analyst, PSE

Niecie Weatherby

Manager, Gas System Integrity, PSE

Don Frieze, PE

Supervisor, Maintenance Planning Gas System Integrity, PSE

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Agenda

Time	Agenda Item	Presenter / Facilitator
10:00 a.m. – 10:05 a.m.	Welcome and introductions	Annie Kilburg Smith, Triangle Associates
10:05 a.m. – 10:15 a.m.	Charter adoption	Annie Kilburg Smith, Triangle Associates
10:15 a.m. – 10:18 a.m.	Introduction and updates	Jennifer Coulson, PSE
10:18 a.m. – 10:55 a.m.	Revisiting electric modeling and assumptions	Elizabeth Hossner, PSE
10:55 a.m. – 11:40 a.m.	Gas energy supply	Jen Coulson, PSE Gurvinder Singh, PSE
11:40 a.m. – 11:50 a.m.	Break	All
11:50 a.m. – 12:50 p.m.	Natural gas delivery system investments and ISP strategy	Niecie Weatherby, PSE Don Frieze, PSE
12:50 p.m – 1:00 p.m.	Next steps and public comment opportunity	Annie Kilburg Smith, Triangle Associates
1:00 p.m.	Adjourn	All

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Meeting purpose

- **Adopt RPAG charter in principle**
- **Finish electric modeling and assumptions conversation from May 15 RPAG and answer outstanding questions**
- **Discuss gas supply portfolio and modeling overview**
- **Review PSE's gas natural gas delivery system**
- **Review approach to non-pipeline alternatives (NPA)**
- **Discuss gas system planning approach for 2027 ISP**
- **Gather feedback from RPAG members**

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What we need from you

- **Share your questions, reflections, and advice on today's topics**
- **Let us know if anything is missing or unclear**
- **Flag areas where deeper discussion is needed**
- **Help us identify risks, tensions, or points of misalignment early**

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Charter adoption

Annie Kilburg Smith, Triangle Associates

June 24, 2025

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RPAG charter: adoption in principle

What we're asking today

We're inviting RPAG members to adopt the revised Charter *in principle*.

This means:

- You **generally support** the updated Charter language
- You believe it reflects RPAG's purpose, structure, and process
- You are **comfortable moving forward** with the Charter as the foundation for ongoing work

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Introduction and updates

Jennifer Coulson, PSE

June 24, 2025

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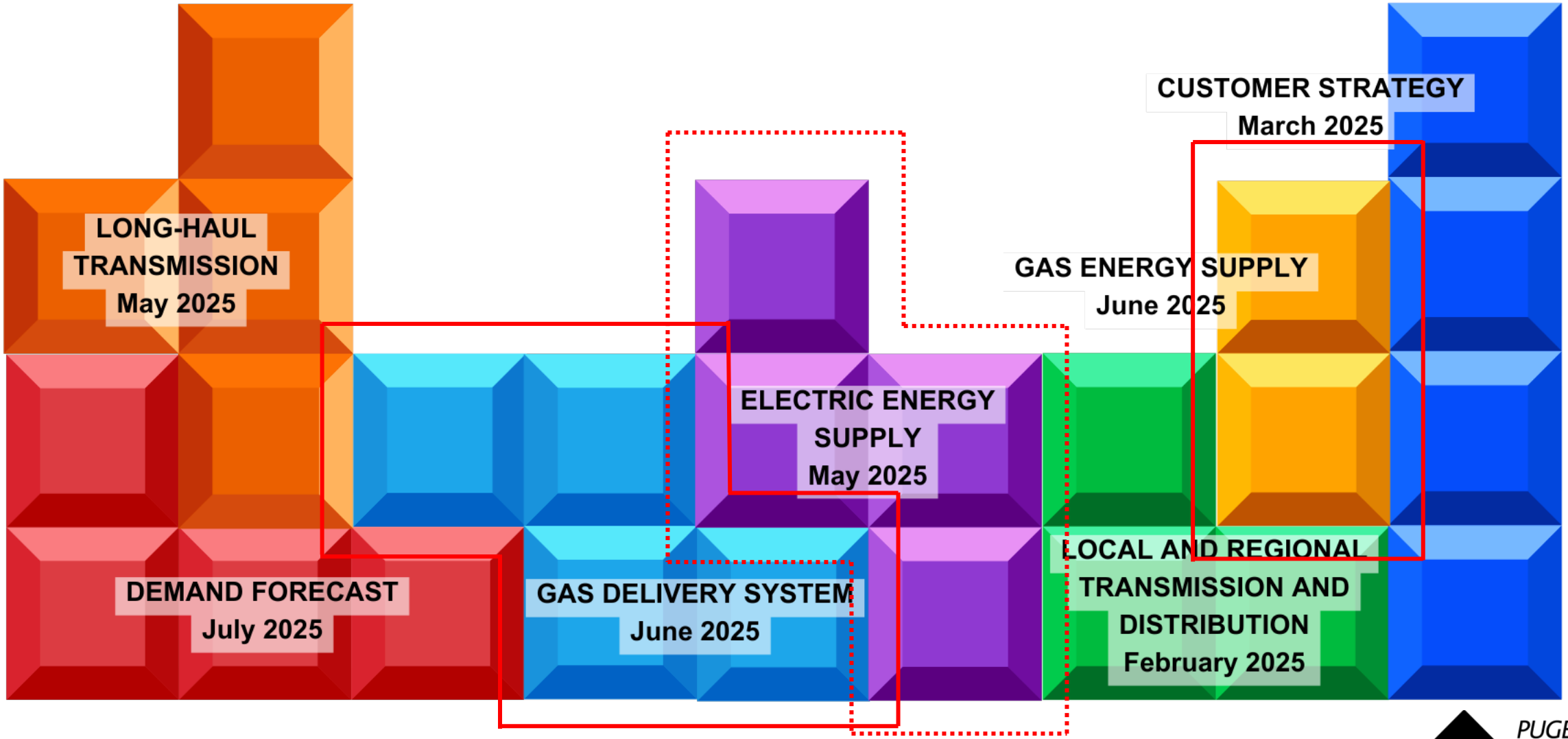
Today's discussion



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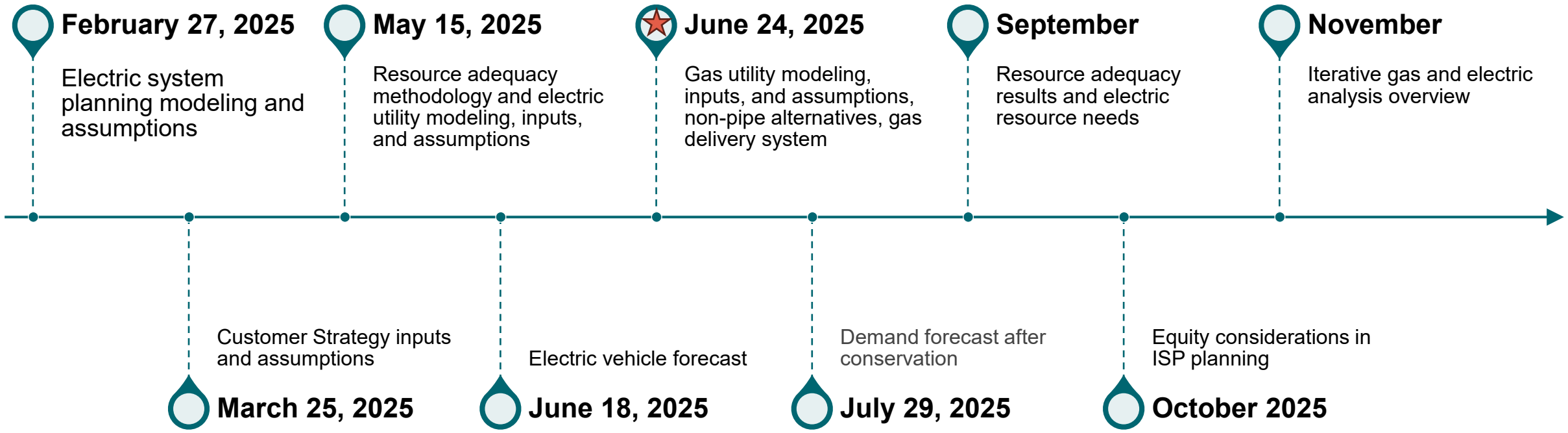
Upcoming engagement topics



No meetings planned for April, August, or December

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27 ISP scenarios

Scenarios	Building Electrification	Large Load Requests	Customer Programs	EV Adoption
Reference (HB 1589): Current Trends	Current building electrification pilots, funding low-income through CCA	Data Centers (+ other new large load requests): based on high probability of interconnection	**Reference CPA for customer programs:** no gas appliance conservation, building codes restricting gas, 2% conservation & 10% DR or commercially feasible (electric only)	Reference
Scenario 1 (Mid): Incentivized electrification	Starting in 2030, building electrification based on equipment failure and market adoption rate with an incentive	Data Centers (+ other new large load requests): based on high probability of interconnection	Customer Programs (DR, DER, DSR, etc.) sized to load (adjusted CPA to demand levels)	Reference
Scenario 2 (High): Enhanced electrification	Starting in 2030, electrify buildings at a pace that brings the emissions of both utilities **below** the Climate Commitment Act combined free allowance line (gas/electric) **Constrained by equipment failure**	Data Centers (+ other new large load requests): based on **mid probability** of interconnection	Customer Programs (DR, DER, DSR, etc.) sized to load (adjusted CPA to demand levels)	High
Scenario 3 (High+): Unconstrained electrification	Starting in 2030, electrify buildings at a pace that brings the emissions of both utilities **below** the Climate Commitment Act combined free allowance line (gas/electric)	Data Centers (+ other new large load requests): based on **mid probability** of interconnection	Customer Programs (DR, DER, DSR, etc.) sized to load (adjusted CPA to demand levels)	High

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Electric modeling assumptions

Elizabeth Hossner, PSE

June 24, 2025

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Objectives

Hear RPAG feedback on and determine next steps for:

- **How to address uncertainty around tariffs**
- **How to address changes in policy surrounding investment tax credit (ITC) and production tax credits (PTC)**
- **How to address uncertainty in emerging resource technology timing and costs**
- **The year emerging resources are assumed to be commercially available**

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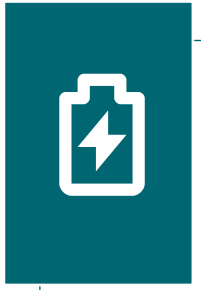
Supply-side resource alternatives for the 2027 ISP

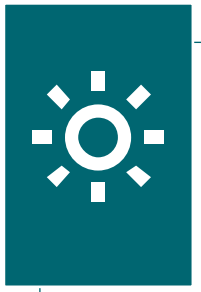


Energy Storage

- Short duration (Lithium-Ion 4 hour)
- **Medium duration (CAES 8-hour) - Emerging**
- **Long duration (Iron-Air 100-hour) - Emerging**

Wind

- Onshore wind
- **Offshore wind - Emerging**
- Hybrid and co-located with energy storage and solar



Solar Photovoltaic (PV)

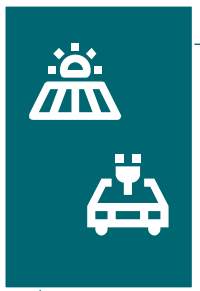
- Utility scale
- Hybrid and co-located with energy storage and wind

Baseload

- **Small Modular Reactor (SMR) – Emerging**
- Combined Cycle Combustion Turbine (CCCT)
- **Enhanced Geothermal - Emerging**

Peaker

- Natural Gas with oil backup – converts to alternative fuel in 2045
- **Hydrogen/NG blend with backup fuel – Emerging**
- Renewable Peaker



Distributed Energy Resources

- Solar
- Energy storage

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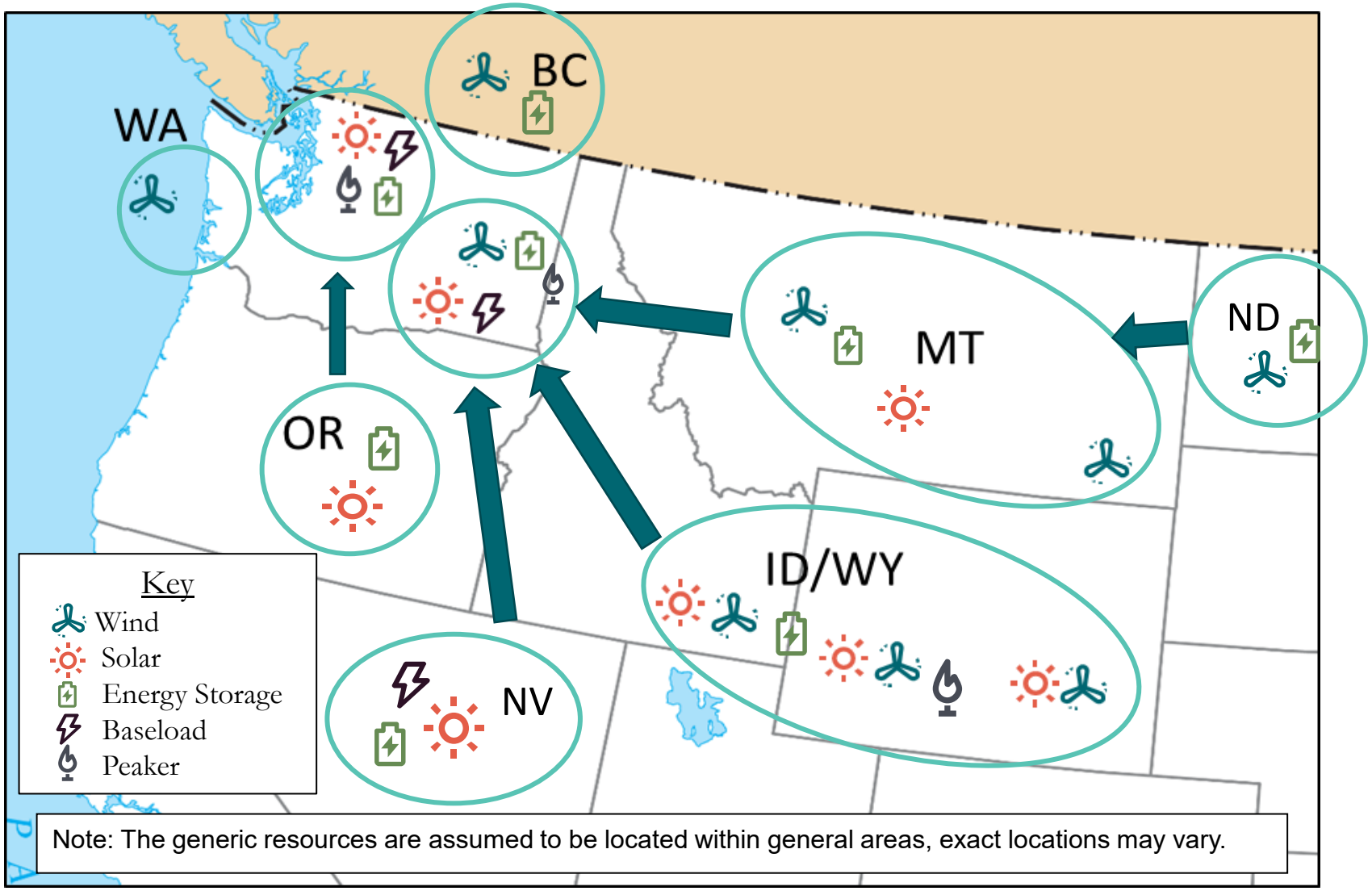
Resource alternatives by transmission zone



- Resources will be organized into 'transmission regions' described in the February 27 presentation
- Allows different resources to be aggregated into unique transmission regions sharing a fixed transmission capacity
- **Updated to include feedback received on May 15 – we will now model battery storage in all zones**

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Generic resources capital costs

Generic resource technologies – presented by Black and Veatch at March 25, 2024 RPAG meeting

- ❖ All costs are in 2022 dollars and vintage year 2025 unless otherwise stated
- ❖ All 2024 NREL ATB Costs are on the conservative cost curve

Draft costs include:

- EPC (Engineer, Procure, Construct)
- Owner's Costs

Not included in draft costs, but will be added later:

- Investment Tax Credit (ITC)
- Production Tax Credit (PTC)
- Interconnection costs
- Lease fees

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Proposed cost adder considerations

- **Construction contingencies**
- **Tariffs**
- **Commercially feasible**
- **Emerging resource**

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Emerging resources draft capital costs

Type	Size	2025 Modeling Black & Veatch Costs	Draft 2027 ISP/ 2024 NREL ATB $/kw	First Year Available	Uncertainty/ Risk Percentage Adder
Nuclear SMR	600 MW	10,627	*12,681	2040?	20%?, 50%, 100%?
Offshore Wind (Floating Foundation) Class 12	100 MW	6,439	*14,694	2045?	20%?, 50%, 100%?
Enhanced Geothermal	100 MW	---	11,057	2035?	20%?, 50%, 100%?

*Vintage year 2030

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Storage resources draft capital costs

Type	Size	2024 NREL ATB $/kw	Draft 2027 ISP $/kw	First Year Available	Uncertainty/risk percentage adder
Short-Duration 4-Hr Li-Ion	100 MW	2,160	2,079		10%?, 20%?
Mid-Duration Advanced Compressed Air	100 MW	*Pumped Storage: 4,270 8-Hr Li-Ion Battery: 3,828	2,439	2035?	10%?, 20%?
Long Duration Iron Air	100 MW	---	2,389	2035?	10%?, 20%?

*24 NREL ATB Class 7

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Thermal resources draft capital costs

Type	Size	2024 NREL ATB	Draft 2027 PSE ISP
NG Peaker[1]	120 MW	1,319	1,705
H2 Peaker	104 MW	---	2,001
Renewable Peaker	98 MW	---	2,088
Combined Cycle[2]	336 MW	1,730	1,730

1. 2024 and 2023 NREL ATB uses a F Class gas turbine (200+ MW) for its analysis. The smaller turbine results in differences in costs and performance numbers from the Black & Veatch estimates. NREL assumptions on the operating profile of the peaker may be different from Black & Veatch assumptions used in thermal modeling resulting in differences in variable O&M costs.
2. NREL ATB Combined Cycle – NG 1-on-1 (H Frame)

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Renewable & co-located draft capital costs

Technology/Size	Cost Category	2024 NREL ATB $/kw	Draft 2027 PSE ISP $/kw	Uncertainty percentage adder
PV Solar Solar Class 8 Single Axis Tracking Utility Scale	100 MW	1,541	2,169	10%?, 20%?
Wind Wind Class 6 On-Shore	100 MW	1,633	1,790	10%?, 20%?
PV Solar + BESS+ Co-Located Hybrid	100MW + 50 MW	2,569	2,139	10%?, 20%?
Wind + BESS Co-Located Hybrid	100MW + 50 MW	---	1,886	10%?, 20%?
PV Solar + Wind + BESS Co-Located Hybrid	100MW + 100MW + 50MW	---	1,999	10%?, 20%?

*All Co-Located Resources are paired with a 4hr Li-Ion BESS
+For the PV Solar + BESS in 24 NREL ATB modeled a DC coupled system with 134MWdc solar and 78MW dc battery for their analysis

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Proposed reference case assumptions

Which assumptions should be included as the reference/base assumption?

- **Investment tax credit (ITC) and production tax credit (PTC)**
  - **Both renewed and available for ISP time horizon OR**
  - **Both no longer available for ISP time horizon**
- **Emerging technology**
  - **Available in portfolio model at assumed first year available OR**
  - **Not available as new resource in the portfolio model**
- **Uncertainty risk adder**
  - **No uncertainty risk adder OR**
  - **Lower uncertainty risk adder (10% - 20%) OR**
  - **Higher uncertainty risk adder (20% - 100%)**

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Gas energy supply

Gurvinder Singh, PSE

June 24, 2025

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Today's objectives

- **Gas supply portfolio overview and modeling approach**
- **Feedback requested on gas supply portfolio inputs and assumptions**
  - Resource alternatives
  - Renewable fuels
  - Commodity gas prices assumptions by scenario
- **How feedback will be used:**
  - Feedback will shape gas supply portfolio scenario input assumptions

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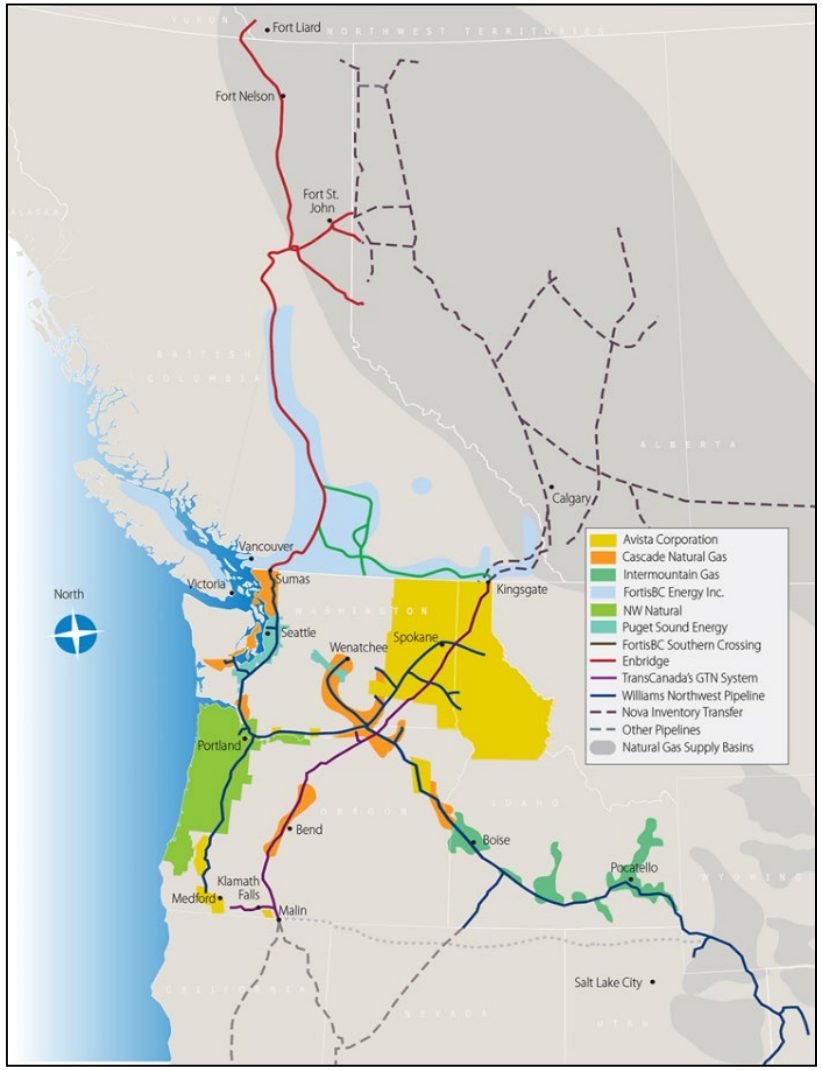
Regional overview: gas basins and pipelines



Supply basins and hubs:

- BC-Station 2
- BC-Sumas
- Alberta- NIT (AECO)
- Alberta at Stanfield
- Rockies- including Clay Basin Storage

Pipelines

- Northwest
- Westcoast
- GTN/Foothills/NGTL
- Cascade

There are 91,503 miles of gas pipeline in the region (Washington, Oregon and Idaho).

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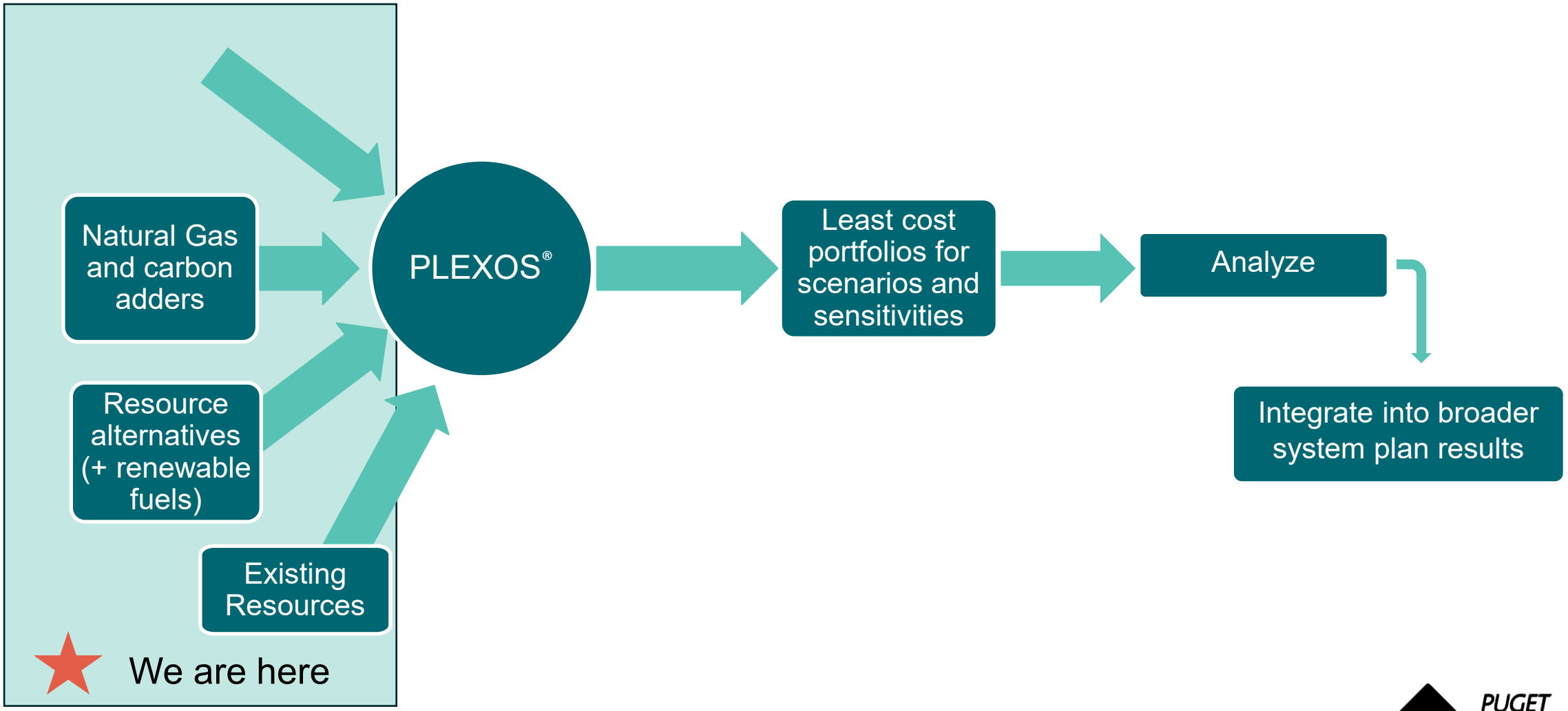
Gas supply analysis approach



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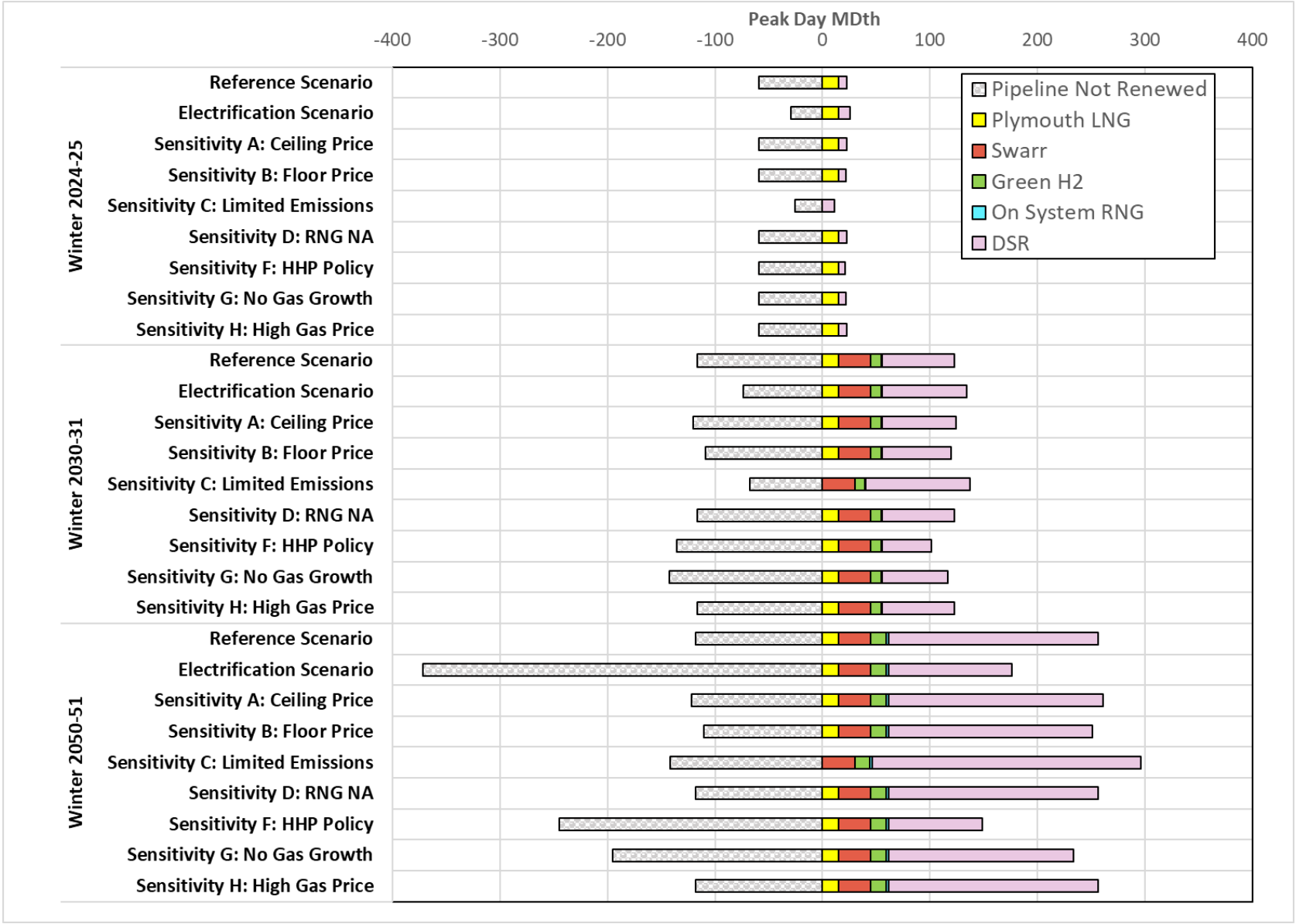
Example of gas supply portfolio output from the 23 Gas IRP for reference only: Resource Builds by Scenarios and Sensitivities



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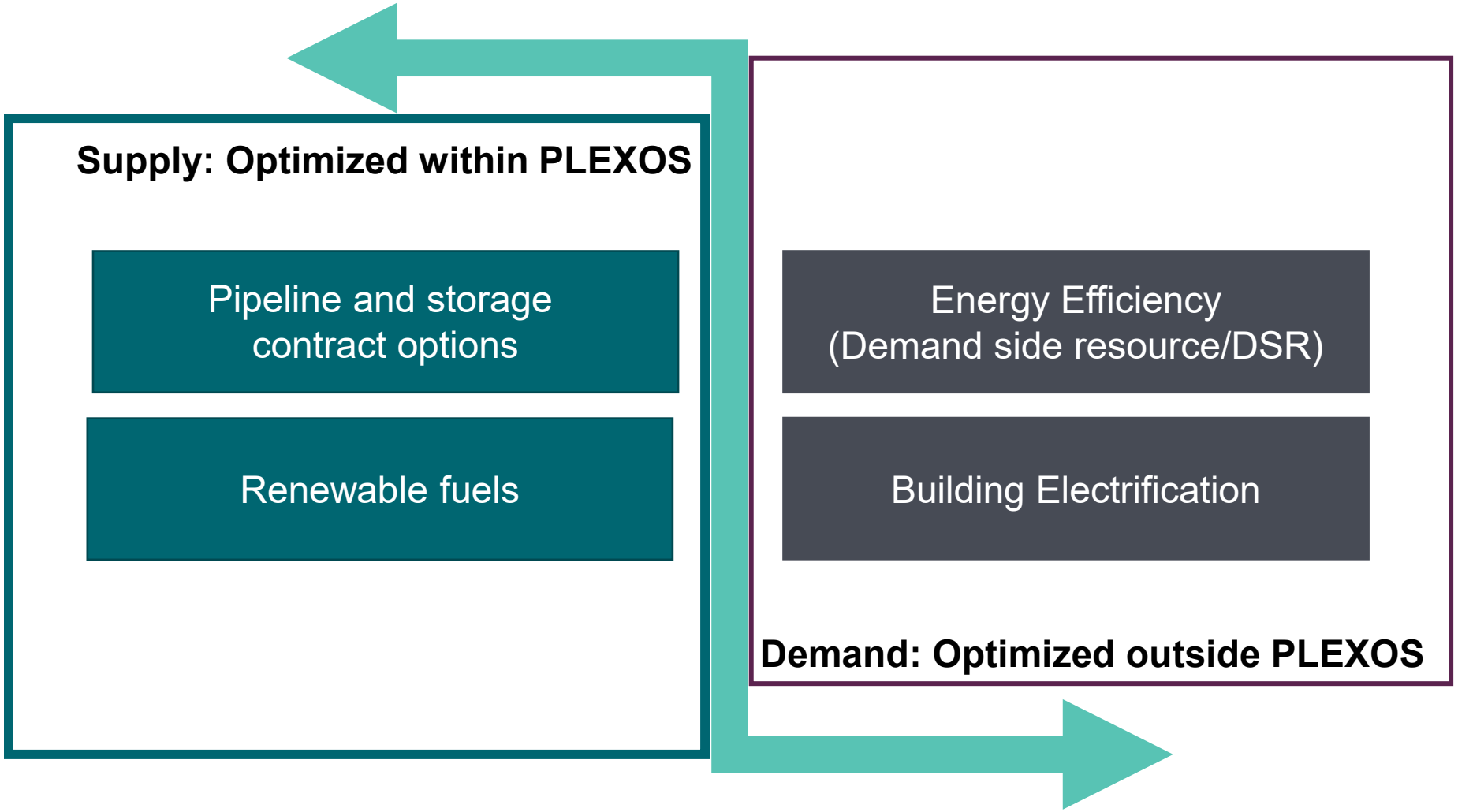
Gas supply: resource alternatives



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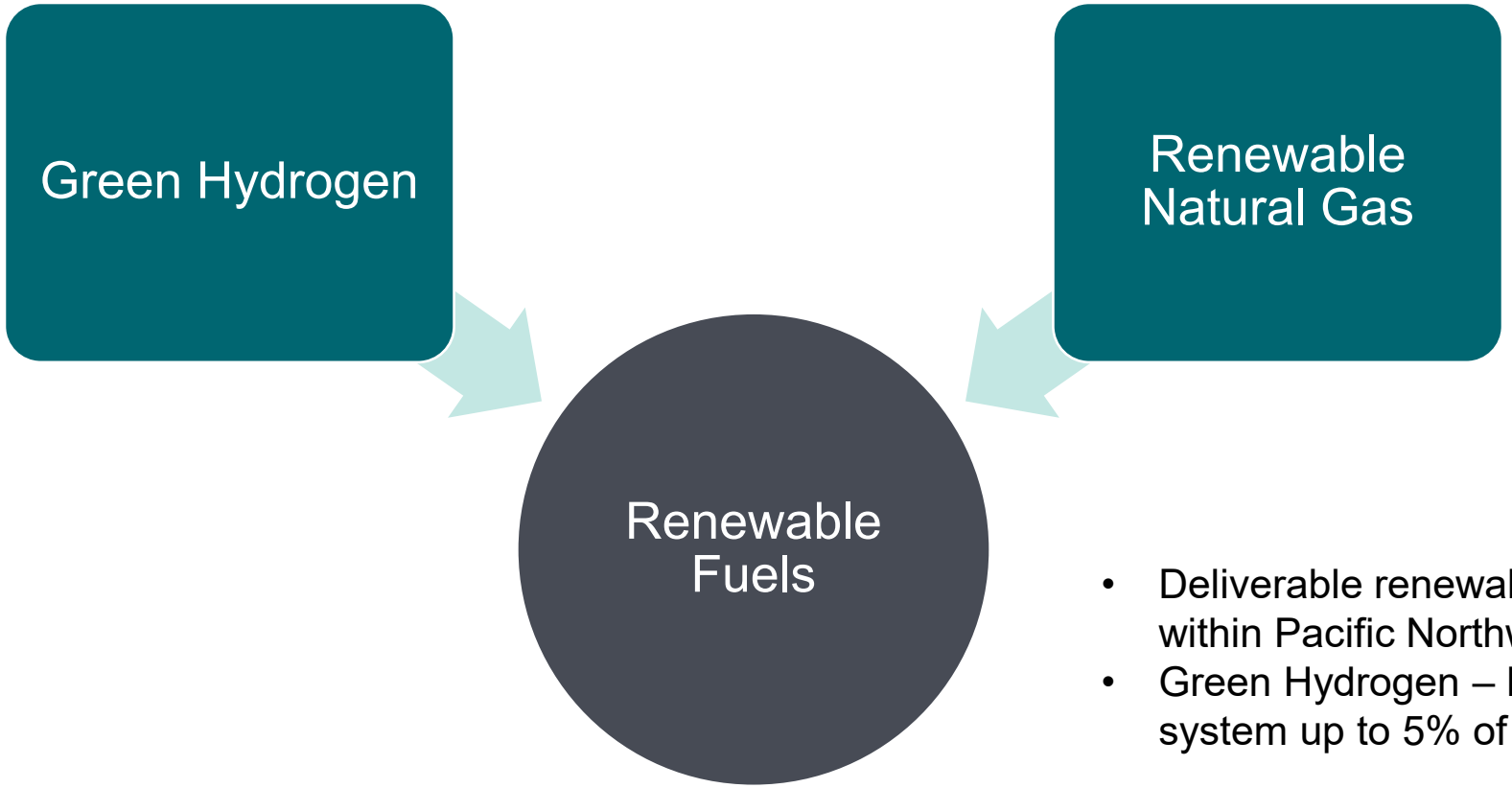
Renewable fuel to be optimized



- Deliverable renewable natural gas within Pacific Northwest area
- Green Hydrogen – blended into gas system up to 5% of energy content

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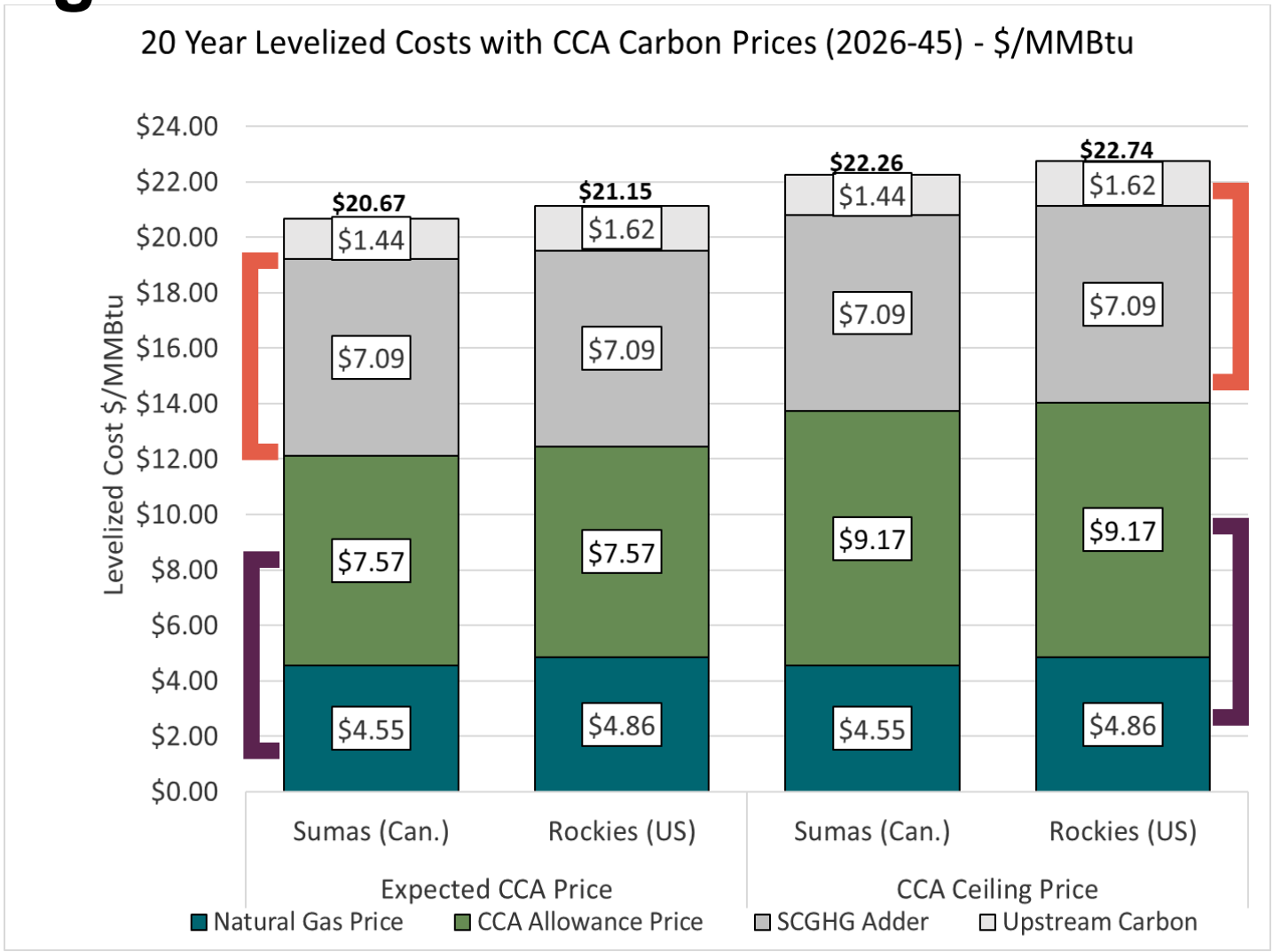
Example of total levelized gas costs

- 2027 ISP Updates:
  - CCA Ceiling price applied across all scenarios (per HB-1589)
  - Include HB 1975 price cap at $80/Metric Ton for 2026-2027
  - SCGHG and Upstream Carbon to be updated



Note: *Natural Gas and CCA Allowances price updated for 2027 ISP*

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Gas supply scenario assumptions

Let's discuss:

- CCA price at the ceiling due to HB 1589 requirements
- Should commodity gas prices vary by scenario?
- Other suggestions?

Scenario	CCA Price	Commodity Gas Price	Alt Fuel	Supply Side Resources
Reference (HB 1589): Current Trends	CCA Ceiling	Mid	RNG in PNW + H2 blended	pipeline optimization, SWARR, Plymouth renewal
Scenario 1 (Mid): Incentivized electrification	CCA Ceiling	Mid	RNG in PNW + H2 blended	pipeline optimization, SWARR, Plymouth renewal
Scenario 2 (High): Enhanced electrification	CCA Ceiling	?	RNG in PNW + H2 blended	pipeline optimization, SWARR, Plymouth renewal
Scenario 3 (High+): Unconstrained electrification	CCA Ceiling	?	RNG in PNW + H2 blended	pipeline optimization, SWARR, Plymouth renewal

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Questions?

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Break

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Natural gas delivery system investments and ISP strategy

Niecie Weatherby, PSE
Don Frieze, PSE

Date

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Today’s objectives

- **Describe the difference in ISP vs IRP for the natural gas delivery system**
- **Describe the inputs and assumptions for the delivery system analysis and gain feedback on assumptions and sensitivities**
- **Review baseline investments and drivers for PSE's delivery system portfolio investments**
- **Review approach to project level non-pipeline alternatives (NPA) and gather input on portfolio level considerations**

- **How feedback will be used:**
  - Feedback will be incorporated into the analysis approach and model runs

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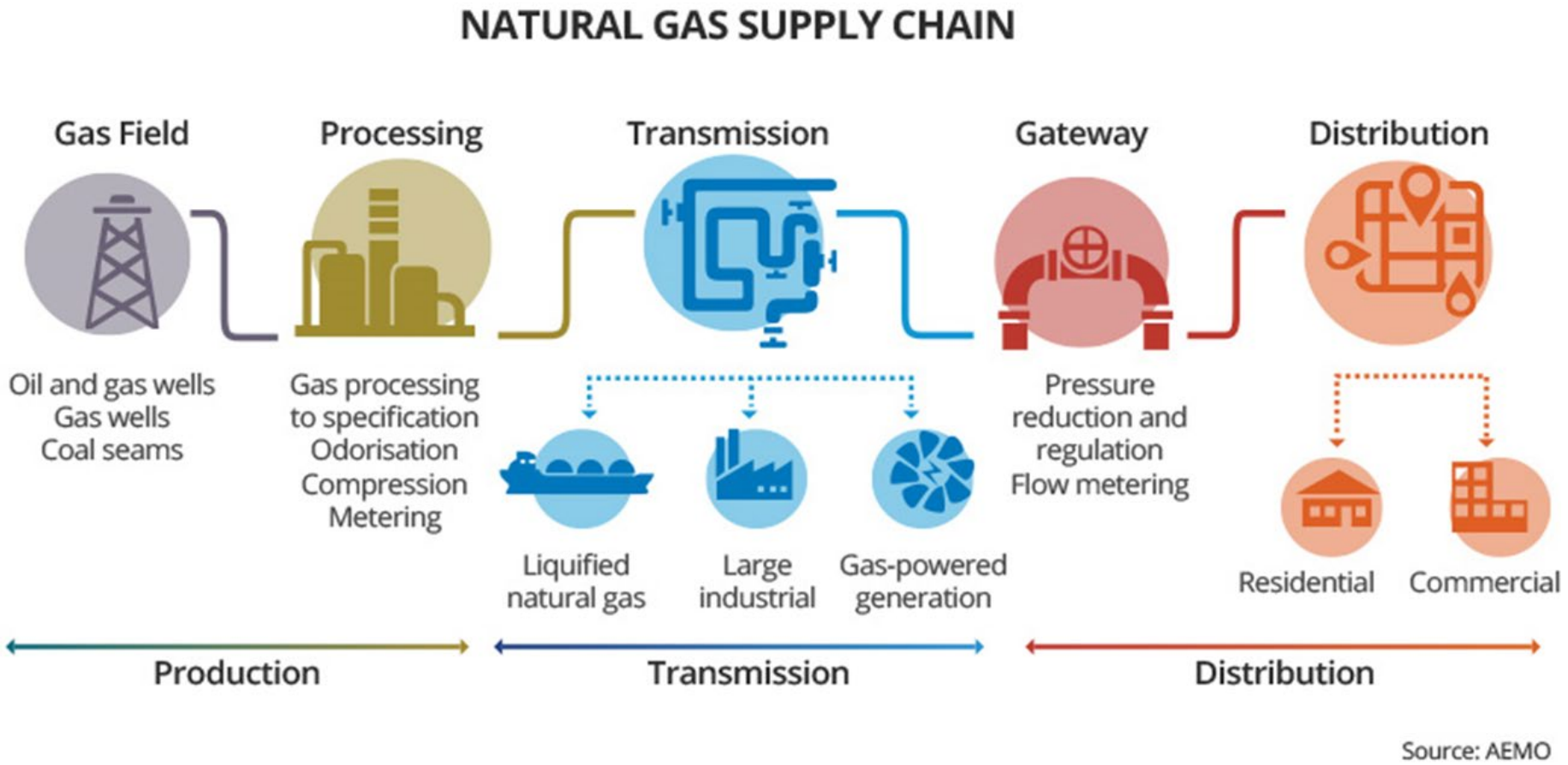
ISP vs IRP – system focus



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IRP vs ISP - Key Differences in Natural Gas Delivery System

Category	IRP	ISP
Gas DSP Overall	Supply	Supply + Pipeline Safety, compliance, reliability, and operations
Investments Decisions	Impacted by usage/load	Impacted by usage/load + miles of pipe, # of customers, and other assets
Conservation/ electrification	Spread evenly "peanut butter"	Locational benefits may exist if targeted and customers are willing
Load	Excludes transport	All customer classes
Analysis	Infrastructure cost data for resource options	Impact to delivery system investments for each scenario and sensitivities
Renewable fuels	Credits/attributions - no impact to system	Location important – impact to system/customers

Draft rule deliverables/ considerations include:

- Gas system assessments
- Types of investments on the system
- Non-pipeline alternative assessment including geographic areas

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IRP vs ISP - inputs and sensitivities for the natural gas DSP

Inputs

- Load forecast with expected customer counts
- Baseline capital investments:
  - Known specific projects
  - 2027-2029 GRC programmatic spend
  - Estimated spend from 2030 on to address programmatic needs
    - Reliability
    - Maintenance
    - Emergency
- Estimated operating costs
- Baseline asset information
  - Quantity of assets
  - Condition of assets/known risks

Sensitivities

Variables	Assumption	Sensitivity
Renewable fuel	Contract only	Evenly distributed through system
Conservation/ electrification	Peanut butter	Directed to "system need"
Partial/full electrification	Customer will not convert whole house at once	When heating changes – all end uses change

Question – what other sensitivities would you expect to see?

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Baseline investments – gas asset life

- Below ground gas facilities are constructed from cathodically protected steel or plastic materials which do not degrade over time when buried
- Properly maintained gas facilities can last indefinitely if unaffected by outside factors
- Excavation damage is the highest threat to gas facilities
- Typical Asset Risk Reduction programs and strategies are based on leakage rates (not due to excavation damage)
- Other factors (operational) may drive replacements like worker safety or changes in population around a facility

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Baseline investments – pipe replacement programs

- A replacement program is created through our Integrity Management Programs for materials identified as a high risk for leaks with the goal to:
  - Remove leak prone assets from the system
  - Fix leaks as they are found
  - Minimize CO2E from pipeline operations

Asset	Completion date	Program duration	Miles replaced	Miles remaining	Percent of total system
Cast Iron Pipe	2007	15 years	287	0	N/A
Bare Steel Pipe	2014	10 years	198	0	N/A
Older Vintage PE Pipe (DuPont)	2032	20 years	250	180	1.4%

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Baseline investments - overall NG investment portfolio

Make the "right" investments to provide safe, reliable natural gas in the most cost effective/efficient manner

ISP category	Description	Programs/drivers included	2025/2026 rate case	Additional notes
New construction	PSE portion of customer requested work	• Customer requests	$52.1 Million	Obligation to Serve
Reliability	Deliver gas to customers	• Pipeline Reinforcement • NPA equipment	$29.7 Millon	
Maintenance	Condition-based repairs and replacements to minimize risk Compliance-driven requirements Franchise agreements	• Integrity Management • Pipeline Replacement Plan • Public Improvement • Digital Monitoring	$275 Million	Estimated Total Pipeline Main Replaced - 55 Miles (0.4%)
Emergent	Time sensitive required work to ensure safety and compliance	• Gas leaks • Critical safety system issues • Customer billing inquiries	$56.6 Million	

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Baseline investments - pipeline replacement plan (PRP)

Program/asset	Pipeline integrity risk	Program status	2-year remediation	Expected expenditures	Type of remediation
Older vintage PE pipe	High consequence of fusion failure and brittle like cracking	Master Plan Active	48 Miles	$145.4 million	Replacement or retirement of pipe
Buried meters	High consequence of external corrosion failure in close proximity to a building wall	Master Plan Completed New Master Plan	20,000 meters	$20.0 million	O&M to clear the meter or replacement of riser
Sewer cross bores	High likelihood of failure and consequence of gas migration directly into a structure	Master Plan Active	14,600 segments cleared	$8.8 million	O&M sewer inspection to clear the risk
No record facilities	High likelihood of outside force damage failure in close proximity to building wall	Master Plan Active	1,420 sites cleared	$6.6 million	Combination of O&M and capital. If asset found, retirement of the asset

On December 31, 2012, the Washington Utilities and Transportation Commission (UTC) issued a policy statement[1] under UG-120715 for the accelerated replacement of natural gas pipeline facilities with elevated risk. The report is filed every 2 years on June 1.

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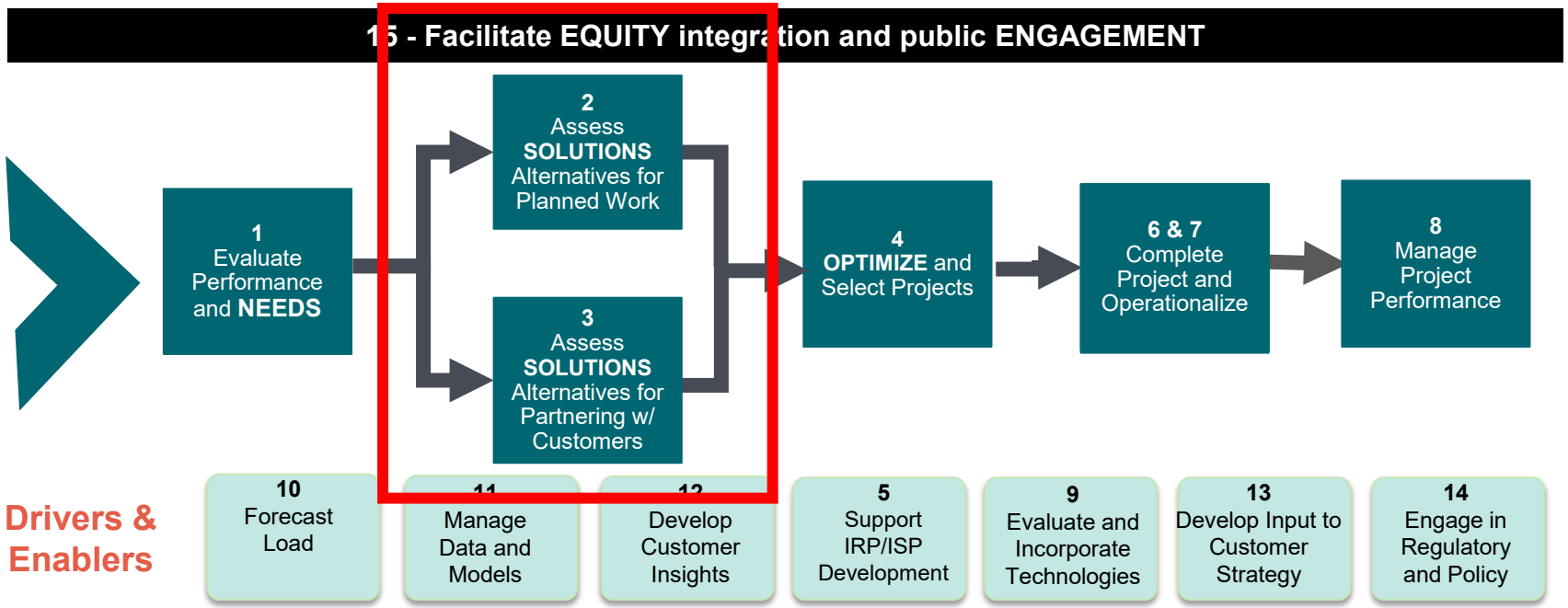
Delivery system planning process includes analysis of alternatives – including NPAs

Triggers:

- Safety issues
- Equity concerns
- Delivery system modernization
- Asset health
- Reliability
- Integrity
- Compliance



Standard alterative analysis criteria	
Meets technical criteria	Customer impact
Mature technology/methodology	Operational requirement
Feasibility	Cost-effectiveness
Permits and timeline	Equity

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Non-pipeline alternatives Within PSE

Need	Type of Action	Alternative	Status of PSE Implementation
Peak load management	Geographic demand-side management	Curtailment rate	Mature and implemented when appropriate
		Energy Efficiency	Piloting as an NPA
		Demand Response (DR)	Residential DR not currently able to defer investment on roadmap
		Targeted Electrification for constrained areas	Pilot approved in PSE 2024 general rate case for Duvall area
Peak load management/Supply	Peak shaving/ injection	Compressed Natural Gas (CNG)	Mature and implemented
		Liquefied Natural Gas (LNG)	Mature and implemented
		Air Propane	Mature and implemented
	Pressure increase	Bypass (temporary)	Mature and implemented
		Pressure Increase/Uprate (permanent)	Mature and implemented
Integrity/Safety	Repair	Fix problem with O&M or smaller capital solution	Mature and implemented
	Pressure decrease	Pressure decrease/downrate (permanent)	Mature and implemented
	Retirement	Targeted electrification for retirement	Pilot
		Networked Geothermal	Pilot being investigated
		Cut and cap	Mature and Implemented

Implemented | **Pilots** | Maturing Tech

Maturing customer sided NPA capabilities

Constrained area pilot:

- Need: peak load reduction
- Scope: Shift customers in Duvall area's heating source to electric to avoid capital project (approved in 2024 GRC)
- Incentive based
- Target customer conversions:
  - 2025/2026 - 500 customers
  - 2027/2028 - 500 customers
- Funded through rate case
- Next step: launch rebates and collect information summer 2025

Integrity/safety retirement pilot

- Need – risk removal/remediation
- Scope – integrity projects with 5 customers or less with expensive capital solutions
- Retire pipe requiring remediation
  - All customers served from pipe must agree to leave the system
  - Must be hydraulically feasible
- Full cost of conversion covered
- Customer choses replacement fuel
- Must be cost effective
- Funded through O&M
- Next step: File tariff summer of 2025

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Discussion

How does the NPA portfolio analysis differ from an individual project evaluation?

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Natural gas delivery system must be safe and reliable

Priorities:

- Build modeling approaches to adequately evaluate delivery system investments required in ISP analysis scenarios
- Continue to develop and implement non-pipeline alternatives to address issues while keeping the system safe
- Continue timely investments to reduce risk on the system and ensure natural gas is available when customers need it

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Questions?

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Next steps

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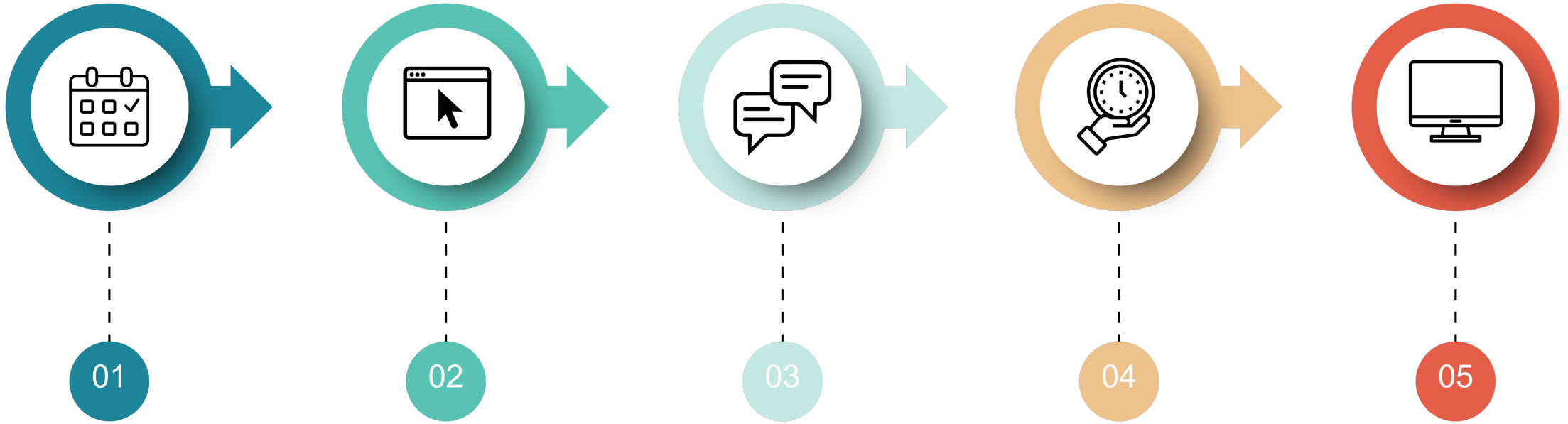
Feedback process reminder



One week prior to meeting

The feedback window for the upcoming meeting opens.

3-5 business days prior to meeting

PSE posts the meeting agenda and slide deck on the Clean Energy website.

Day of meeting

PSE engages RPAG for feedback and facilitates a public comment opportunity.

One week post meeting

Feedback window for the latest RPAG meeting closes. Feedback received outside this window will go into the subsequent feedback report.

Four weeks post meeting

PSE posts the meeting summary and feedback report from the latest RPAG meeting on the Clean Energy website.

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Upcoming activities

Date	Activity
July 1, 2025	Feedback form from this meeting closes
July 29, 2025	RPAG meeting
July 17 and 22, 2025	Public webinars

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Contact us

- Via email at isp@pse.com
- Via feedback form at: https://www.cleanenergyplan.pse.com/contact
- Leave us a voicemail at 425-818-2051
- Subscribe to our email list
- Visit our website: cleanenergyplan.pse.com

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Public comment opportunity

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How to participate in the public comment opportunity

- Please use the “raise hand” if you would like to provide comment
- Each speaker will have up to **3 minutes** to give comments
- Comments should relate to **today’s meeting topics**
- Please keep remarks respectful – no personal attacks
- Comments and questions will be included in the feedback report
- You are welcome and encouraged to send written feedback to isp@pse.com

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Thanks for joining us!

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Appendix

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Acronyms

Acronym	Meaning
CAES	Compressed air energy storage
CCA	Climate Commitment Act
CETA	Clean Energy Transformation Act
CEIP	Clean Energy Implementation Plan
CETA	Clean Energy Transformation Act
CPA	Conservation potential assessment
DER	Distributed energy resources
DR	Demand response
DSR	Demand-side resource
HHP	Hybrid head pump
IRP	Integrated Resource Plan
ISP	Integrated System Plan

Acronym	Meaning
ITC	Investment tax credit
MW	Megawatt
NG	Natural gas
NPA	Non-pipeline Alternative
NREL ATB	National Renewable Energy Laboratory Annual Technology Baseline
PTC	Production tax credit
PV	Photovoltaic
RNG	Renewable natural gas
RPAG	PSE's Resource Planning Advisory Group
SCGHG	Social cost of greenhouse gas
SMR	Small modular reactor

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Industry information guiding NPA approach

Subject	Sponsor	Link
NPA development	Rocky Mountain Institute (RMI)/ National Grid	Non-Pipeline Alternatives: Emerging Opportunities in Planning for U.S. Gas System Decarbonization
	Lawrence Berkeley National Laboratory	Non-Pipeline Alternatives: A Regulatory Framework and a Case Study of Colorado
NPA pilot efforts	California Energy Commision/ Gridworks	An Analytical Framework for Targeted Electrification and Strategic Gas Decommissioning: Identifying Potential Pilot Sites in Northern California's East Bay Region Final Project Report
	Pacific Gas and Electric (PG&E)	PG&E's Alternative Energy Program
	Pacific Gas and Electric (PG&E)	East Campus may become California's largest electrification project | California State University Monterey Bay
	Pacific Gas and Electric (PG&E)	PG&E motion to withdraw California State University Monterey Bay Project
NPA criteria	Berkshire Gas, Eversource, Liberty, National Grid, Unitil	Massachusetts Local Distribution Company NPA framework