2021 IRP Webinar #8: Natural Gas IRP

Analyze Alternatives & Portfolios

Natural Gas Portfolio Model

October 14, 2020

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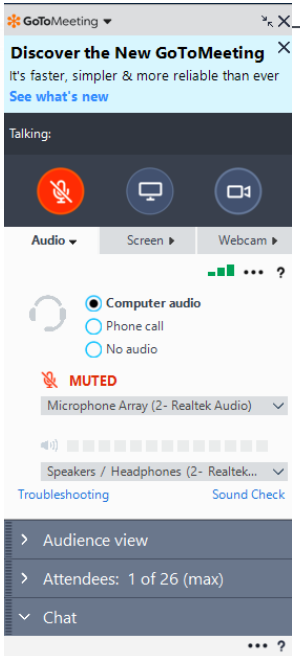
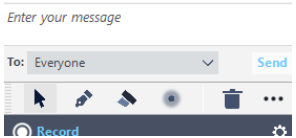
Welcome to the webinar and thank you for participating!





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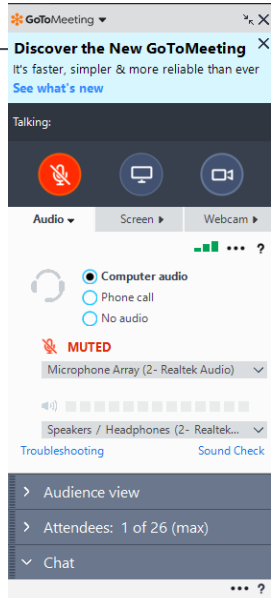
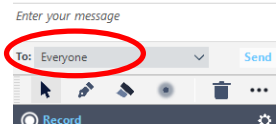
  - **In writing:** your question will be read
  - **Verbally:** type "Raise hand" and slide #, share with "Everyone"; please wait to be called on to ask your question
- Be considerate of others waiting to participate
- We will try to get to all questions



Raise hand, slide 33



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Agenda

- Safety moment
- Natural gas IRP
  - portfolio modeling
  - draft portfolio results
  - peak day planning standard
  - scenarios and portfolio sensitivities
- Renewable natural gas (RNG) background and customer program

Safety Moment: Fatigue prevention

As the daylight hours shorten and many of us are in long meetings indoors, consider these tips to prevent fatigue:

- Eat healthy choices often
- Get moving
- Sleep well
- Reduce stress to boost energy
- Talk with a friend
- Cut out/reduce caffeine
- Drink less alcohol
- Drink more water
- Consult a heath professional if you think there may be a health concern

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Today's speakers

Gurvinder Singh
Senior Energy Resource Planning Analyst, PSE

Elizabeth Hossner
Manager Resource Planning & Analysis, PSE

Bill Donahue
Manager Natural Gas Resources, PSE

Alison Peters & Alexandra Streamer
Co-facilitators, EnviroIssues

Natural Gas Portfolio Modeling

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Participation Objectives

- PSE will inform stakeholders of the gas portfolio model, resource need, levelized gas prices and resource alternatives used in the 2021 IRP analysis

IAP2 level of participation: INFORM

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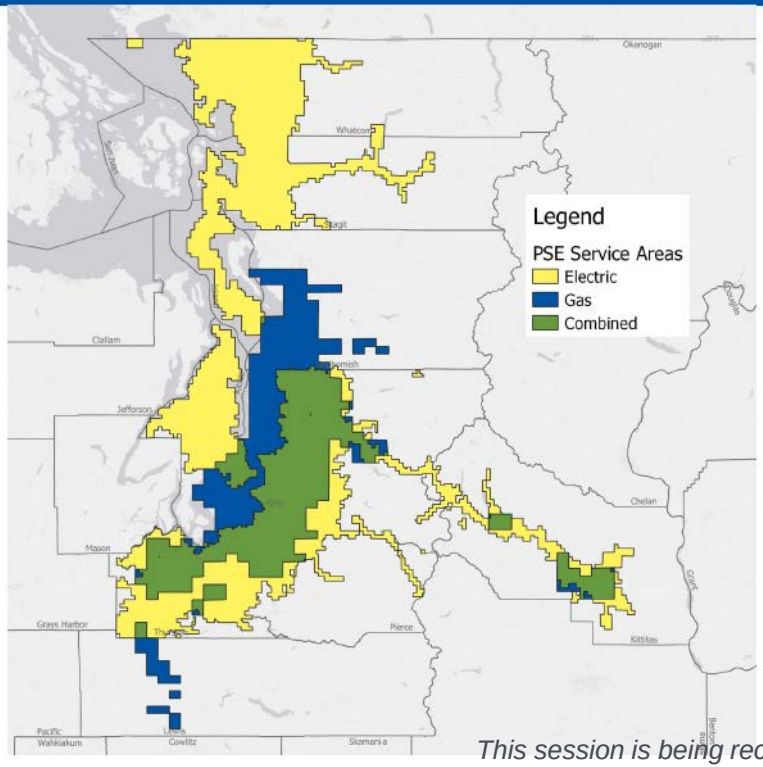
Natural gas analysis

PSE SERVICE TERRITORY



- More than 800,000 customers in Washington state depend on PSE for safe, reliable and affordable natural gas services.
- PSE's gas sales need is driven by peak day demand, which occurs in the winter when temperatures are lowest and heating needs are highest.

Infrastructure reliability

Natural gas transportation and distribution systems are not designed to include the type of redundant capacity that electric distribution systems. Equipment failure is rare, but it does occur, and there can be significant repercussions. For this reason, PSE builds flexibility and resiliency into the system in four ways.

1. **A conservative planning standard.** Peak day planning standard.
2. **Diverse transport resources**. A transport portfolio that intentionally sources gas equally from north and south of our service territory to preserve flexibility in the event of supply disruptions.
3. **Natural gas storage**. Storage minimizes the need and costs associated with relying on long haul pipelines to deliver gas on cold days; it allows more gas to be purchased in the typically less expensive summer season; and it can furnish gas supply in the event of a pipeline disruption.
4. **Cooperation with regional entities.** The Northwest Mutual Assistance Agreement (NWMAA) members agree to utilize, operate or control natural gas transportation and/or storage facilities in the Pacific Northwest, and they pledge to work together to provide and maintain firm service during emergency conditions and to restore normal service to their customers as quickly as possible after such events occur.

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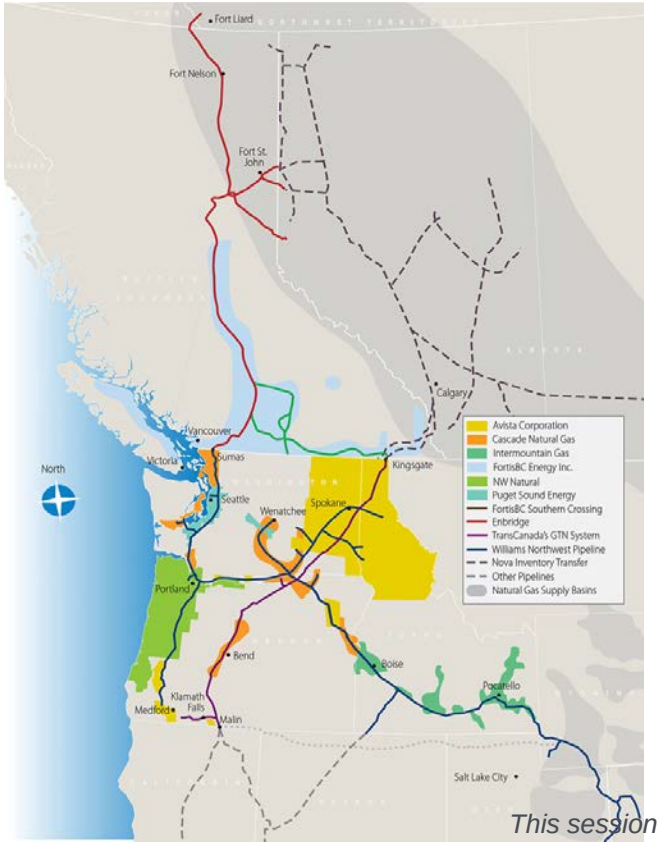
Regional overview – Natural gas basins and pipelines



<u>Supply basins and hubs:</u>

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

<u>Pipelines</u>

- 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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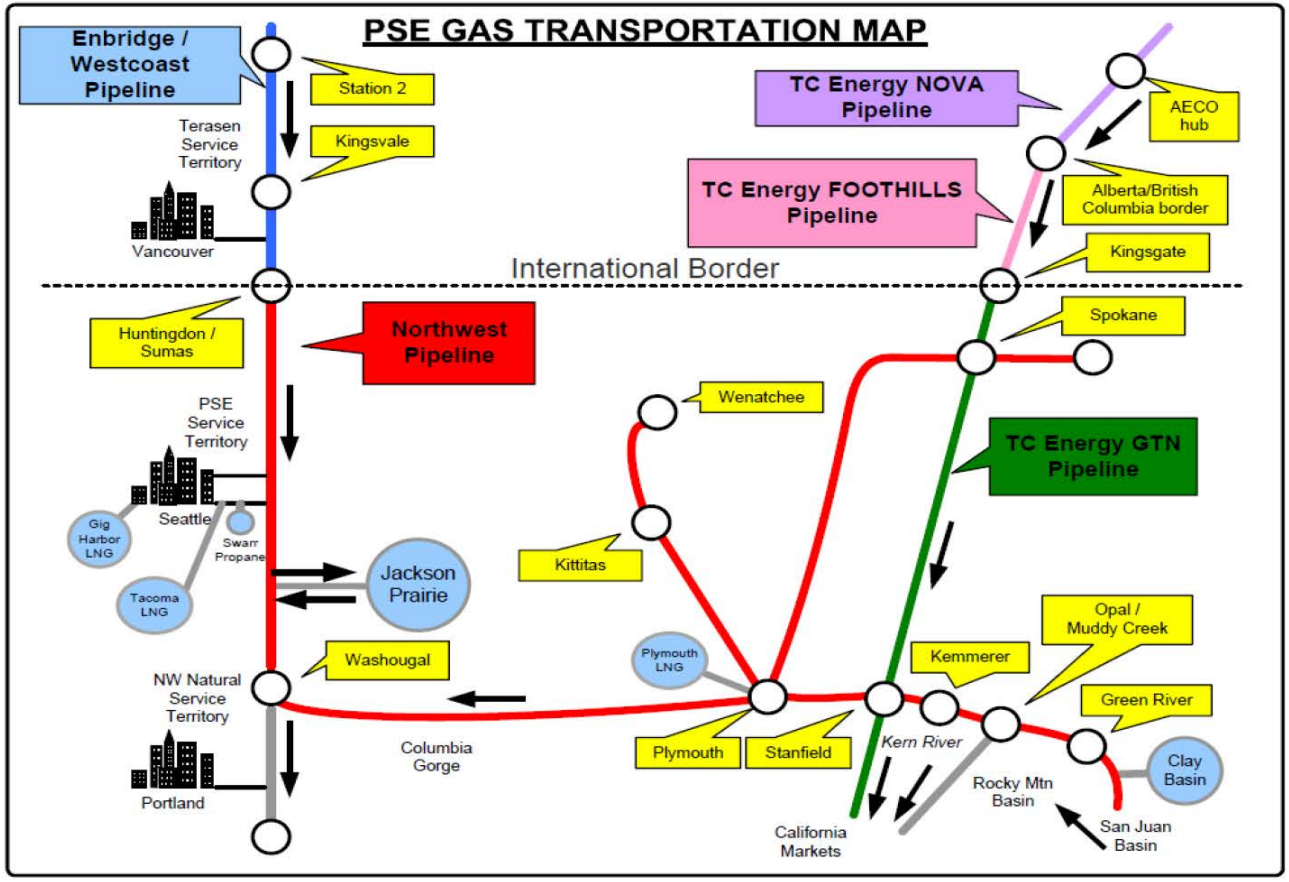
PSE existing natural gas transmission and storage infrastructure



2021 IRP natural gas modeling process

The 2021 natural gas IRP will follow a 5-step process for analysis:

1. Analyze and establish resource need
2. Determine planning assumptions and identify resource alternatives
3. Analyze scenarios and sensitivities using deterministic and stochastic risk analysis
4. Analyze results
5. Develop resource plan

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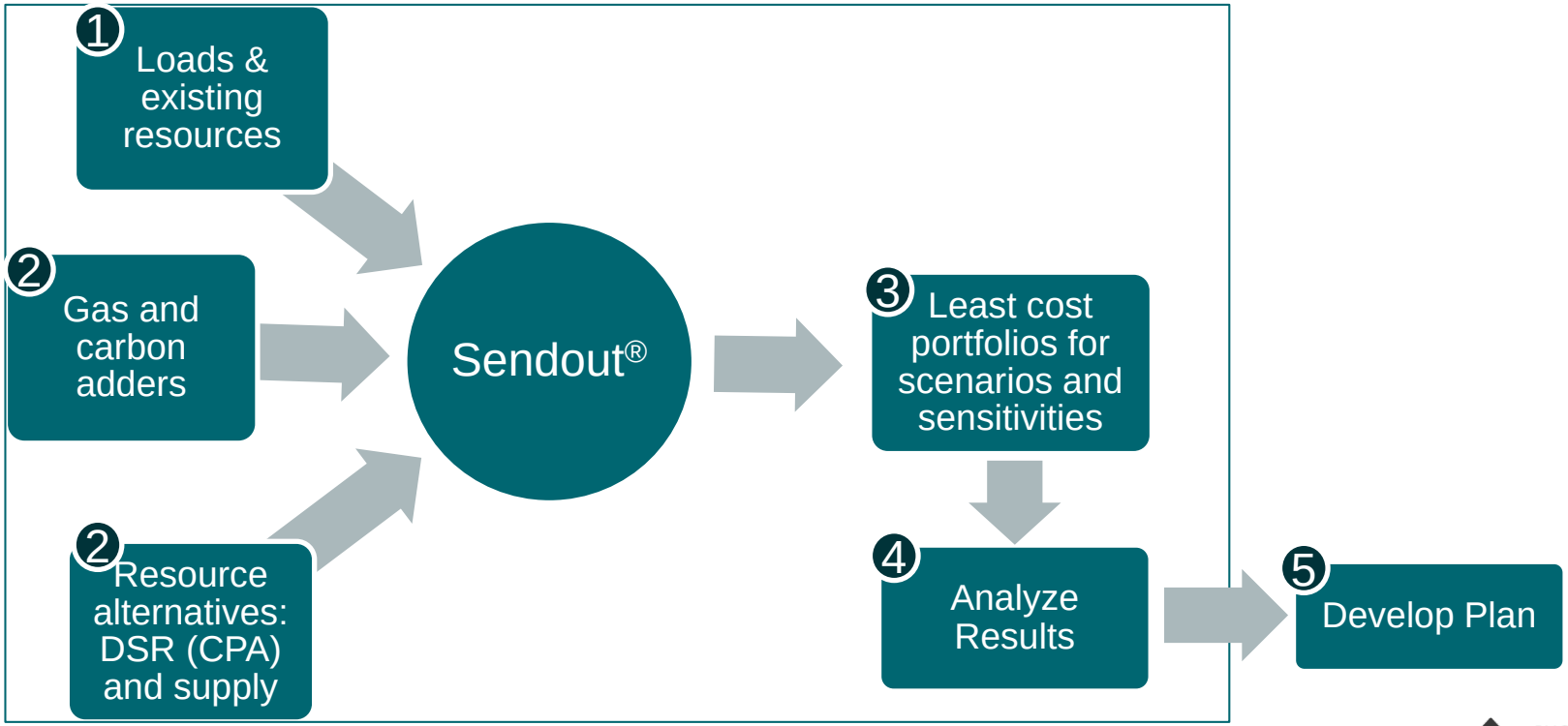
Gas portfolio modeling - SENDOUT®



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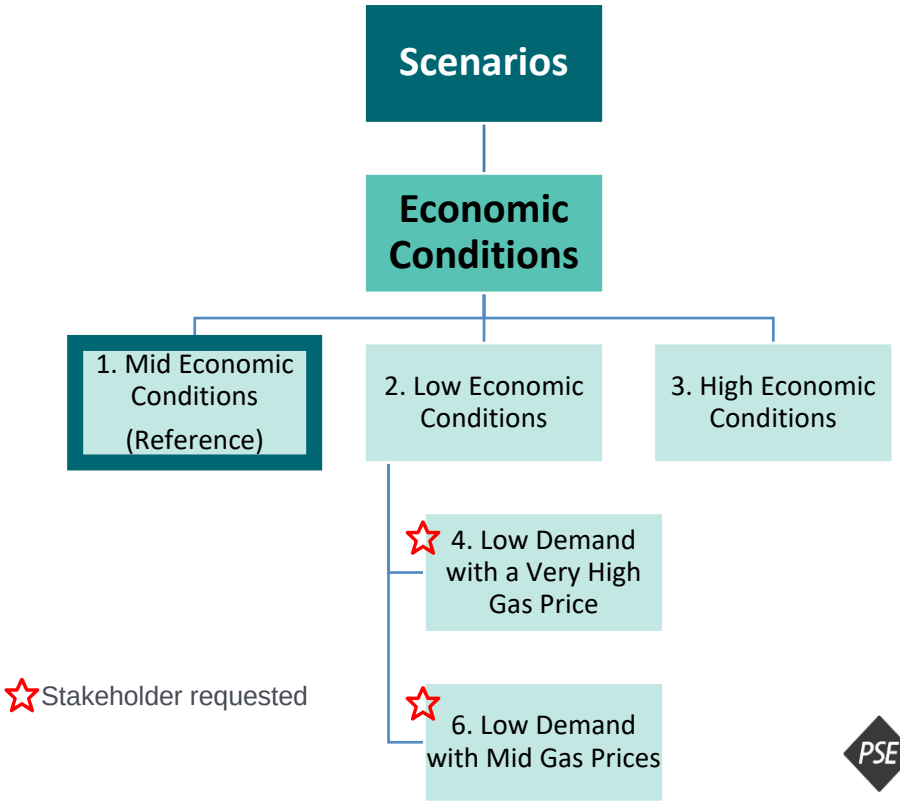
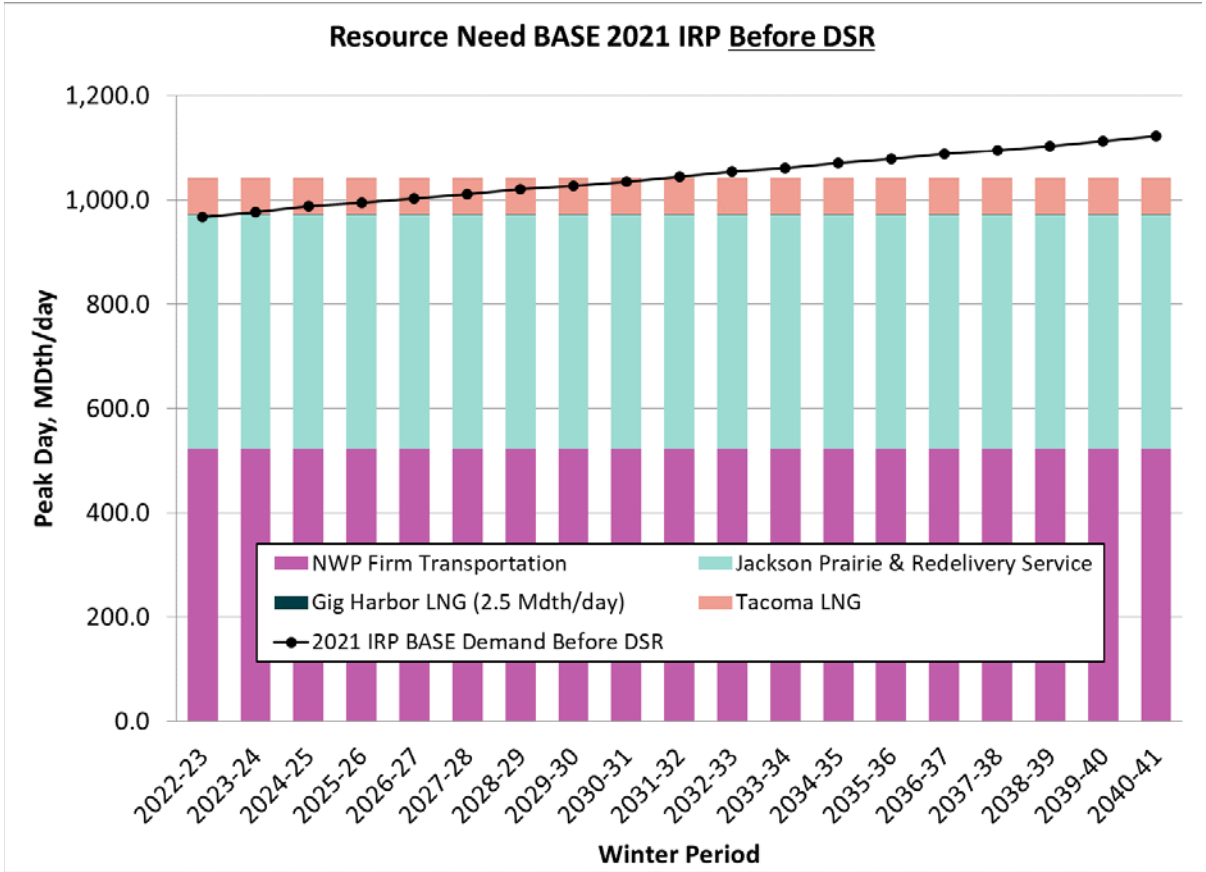
Planning assumptions and resource alternatives

Natural gas scenarios

- Gas prices, carbon regulation and loads create different portfolio results.



Gas resource need – base scenario

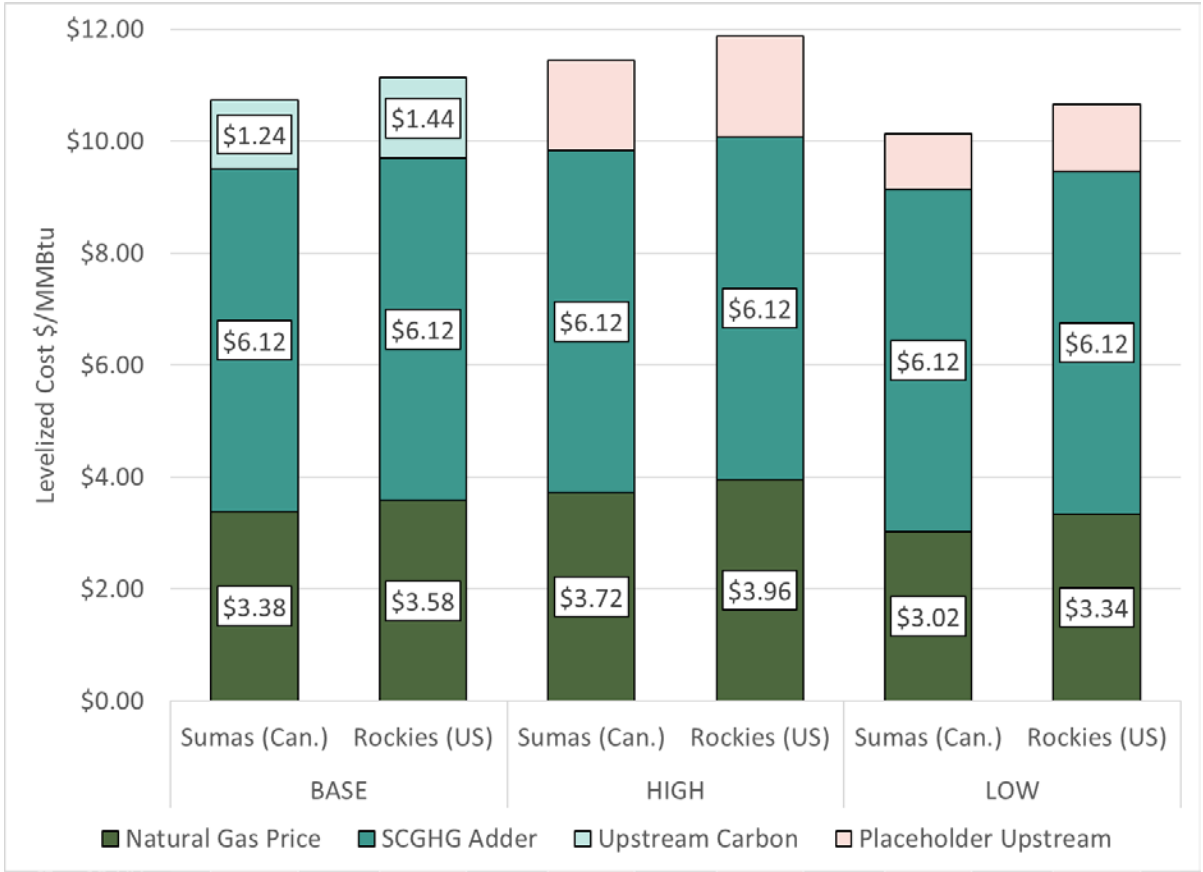


Notes:

1. Base scenario is used interchangeably in reference to the Mid-economic conditions.

2. Winter period is from November thru February of the following year.

Gas prices with SCGHG adders



Notes:

1. The upstream adder for the High and Low will be calculated once the demand High and Low is ready. This chart shows a placeholder that will be updated at a later date.

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Resource alternatives

Option 1	Purchase northern British Columbia gas at Station 2 and transport via expanded capacity on Westcoast, along with an expansion of Northwest Pipeline (NWP).
	Option #1a – Purchase short term NWP TF-1 capacity from Sumas (2020-24 only)
Option 2	Purchase AECO gas and transport via expanded capacity on TC-AB (Nova) and TC-BC (Foothills) pipelines, along with the proposed Fortis BC Kingsvale -Oliver Reinforcement Project (KORP) and a NWP expansion from Sumas.
Option 3	Purchase AECO gas and transport via expanded capacity on NGTL, Foothills and GTN, along with a NWP Columbia Gorge pipeline expansion.
Option 4	MIST Storage Expansion – lease capacity from NW Natural with redelivery to PSE service territory using backhaul capacity resulting from a Sumas South Expansion.
Option 5	15 MDth per day firm Plymouth LNG service and firm NWP pipeline capacity from the Plymouth LNG plant to PSE
Option 6	Distribution system upgrade to allow greater utilization of LNG peaking - additional 16 MDTh per day
Option 7	Upgrade the existing Swarr LP-air facility to 30 MDth per day.

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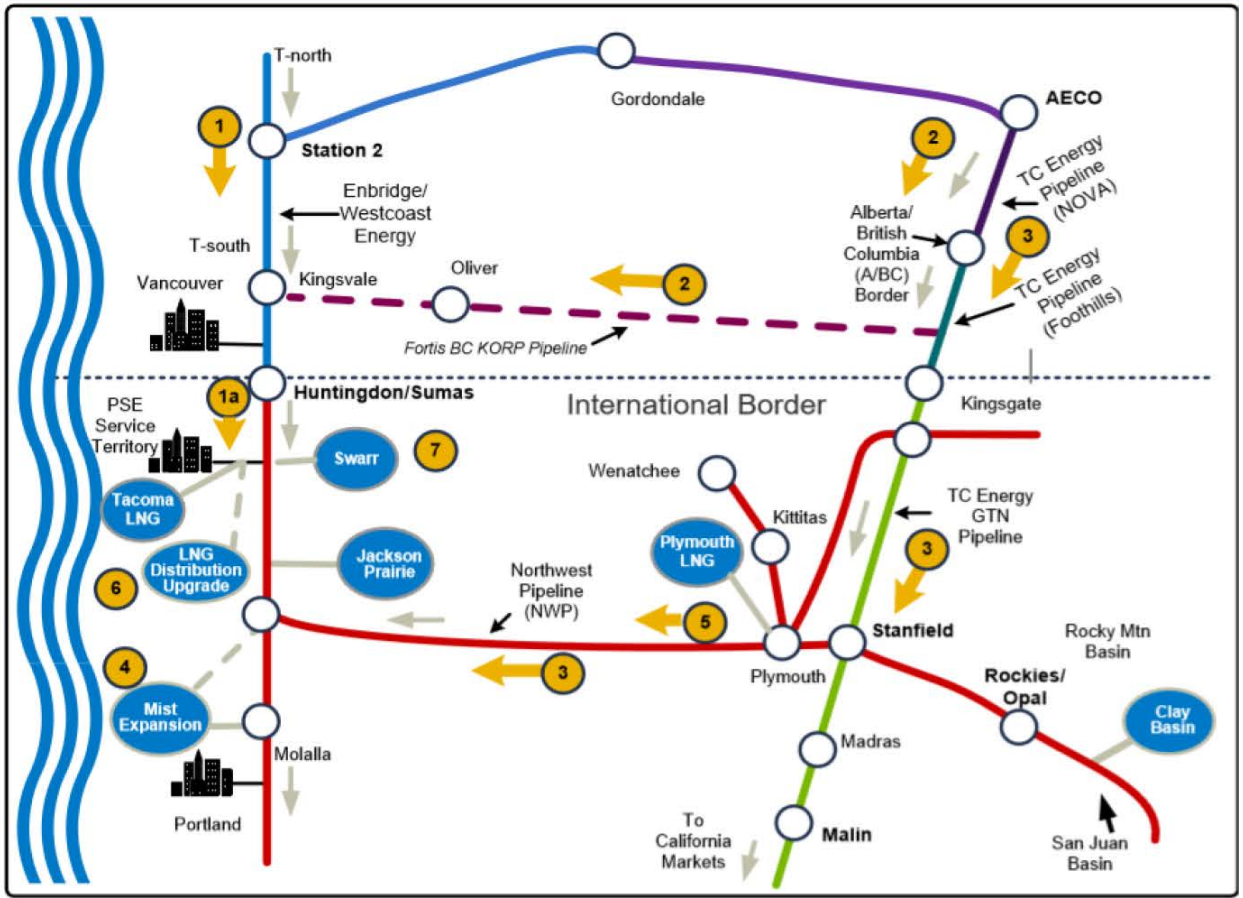
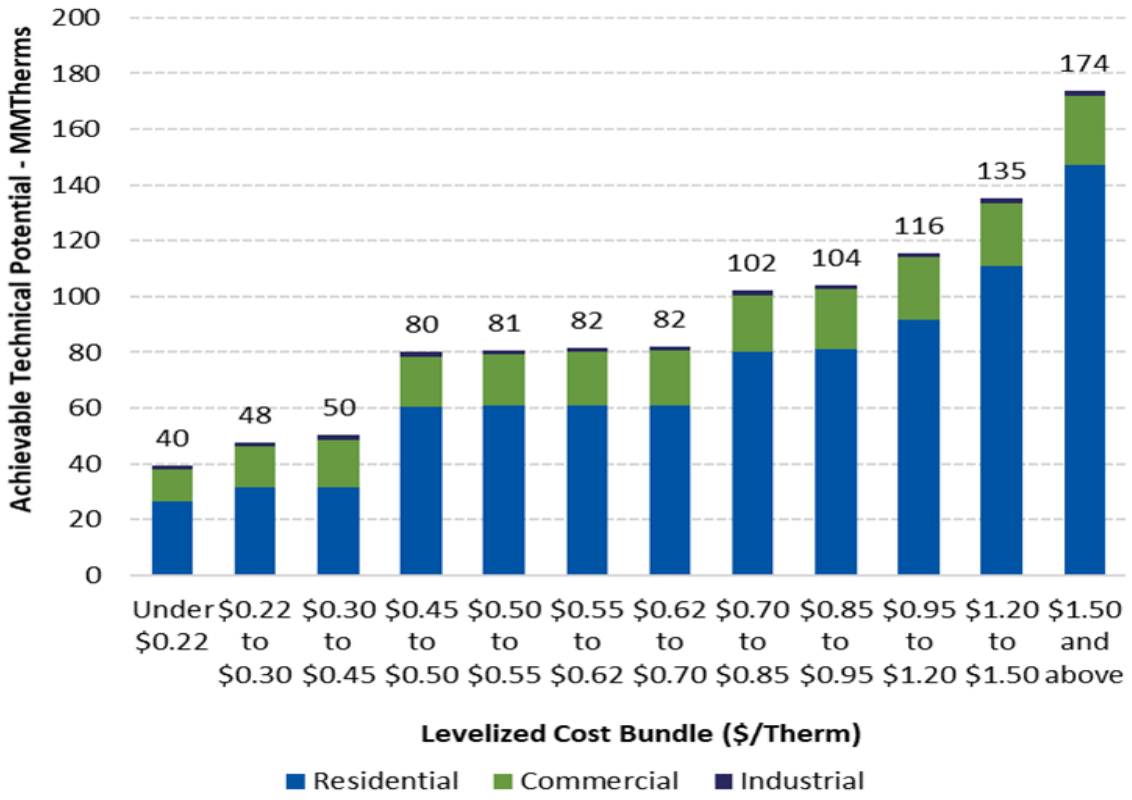
Resource alternatives - Schematic



Resource alternatives – Demand Side Resources (DSR)



Notes:

1. This chart was presented in the July webinar and is the conservation supply curve developed by the Conservation Potential Assessment (CPA).

2. The supply curve is divided into various price points, also referred to as bundles, before it is input into the portfolio model.

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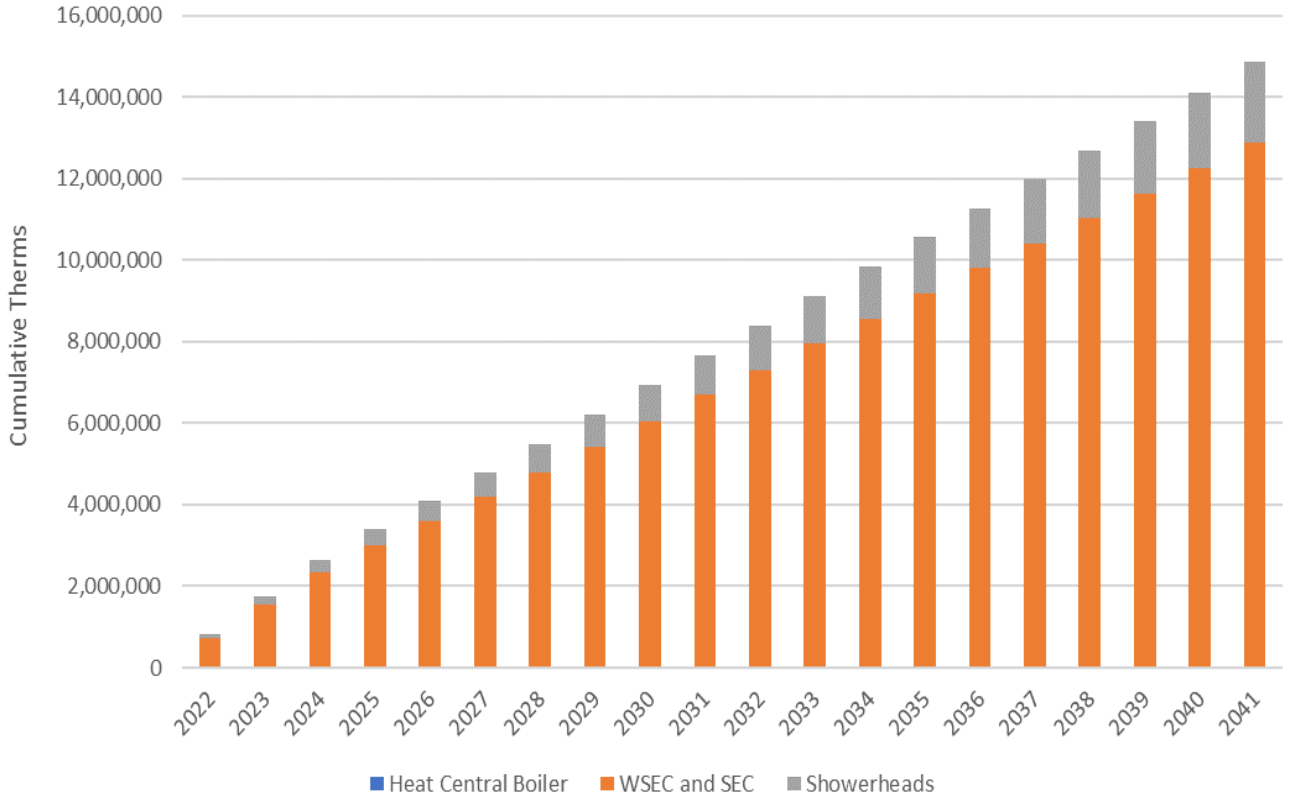
Resource alternatives – DSR codes + standards



Note:

1. This chart represents the demand reduction from codes and standards, developed by the CPA.

2. It is input into the portfolio model as a reduction to the demand.

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5-minute break

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Draft Natural Gas Resource Portfolio Results – Base Scenario

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Participation Objectives

- PSE will inform stakeholders of the draft natural gas portfolio results.

IAP2 level of participation: INFORM

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Draft Base Scenario Builds – Resource need filled by DSR

Winter Period	DSR (Incl Standard Bundle)	NWP Additions + Westcoast	Short Term NWP	KORP	Cross Cascades - New	Mist Storage	Ply LNG	LNG Tacoma Distr	Swarr
Option	DSR	#1	#1a	#2	#3	#4	#5	#6	#7
2022-23	4.8	-	-	-	-	-	-	-	-
2023-24	10.2	-	-	-	-	-	-	-	-
2024-25	16.0	-	-	-	-	-	-	-	-
2025-26	21.8	-	-	-	-	-	-	-	-
2026-27	27.9	-	-	-	-	-	-	-	-
2027-28	34.2	-	-	-	-	-	-	-	-
2028-29	40.8	-	-	-	-	-	-	-	-
2029-30	47.6	-	-	-	-	-	-	-	-
2030-31	54.6	-	-	-	-	-	-	-	-
2031-32	61.9	-	-	-	-	-	-	-	-
2032-33	66.4	-	-	-	-	-	-	-	-
2033-34	71.0	-	-	-	-	-	-	-	-
2034-35	75.7	-	-	-	-	-	-	-	-
2035-36	80.5	-	-	-	-	-	-	-	-
2036-37	85.2	-	-	-	-	-	-	-	-
2037-38	90.0	-	-	-	-	-	-	-	-
2038-39	94.7	-	-	-	-	-	-	-	-
2039-40	99.5	-	-	-	-	-	-	-	-
2040-41	104.2	-	-	-	-	-	-	-	-
2041-42	108.7	-	-	-	-	-	-	-	-

- Results reflect:
  - impact of lower demand forecast in 2021 IRP
  - more DSR in lower cost bundles
  - high total gas cost
- Cost-effective DSR is sufficient to cover future demand growth

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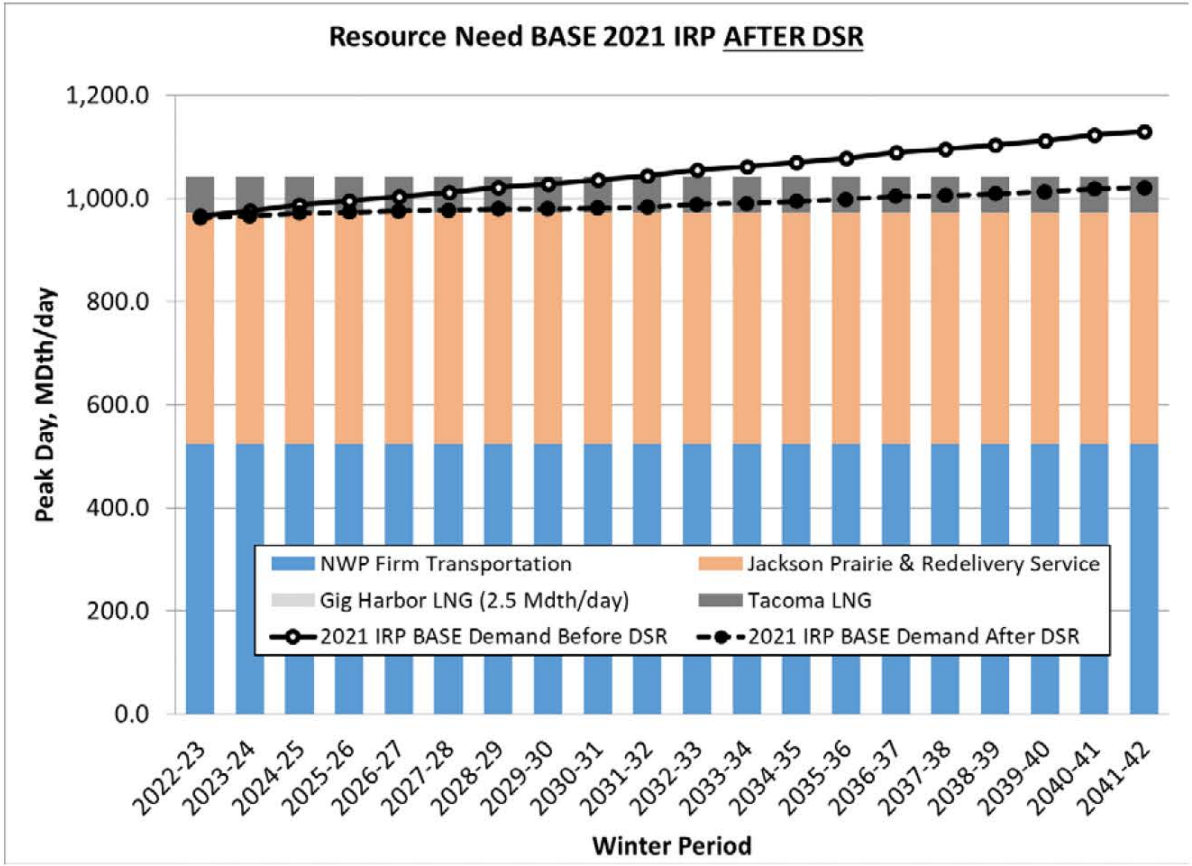
Draft base scenario – DSR sufficient to meet future demand



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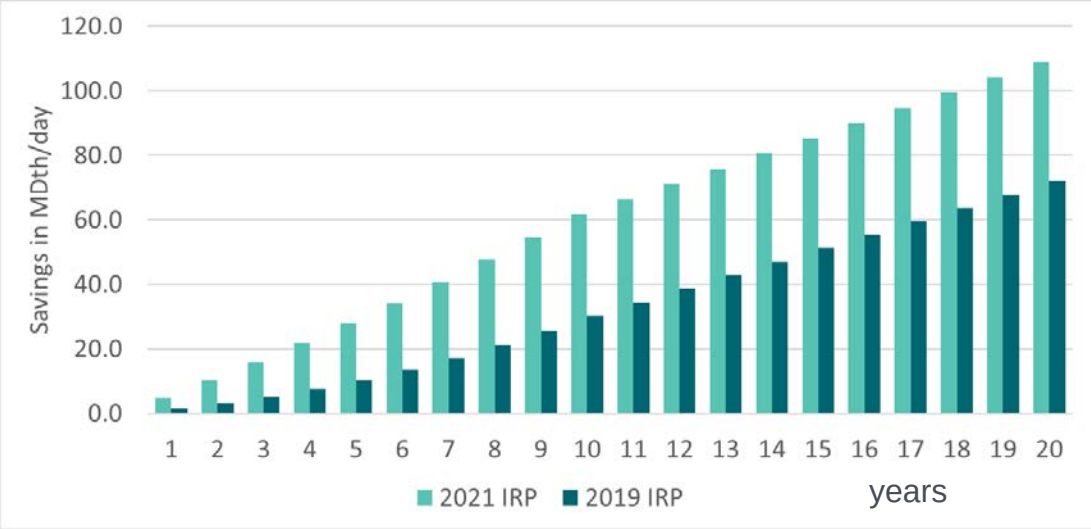
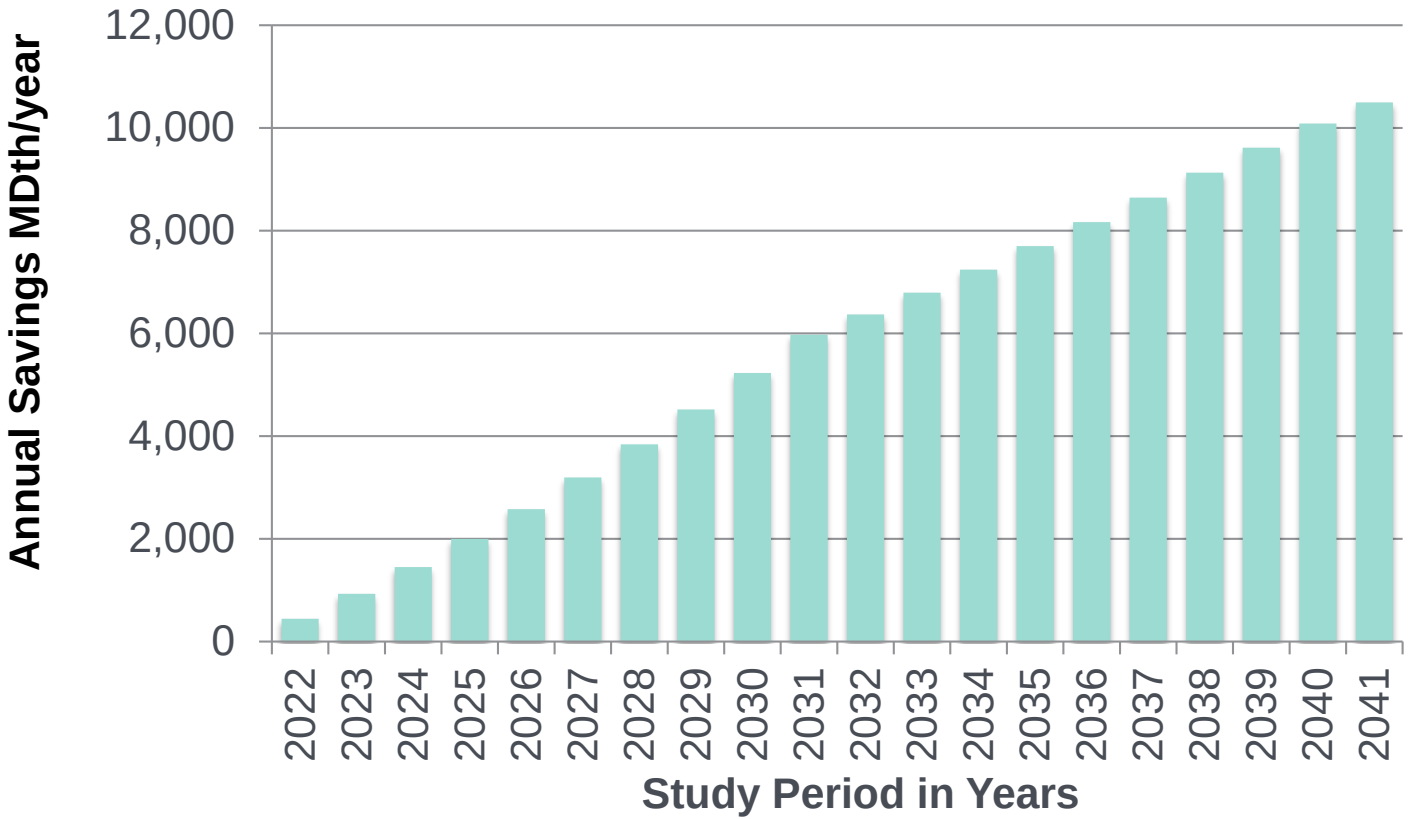
Draft base scenario – Cost effective DSR peak day capacity

Bundles	Base	Bundle
Residential Firm	9	$0.85 to $0.95
Commercial Firm	9	$0.85 to $0.95
Commercial Interruptible	6	$0.55 to $0.62
Industrial Firm	9	$0.85 to $0.95
Industrial Interruptible	9	$0.85 to $0.95



- Similar cost point bundle selected as 2019 IRP process result, but higher than 2017 IRP
- Higher savings due to shift of non-cost effective measures into lower cost bundles & higher gas cost

Draft base scenario – Cost effective DSR energy



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Natural Gas Peak Day Planning Standard

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Participation Objectives

- PSE will inform stakeholders of its natural gas peak day planning standard in the 2021 IRP analysis

IAP2 level of participation: INFORM

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Natural gas peak day planning standard overview

- Background: PSE's gas planning standard
- Methodology for developing the standard
- Update with more recent temperature data
- Comparison with other gas utility planning standards

Background: peak day planning standard

- Gas utilities typically define a design peak planning standard in terms of firm load at a target Heating Degree Day (HDD)
- The target HDD is derived from an Average Daily Temperature using the following relationship:

  HDD = 65 - Average Daily Temperature

  where 65 deg. F is the HDD base temperature

- Example: if average daily temperature = 13º
  Then, planning standard = 65 – 13 = 52 HDD

PSE's Design Peak Day Planning Standard

Methodology

2005 IRP (LCP): PSE's performed a benefit/cost analysis to establish the temperature threshold for the design peak day planning standard

Benefits: Primarily avoided cost of lost load - relighting cost and customer value of reliability

Cost: Portfolio cost associated with higher planning standards

Reliability of gas service is very important

- Service must be manually restored to firm customers
- If PSE lost 10% of its firm customers, it could take 15-20 days to get service fully restored in a safe manner.

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Estimating the Value of Reliability

Begin with a planning standard; e.g., 50 HDD (15^{o} F)
What if temperature is colder, such as 51 HDD (14^{o} F)?

- Estimate how many customers lost based on volume lost
- Estimate how many days to restore service
- Multiply number of customers out, per day, by value of lost load
- Multiply by likelihood of experiencing the colder temperature

= Probability weighted value of lost load

Repeat for 51 HDD to 52 HDD, etc., through 55 HDD

Results from benefit/cost analysis

Exhibit I-4
Incremental Benefits and Costs of Reliability

Planning Standard	Incremental Benefit	Incremental Cost	Benefit/Cost Ratio
48 HDD (17° F)	$ 5,195,876	$238,645	21.8
49 HDD (16° F)	$ 3,332,322	$260,798	12.8
50 HDD (15° F)	$ 2,026,693	$423,036	4.8
51 HDD (14° F)	$ 1,169,251	$209,789	5.6
52 HDD (13° F)	$ 535,076	$455,153	1.2
53 HDD (12° F)	$ 145,373	$1,684,778	0.1
54 HDD (11° F)	$ -	$2,531,502	-
55 HDD (10° F)	$ -	$2,831,158	-

Source: PSE's 2005 Least Cost Plan

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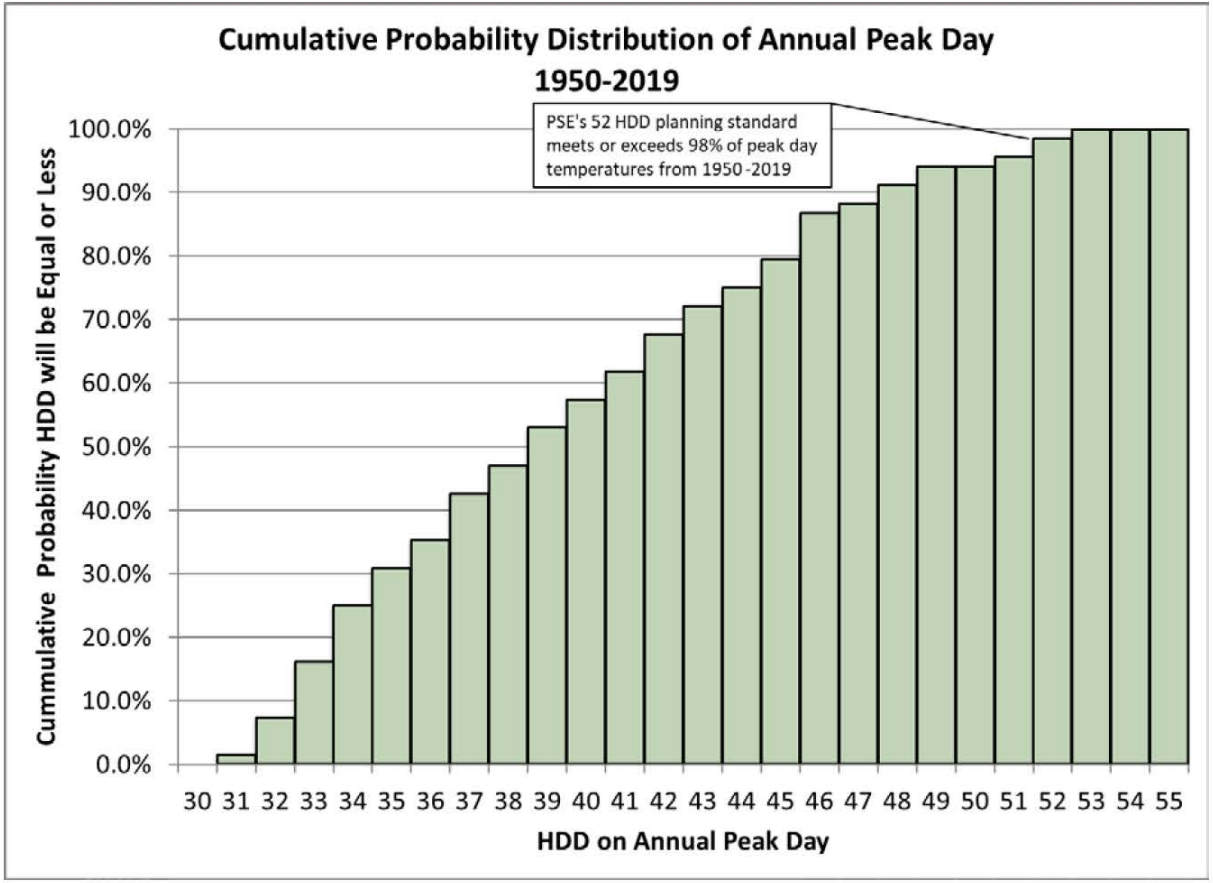
Implied temperature criteria



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Pacific NW gas utility peak day planning standards

PNW Gas Utility	Peak Capacity Design Standard
NW Natural	NW Natural will plan to serve the highest firm sales demand day in any year with 99% certainty: 99th percentile of annual peak days over last 100 years.
Cascade Natural	Coldest day during the past 30 years.
Avista Corp	Adjust the middle day of the five-day cold weather event to the coldest temperature on record for a service territory, as well as adjusting the two days on either side of the coldest day to temperatures slightly warmer than the coldest day.
Fortis NG	1 in 20 years temperature based on annual peak days over last 60 years.
PSE	98th percentile of annual peaks days from 1950-2019

5-minute break

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Natural Gas Scenarios and Sensitivities

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Participation Objectives

- PSE will present possible scenarios or sensitivities for the gas analysis.
- Stakeholders to share input on possible scenarios or sensitivities around for the gas analysis

IAP2 level of participation: INVOLVE

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Stakeholder involvement

- PSE requested stakeholder involvement at the August 11 webinar to help create the list of portfolio sensitivities.
- PSE is now asking for stakeholders to help to prioritize the analysis.
- PSE will make best efforts to complete all the requested analysis, however some analysis may take longer than others to complete and it is possible that not everything can be finished to meet the IRP filing date.
  - PSE will start modeling with the highest priority items.

Stakeholder involvement

- The list of sensitivities is the current thinking and includes sensitivities identified so far.
- The list of sensitivities will be finalized after stakeholder involvement is incorporated.
- Multiple sensitivities will be modelled for most themes.
- Details are included in the spreadsheet and on following slides.

Stakeholder requested natural gas portfolio sensitivities

	Theme	Description	Corresponding number in spreadsheet
1.	Economic conditions	Low Demand with very high gas price	4
2.	Economic conditions	Low demand with mid gas price	6
3.	Conservation	6-yr ramp rate	14
4.	Conservation	8-yr ramp rate	15
5.	Conservation	Non-energy impacts (NEI)	16
6.	Conservation	Social discount rate	17
7.	CO_2 Regulation	High impact SCGHG	18
8.	CO_2 Regulation	CO_2 tax	22
9.	CO_2 Regulation	Use AR5 to model upstream emissions	21
10.	Demand Adjustments	Fuel switching from gas to electric	30
11.	Demand Adjustments	Fuel switching from electric to gas	33
12.	Demand Adjustments	Temperature Sensitivity	31
13.	Equity	Equity focused portfolio	45

Renewable Natural Gas Background and PSE Status

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PSE has and will continue to pursue direct carbon reduction

- **Continued energy efficiency investments**
  - PSE is incorporating Social Cost of GHG emissions in portfolio selection
  - Results to be determined through 2021 IRP
- **Renewable Natural Gas**
  - Klickitat landfill supply: ~ 2% of 2019 gas sales
  - Additional sources available
- **Voluntary Carbon Balance program for gas customers**
  - Current enrollment 14,500 customers and approx. doubling annually
- **Hydrogen**
  - Founding member Renewable Hydrogen Alliance
  - Tracking other development activities in the region
- **Leak reduction**
  - Includes enhanced repair and reporting requirements

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Overview

State Legislation:
WA passed HB 1257 in 2019; bill promotes additional Renewable Natural Gas (RNG) supply

- Voluntary customer program:
  - PSE obligated to offer by tariff a voluntary RNG service available to all customers to replace any portion of natural gas otherwise provided
- Integration into core portfolio:
  - PSE is allowed to incorporate RNG for portion of natural gas sold/delivered to retail customers
  - Subject to commission review and approval
  - Program cost capped at 5% of amount charged to retail natural gas customers

Background on RNG

What is Renewable Natural Gas?

- Primarily methane blend from decomposition of organic materials as byproduct of waste disposal (e.g. waste water treatment facilities, landfills, dairy waste, etc.)
- RNG is functionally no different for delivery and usage than conventional natural gas
- Majority of RNG produced in WA is supplied as a vehicle fuel to CA to satisfy Low Carbon Fuel Standard (LCFS) and EPA Renewable Fuel Standard for refineries.

Environmental Benefits of RNG:

- On a life-cycle basis, RNG total emissions are significantly lower than those of natural gas
  - Methane is captured and refined, from otherwise decomposing organic waste and then combusted, yielding a much lower emissions profile

Drawbacks of RNG:

- High cost of connection, production, and gas scrubbing to pipeline specifications.
- Dependent on source, carbon reduction cost = $40-250 (average $144) per Mega Ton (MT) CO_2e
- Relative value driven by lucrative Calif. compliance market (LCFS and EPA-RFS2)
- Limited supply
  - WA consumed 300 (Billion Cubic Feet) (BCF) of natural gas in 2015
  - PSE estimates available feedstock supplies could replace ~3-5% of usage

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RNG has lower carbon intensity than natural gas

- Carbon intensity (CI) is measured in grams of carbon dioxide (CO_2) equivalent greenhouse gas (GHG) per Mega Joule (MJ)
- Considers CO_2, methane, nitrous oxide, Volatile Organic Compounds (VOCs) and carbon monoxide
- CI of RNG measured relative to "No Action"- examples:
  - If No Action, Dairy Waste (manure) is left in field and emits GHG to atmosphere
  - If No Action, by law, Landfill Gas would be collected and flared (converted to CO_2)

Global Warming Potentials of Greenhouse Gases: relative to CO2	
CO2	1
CH4	25
N2O	298
VOC	3.1
CO	1.6

	gCO2e/MJ					
RNG Carbon Intensity (generic resources)	**Nat.Gas BC/Rockies (65/35)**	**Dairy Waste**	**Food Waste**	**Green Waste**	**Landfill Gas**	**Waste Water TP**
Source - Supply (upstream)	13.8	-321.9	-112.2	-64.2	-34.2	-17.9
Use - Demand (boiler/furnace)	56.4	56.4	56.4	56.4	56.4	56.4
Total Carbon Intensity	**70.1**	**-265.5**	**-55.8**	**-7.9**	**22.2**	**38.5**
GHG Reduction						
gCO2e/MJ		**-335.6**	**-125.9**	**-78.0**	**-48.0**	**-31.6**
Natural Gas Offsets						
(one unit of RNG offsets __units of Nat Gas)		**4.8**	**1.8**	**1.1**	**0.7**	**0.5**

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RNG potential in the Northwest

Major RNG Projects in Washington:

Project	Location	Plant Owner	COD	Purchaser	Market served	Dth / Yr.
Cedar Hills Landfill	Maple Valley, W.	Bio-Energy WA	2009	PSE	CA vehicle	1,600,000
Roosevelt Landfill	Roosevelt, WA	Klickitat PUD	2018	PSE	PSE system (1)	1,700,000
King County Wastewater	Renton, WA	King County	@1990	BP	CA vehicle (2)	250,000
City of Tacoma Wastewater	Tacoma, WA	City of Tacoma	2020	BP	CA vehicle	220,000

(1) 2/3 of volumes serve CA vehicle market through 2023, via BP
(2) PSE gas supply until @ 2018

Dth = decatherm; 10 therms or 1.055 GJ

MDth = thousand decatherms

BP = British Petroleum

Dth/d = decathem/day

Prospects:

PSE has identified approximately 15 other projects in WA and OR that may be economically feasible.

- Many small dairy-waste projects currently supply green power to PSE,
  - most wish to convert to making RNG,
  - all would require major investments to upgrade processing
  - most require expensive connection to pipelines
- PSE currently controls 2,200 MDth/yr, growing to 3,300 MDth/yr in 2024
- PSE identified prospects to provide an additional 3,700 MDth/yr for a total of approx. 5-6% of PSE natural gas deliveries per year.

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PSE's RFP for RNG supply

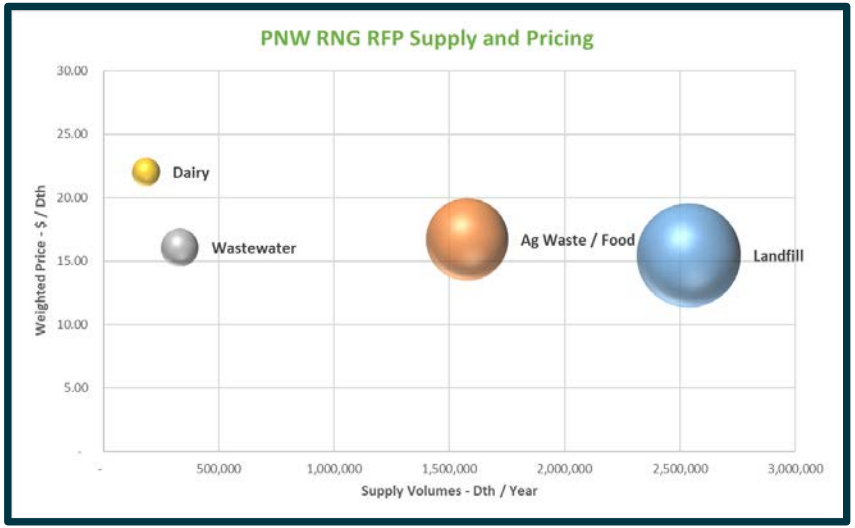
- In response to HB 1257, (effective in July, 2019) PSE issued a RFP to determine availability and pricing of RNG - targeted 20+ suppliers in November 2019
- PSE received 19 diverse responses, from CA, MI, OH, TX, and PNW

PNW Supply

- Price range: $15-27/Dth
- Volume: ~4,600 MDth/yr
  - Available today: ~550 *MDth/yr*
  - Most volume projected to be available by 2022

Other Supply

- Price range: $12-18/Dth
- Volume: ~2,900 MDth/yr
  - Available today: ~1,000 MDth/yr
  - Another ~550 MDth/yr available end-2020



- PSE Annual LDC sales + transport **deliveries** in **2018** exceeded **114,000 MDth**
- PSE Annual gas **demand** for electricity varies, but falls **between 20-40,000 MDth**

PUGET SOUND ENERGY

PSE's RNG acquisition

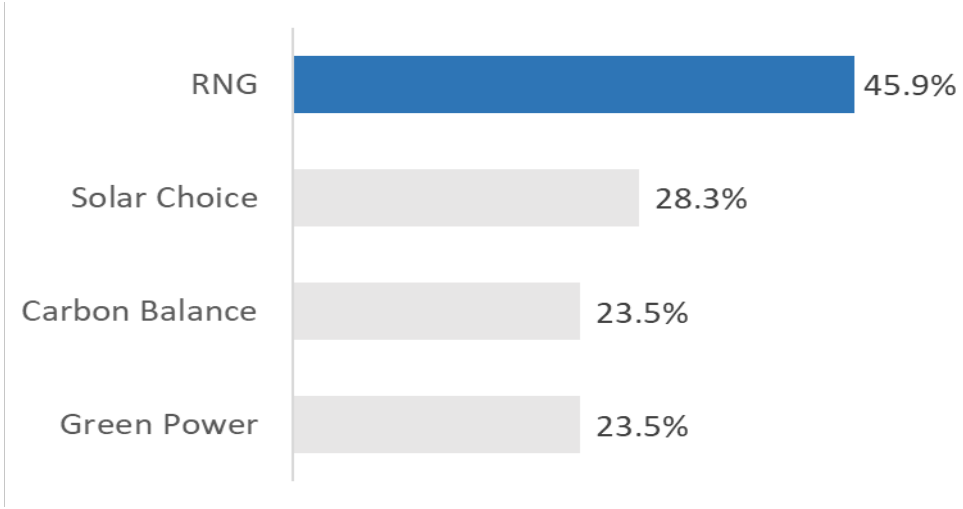
Roosevelt Landfill RNG

- **Location**: Roosevelt, WA along Columbia River
- **Project Ownership**: PUD No. 1 of Klickitat County (KPUD)
- **Gas Rights**: County owns landfill gas rights; assigned to KPUD in perpetuity
- **Landfill Ownership**: Republic Services (RS); supply optimization agreement exists between RS and KPUD
- **Contract:**
  - 20 year deal starting July 1, 2020
  - Fixed Price for term
  - Approx. 1,500 Dth/d until Oct 31, 2023 then full output of 4,500 + Dth/d
  - Unit contingent, with protection
- **Benefits:**
  - lowest reasonable cost RNG supply
  - Low risk- project fully operational
  - Already connected to pipeline-PSE can use its existing capacity
  - Low CI landfill RNG supply

Customer interest in subscription product

- Existing clean products gas participants (n=880) reported that they were likely to participate in voluntary RNG program, with about a third saying they would definitely participate and about half saying they would probably participate
- General customers reported that they were very interested in participating in a program like the subscription-style voluntary RNG program.

Survey question: If this RNG program was offered by Puget Sound Energy, how interested would you be in participating?



Next steps for PSE RNG program

- Continue development of customer RNG programs
- Continue development of regulatory rules with WUTC and stakeholders
- File with WUTC for approval of customer programs
- Implement customer programs
- Continue long-term planning, including assessment of potential use of RNG for generation under CETA

Questions & Answers

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Tools for public participation

To keep you informed...

- Website postings
- Email notifications
- Briefings
- Feedback Reports
- Consultation Updates
- E-Newsletters
- Topical fact sheets

To seek your thoughts, ideas, concerns...

- Stakeholder interviews - *completed*
- Feedback webinars - *seven completed*
- Feedback reports - *seven completed*

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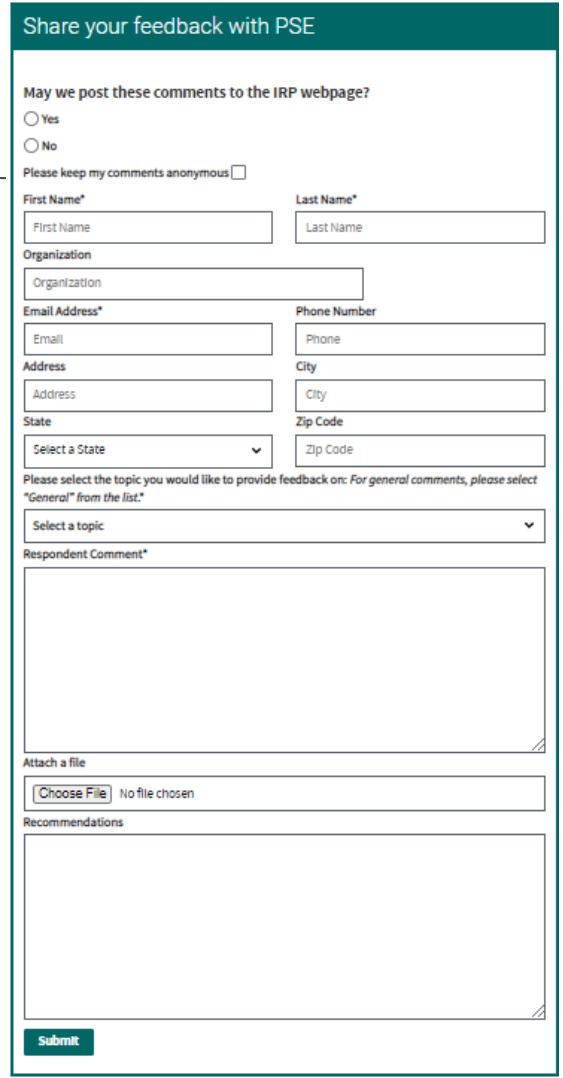
Feedback Form

- An important way to share your input
- Available on the website 24/7
- Comments, questions and data can be submitted throughout the year, but timely feedback supports the technical process
- Please submit your Feedback Form <u>within a week of the meeting topic</u>



Feedback Form → **Feedback Report** → **Consultation Update**

This session is being recorded by Puget Sound Energy. Third-party recording is not permitted.

Feedback Form

- An important way to share your input
- Available on the website 24/7
- Comments, questions and data can be submitted throughout the year, but timely feedback supports the technical process
- Please submit your Feedback Form within a week of the meeting topic

Feedback Form → **Feedback Report** → **Consultation Update**

Feedback cycle

Action	Timing
Stakeholders can submit questions and feedback via the Feedback Form.	**Anytime, 24/7 online access**
PSE will share the meeting agenda, presentation slides and any supporting materials on the website.	**One week before each meeting**
A recording of the webinar and the transcript of the chat will be posted to the website so those who were unable to attend can review.	**One day after each meeting**
Feedback Forms related to the specific meeting topic are due.	**One week after each meeting**
A Feedback Report of all comments collected from the Feedback Form, along with PSE's responses, will be shared with stakeholders via the website.	**Two weeks after each meeting**
A Consultation Update, where PSE demonstrates how stakeholder feedback was applied, will be posted to the website.	**Three weeks after each meeting**

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Thank you for your participation in PSE's 2021 IRP!

- To date, 145 unique individuals have participated in webinars
- Over 1,900 unique individual website users since May 2020
- 1,441 total audience members are receiving IRP newsletters
- 130 Feedback Forms received for the first 7 webinars
- Average message open rate of 20% for all newsletters sent between May and August 2020

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Next steps

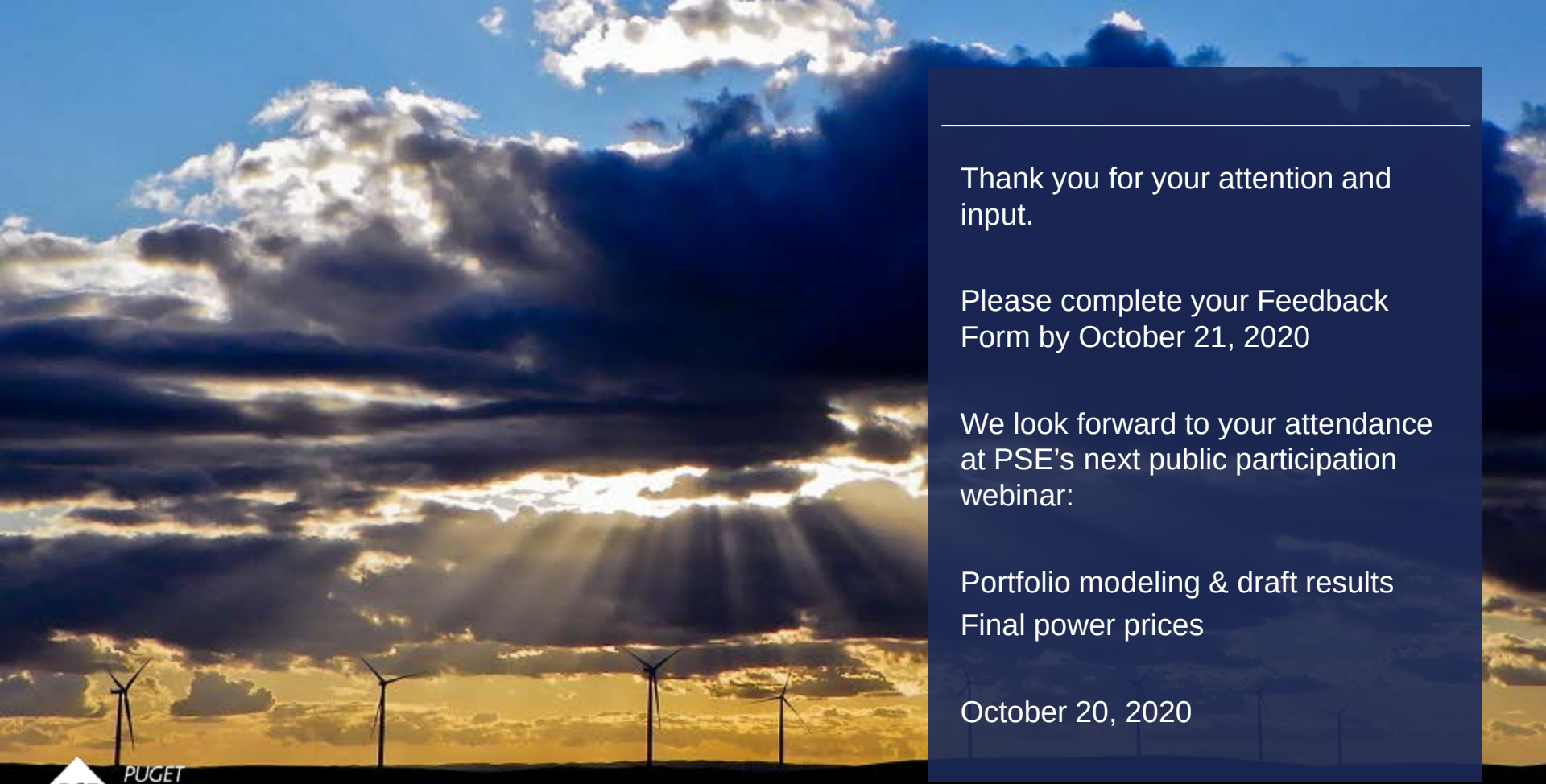
- Submit Feedback Form to PSE by **October 21, 2020**
- A recording and the chat from today's webinar will be posted to the website **tomorrow**
- PSE will compile all the feedback in the Feedback Report and post all the questions by **October 28, 2020**
- The Consultation Update will be shared on **November 4, 2020**

Details of upcoming meetings can be found at pse.com/irp

Date	Topic
October 20, 1:00 – 4:30 pm	Portfolio modeling and draft results Final power prices
November 4, 1:00 – 4:30 pm	Clean Energy Action Plan 10-year Distribution & Transmission Plan
December 9, 1:00 – 4:30 pm	Portfolio draft results Flexibility analysis Wholesale market risk

Note:

2021 IRP webinars schedule will be released in November 2020



Thank you for your attention and input.

Please complete your Feedback Form by October 21, 2020

We look forward to your attendance at PSE's next public participation webinar:

Portfolio modeling & draft results
Final power prices

October 20, 2020

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Appendix

Resource alternatives – Pipeline costs

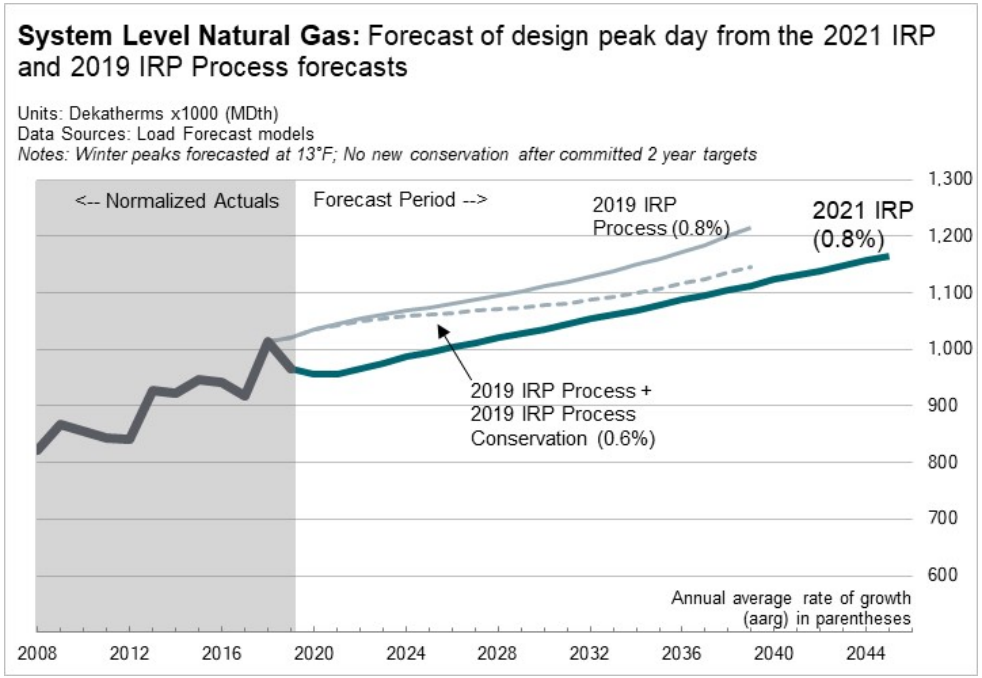
	Alternative	From/To	Capacity Demand ($/Dth/Day)	Variable Commodity ($/Dth)	Fuel Use (%)	Earliest Available	Comments
1	Westcoast + NWP Expansions	Station 2 to PSE	0.52 + 0.56	0.05 + 0.09	1.6 + 1.5	Nov. 2025	Westcoast expansion coupled with NWP expansion
1a	Short Term NWP TF-1	Sumas to PSE	0.38	0.09	1.5	Nov. 2021	Potential available from PSE Power Book, possible from 3rd parties
2	Fortis BC / Westcoast (KORP) + NWP Expansions	Kingsgate to PSE via Sumas	0.42 + 0.56	0.05 + 0.09	1.6 + 1.5	Nov. 2025	Prospective projects & estimated project cost - requires NGTL and Foothills
3	NGTL (Nova) Pipeline	AECO to Alberta / BC border	0.16	0	0	Nov. 2025	Prospective projects & estimated project cost - requires Foothills and GTN
3	Foothills Pipeline	Alberta / BC Border	0.12	0	1	Nov. 2025	Prospective projects & estimated project cost - requires NGTL and GTN
3	GTN Pipeline	Kingsgate to Stanfield	0.20	0.044	1.4	Nov. 2025	Prospective projects & estimated project cost - requires NGTL and Foothills.
3	NWP Columbia Gorge	Stanfield to PSE	0.80	0.005	2	Nov. 2025	Prospective project & estimated project cost - requires NGTL/Foothills/GTN.
4	Incremental NWP - Backhaul	I-5 to PSE	0.28	0.09	1.5	Nov. 2025	capacity resulting from NWP Sumas South Expansion; Demand Charge Winter Only rate requires Mist Storage
5	Long Term NWP TF-1	Plymouth to PSE	0.38	0.09	1.5	Apr. 2023	Maximum 15 MDth/d, available from 3rd Parties effective Apr. 2023
6	Tacoma LNG Distribution Upgrade	Tacoma LNG to PSE	0.23	0	0	Nov. 2025	Upgrade of the distribution system to connect the LNG plant to additional area of the PSE system

Resource alternatives – Storage costs

	Alternative	Storage Capacity (MDth)	Maximum Withdrawal Capacity (MDth/day)	Days of Full Withdrawal (days)	Max. Injection Capacity (MDth/day)	Earliest Available	Comments
4	Mist Expansion	1000	50	20	20	Nov. 2025	Prospective project, estimated size and costs, confidential- requires NWP backhaul capacity
5	Plymouth LNG	241.7	15	16	-	Apr. 2023	Existing plant - requires LT firm NWP capacity
7	Swarr	90	30	3	-	Nov. 2024	Existing plant requiring upgrades- on-system, no pipeline required

Webinar #7: Natural Gas: Peak demand forecast [System Level]

- 2021 IRP peak down 7% compared to 2019 IRP process forecast.
- Lower peak demand:
  - Lower residential customer and UPC growth.
  - Incorporating recent cold winters.
  - COVID-19 slows initial growth.
  - 2020/2021 conservation targets.
- Long term growth drivers:
  - New customer growth.
- The 2021 IRP peak forecast after DSR will be available once final DSR determined by the 2021 IRP process.



Webinar #5: Published emission rates

Natural Gas Supply Chain Upstream Life Cycle Emission Rates

Supply Chain Segment		GHGenius (Baseline Sensitivity), g/MMBtu				GREET (Upper Sensitivity), g/MMBtu			
		Carbon Dioxide	*Methane*	*Nitrous Oxide*	*Carbon Dioxide Equivalent*	*Carbon Dioxide*	*Methane*	*Nitrous Oxide*	*Carbon Dioxide Equivalent*
Natural Gas Extraction	**Extraction**	2,303.16	25.05	0.110	2,962.2	2,153.87	8.04	0.019	2,360.5
Extraction Fugitive		2.69	115.53	0.000	2,890.9	0.00	137.87	0.000	3,446.6
Natural Gas Processing	**Processing**	2,325.46	10.35	0.040	2,596.1	1,665.98	5.94	0.013	1,818.3
Processing Fugitive		1,101.04	0.00	0.000	1,101.0	702.06	6.17	0.000	856.3
Transmission - Distribution	**Transport & Storage**	1,192.80	2.29	0.009	1,252.8	1,650.74	63.04	1.385	3,639.4
Total		6,925.14	153.21	0.160	**10,803.0**	6,172.66	221.05	1.417	**12,121.1**

Source: Puget Sound Clean Air Agency, Final Supplemental Environmental Impact Statement (March 29, 2019)

Upstream Emission Rate - Sum of All Segments Expressed in CO2equivalent (CO2e)