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January 7, 2021

MEMORANDUM

TO: Council Members

FROM: Steven Simmons

SUBJECT: H.W. Hill Renewable Gas Facility

BACKGROUND:

Presenter: Bill Donahue, Manager of Natural Gas Resources at Puget Sound Energy, and Kevin Ricks, Renewable Energy Asset Manager at Klickitat PUD

Summary: Renewable natural gas (RNG) projects capture and convert waste streams into pipeline-ready natural gas that can be used to heat homes, power engines, and generate electricity. RNG can provide a number of beneficial results for the region, including the reduction of vented or flared waste gas emissions, offset dependence on imported fossil fuel, and provide a stable, local source of energy.

In 2018, Klickitat PUD opened the H.W. Hill Renewable Gas Facility at the Roosevelt Regional Landfill site in Klickitat County WA. The landfill site is ideally situated near the Williams NW Pipeline. This year, Puget Sound Energy entered into an agreement with Klickitat to purchase RNG produced at the facility and place on their system through 2040.

Relevance: The 2021 Power Plan will be first plan to incorporate renewable natural gas (RNG) into the planning process. We are modeling a “blended” natural gas supply as part of the power plan forecast. This “blend” reflects the impact of regional RNG supply entering the existing natural gas pipeline system and displacing conventionally sourced fossil natural gas that is currently imported from Canada and the US Rockies.

Workplan: A.4. Forecasting and Economic Analyses

**KLICKITAT PUD
RENEWABLE ENERGY PROJECTS AT
THE REPUBLIC SERVICES
ROOSEVELT REGIONAL LANDFILL**



Republic Services

Roosevelt Regional Landfill

- Accepted first load of waste in 1990
- Approx. 60 million tons of waste in place
- Permitted for 245 million tons, 75 year life at current fill rate of 2.5MM tons/year
- Serves 5 Western states and B.C. Canada
- Designed from day 1 to incorporate landfill gas collection and energy production

- 175 Full time employees
- 2 trains per day
- 300 containers per day
- Ideal hydrogeology with 300' of low permeability of Selah Clay and 1500' separation from groundwater
- All natural materials required for operation on site
- Fully double-lined facility
- Self contained leachate system to reduce waste and enhance gas production
- Active wheat farm operation on site



KPUD H.W. Hill Landfill Gas Projects

LFG 1

- 10.5 MW Reciprocating Engine Plant consisting of 5, 2.1 MW 12 cylinder Engines (idled)

LFG2 (Expansion Project)

- 26 MW Combined Cycle Gas Turbine/Steam Turbines
 - Advanced Gas Cleaning and Compression System
- ### Renewable Natural Gas Project (RNG)
- Re-utilize existing cleaning and compression systems
 - Adds CO₂, O₂, and N₂ removal plus compression

Future

- Re-purpose Combustion Turbines into Capacity Service



Landfill Gas Phase 2 Combined-Cycle Electric Generation Facility

the real 'Notting Hill'

SCENE, F 1

NIGHT FINAL

Dow closes down 143.74

STORY, E 1; TABLES, E 4

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TUESDAY

JUNE 8, 1999

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A heap of power from trash



Peace deal gets a boost

NATO overcomes Russian resistance

SEATTLE TIMES NEWS SERVICES

COLOGNE, Germany — Breaking a diplomatic logjam, representatives from eight countries agreed today on terms of a U.N. Security Council resolution authorizing a NATO-based peacekeeping force for Kosovo, the United States said.

Foreign ministers who had been wrestling with a proposed resolution to endorse settlement terms accepted last week by Yugoslav President Slobodan Milosevic apparently overcame the resistance of the Russian delegation, which had balked at NATO control over the peacekeepers.

"We got what we came for," Secretary of State Madeleine Albright said.

PLEASE SEE *Balkans* ON A 11

June 8, 1999: We've been making renewable energy for a long time!

Phase 1

Reciprocation Engine Plant (1999-2010)

- 70,000 mw-hr/year, 8 average mw over an 11 year run
- No loss time accidents
- High energy prices, as high as \$68/mw-hr.

Combined Cycle Turbine Project (2010-2018)

- Combined Cycle: Recovers waste heat from the combustion turbines to generate an additional 6 mega-watts of power in a steam turbine!
- One of the largest LFGTE projects anywhere
- 90% + reliability!
- Nearly 100% beneficial use of landfill gas collected.
- Dramatically lower emissions than reciprocating engines, making the power more valuable

Renewable Natural Gas (RNG)

- Makes pipeline specification Natural Gas for use as a transportation fuel under federal and state programs
- Up to 18 million + gallons/year (gasoline equivalent)
- RNG has one of the lowest “well-wheel” carbon emission ratings, on par with even EVs!
- > 60% reduction in CO₂ emissions when used to displace conventional diesel fuel.
- Incorporates first-on-landfill technology, Cryogenic N₂ Removal!
- Technology selected saves up to 18,000 mega-watt hours/year!



Aerial view of H.W. Hill Renewable Natural Gas Plant

Partnerships

- The Klickitat PUD H.W. Hill Renewable Natural Gas Project is the result of a unique partnership with Klickitat County, Klickitat PUD and Republic Services Roosevelt Regional Landfill.
- As part of the permitting process, Klickitat County retained the gas rights for the methane gas produced by the landfill. Klickitat County then deeded those rights to Klickitat PUD to generate renewable energy.
- Additionally, Klickitat PUD has landfill gas optimization agreements with Republic Services whereby Republic Services and Klickitat PUD work collaboratively to maximize the amount of gas harvested.

Partnerships (continued)

- Off-takers: In May 2017, the Klickitat PUD signed a 15 year off-take agreement that made the project possible.
- In May 2020, the Klickitat PUD signed a 20 year agreement with Puget Sound Energy that brings renewable natural gas home to the State of Washington and PSE Customers.

Unique Production Processes

- Pipeline natural gas that is used in homes and business to cook, heat and generate electricity is composed primarily of methane, known molecularly as CH_4 .
- Landfill gas is generated in the landfill by anaerobic (without oxygen) decomposition of organic (plant and animal) material. The by-product of this decomposition is CH_4 and CO_2 .
- Naturally occurring, sulfur-reducing bacteria that is widely found in our environment also produce trace amounts of H_2S (hydrogen sulfide). To collect the gas that is produced in the landfill, a vacuum is applied through a network of nearly 300 wells resulting in an intrusion of atmospheric air (N_2 and O_2) into the gas stream.
- The combination of all of these results in landfill gas that is 53% methane, 36% CO_2 , 7% N_2 , 3.5% H_2O and 0.5% O_2 (with trace amounts of H_2S).

Unique Production Processes (cont)

- The H.W. Hill project removes water, H₂S, CO₂, O₂ and N₂ (in that order) and produces pipeline gas that is over 98% pure CH₄, exceeding pipeline gas quality standards.
- The H.W. Hill project also utilizes unique technology for use on landfill: Cryogenic Nitrogen Removal.
- Lastly, the gas is cooled to -280F liquefying the CH₄, causing the N₂ to separate from the CH₄. This process results in reduced electrical load of the facility and saves up to 18 million kilowatt hours of electricity per year!

Gas Quality Comparison

	Inlet LFG	Pipeline Sales
Methane	52%	98%
CO ₂	37.8%	ND
Oxygen	0.2%	ND
Nitrogen	10%	2%
Water	Saturated	non-detectable
Flow	8000 SCFM	3994 SCFM



Nitrogen Removal Unit (NRU)
Tower
107' Tall!

Summary

H.W. Hill RNG project is the result of over 30 years of planning, collaboration and support from Klickitat County and Klickitat PUD commissioners and customers, Klickitat County State Legislators, and the State of Washington. Project produces pipeline quality natural gas that is completely interchangeable with conventional natural gas. PSE partnership ensures locally produced RNG has a home in the state for at least a generation!



H.W. Hill Landfill Gas RNG Project

Renewable Natural Gas

January 13, 2021



Bill Donahue

Manager, Natural Gas Resources

Agenda

- RNG overview
- Types of RNG and carbon intensity
- RNG in the Northwest
- PSE's RNG supply
- Voluntary product development
- Next steps
- Q&A

Why is PSE interested in RNG?

Incorporation of RNG into the gas system is the most effective method for reducing the environmental impact of gas use, And customers are interested.....And, it's the right thing to do.

State Legislation

WA passed HB 1257 in 2019; bill promoting additional RNG supply- input from several utilities

- **Voluntary Customer Program:**
 - PSE and other gas utilities are obligated to offer a voluntary RNG supply - available to all customers to replace any portion of NG otherwise provided
- **Integration into Core Portfolio:**
 - PSE and other utilities are allowed to include RNG as a part of gas supply for retail customers in PGA
 - Subject to commission review and approval
 - Program cost capped at 5% of amount charged to retail NG customers

Additional fossil fuel legislation is probable for further consideration in Olympia

WUTC Policy Statement

Issued December 2020, provides guidelines for implementing compliance with HB 1257

- received input from utilities and others
- appears consistent with utility expectations

What is RNG ?

- RNG results from the decomposition of organic materials as byproduct of waste disposal (e.g. waste water treatment facilities, landfills, dairy waste, etc.)- then processed to pipeline quality
- RNG is functionally no different for delivery and usage than conventional NG
- Majority of RNG produced in WA is supplied as a vehicle fuel to CA to satisfy Low Carbon Fuel Standard 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 NG
 - Methane is captured and refined, from otherwise decomposing organic waste

Drawbacks of RNG:

- High cost of production, gas scrubbing to pipeline specifications and connection to pipeline.
- Dependent on source, carbon reduction cost = \$40-250 (average \$144) per MT CO₂e
- Relative value driven by lucrative CA compliance market (LCFS and RFS)
- Limited supply
 - WA consumes 300+ BCF of NG per year
 - PSE estimates available feedstock supplies could replace ~3-5% of WA usage

Carbon Intensity considers impact of end-use and “upstream”

- Measured in CO₂ equivalents (CO₂e) in grams per mega-joule
- Based on standardized calculations in “GREET” model using “AR-4, 100 year” values (current state/federal and international standard)
- Methane impact is 25 times CO₂ -thus methane leakage has big impact

All sources consider:

- Localized electric grid fuel mix
- source to use distance

Natural Gas considers:

- production, processing and pipeline transportation - fuel use, energy consumed, and leaks
- source location production area leakage data and pipeline mileage and fuel & loss factors

Global Warming Potentials of Greenhouse Gases relative to CO₂ (AR-4, 100 yr.)	
CO₂	1
CH₄	25
N₂O	298
VOC	3.1
CO	1.6

Carbon Intensity -continued

Dairy considers:

- Absent RNG, the waste evaporates as pure methane to atmosphere- no legal requirement otherwise
- Very low energy use to process to pipeline quality, due to fewer impurities
- Closed system minimizes nitrogen

Food/Green waste considers:

- more avoided methane release in Food than Green (plant) waste (but, both much less than dairy)
- Higher energy use to process/eliminate contamination

Landfill considers:

- Existing federal requirement to collect methane and convert to CO₂ (via flare), thus not as much benefit as other sources
- very high energy use to process to pipeline quality, due to variety of chemical impurities
- open system results in significant nitrogen to be removed

Wastewater considers:

- some existing federal requirements to collect methane and convert to CO₂
- very high energy use to process to pipeline quality, due to high liquid content and variety of chemical impurities (including siloxanes)

RNG has lower carbon intensity, but source matters

Carbon Intensity (gCO ₂ e/MJ)	Specific	Generic				Specific
	Natural Gas: 65/35%, BC/Rockies	Anerobic Digester: Dairy Waste	Anerobic Digester: 40/60% Food/Green Waste	Anerobic Digestion: Landfill Gas	Anerobic Digester: Waste-water Treatment	Anerobic Digestion: HW Hill Project (tentative)
Source/Supply/"upstream"	13.8	(321.9)	(82.7)	(34.2)	(17.9)	(40.9)
Use/Demand/furnace,boiler end use	56.4	56.4	56.4	56.4	56.4	56.4
Total Carbon Intensity	70.1	(265.5)	(26.3)	22.2	38.5	15.5
GHG reduction per MJ		(335.6)	(96.5)	(48.0)	(31.6)	(54.7)
1 unit of RNG offsets __ units of N.G.		4.8	1.4	0.7	0.5	0.8

RNG potential in the Northwest

Major RNG to pipeline quality gas Projects in Washington (current July 2020):

<u>Project</u>	<u>Location</u>	<u>Plant Owner</u>	<u>COD</u>	<u>Purchaser</u>	<u>Market served</u>	<u>Dth / Yr.</u>
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

Prospects:

- ❖ PSE has identified approximately 15 other projects in WA & OR that may be economically feasible.
 - several small dairy-waste projects currently supplying Green Power to PSE or others,
 - many small wastewater treatment projects, some potential landfill projects
 - all would require major investments to upgrade processing and build connection to pipelines.
- ❖ Identified PSE prospects could, if acquired by PSE, provide an additional 3,700,000 Dth/yr for a total of 7,000,000 Dth/yr or approx. 7 % of PSE natural gas system use per year.
- ❖ Additional projects - less economic (due to small volumes and remote locations) could provide another 5,000,000 to 7,000,000 Dth/yr or approx. 4 to 4.7% of WA gas usage.

PSE's RNG acquisition

Acquisition Process

- Researched potential projects, developers and representatives
- PSE issued an RFP for RNG to 20+ potential suppliers in November 2019
- PSE received a geographically diverse response set; projects were submitted from CA, MI, OH, TX, and PNW, with varieties of source and technology
- RFP timing gave PSE the first opportunity to lock-up desirable local/regional resources
- PSE selected most desirable project and began negotiations of details
- Sought and obtained final approval from Sr. Mgmt.

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 PUD in perpetuity
- **Landfill Ownership:** Republic Services (RS); optimization agreement exists between RS and KPUD
- **Contract:**
 - 20 year deal starting July 1, 2020
 - Fixed Price for term
 - 1,500 Dth/d until late 2023 then full output of 4,500++ Dth/d
 - Unit contingent, with protection
- **Benefits:**
 - Lowest reasonable cost RNG supply
 - Low risk- project fully operational and reputable counter-party
 - Already connected to pipeline- PSE can use its existing capacity
 - Very Low Carbon Intensity & Local

Voluntary RNG product overview



Challenge

A subset of PSE customers are concerned about the environmental impacts and carbon footprint of their natural gas usage. Additionally, a new Washington law requires that PSE offer a voluntary RNG program to all of its customers.

Solution

Voluntary RNG provides a way for customers to ensure that a portion of their natural gas consumption is replaced with a supply of local, renewable natural gas from projects in the Northwest. This product allows customer to reduce their carbon footprint from their natural gas usage.



Target customers

Residential and commercial customers who are concerned about the carbon emissions related to their gas usage.



Key benefits

Customer choice – Provide clean products options for customers, meet demand for a program that support local energy projects

Supplier benefit – Provide financial stability and consistent demand for local RNG suppliers

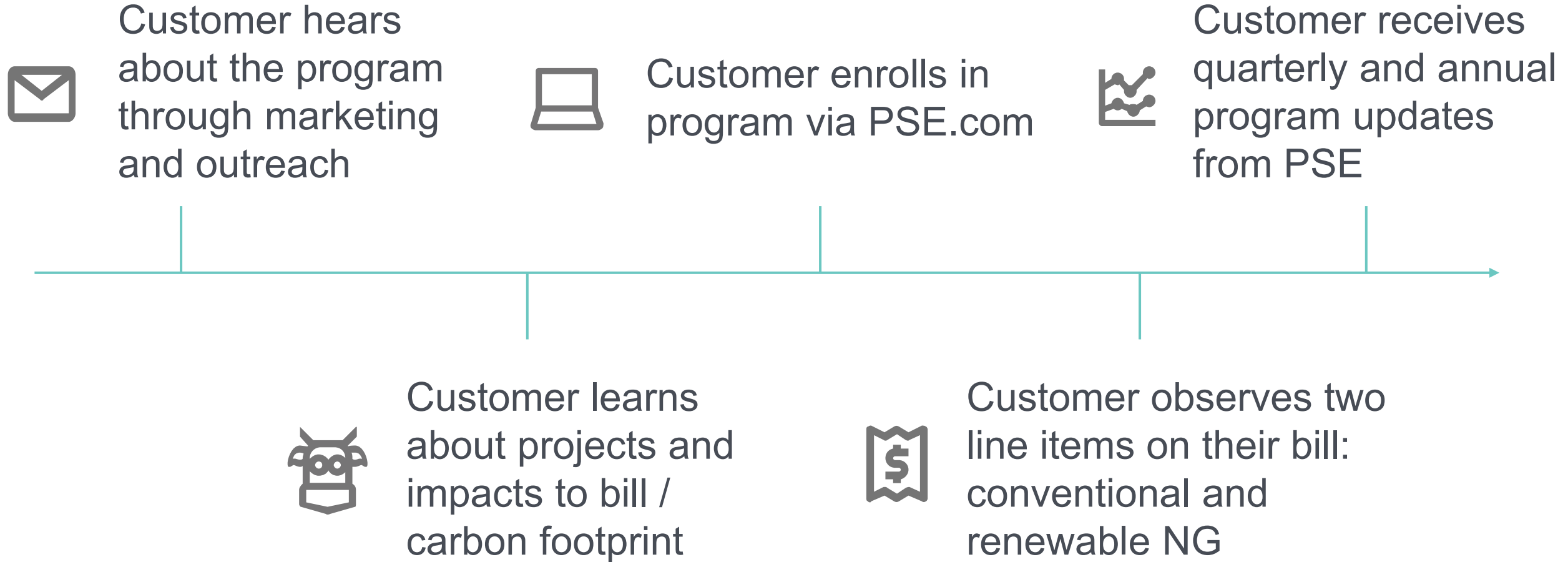
Carbon reduction – Maximize one of a relatively few avenues to decarbonize the natural gas business

Stakeholder management – Proactively take steps to reduce emissions from the gas business in advance of stakeholder pressure

High-level regulatory approach

- **File a tariff schedule for the voluntary subscription product in early 2021 for expected April approval**
 - The commitment-free, monthly subscription product will be open to commercial customers, but would be targeted at residential customers.
- **Consider filing a tariff schedule for the voluntary commercial product after co-designing the concept with likely buyers**
 - The commercial component would be a long-term supply contract model targeted at major commercial and governmental accounts.
- **Comply with other aspects of WUTC Policy Statement re: RNG**
 - Cost allocation to program participants
 - Record, track and retire RNG “Thermal” credits with accredited agent

Subscription product customer experience

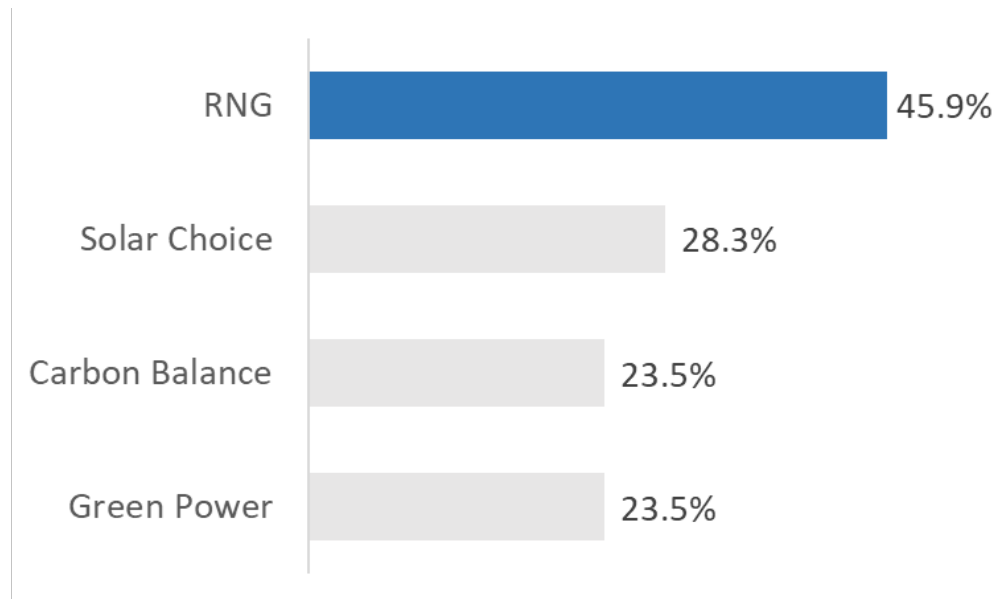


Preliminary subscription product design

- Local RNG supply from NW production
- Subscription model
- Available to commercial and residential customers
- ~\$5/month price point - per block
- Subscription blocks equate to ~3 therms per month (quantity per block is fixed annually)
- Customer requested quantity of RNG replaces equal quantity of conventional natural gas on bill
- No sign-up commitment
- No termination fees

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 (shown below relative to other PSE “green” offerings)



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

Next steps

- Verify that all current plans align with WUTC Policy Statement (Yes?)
- File and obtain approval of Tariff for first customer program
- Implement customer marketing and program sign-up
- Assess, develop and file additional customer programs
- Continue long-term planning, including assessment of potential use of RNG for generation under CETA, or potential LC fuel standard
- Assess performance of customer programs and adapt or enhance
- Acquire (or assist in development of) new RNG sources – up to limit of 5% increment of Revenue Requirement
- Promote RNG development by continuing to allow connection of RNG to the PSE gas system

Q&A

- Thank You