2021 IRP Webinar #7: CETA Assumptions, Demand Forecast, Resource Adequacy, Resource Need

Establish Resource Need
Electric & Gas Portfolio Model

September 1, 2020

Agenda

- Clean Energy Transformation Act (CETA) alternative compliance assumptions
- Electric and natural gas demand forecast
- Electric resource adequacy analysis
- Electric resource need

Safety Moment: Water Safety

- Know the water – Water that is warm on the surface, may be much colder below. Use caution when swimming and always supervise young children playing in or near the water.
- Know your limits – stay in lifeguarded areas and be cautious of sudden drop-offs in lakes and rivers
- Where a life jacket that fits you
- Be prepared - Check river or steam conditions, or beach advisories before you go swimming

More information:
https://www.doh.wa.gov/CommunityandEnvironment/WaterRecreation/LakeRiverandBeachSafety

Today's Speakers

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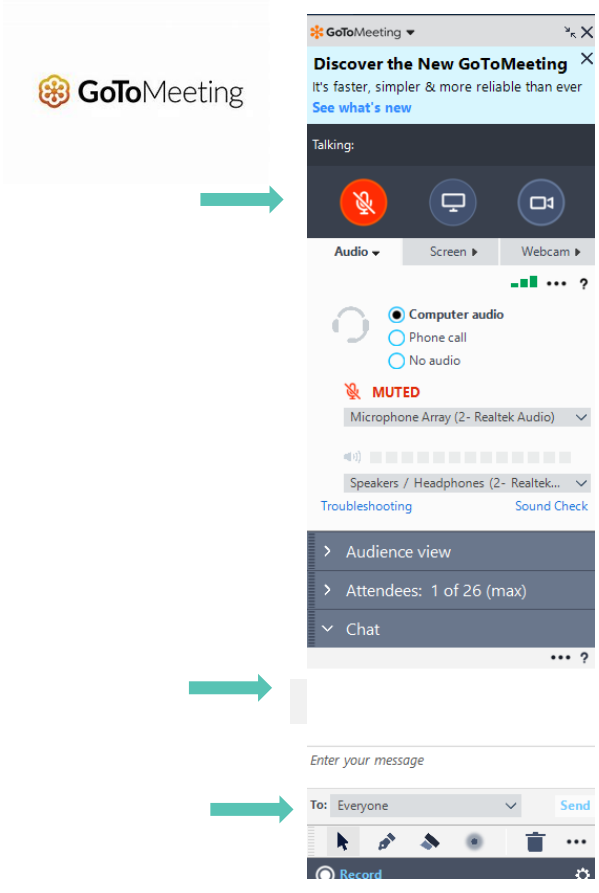
Welcome to the webinar and thank you for participating!



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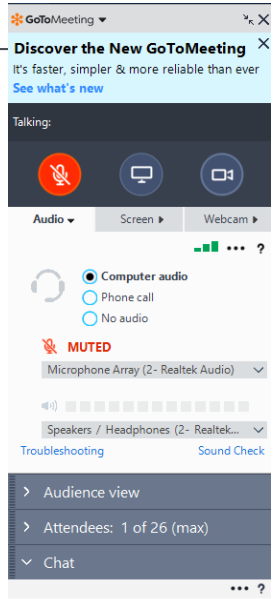
- Mute your mic during the presentation
- You can participate in writing or verbally using the chat window
  - **In writing:** your question will be read
  - **Verbally:** type "Raise hand" and slide #, share with "Everyone"; please wait to be called on to ask your question
- Be considerate of others waiting to participate
- We will try to get to all questions



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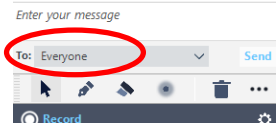

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CETA alternative compliance assumptions: 2030-2045

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Participation Objectives

- PSE will consult stakeholders on assumptions to use for the alternative compliance as part of the Clean Energy Transformation Act (CETA) for the 2021 Electric IRP.
- PSE will consult with stakeholders about the best way to meet the 20% carbon-neutral method outlined by CETA.

IAP2 level of participation: CONSULT

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CETA Targets

"With our wealth of carbon-free hydropower, Washington has some of the cleanest electricity in the United States. But electricity remains a large source of emissions in our state. We are at a critical juncture for transforming our electricity system. **It is the policy of the state to eliminate coal-fired electricity, transition the state's electricity supply to one hundred percent carbon-neutral by 2030, and one hundred percent carbon-free by 2045.** In implementing this chapter, the state must prioritize the maximization of family wage job creation, seek to ensure that all customers are benefiting from the transition to a clean energy economy, and provide safeguards to ensure that the achievement of this policy does not impair the reliability of the electricity system or impose unreasonable costs on utility customers."

- CETA Section 1, Subsection 2

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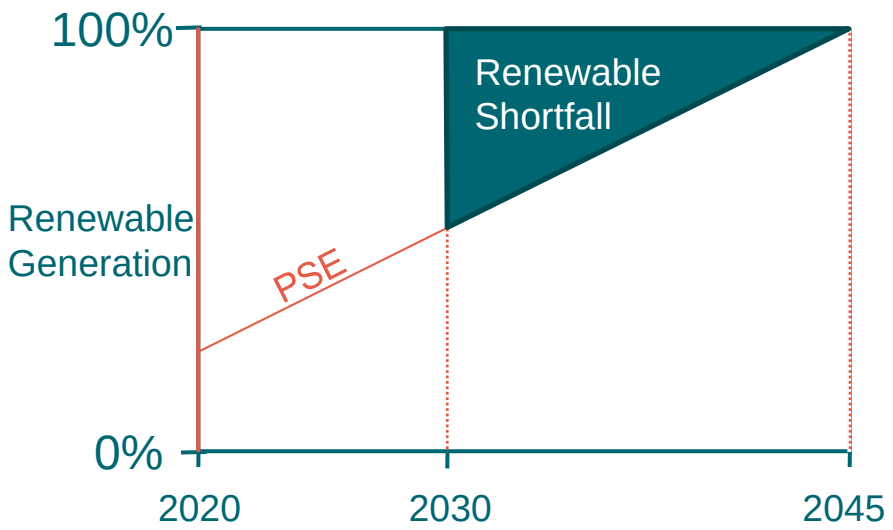
Carbon Neutral by 2030, with 80% renewable/non-emitting generation

- CETA states that all utilities must be carbon neutral by 2030, and that 80% generation must be renewable/non-emitting.
- CETA provides flexibility with the remaining 20% between the years 2030 and 2045.
- PSE must determine how to best meet the carbon neutral goal until the utility can achieve 100% renewable/non-emitting generation.



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Meeting CETA between 2030 and 2045

(b) Through December 31, 2044, an **electric utility may satisfy up to twenty percent of its compliance obligation** under (a) of this subsection **with an alternative compliance** option consistent with this section. An alternative compliance option may include any combination of the following:

(i) **Making an alternative compliance payment** under section 9(2) of this act;

(ii) **Using unbundled renewable energy credits**, provided that there is no double counting of any nonpower attributes associated with renewable energy credits within Washington or programs in other jurisdictions, as follows:

(A) Unbundled renewable energy credits produced from eligible renewable resources, as defined under RCW 19.285.030, which may be used by the electric utility for compliance with RCW 19.285.040 and this section as provided under RCW 19.285.040(2)(e); and

(B) Unbundled renewable energy credits, other than those included in (b)(ii)(A) of this subsection, that represent electricity generated within the compliance period; p. 11 E2SSB 5116.PL

(iii) **Investing in energy transformation projects**, including additional conservation and efficiency resources beyond what is otherwise required under this section, provided the projects meet the requirements of subsection (2) of this section and are not credited as resources used to meet the standard under (a) of this subsection; or

(iv) **Using electricity from an energy recovery facility using municipal solid waste as the principal fuel source**, where the facility was constructed prior to 1992, and the facility is operated in compliance with federal laws and regulations and meets state air quality standards. An electric utility may only use electricity from such an energy recovery facility if the department and the department of ecology determine that electricity generation at the facility provides a net reduction in greenhouse gas emissions compared to any other available waste management best practice. The determination must be based on a life-cycle analysis comparing the energy recovery facility to other technologies available in the jurisdiction in which the facility is located for the waste management best practices of waste reduction, recycling, composting, and minimizing the use of a landfill.

Options for meeting the next 20%: Alternative compliance payments

- The alternative compliance payment is a base fine of $100 for each MWh of electricity that is not produced by a renewable or non-emitting resource.
  - Coal-fired resources receive a fine of $150/MWh
  - Gas-fired peakers receive a fine of $84/MWh
  - Gas-fired combined-cycle power plants receive a fine of $60/MWh

- These fines are adjusted to inflation every 2 years.

Options for meeting the next 20%: Unbundled RECs

- Unbundled Renewable Energy Credits (RECs) are tradeable certificates issued by the EPA that are attached to a single MWh of renewable generation.
- RECs are available nationally, but must correspond to an “eligible period” of generation.
    - For example, PSE could not purchase RECs from 2029 to meet the 2030 CETA requirements.
- “Unbundled” RECs mean that they are sold separately from the electricity that they are tied to.
- What is the price of unbundled RECs?

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Options for Meeting the Next 20%: Energy Transformation Projects

- Utilities may also invest in “Energy Transformation Projects” to achieve the “Carbon Neutral” status outlined in CETA.

- Energy transformation projects reduce emissions from sectors that are not specifically related to energy production. These reductions can be used to offset emissions from CO_2-generating resources.

- Potential projects may include:
  - Electrification of the transportation sector (e.g. public transportation, electric vehicles)
  - Investments in hydrogen as a fuel for transportation
  - Distributed energy resource programs
  - Efficiency and conservation efforts
  - Agricultural emission reduction

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Stakeholder feedback on 20% alternative compliance

- PSE is seeking feedback from stakeholders on prioritization of the options for the 20% alternative compliance to reach carbon neutral target by 2030 in the 2021 IRP.

- PSE will also analyze a sensitivity to reach 100% renewable resources by 2030. (see Sensitivity 26 No new gas generation)

Service Area Electric and Natural Gas Demand Forecast

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Participation Objectives

- PSE will inform stakeholders about the electric and natural gas demand forecast.

IAP2 level of participation: INFORM

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Presentation outline

- Introduction and role of demand forecast in IRP
- Methodology
- Forecast drivers/assumptions
  - Economics and demographics
  - COVID-19
  - Electric vehicles
  - Normal weather
- 2021 IRP Demand forecast results
  - Gas
  - Electric

Introduction

- The demand forecasts developed for the IRP estimate the amount of electricity and natural gas that will be required to meet the needs of customers through 2045.
- The demand forecast that PSE develops for the IRP is an estimate of energy sales, customer counts, and peak demand.
- The forecasts presented herein are for PSE's service area.
  - Trends for pockets within PSE's service area may differ from overall trends forecasted for PSE's service area.
- Forecast results presented herein are for the Base Demand Forecast case.
  - To model a range of potential economic and weather conditions PSE also prepares Low and High Forecasts in addition to the Base Forecast, to be presented at a later date.

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Role of demand forecasts in the Integrated Resource Plan

- The 20+ year demand forecasts are used as an input into the IRP, and do not include long-term projections of demand-side resources (DSR).
  - Note: DSR measures through December 2021 (i.e., committed targets) are included in the forecast.
- The IRP analysis determines the most cost-effective amount of future DSR to include in the resource plan.
- Demand is reduced significantly when forward projections of DSR savings are applied.
  - DSR includes utility-sponsored conservation programs, codes and standards, distribution efficiency, and demand response.
- This presentation reviews the demand forecasts used as an input into the IRP analysis, therefore is the demand forecast ***before forward projections of DSR*** are applied.
- Distributed generation, including customer-level generation via solar panels, is not included in the demand forecast; this energy production is captured in the IRP scenario modeling process.
- The Clean Energy Transformation Act (CETA) affects the amount of demand-side resources. Demand-side resources are included as an option in the IRP portfolio model and not included in the base demand forecast.

Terminology

- The terms “demand” and “load” are often used interchangeably, but in the IRP they actually refer to different concepts.
  - **Demand** refers to the amount of energy needed to meet the needs of customers, including energy to account for losses.
  - **Load** refers to demand plus the planning margin and operating reserves needed to ensure reliable and safe operation of the electric and gas systems.
  - The forecast results presented herein are demand forecasts and do not include planning margin and operating reserves.
- **Energy demand** refers to the total amount of electricity or natural gas needed to meet customer needs in a given year.
- **Peak demand** refers to the maximum energy needed to serve customer demand in a given hour (electric) or day (natural gas), typically occurring on the coldest hour/day of the year, since PSE is a winter-peaking utility.
- **Conservation** and **Demand-Side Resources (DSR)**. Used interchangeably in this presentation to represent optimal bundles of conservation programs, codes and standards, distribution efficiency, and demand response as developed by the Conservation Potential Assessment (CPA) and the Portfolio Model activities.
- **System-level** demand forecasts (both electric and gas) include residential, commercial, industrial, and interruptible customer classes; does not include transport or network loads.
- **Average annual rate of growth (aarg)** for the forecast period is provided in the results graphics.

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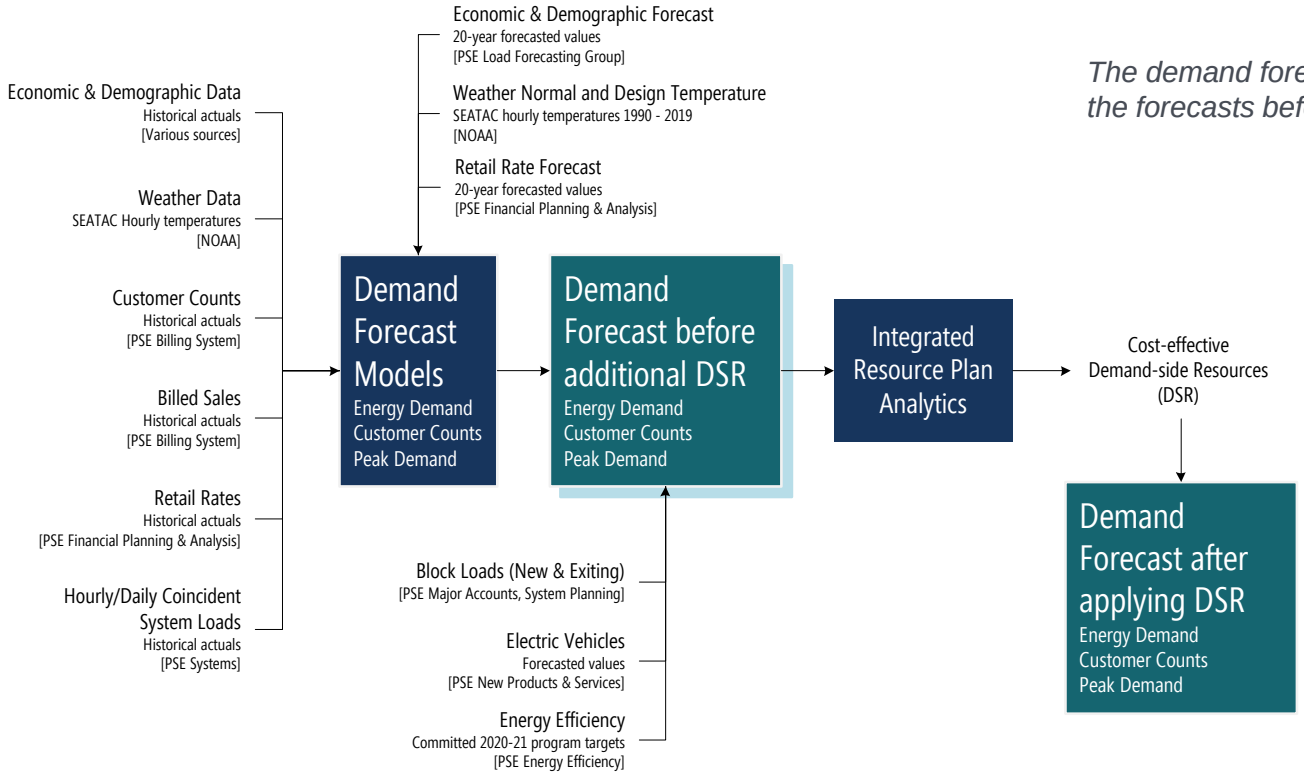
Demand forecast development



The demand forecasts presented herein are the forecasts before additional DSR.

Demand forecast models

Typical Drivers:
- Population
- Housing Permits
- Employment

Typical Drivers:
- Employment
- Energy retail rates
- Personal Income
- Weather

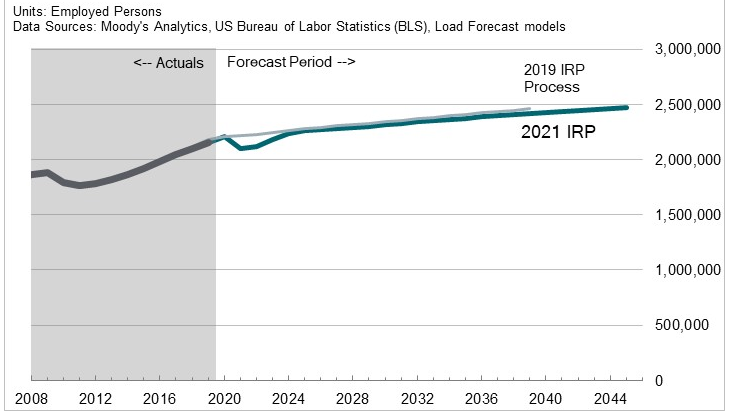
- STEP 1: Compile actual history
  - Compile actual PSE sales data and drivers
  - Determine the *relationship* of drivers to customer growth and sales

- STEP 2: Forecast the future
  - Compile forecasts of economic and demographic drivers, normal weather
  - Apply historical *relationships* to forecasts of drivers and normal weather

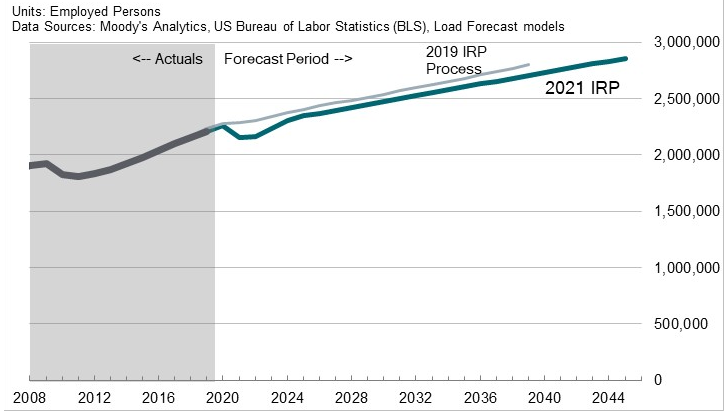
Economic & demographic model: employment forecast

- Pandemic assumptions (Moody's May 2020 forecast):
  - New infections begin to abate in July.
  - Does not include a second wave of infections.
- Economic assumptions (Moody's May 2020 forecast):
  - Partial bounce back in Q3 2020, then slow, steady recovery.
  - Housing/construction and manufacturing quicker bounce back.
  - Unemployment rate above 6% until Q1 2022 and above 5% until Q1 2023.
  - Long term total employment down 1.8% from 2019 IRP process projections.

Electric Service Area: Forecast of annual change in non-farm employment used in the 2021 IRP and 2019 IRP Process forecasts

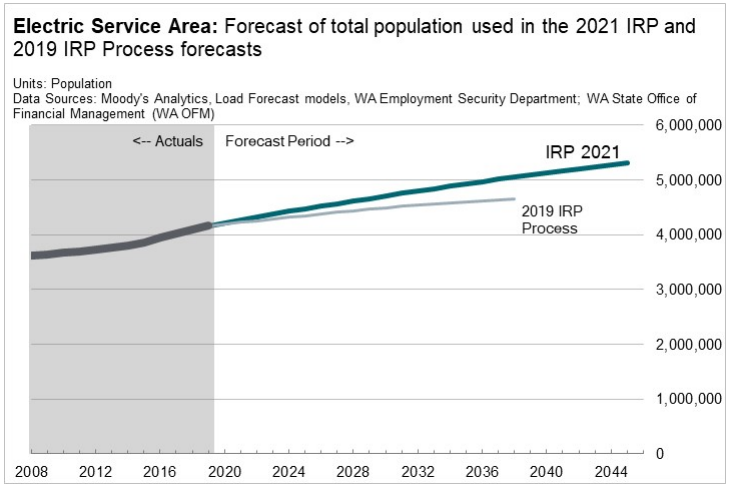


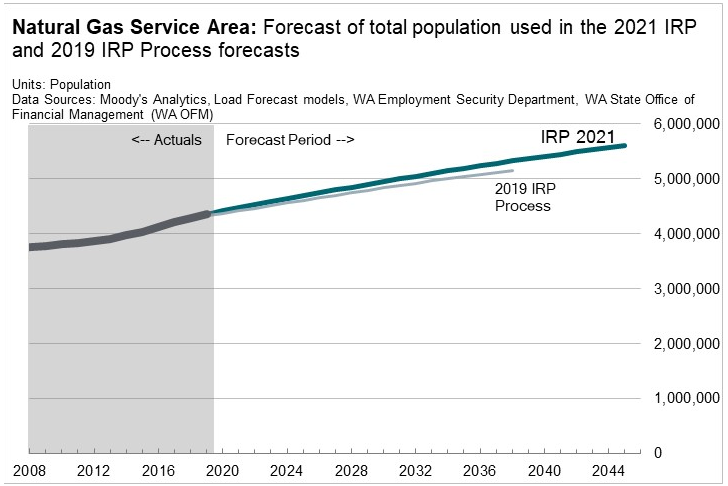
Natural Gas Service Area: Forecast of annual change in non-farm employment used in the 2021 IRP and 2019 IRP Process forecasts



Economic & demographic model: population forecast

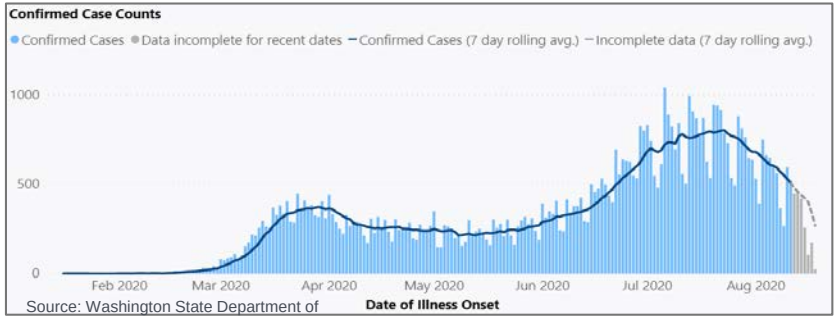
- Population drives residential customer growth
- Switched to WA Employment Security Department (ESD) population forecast instead of Moody's US level forecast.
- COVID-19 impacts not included in ESD population forecast.
- Aligned residential growth with slowing population growth





COVID-19 Impacts

- COVID-19 reached the Puget Sound region in earnest early March 2020
- Immediate impacts to local economy
  - "Stay Home, Stay Healthy" order officially issued March 23rd
- Typical historical economic assumptions used in the forecast were not going to capture all of the immediate impacts
- Additional assumptions and adjustments were made to the forecast to reflect the quantitative and qualitative impacts



Source: Washington State Department of Health

In our last economic crisis the economy shrank around 6 percent relative to its long-run trend, and the unemployment rate rose around five percentage points. At a guess, we're now looking at a slump three to five times that deep.

This plunge isn't just quantitatively off the charts; it's qualitatively different from anything we've seen before. **Normal recessions happen when people choose to cut spending**, with the unintended consequence of destroying jobs. **So this slump mainly reflects the deliberate, necessary shutdown of activities** that increase the rate of infection.

-Paul Krugman in the NY Times 4/7/2020

COVID-19 Impacts (cont.)

- **Immediate impacts, 2020**
  - Forecast used the most current Moody's economic forecasts (May 2020),
    - Includes epidemiological assumptions about the pandemic and its effects on economy
    - No model history to pick up severity of immediate downturn
  - Additional analyses that were incorporated into the demand forecast for the remainder of 2020:
    - Tracked daily loads of residential, commercial, and industrial classes
    - Assessed the potential impacts of the "Stay Home, Stay Healthy" order on commercial building energy consumption
    - Aligned expected energy consumption patterns to the "Safe Start" order
- **Medium-term impacts, 2021 – 2024**
  - Macroeconomic variables drive COVID impacts to forecast beyond 2020
  - Persistence of the pandemic and slow recovery affect demand for the next few years
- **Long term impacts, 2024+**
  - While the economic forecasts assume a recovery by ~2024, lingering effects of the recession persist throughout the remainder of the forecast

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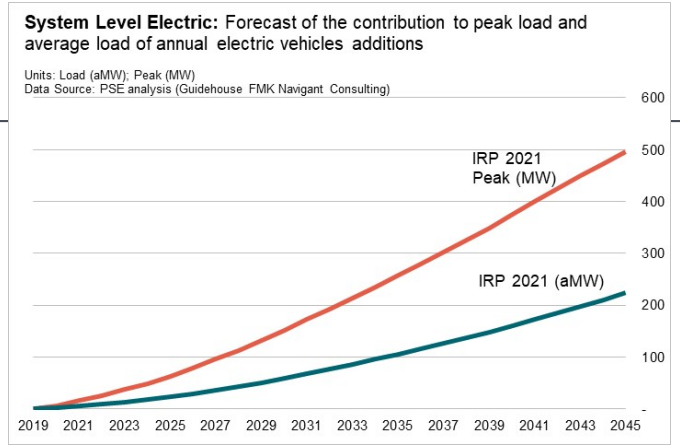
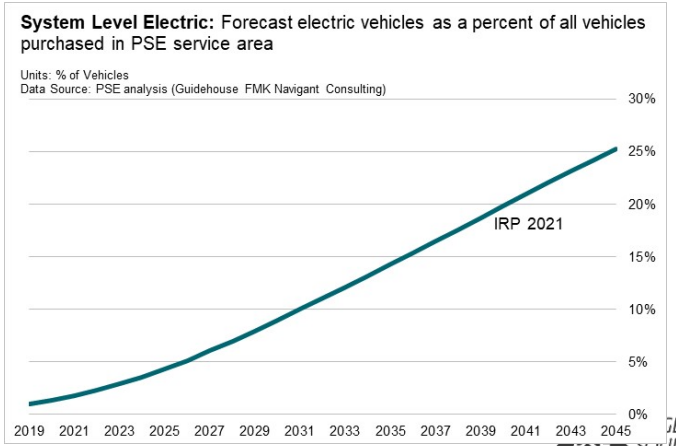
Electric Vehicles (EVs)

- The electric vehicle market remains nascent and heavily influenced by state/federal policy along with automaker's model availability.
- Forecast of electric light duty vehicles provided by consultant Guidehouse (formerly Navigant).
  - EV adoption
  - Charger counts
  - Annual Energy
  - Load Profiles
- Forecasted EV demand increases to 2-3% of total load and peak forecasts by 2030, and 7-8% by the end of forecast period.
- Future EV forecasts will include medium and heavy duty vehicles.





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Normal heating and cooling degree days

- Energy demand is forecasted on a normal weather basis.
- PSE assumption of normal weather is based on average of most recent 30 years.
- Alternative definitions of normal will be analyzed as sensitivities.

Normal Degree Days (Base65), Annual			
Period	**Description**	**Heating**	**Cooling**
1990-2019	**2021 IRP Forecast (30 years)**	**4,765**	**200**
1988-2017	2019 IRP Process Forecast (30 years)	4,800	192
1981-2010	NOAA Normal Period	4,903	167
2000-2019	20 years	4,761	218
2005-2019	15 years	4,689	241
2010-2019	10 years	4,538	266
2015-2019	5 years	4,323	336

10 minute break

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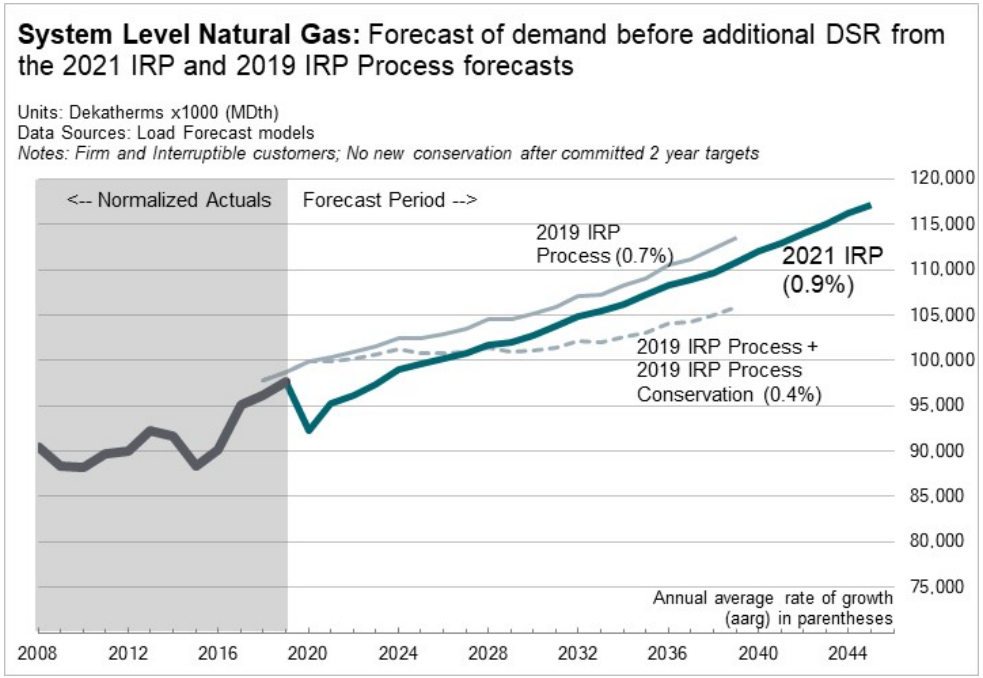
Results outline

- Natural Gas Demand Forecasts
    - Energy Demand
    - Peak Demand
- Electric Demand Forecasts
    - Energy Demand
    - Peak Demand

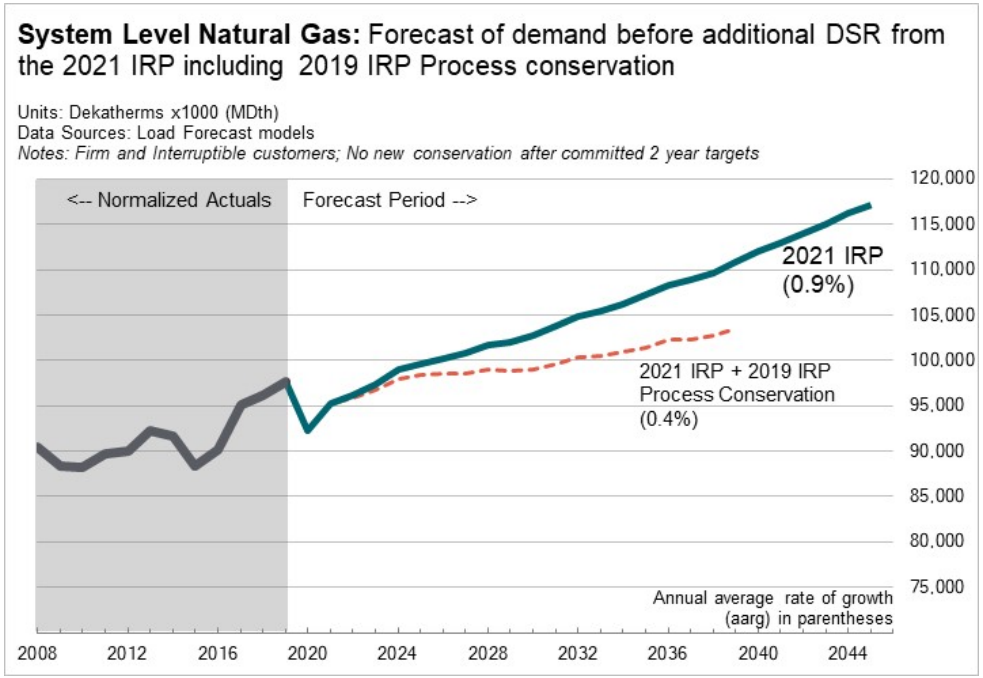
Natural Gas: Energy demand forecast [System Level]

- Demand lower by 5-8% in short term due to COVID-19 impacts.
- Demand down 2% in long term:
  - Slower residential customer growth.
  - Lower residential Use Per Customer (UPC).
  - Commercial usage is up.
  - 2020/21 conservation targets.
- The 2021 IRP demand forecast after DSR will be available once final DSR determined by the 2021 IRP process.



Natural Gas: Energy demand forecast after DSR [System Level]

- *This graph is for illustrative purposes only.*
- Using the amount of DSR determined by the 2019 IRP process, this graph illustrates an example of the 2021 IRP demand forecast after DSR.
- The final DSR amount for 2021 IRP is still to be determined by the portfolio model.



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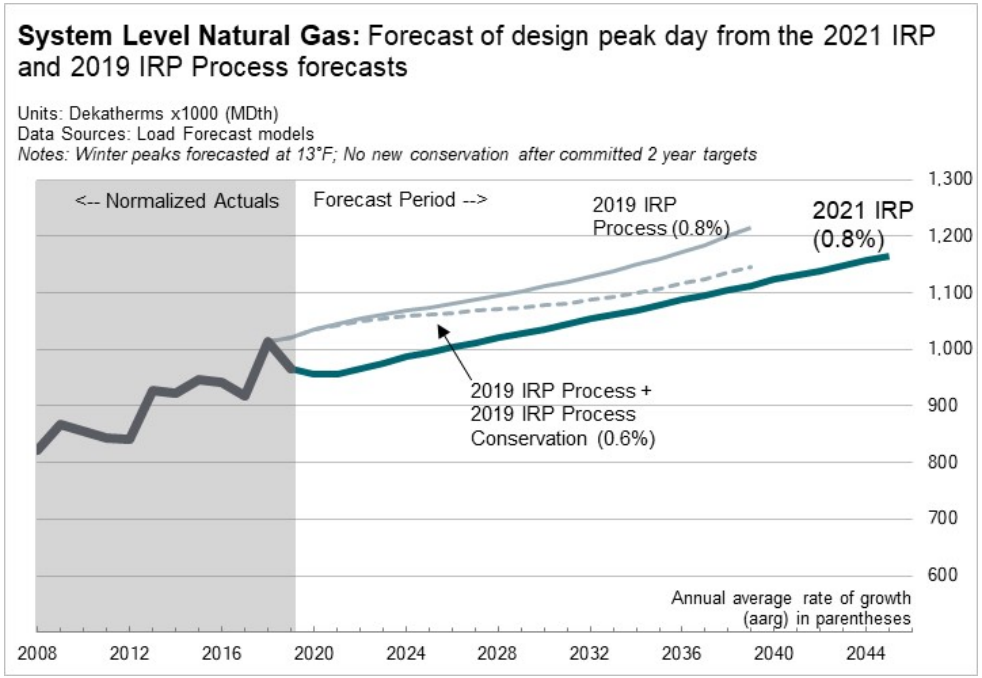
Natural Gas: Peak demand forecast [System Level]

- 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.



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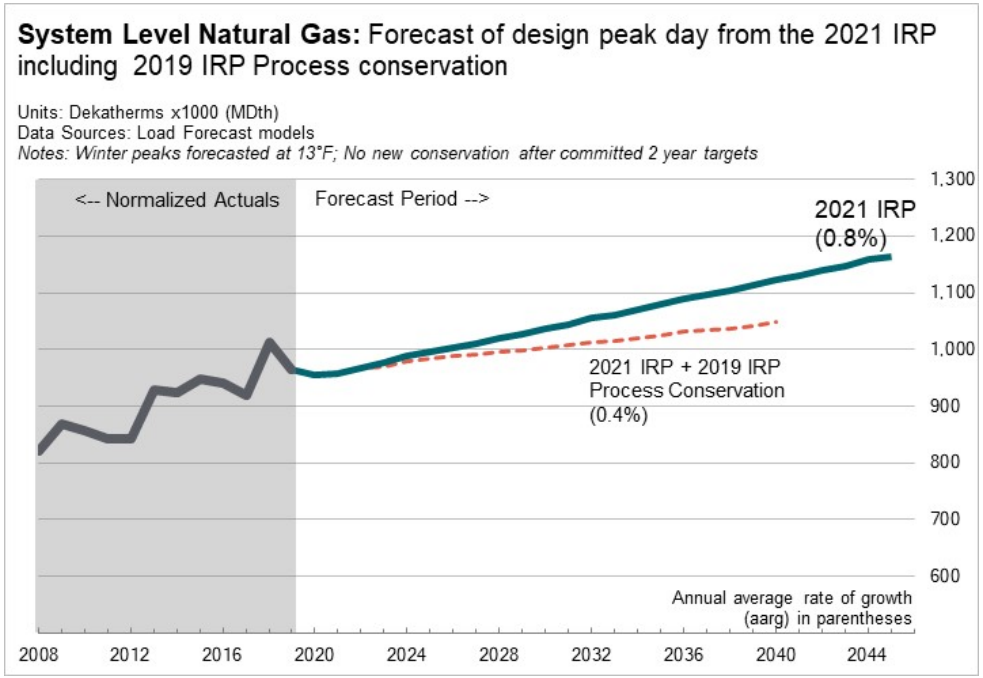
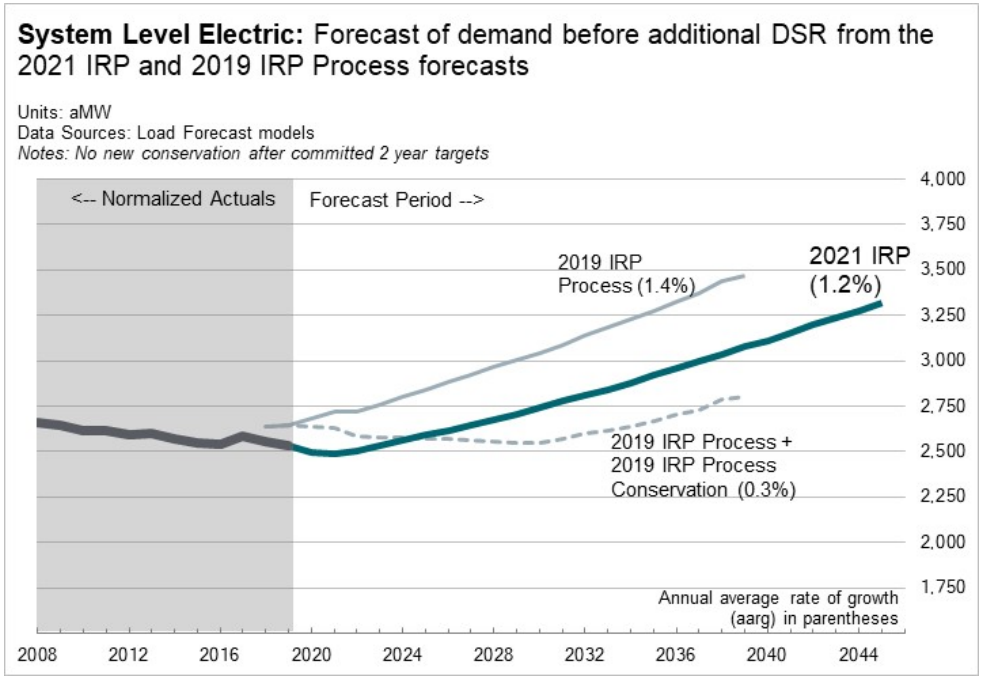


Electric: Energy demand forecast [System Level]

- Positive customer growth, steady UPC, and EVs yield demand growth, before DSR.
  - Applying DSR will result in an “after DSR” forecast with lower growth than “before DSR.”
- Conservation targets for 2020/21 decreases load materially (standard IRP methodology, ~50% of initial 2022 forecast change).
- Lower growth than 2019 IRP process forecast due to:
  - Lower customer growth (commercial significantly).
  - Lower UPC forecast (all non-residential).
- The 2021 IRP demand forecast after DSR will be available once final DSR determined by the 2021 IRP process.



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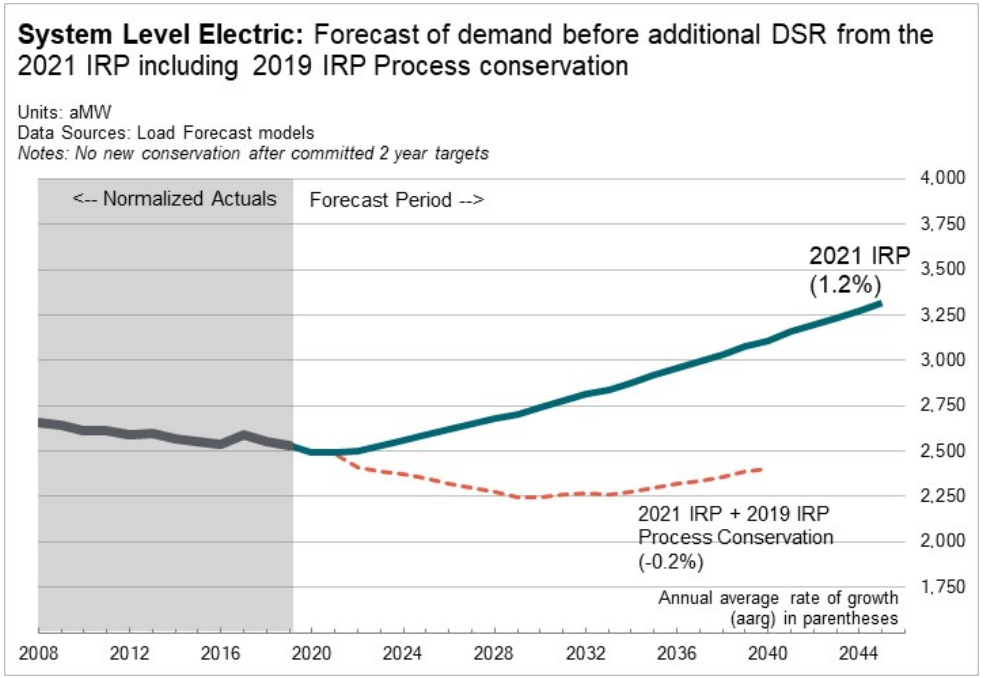
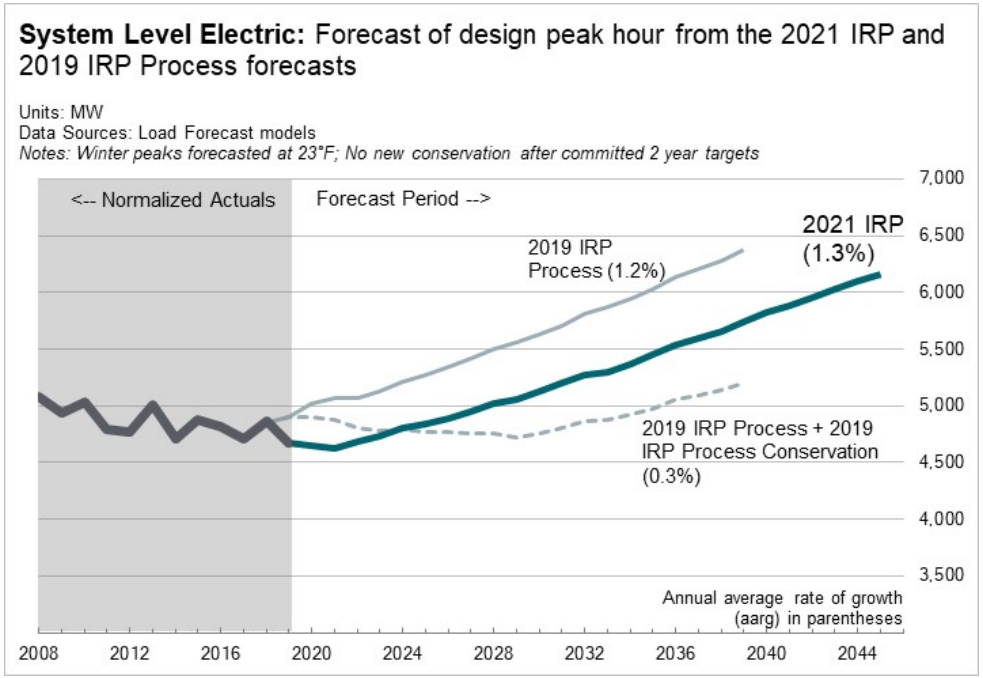


Electric: Peak demand forecast [System Level]

- Hourly forecast for winter weekday non-holiday evening at 23°F.
- Short-term downward driving forces:
  - Recent observed actuals (peak events, especially Feb. 2019 cold snap).
  - 2020/2021 conservation targets.
  - Economic slowdown due to COVID-19 will likely mitigate growth until ~2024.
- Long-term growth drivers:
  - New customer growth.
  - Electric Vehicles.
- The 2021 IRP peak demand forecast after DSR will be available once final DSR determined by the 2021 IRP process.



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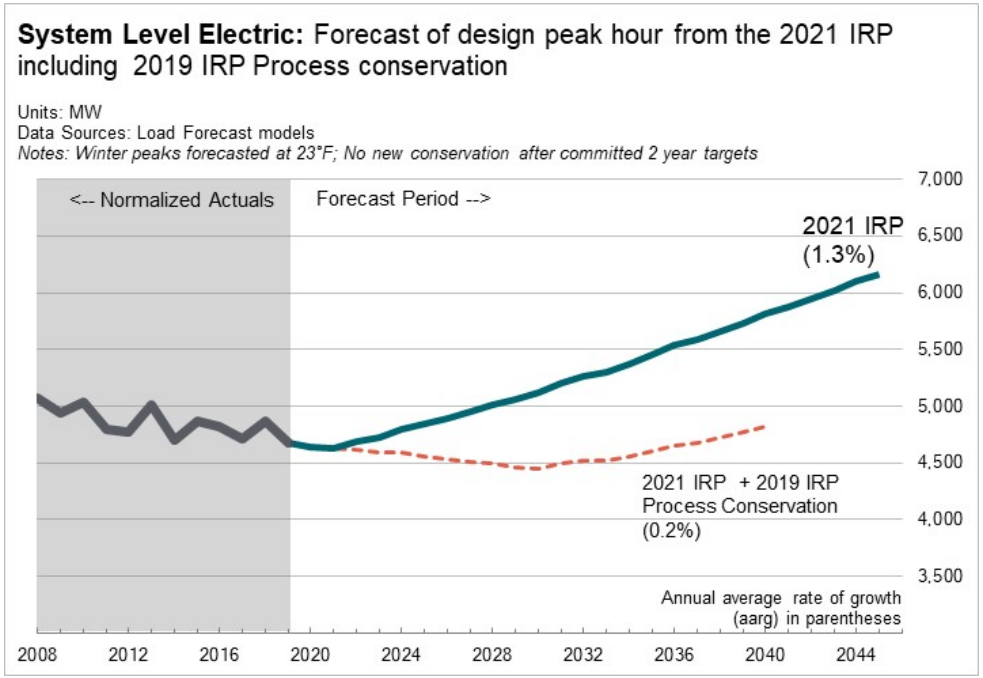

Appendix – Demand Forecast

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Economic & demographic model: Data sources

- PSE's economic and demographic model uses both national and regional data to produce a forecast of:
  - total employment,
  - types of employment,
  - unemployment,
  - personal income,
  - population,
  - households,
  - consumer price index (CPI) and
  - building permits.

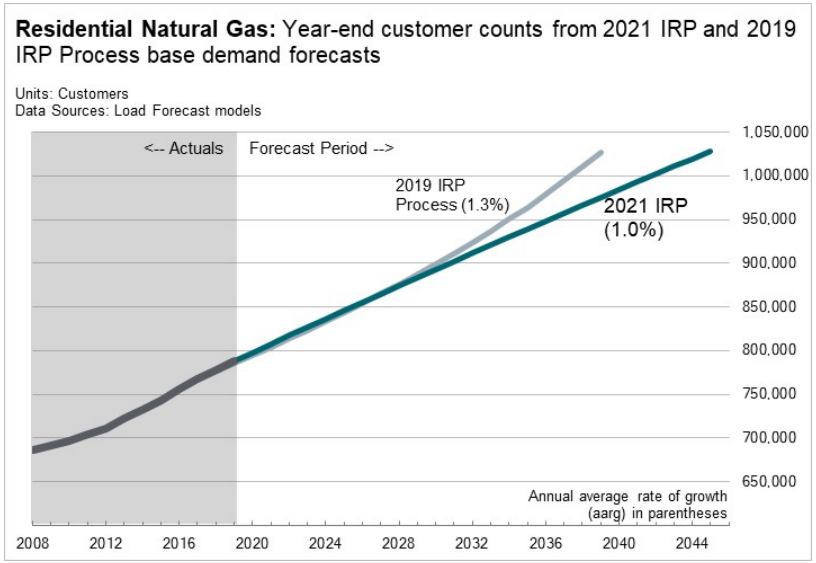
- Historical data are sourced from a number of external data sources, including local and federal agencies

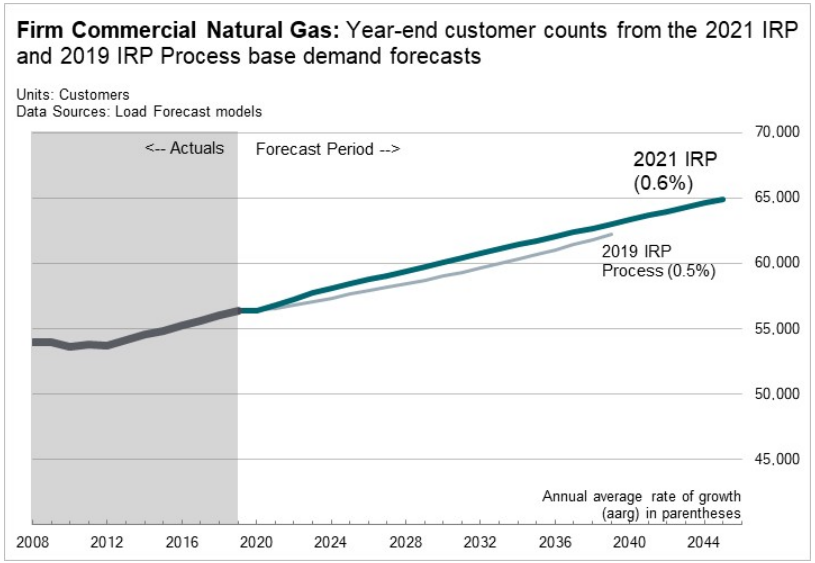
- US-level forecasts come from Moody's Analytics

DATA USED IN ECONOMIC AND DEMOGRAPHIC MODEL	
County-level Data	**Source**
Labor force, employment, unemployment rate	U.S. Bureau of Labor Statistics (BLS) www.bls.gov Puget Sound Regional Council (PSRC) www.psrc.org
Total non-farm employment, and breakdowns by type of employment	WA State Employment Security Department, using data from Quarterly Census of Employment and Wages https://fortress.wa.gov/
Personal income	U.S. Bureau of Economic Analysis (BEA) www.bea.gov
Wages and salaries	
Population	U.S. Bureau of Economic Analysis (BEA) WA State Office of Financial Management (OFM) www.ofm.wa.gov Washington State Employment Security Department (ESD) https://www.esd.wa.gov/
Households, single- and multi-family	U.S. Census www.censtats.census.gov
Household size, single- and multi-family	
Housing permits, single- and multi-family	U.S. Census / Puget Sound Regional Council (PSRC) / City Websites / Building Industry Association of Washington (BIAW) www.biaw.com
Aerospace employment	Puget Sound Economic Forecaster www.economicforecaster.com
US-level Data	**Source**
GDP	Moody's Analytics www.economy.com
Industrial Production Index	
Employment	
Unemployment rate	
Personal income	
Wages and salary disbursements	
Consumer Price Index (CPI)	
Housing starts	
Conventional mortgage rate	
T-bill rate, 3 months	

Natural Gas: Customer counts forecast [Class Level]

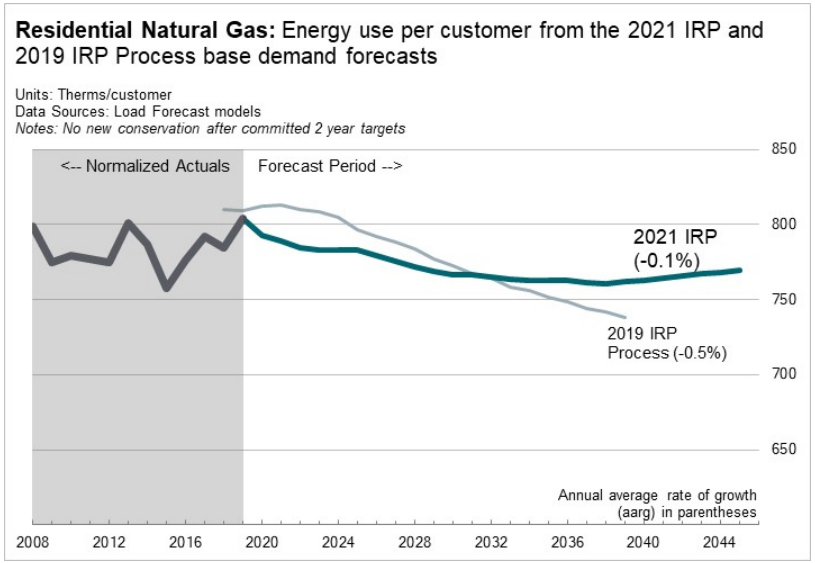
- System demand includes residential, commercial, industrial, and interruptible demand.
- Residential and Firm Commercial make up 93% of natural gas system consumption.
- Residential growth aligned with population growth.

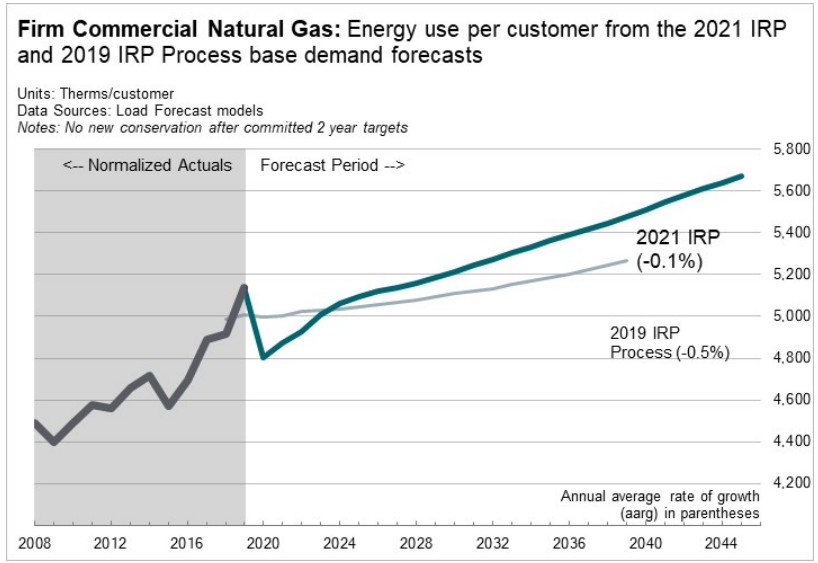




Natural Gas: Energy Use Per Customer (UPC) Forecast [Class Level]

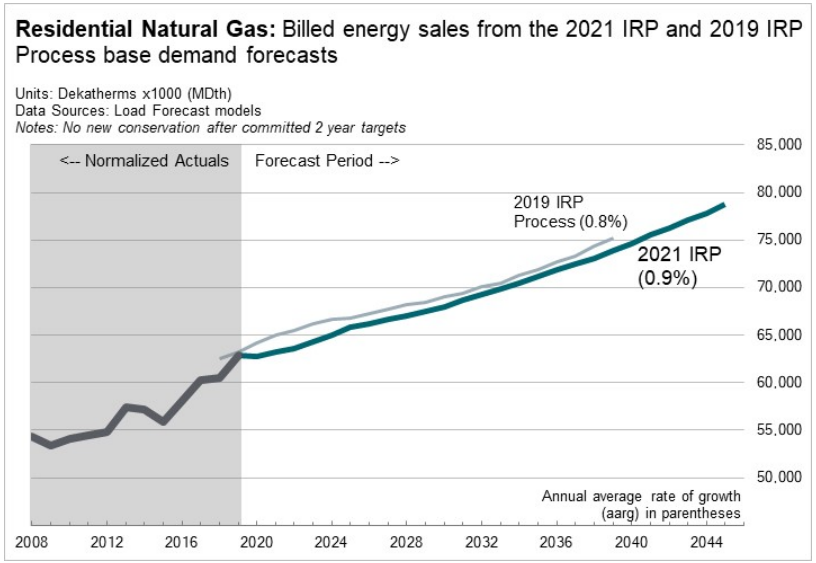
- Residential
  - Lower recent actuals, Conservation commitments applied in 2020/2021, lower retail rate.
  - No explicit COVID-19 impacts in addition to economic forecast.
- Commercial
  - Drop in 2020 due to COVID-19 impacts, higher recent actuals.

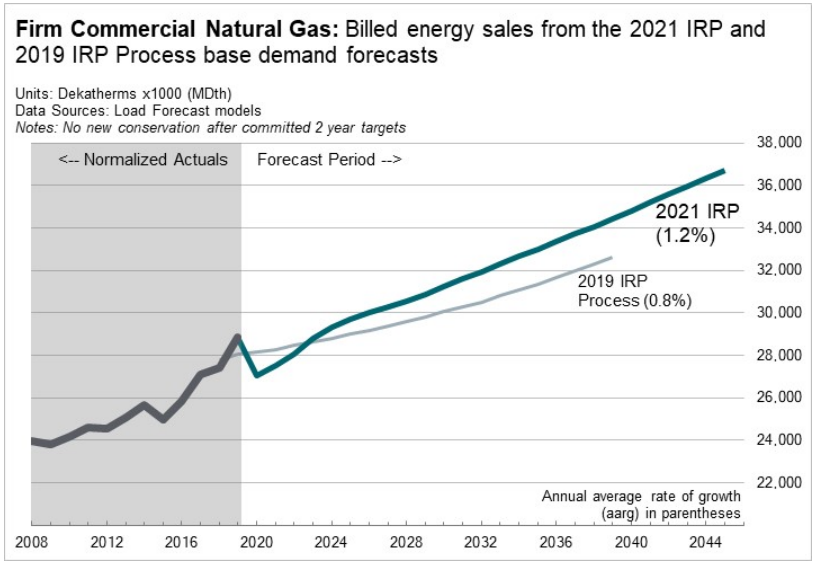




Natural Gas: Billed energy sales Forecast [Class Level]

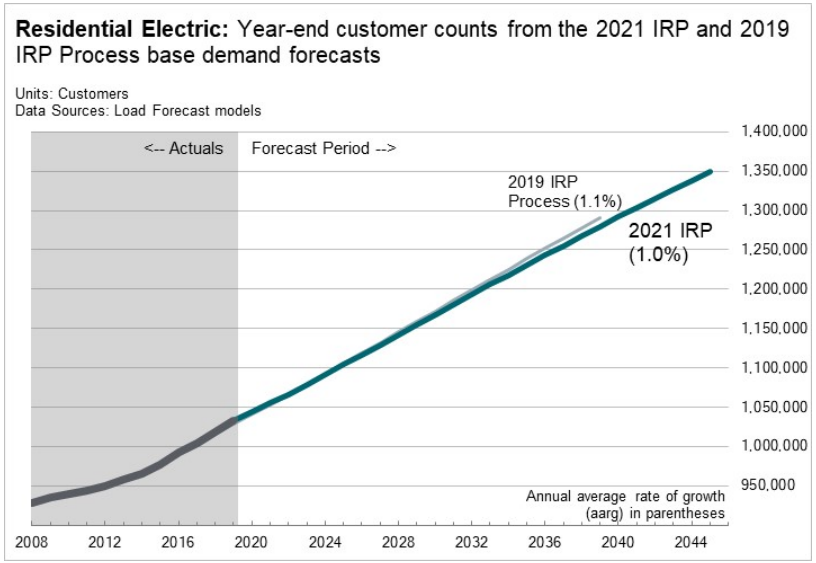
- Lower residential sales from slower customer growth.
- Higher commercial customers and UPC post COVID-19 results in higher sales in the long term.

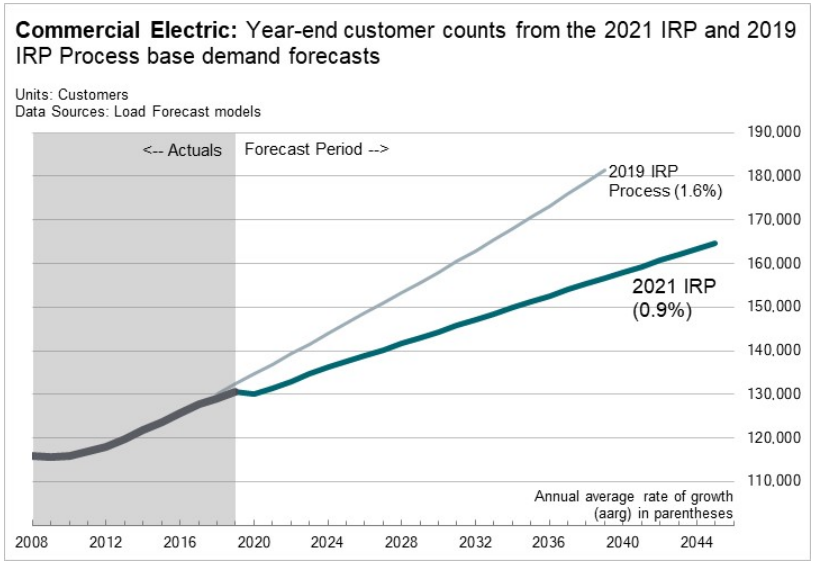




Electric: Customer counts forecast [Class Level]

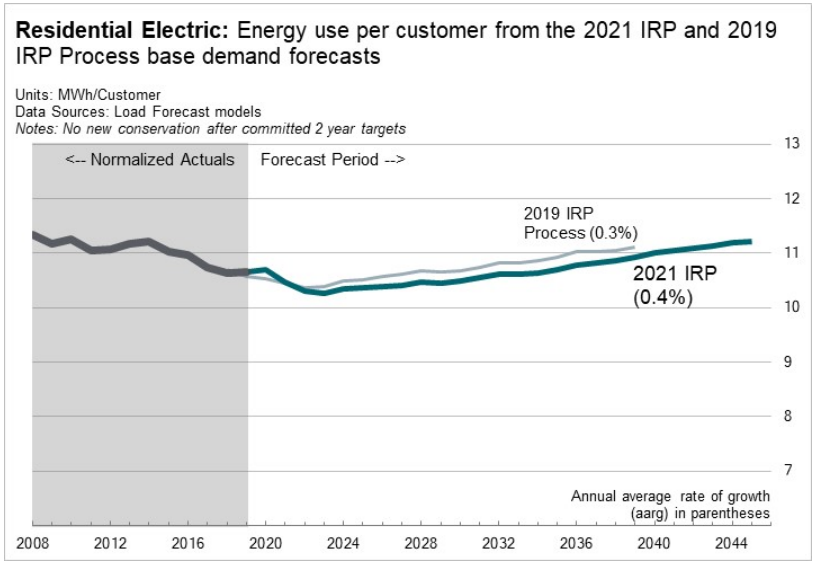
- Starting point adjustment: more residential and fewer commercial additions in 2018/2019.
- Lower growth than 2019 IRP process forecast due to:
  - COVID-19 shut down.
  - Updated economic outlook and relationships.
  - Updated trends/drivers (commercial growth more aligned with residential).

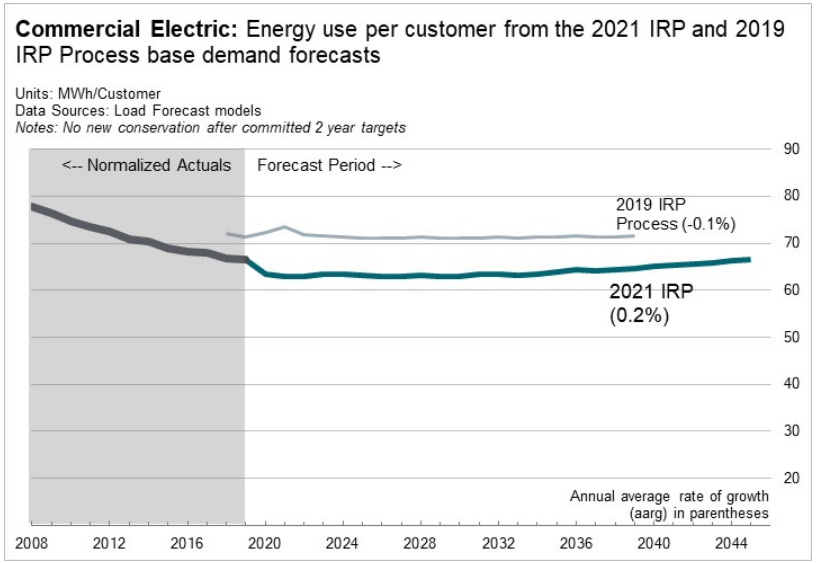




Electric: Energy Use Per Customer (UPC) forecast [Class Level]

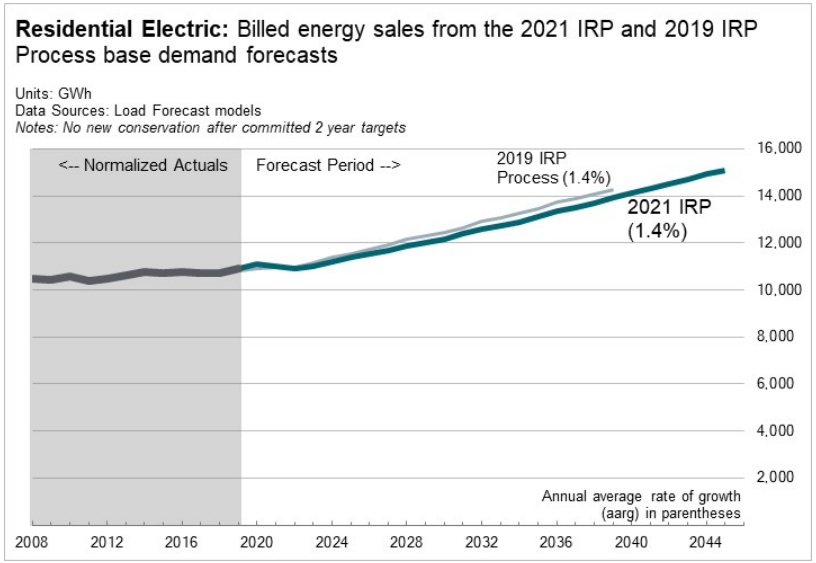
- 2020/2021 conservation targets shift forecast levels downward, all else equal.
- Increased residential and decreased commercial usage due to pandemic effects pre-2023.
- EV growth solely drives UPC growth.
- Updated methodology to better estimate non-residential temperature sensitivity and growth.

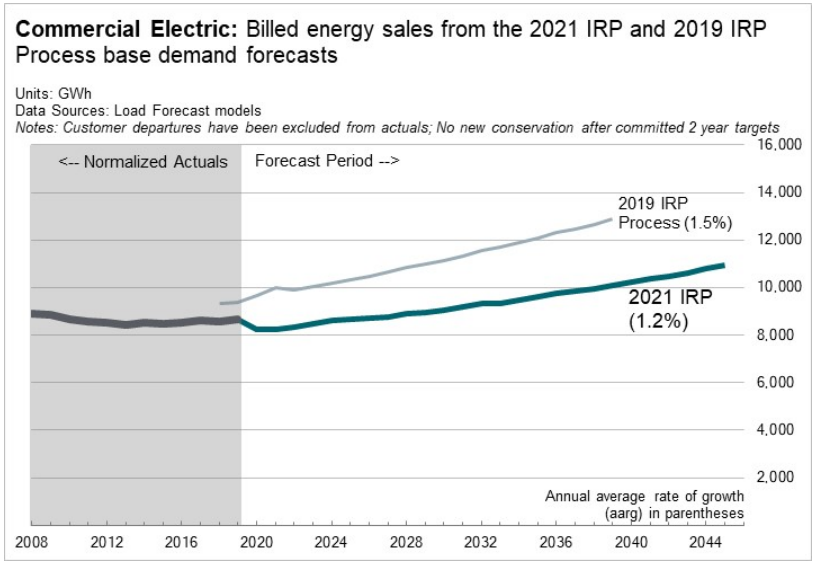




Electric: Billed energy sales forecast [Class Level]

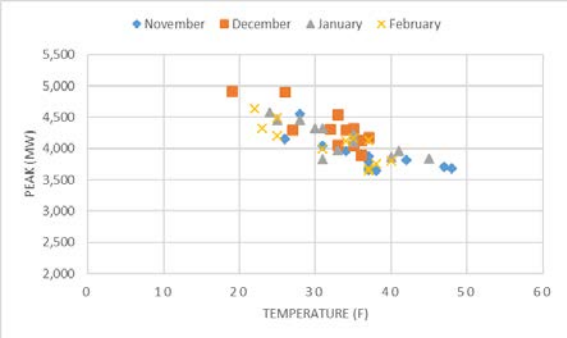
- Positive customer growth, steady UPC, and EVs yield sales growth, all else equal
- Inclusion of conservation targets for 2020/2021 decreases total usage levels materially (~50% of initial 2022 forecast change, standard practice)
- Lower growth than 2019 IRP process forecast due to
  - Lower customer growth (commercial significantly)
  - Lower UPC forecast (all non-residential)

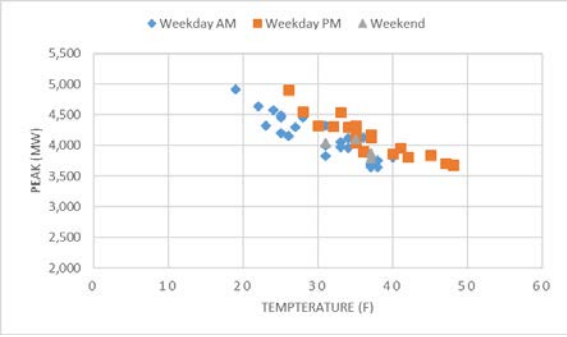




Electric: Observed system winter peaks 2008 - 2019

- Source: Puget Sound Energy FERC Form 1 Years 2008 – 2019 (https://elibrary.ferc.gov page 401b)
- System peak forecast is for winter weekday non-holiday evening at 23°F.
- The system peak forecast varies between 4,350-4,650 through 2022 for Nov/Dec/Jan/Feb.
- Historical observed values includes Jefferson County through March 2013 and Microsoft through April 2019.

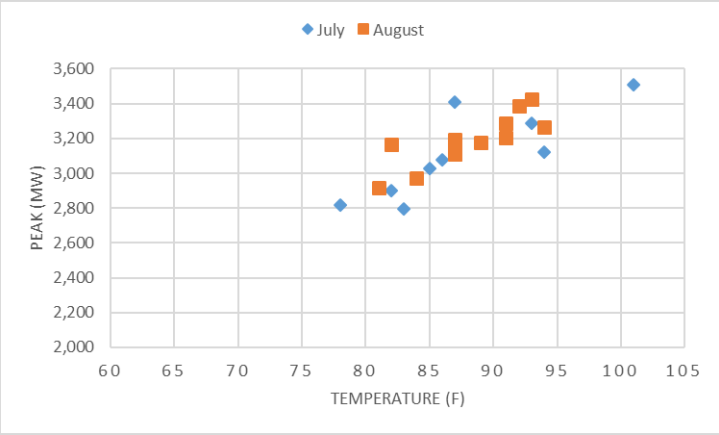




Winter Peak MW**, Seatac Hourly Temperature, Day of Week, and Hour				
Winter Season	November	December	January	February
2008/2009	3,696MW (37°F,M,HE8)	4,906MW (26°F,M,HE19)	4,451MW (25°F,M,HE8)	4,171MW (35°F,T,HE19)
2009/2010	3,683MW (48°F,W,HE18)	4,911MW (19°F,Th,HE8)	3,837MW (45°F,Th,HE18)	3,760MW (38°F,M,HE8)
2010/2011	4,547MW (28°F,W,HE18)	4,305MW* (32°F,F,HE18)	4,326MW (31°F,M,HE8)	4,317MW (23°F,F,HE8)
2011/2012	3,874MW (37°F,Sun,HE18)	4,297MW (34°F,M,HE19)	4,328MW (30°F,W,HE18)	3,997MW (31°F,M,HE8)
2012/2013	3,812MW (42°F,M,HE19)	4,172MW (37°F,T,HE18)	4,226MW (35°F,M,HE18)	3,799MW (40°F,F,HE8)
2013/2014	3,955MW (34°F,F,HE8)	4,543MW (33°F,M,HE18)	3,973MW (33°F,M,HE8)	4,637MW (22°F,Th,HE8)
2014/2015	4,048MW (31°F,Sun,HE19)	4,298MW (27°F,M,HE8)	3,866MW (40°F,F,HE18)	3,680MW (37°F,M,HE8)
2015/2016	4,155MW (26°F,M,HE8)	4,047MW* (35°F,W,HE19)	4,101MW (35°F,Sun,HE18)	3,649MW (37°F,T,HE8)
2016/2017	3,709MW (47°F,M,HE18)	4,317MW (35°F,Th,HE18)	4,572MW (24°F,Th,HE8)	4,114MW (34°F,Th,HE8)
2017/2018	3,652MW (37°F,M,HE8)	4,058MW (33°F,M,HE8)	3,954MW (41°F,T,HE18)	4,206MW (25°F,F,HE8)
2018/2019	3,644MW (38°F,M,HE8)	4,132MW (36°F,Th,HE8)	3,833MW* (31°F,T,HE8)	4,498MW (25°F,W,HE9)
2019	3,786MW (37°F,Sa,HE10)	3,902MW* (36°F,Th,HE18)		
*On or adjacent to Federally observed holiday				
** Not adjusted for Jefferson County and other large customer exits				
Source: Puget Sound Energy FERC Form 1 Years 2008-2019, Accessed via https://elibrary.ferc.gov/, Reference Page 401b				

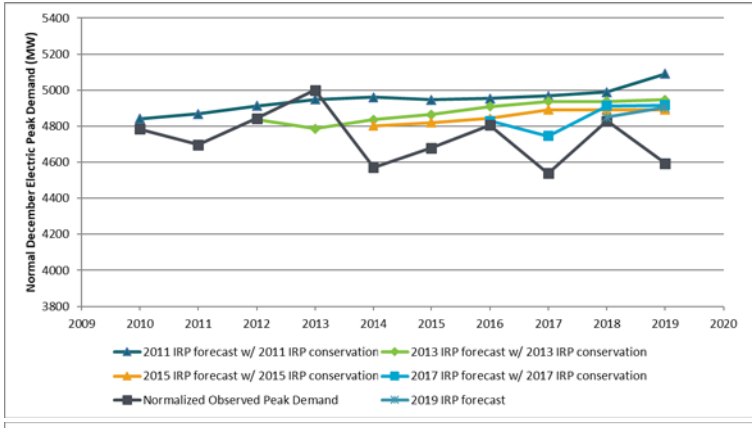
Electric: Observed system summer peaks 2008 - 2019

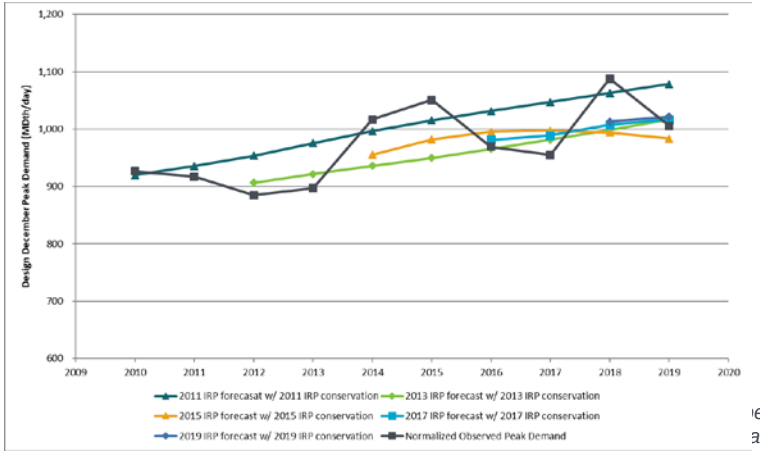
- Source: Puget Sound Energy FERC Form 1 Years 2008 – 2019 (https://elibrary.ferc.gov page 401b)
- Observed system summer peaks from 2008 – 2019 occur in the evening.
- System peak forecast is for summer weekday at 93°F.
- The system peak forecast varies between 3,380-3,500 through 2022 for July/August.
- Historical observed values includes Jefferson County through March 2013 and Microsoft through April 2019.



Summer Peak MW**, Seatac Hourly Temperature, Day of Week, and Hour		
Year	July	August
2008	2,900MW (82°F,T,HE18)	3,113MW (87°F,F,HE16)
2009	3,508MW (101°F,W,HE15)	3,164MW (82°F,W,HE13)
2010	3,123MW (94°F,Th,HE18)	3,176MW (89°F,M,HE17)
2011	2,795MW (83°F,W,HE18)	2,917MW (81°F,Th,HE17)
2012	2,820MW (78°F,Th,HE18)	3,204MW (91°F,Th,HE17)
2013	3,147MW (87°F,M,HE17)	2,973MW (84°F,M,HE18)
2014	3,123MW (87°F,W,HE18)	3,288MW (91°F,M,HE18)
2015	3,286MW (93°F,Th,HE18)	3,179MW (87°F,W,HE18)
2016	3,163MW (87°F,Th,HE18)	3,266MW (94°F,F,HE17)
2017	3,079MW (86°F,T,HE18)	3,386MW (92°F,Th,HE18)
2018	3,407MW (87°F,M,HE18)	3,423MW (93°F,W,HE18)
2019	3,026MW (85°F,F,HE18)	3,196MW (87°F,M,HE18)

Previous IRP electric and gas peak demand Forecasts





- PSE updates and adopts a new long-term forecast each year.
- Forecasts are projections of peak demand with normal/design temperatures and for peak conditions (i.e., time of day, day of week, etc.).
- For comparison purposes, actual observed December loads are “normalized.”
  - The normalized actual observations account for peak hourly temperature, monthly HDDs, and the day of week and time of day the actual peak was observed.
- These are “after DSR is applied.”

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Forecast performance discussion

- **Economic and Demographic Forecasts**
  - Economic and demographic factors are key drivers for the IRP peak demand forecast. After the 2008 recession hit the US economy, many economists assumed that the economy would recover sooner than it did. A full recovery was pushed out with each successive forecast as the U.S. economy failed to bounce back to its previous state year after year.

- **Conservation and Customer Usage**
  - Consumers have adopted energy efficient technologies that are above and beyond what is incentivized by utility-sponsored conservation programs and building codes and standards. This leads to more actual conservation taking place than forecasted.
  - Conservation programs can change over time. Programs that were not cost effective in the past, and therefore not included in the optimal bundle, can be chosen in a later IRP as cost effective. This can make an older forecast out of date, making the forecast of conservation too low and therefore the load forecast after conservation too high.
  - The Global Settlement from the 2013 General Rate Case (GRC) PSE accelerates electric conservation by 5 percent each year. This was taken into account in the 2015 IRP forecast and subsequent forecasts, but it was not included in conservation estimates for the 2011 or 2013 IRP forecasts after conservation. Similarly, gas conservation was increased 5 percent each year from the 2017 GRC and was taken into account in the 2019 IRP process forecast, but not included in prior forecasts.

- **Weather Sensitivity**
  - Over time PSE's customers' weather sensitivity has been changing. As energy efficiency measures have been implemented, customers use less energy at a given temperature, including at peak temperatures. More recent forecasts reflect this change in weather sensitivity better than older forecasts.

- **Non-design Conditions during Observed Peaks**
  - Peak values are normalized using the peak forecasting model. This model uses peak values from each month to create a relationship between peak demand, monthly demand and peak temperature. However, some of the observed December peaks shown above occurred on atypical days rather than typical days.
    - Gas peaks in 2010, 2013, 2016, and 2017 occurred on weekends, and gas peaks in 2010, 2012, and 2015 occurred on New Year's Eve
    - In 2014, the electric peak occurred on the Monday morning after Thanksgiving weekend, and in 2015 it occurred on New Year's Eve
- **Service Area Changes**
  - In March 2013, Jefferson County left the PSE service area. Jefferson County usage was included in the electric peak demand forecast in the 2011 IRP, therefore, when comparing that forecast to today's actuals, we would expect those forecasts to be higher than the actual peak demand.

Electric resource adequacy

PSE PUGET SOUND ENERGY

Participation Objectives

- PSE will inform stakeholders about the resource adequacy analysis and electric peak capacity need.

IAP2 level of participation: INFORM

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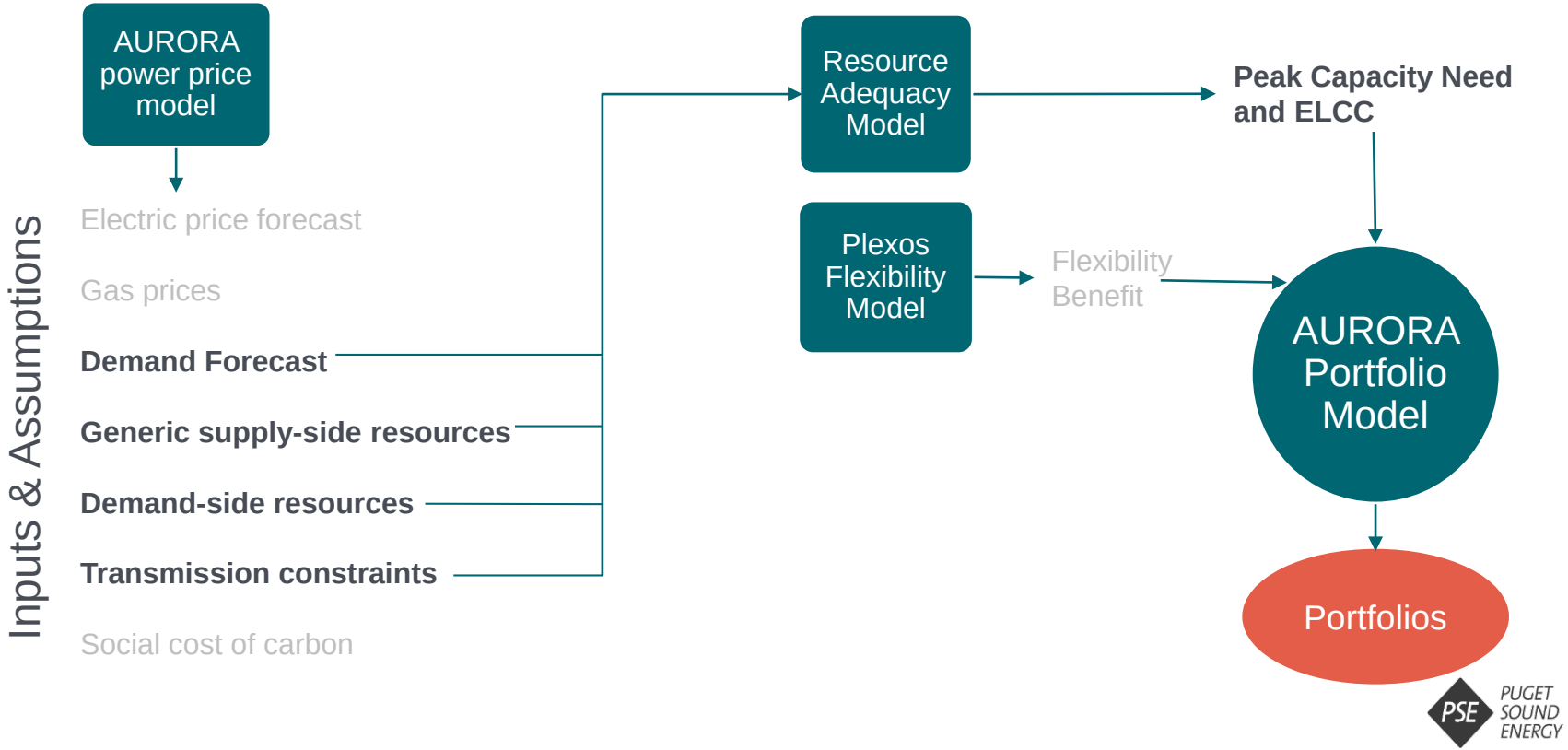
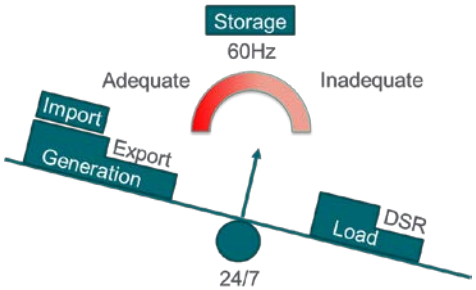
Electric IRP Models



Resource Adequacy overview

- A system is "**Resource Adequate**" if it has sufficient capacity to serve load across a broad range of weather conditions, subject to a long-run standard for frequency of reliability events.
- Resource adequacy analysis determines the amount of peak capacity needed to meet a reliability standard.
- There is no mandatory or voluntary standard for Resource Adequacy in the PNW.
  - Each Balancing Authority establishes its own standard subject to oversight by state commissions or locally-elected boards.
  - North American Electric Reliability Council (NERC) and Western Electric Coordinating Council (WECC) publish information about Resource Adequacy but have no formal governing role.



Resource Adequacy Model (RAM)

Storage **Hydro** **DR**

RAM calculates reliability metrics for high renewable systems:

- **LOLP: Loss of Load Probability**
- **LOLH: Loss of Load Hours**
- **LOLE: Loss of Load Expectation**
- **EUE: Expected Unserved Energy**
- **ELCC: Effective Load-Carrying Capability for hydro, wind, solar, storage and DR**
- **PM: Planning Margin needed to meet specified LOLP**

The resource adequacy model (RAM) evaluates adequacy through stochastic simulations over varying years of temperature/load, renewable, hydro, and stochastic forced outage conditions

- Captures thermal resource forced outages
- Captures variable availability of renewable & hydro generation
- Captures market through regional resource adequacy
- Aligns with most recent NWPCC Adequacy Assessment reliability standard

RAM calculates a number of metrics that are useful for resource planning

- Loss of Load Probability (LOLP) (%): is the probability of a shortfall (load plus reserves exceed generation) in a given year
  - Northwest Power & Conservation Council adequacy metric targets 5%
- Loss of Load Hours (LOLH) (hrs/yr): is total number of hours in a year wherein load plus reserves exceeds generation
- Loss of Load Expectation (LOLE) (days/yr): is total number of days in a year wherein load plus reserves exceeds generation
  - CAISO targets 1-in-10
- Expected Unserved Energy (EUE) (MWh/yr): is the expected unserved load plus reserves in MWh per year
- Effective Load Carrying Capability (ELCC) (%): is the additional load met by an incremental generator while maintaining the same level of system reliability (used for dispatch-limited resources such as wind, solar, storage and demand response)
- Planning Margin (PM) (%): is the resource margin above 1-in-2-year peak load, in %, that is required in order to maintain acceptable resource adequacy

Years modeled for resource adequacy analysis

(2) For an investor-owned utility, **the clean energy action plan must**:

(d) identify renewable resources, non-emitting electric generation, and distributed energy resources that may be acquired and **evaluate how each identified resource may be expected to contribute to meeting the utility's resource adequacy requirement**;

CETA – Section 14

PSE IRP start year:	2022
5-years from start:	2027 → modeled October 2027 – September 2028
10-years from start:	2031 → modeled October 2031 – September 2032

Note: The modeled year follows the hydro year (October – September) and allows the full winter and summer seasons to stay intact for the analysis. This is consistent with the Northwest and Conservation Council's GENESYS model. If PSE modeled the calendar year, it would break up the winter season (November – February).

Planning for resource adequacy

Regional planning standard: 5% LOLP

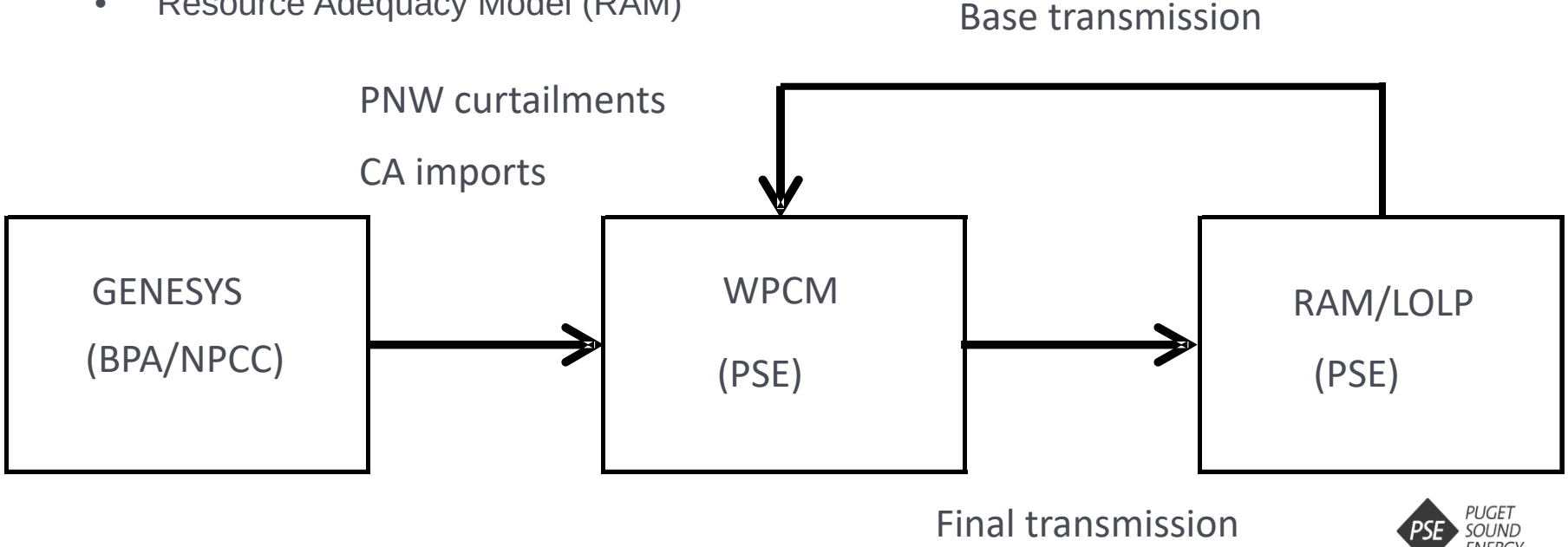
- Used by Northwest Power and Conservation Council (NWPCC)
- Consistent with WUTC guidance in 2015 IRP

What does this mean?

- Loss of load probability of any firm shortage in a given year, e.g., net demand exceeds firm supply in at least one hour
- 5% is a one-in-twenty chance in a given year
- Does not reflect magnitude or duration of shortages

Model interactions

- GENeration Evaluation SYStem Model (GENESYS)
- Wholesale Purchase Curtailment Model (WPCM)
- Resource Adequacy Model (RAM)



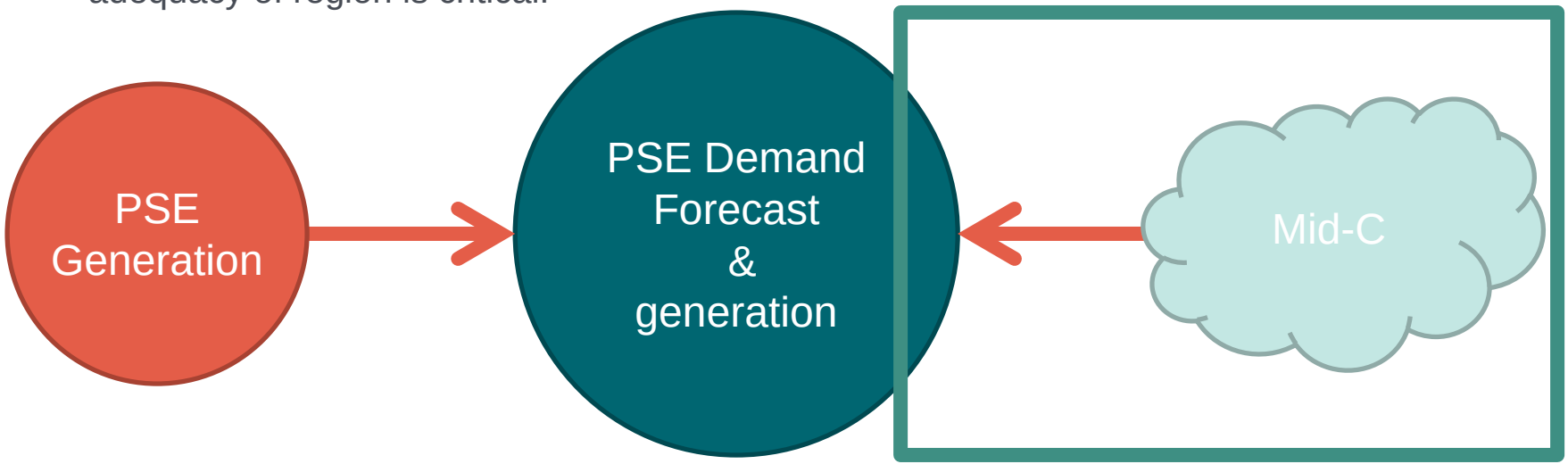
Regional view from GENESYS

- NWPCC Adequacy Assessment for 2023 GENESYS base case is used for the 2021 IRP
  - Updated for load growth and unit retirements expected in 2027 and 2031
  - Includes new PSE resource additions

- Key assumption in regional model:
  - Economics drive joint coordination of resources in the Pacific Northwest
  - No consideration of firm transmission rights
  - All PNW transmission resources can be fully utilized up to modeled limits by any entity
  - Assumes 3400 MW California import limit

PSE's system diagram for RAM

- Firm transmission to Mid-C power trading hub for short-term capacity market purchases is treated as a resource.
- PSE currently relies on 1500 MW of firm transmission to Mid-C for peak planning, so adequacy of region is critical.



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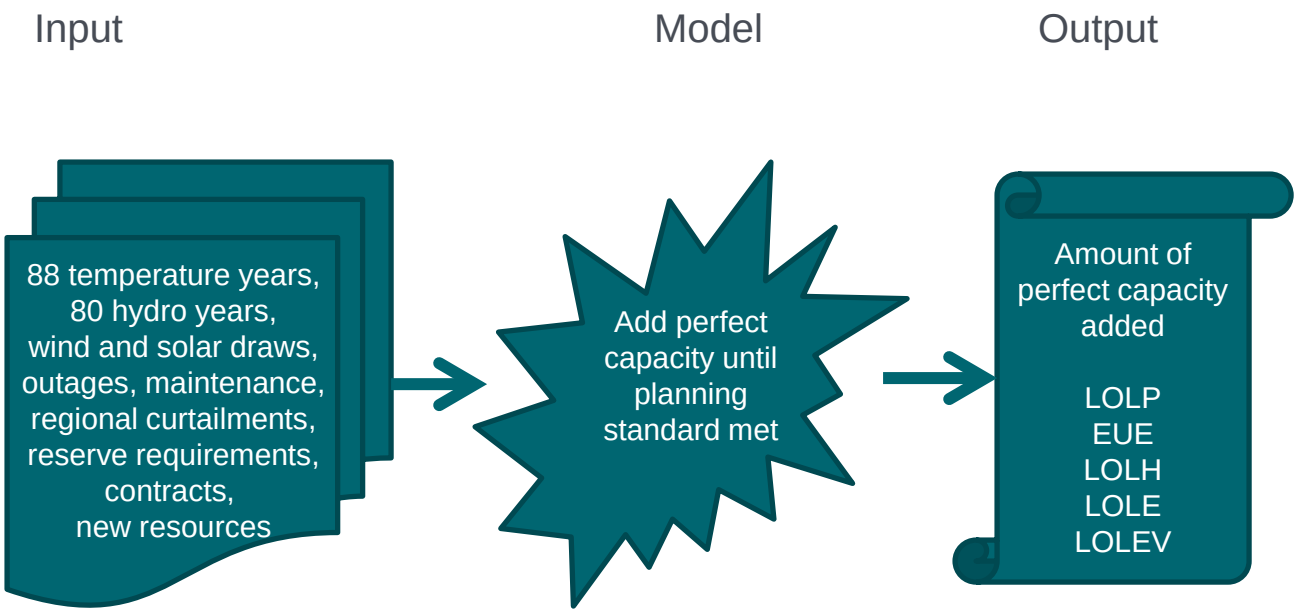
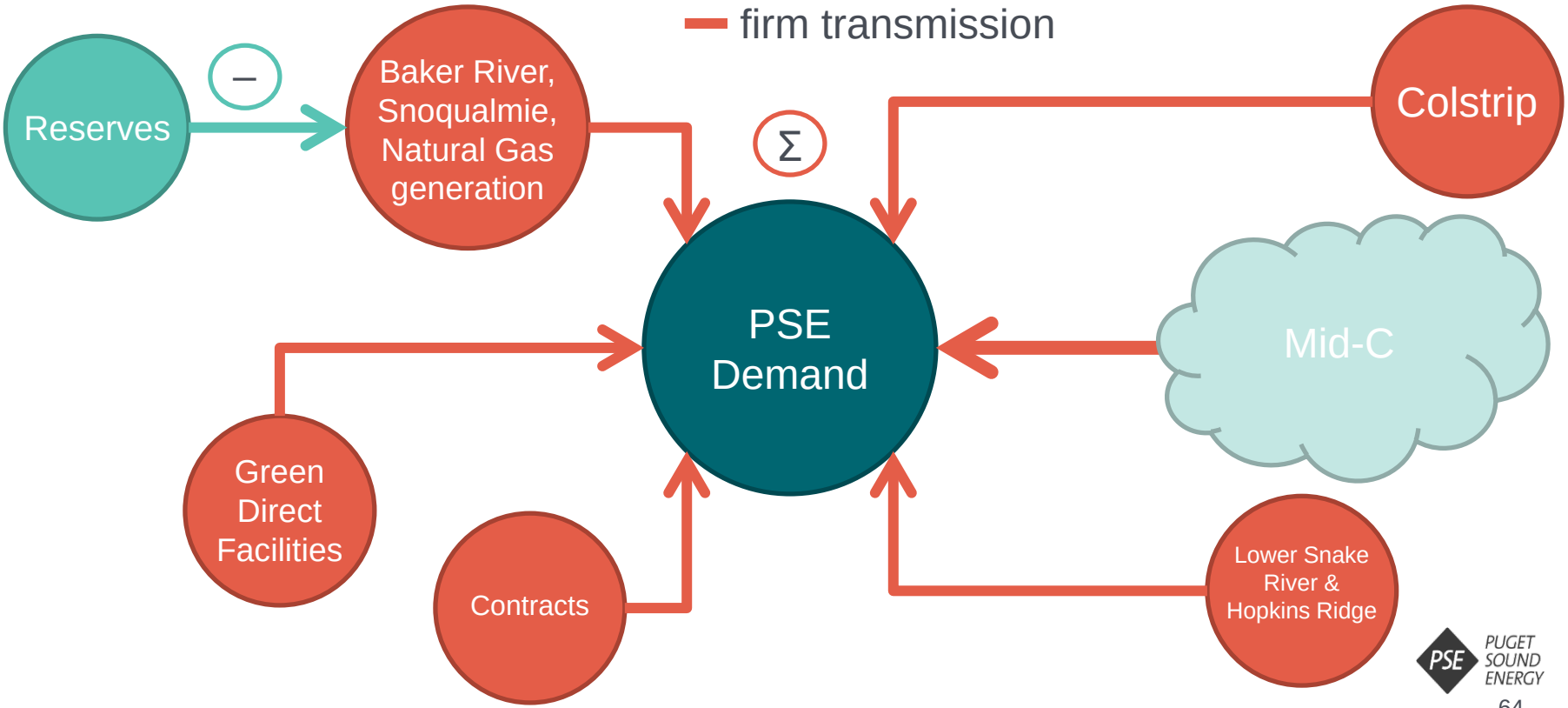
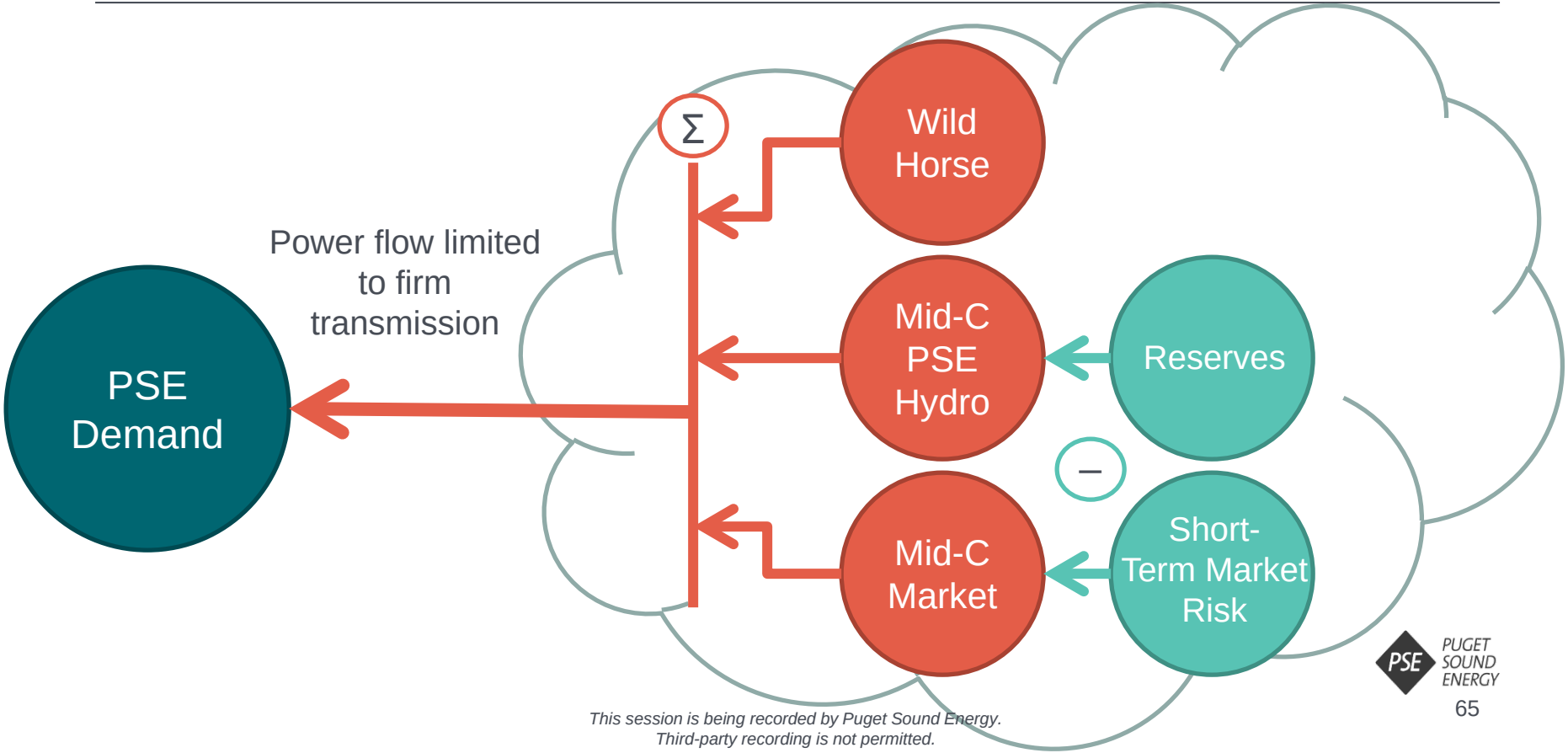
RAM inputs and outputs



RAM framework



RAM Mid-C framework



Draft PSE Resource need at 5% LOLP for 2027-2028

- Study year October 2027 – September 2028
- **1273 MW resource need** for 5% LOLP
- Reliability metrics at 5% LOLP:

Metric Name	Base System, No Added Resources	System at 5% LOLP, 1273 MW Added
LOLP	74.97%	4.99%
EUE	6667 MWh	88 MWh
LOLH	18.70 hours/year	0.16 hours/year
LOLE	4.06 days/year	0.06 days/year
LOLEV	5.46 events/year	0.06 events/year

Draft PSE Resource need at 5% LOLP for 2031-2032

- Study year October 2031 – September 2032
- **1581 MW resource need** for 5% LOLP
- Reliability metrics at 5% LOLP:

Metric Name	Base System, No Added Resources	System at 5% LOLP, 1581 MW Added
LOLP	98.61%	4.99%
EUE	28551 MWh	188 MWh
LOLH	85.81 hours/year	0.34 hours/year
LOLE	18.96 days/year	0.07 days/year
LOLEV	24.51 events/year	0.09 events/year

Draft Planning Margin

The planning margin (expressed as percent) is determined as:

Planning Margin = (Peak Need – Normal Peak Load) / Normal Peak Load

Where Peak Need (in MW) is the resource capacity that meets the reliability standard established in a probabilistic resource adequacy model (Peak Capacity Need from LOLP) in addition to the peak capacity contribution from existing resources (Total Resources) and short-term Mid-C bilateral market purchases.

	Winter Peak 2027	Winter Peak 2031
Peak Capacity Need to meet 5% LOLP	1,273 MW	1,581 MW
Total Resources Peak Capacity Contribution	3,326 MW	3,316 MW
Short-term Market Purchases	1,492 MW	1,497 MW
Peak Need	6,091 MW	6,394 MW
Normal Peak Load	4,949 MW	5,199 MW
Planning Margin	**23.1%**	**23.0%**

Note: planning margin includes contingency and balancing reserves

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Electric resource need

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Participation Objectives

- PSE will inform stakeholders about the electric resource need.

IAP2 level of participation: INFORM

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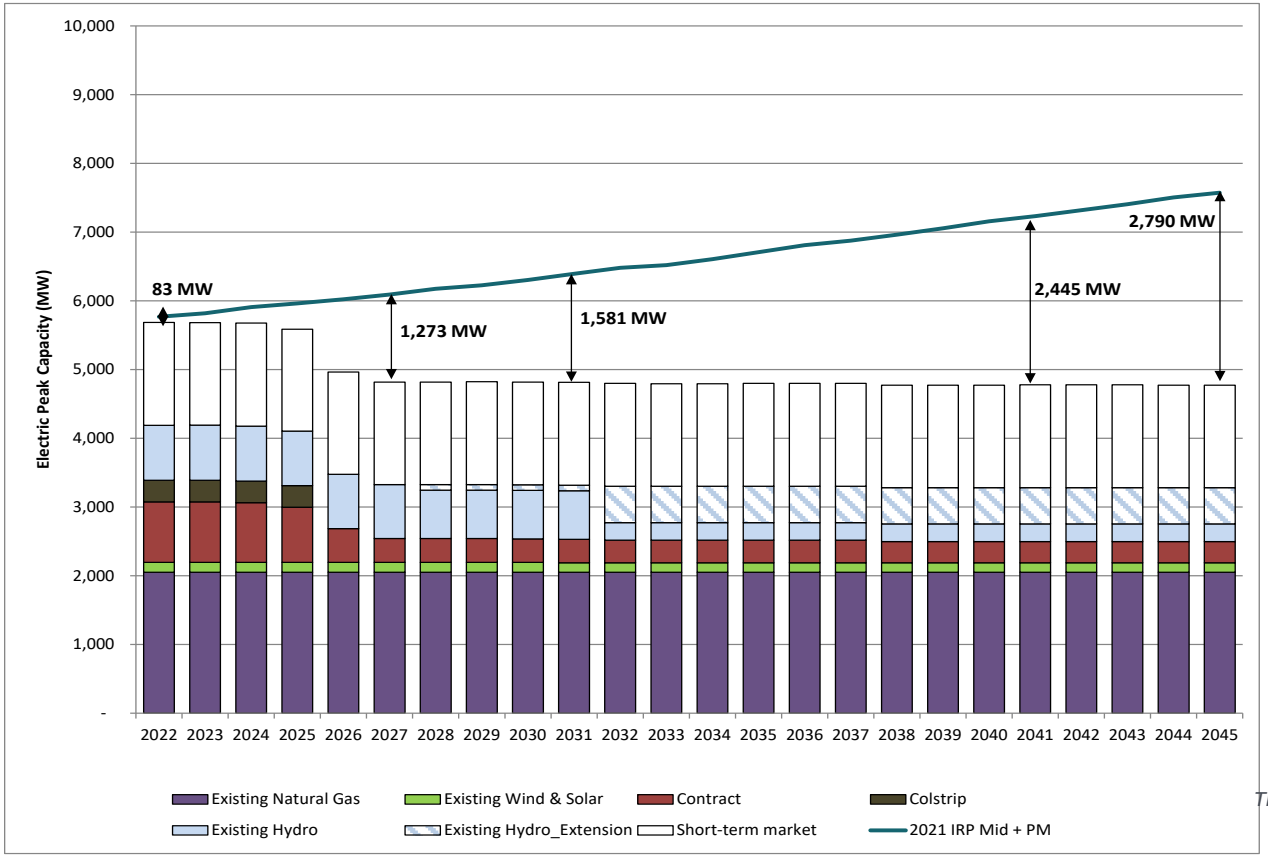
Draft electric peak capacity resource need

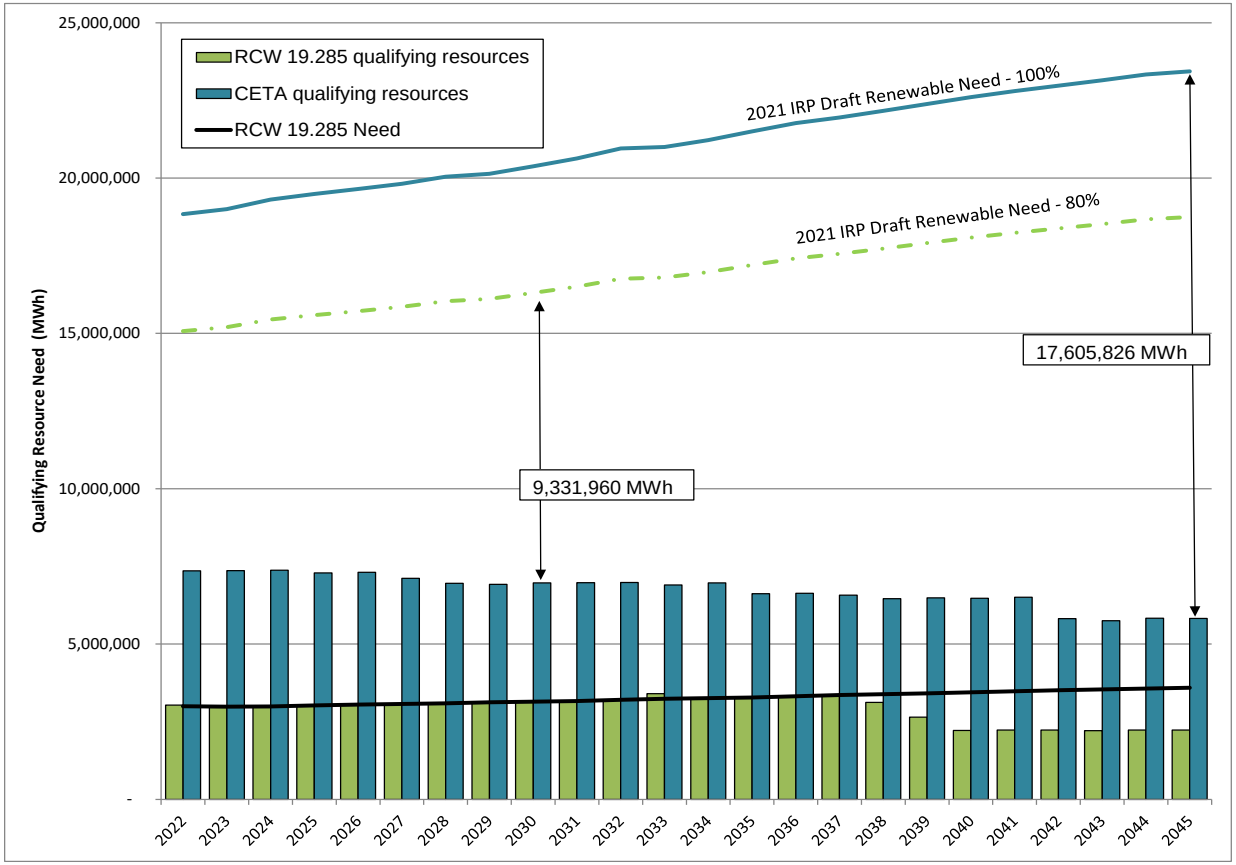


Notes:

1. 2021 IRP peak capacity need does not include any demand side resources. Demand side resources will be determined as part of the 2021 IRP and include conservation (energy efficiency), codes and standards, distribution efficiency, or demand response.

2. 2021 IRP peak capacity need does not include 2018 RFP resources under negotiations. Peak need will be updated for new resources.

Draft electric renewable need



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2. 2021 IRP peak capacity need does not include 2018 RFP resources under negotiations. Peak need will be updated for new resources.

Wrap-up

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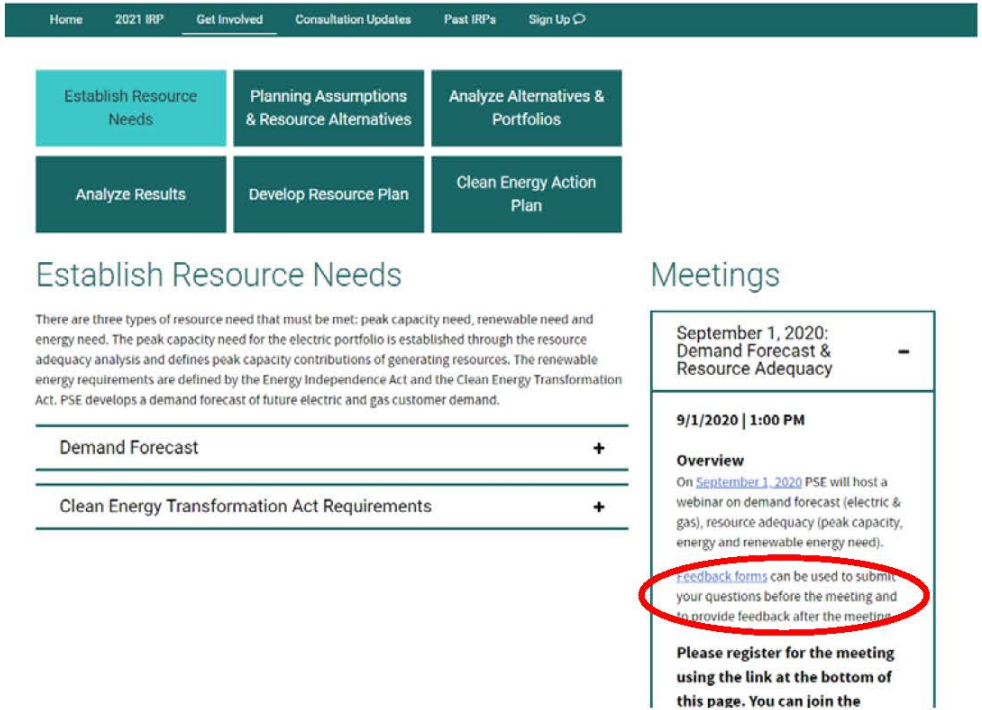
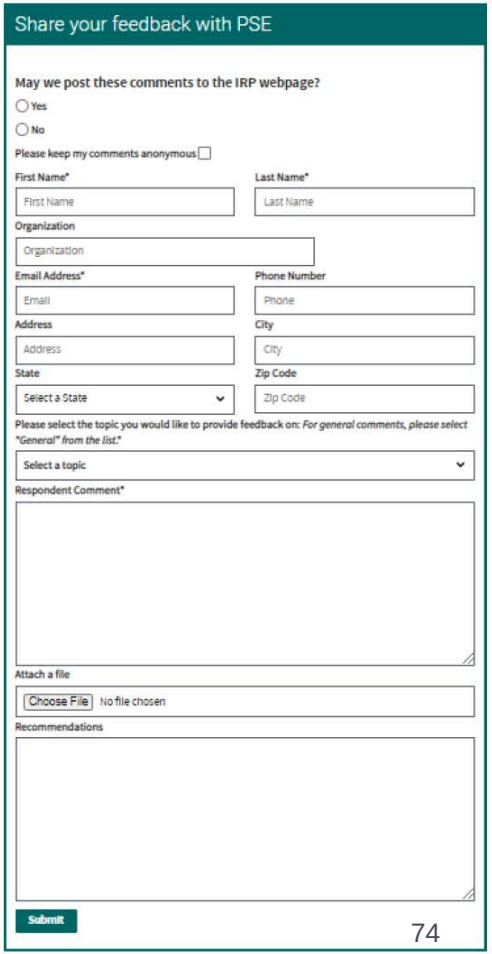
Feedback Form





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**

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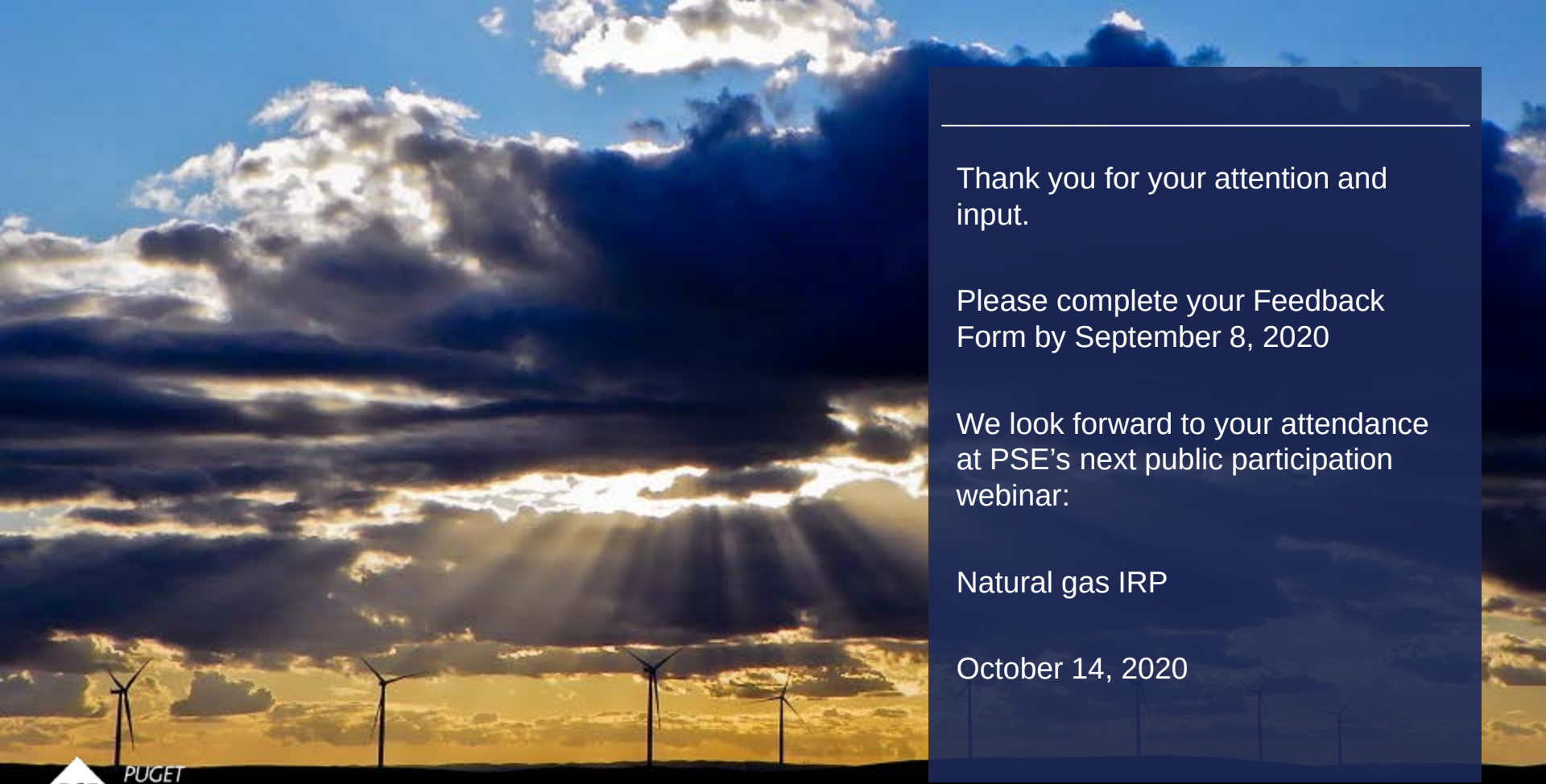
Next steps

- Submit Feedback Form to PSE by **September 8, 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 **September 15, 2020**
- The Consultation Update will be shared on **September 22, 2020**

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

Date	Topic
October 14, 1:00 – 5:00 pm	Natural gas IRP: design peak day, portfolio modeling and draft results, resource alternatives, scenarios and portfolio sensitivities review
October 20, 1:30 – 4:30 pm	Portfolio sensitivities draft results Flexibility analysis
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 Stochastic analysis Wholesale market risk



Thank you for your attention and input.

Please complete your Feedback Form by September 8, 2020

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

Natural gas IRP

October 14, 2020

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