EXH. CPC-3
DOCKETS UE-22___/UG-22___
2022 PSE GENERAL RATE CASE
WITNESS: COLIN P. CROWLEY

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY,** **Respondent.**	**Docket UE-22____** **Docket UG-22____**

SECOND EXHIBIT (NONCONFIDENTIAL) TO THE
PREFILED DIRECT TESTIMONY OF

COLIN P. CROWLEY

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 31, 2022

2017 PSE Integrated Resource Plan

Chapters 1-8

November 2017

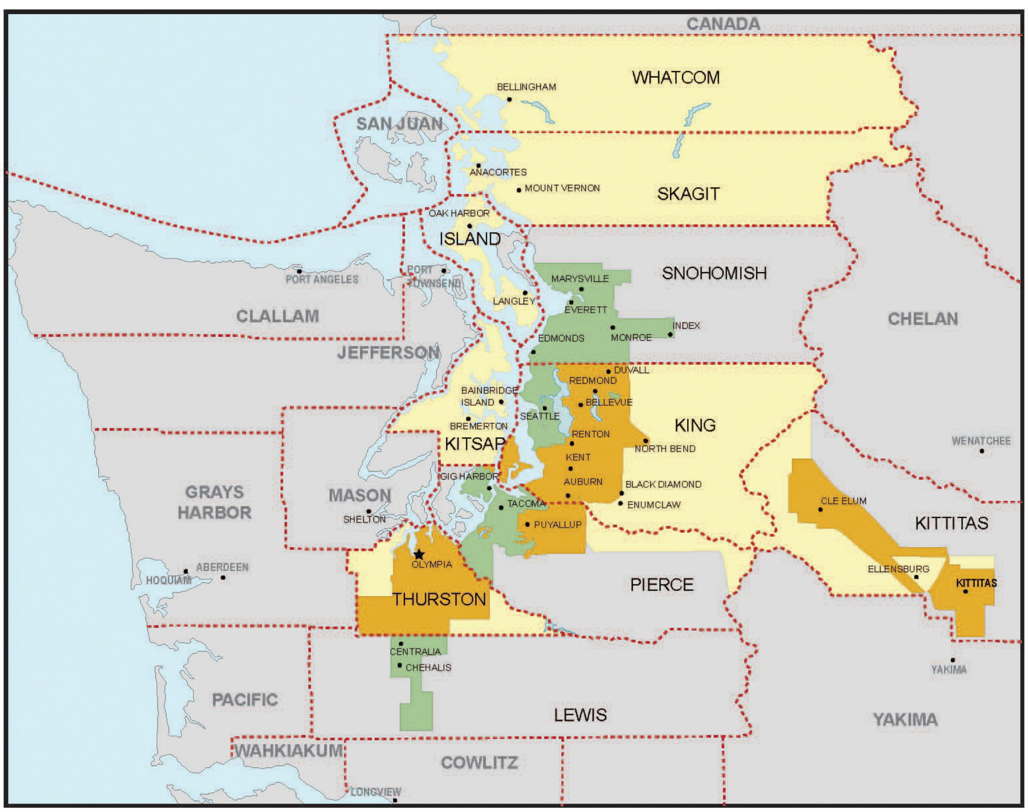
pse.com

PSE PUGET SOUND ENERGY

2017 PSE Integrated Resource Plan

About PSE

Puget Sound Energy is Washington state's oldest local energy company, providing electric and natural gas service to homes and businesses primarily in the vibrant Puget Sound area. Our service area covers more than 6,000 square miles, stretching from south Puget Sound to the Canadian border, and from central Washington's Kittitas Valley west to the Kitsap Peninsula. We serve more than 1.1 million electric customers and more than 800,000 natural gas customers in 10 counties.



Combined electric and natural gas service
Electric service
Natural gas service

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2017 PSE Integrated Resource Plan

Key Definitions and Acronyms

Term/Acronym	Definition
AARG	average annual rate of growth
AB32	The California Global Warming Solutions Act of 2006, which mandates a carbon price be appied to all power generated in or sold into that state.
ACE	Area Control Error
AECO	Alberta Energy Company, a natural gas hub in Alberta, Canada.
AMI	advanced metering infrastructure
AMR	automated meter reading
aMW	The average number of megawatt-hours (MWh) over a specified time period; for example, 175,200 MWh generated over the course of one year equals 20 aMW (175,200 / 8,760 hours).
AOC	Administrative Order Of Consent
ARMA	autoregressive moving average
AURORA	One of the models PSE uses for integrated resource planning. AURORA uses the western power market to produce hourly electricity price forecasts of potential future market conditions.
BA	Balancing Authority, the area operator that matches generation with load.
BAA	Balancing Authority area
BACT	Best available control technology, required of new power plants and those with major modifications, pursuant to EPA regulations.
balancing reserves	Reserves sufficient to maintain system reliability within the operating hour; this includes frequency support, managing load and variable resource forecast error, and actual load and generation deviations. Balancing reserves must be able to ramp up and down as loads and resources fluctuate instantaneously each hour.
BART	Best available retrofit technology, an EPA requirement for certain power plant modifications.
Base Scenario	In an analysis, a set of assumptions that is used as a reference point against which other sets of assumptions can be compared. The analysis result may not ultimately indicate that the Base Scenario assumptions should govern decision-making.

Term/Acronym	Definition
Baseload gas plants	Baseload generators are designed to operate economically and efficiently over long periods of time, which is defined as more than 60 percent of the hours in a year. Generally combined-cycle combustion turbines (CCCTs).
baseload resources	Baseload resources produce energy at a constant rate over long periods at lower cost relative to other production facilities; typically used to meet some or all of a region's continuous energy need.
Bcf	billion cubic feet
BEM	Business Energy Management sector, for electric energy efficiency programs.
BES	Bulk Electric System
BPA	Bonneville Power Administration
BSER	Best system of emissions reduction, an EPA requirement for certain power plant construction or modification.
BTU	British thermal units
CAISO	California Independent System Operator
capacity factor	The ratio of the actual generation from a power resource compared to its potential output if it was possible to operate at full nameplate capacity over the same period of time.
CAP	Corrective action plans. A series of operational steps used to prevent system overloads or loss of customers' power.
CAR	the Washington state Clean Air Rule
CARB	California Air Resources Board
CCCT	Combined-cycle combustion turbine. These are baseload gas plants that consist of one or more combustion turbine generators equipped with heat recovery steam generators that capture heat from the combustion turbine exhaust and use it to produce additional electricity via a steam turbine generator.
CCR	coal combustion residuals
CCS	carbon capture and sequestration
CDD	cooling degree day
CEC	California Energy Commission
CI	confidence interval
CNG	compressed natural gas
CO2	carbon dioxide
CO2e	carbon dioxide equivalents
COE	U.S. Army Corps of Engineers
contingency reserves	Reserves added in addition to balancing reserves; contingency reserves are intended to bolster short-term reliability in the event of forced outages and are used for the first hour of the event only. This capacity must be available within 10 minutes, and 50 percent of it must be spinning.

Term/Acronym	Definition
CPI	consumer price index
CPP	federal Clean Power Plan
CPUC	California Public Utilities Commission
CRAG	PSE's Conservation Resource Advisory Group
CT	Natural gas-fired combustion turbine, also referred to as a "peaker."
CVR	conservation voltage reduction
Demand response	Flexible, price-responsive loads, which may be curtailed or interrupted during system emergencies or when wholesale market prices exceed the utility's supply cost.
demand-side resources	These resources reduce load and originate on the customer side of the meter. PSE's primary demand-side resources are energy efficiency and customer programs.
Deterministic analysis	Deterministic analysis identifies the least-cost mix of demand-side and supply-side resources that will meet need, given the set of static assumptions defined in the scenario or sensitivity.
distributed generation	Small-scale electricity generators like rooftop solar panels, located close to the source of the customer's load.
DOE	U.S. Department of Energy
DSM	demand-side measure
DSO	Dispatcher Standing Order
DSR	demand-side resources
Dth	dekatherms
dual fuel	Refers to peakers that can operate on either natural gas or distillate oil fuel.
EIA	U.S. Energy Information Agency
EIM	The Energy Imbalance Market operated by CAISO.
EIS	environmental impact statement
EITEs	energy-intensive, trade-exposed industies
ELCC	Expected load carrying capacity. The peak capacity contribution of a resource relative to that of a gas-fired peaking plant.
ELCC	expected load carrying capacity
EMC	Energy Management Committee
energy need	The difference between forecasted load and existing resources.
energy storage	A variety of technologies that allow energy to be stored for future use.
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPS	Washington state law RCW 80.80.060(4), GHG Emissions Performance Standard
ERU	Emission reduction units. An ERU represents one MtCO2 per year.

Term/Acronym	Definition
ESS	energy storage systems
EUE	Expected unserved energy, a reliability metric measured in MWhs that describes the magnitude of electric service curtailment events (how widespread outages may be).
EV	electric vehicle
FERC	Federal Energy Regulatory Commission
FIP	final implementation plan
GDP	gross domestic product
GENESYS	The resource adequacy model used by the Northwest Power and Conservation Council (NPCC).
GHG	greenhouse gas
GPM	gas portfolio model
GRC	General Rate Case
GTN	Gas Transmission Northwest
GW	gigawatt
HDD	heating degree day
HVAC	heating, ventilating and air conditioning
I-937	Initiative 937, Washington state's renewable portfolio standard (RPS), a citizen-based initiative codified as RCW 19.285, the Energy Independence Act.
iDOT	Investment Optimization Tool. An analysis tool that helps to identify a set of projects that will create maximum value.
IGCC	Integrated gasification combined-cycle, generally refers to a model in which syngas from a gasifier fuels a combustion turbine to produce electricity, while the combustion turbine compressor compresses air for use in the production of oxygen for the gasifier.
intermittent resources	Resources that provide power that offers limited discretion in the timing of delivery, such as wind and solar power.
IOU	investor-owned utility
IPP	independent power producer
IRP	integrated resource plan
IRPAG	PSE's Integrated Resource Plan Advisory Group
ISO	independent system operator
ITA	independent technical analysis
ITC	investment tax credit
KORP	Kingsvale-Oliver Reinforcement Project pipeline proposal
kV	kilovolt
kW	kilowatt
kWh	kilowatt hours

Term/Acronym	Definition
LAES	liquid air energy storage
LNG	liquified natural gas
load	The total of customer demand plus planning margins and operating reserve obligations.
LOLH (or LOLE)	Loss of load hours (or loss of load energy), a reliability metric focused on the duration of electric service curtailment events (how long outages may last).
LOLP	Loss of load probability, a reliability metric focused on the likelihood of an electric service curtailment event happening.
LP-Air	vaporized propane air
LSR	Lower Snake River Wind Facility
MATS	Mercury Air Toxics Standard
MDEQ	Montana Department of Environmental Quality
MDQ	maximum daily quantity
MDth	thousand dekatherms
MEIC	Montana Environmental Information Center
MESA	Modular Energy Storage Architecture. A protocol for communications between utility control centers and energy storage systems.
Mid-Columbia (Mid-C) market hub	The principle electric power market hub in the Northwest and one of the major trading hubs in the WECC, located on the Mid-Columbia River.
MMBtu	million British thermal units
MMtCO2e	million metric tons of CO2 equivalent
MSA	metropolitan statistical area
MW	megawatt
MWh	megawatt hour
NAAQS	National Ambient Air Quality Standards, set by the EPA, which enforces the Clean Air Act, for six criteria pollutants: sulfur oxides, nitrogen dioxide, particulate matter, ozone, carbon monoxide and lead.
nameplate capacity	The maximum capacity that a natural gas fired unit can sustain over 60 minutes when not restricted to ambient conditions.
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Council
net maximum capacity	The capacity a unit can sustain over a specified period of time – in this case 60 minutes – when not restricted by ambient conditions or deratings, less the losses associated with auxiliary loads.
net metering	A program that enables customers who generate their own renewable energy to offset the electricity provided by PSE.
NGV	natural gas vehicles
NO2	nitrogen dioxide
NOS	Network Open Season, a BPA transmission planning process

Term/Acronym	Definition
NO_x	nitrogen oxides
NPCC	Northwest Power & Conservation Council
NPV	net present value
NRC	Nuclear Regulatory Commission
NREL	National Renewables Energy Laboratories
NRF	Northwest Regional Forecast of Power Loads and Resources, the regional load/balance study produced by PNUCC.
NSPS	New source performance standards, new plants and those with major modifications must meet these EPA standards before receiving permit to begin construction.
NUG	non-utility generator
NWE	NorthWestern Energy
NWGA	Northwest Gas Association
NWP	Northwest Pipeline
NWPP	Northwest Power Pool
OASIS	Open Access Same-Time Information System
OATT	Open Access Transmission Tariff
OTC	once-through cooling
PACE	PacifiCorp East
PACW	Pacificorp West
PCA	power cost adjustment (electric)
PCORC	power cost only rate case
peak need	Electric or gas sales load at peak energy use times.
peaker (or peaking plants)	Peaker is a term used to describe generators that can ramp up and down quickly in order to meet spies in need. They are not intended to operate economically for long periods of time like baseload generators.
peaking resources	Quick-starting electric generators that can ramp up and down quickly in order to meet short-term spikes in need, or gas sales resources used to meet load at times when demand is highest.
PEFA	ColumbiaGrid's planning and expansion functional agreement, which defines obligations under its planning and expansion program.
PEV	plug-in electric vehicle
PG&E	Pacific Gas and Electric Company
PGA	purchased gas adjustment
PGE	Portland General Electric
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIPES Act	Pipeline Inspection, Protection, Enforcement, and Safety Act (2006)

Term/Acronym	Definition
planning margin or PM	These are amounts over and above customer peak demand that ensure the system has enough flexibility to handle balancing needs and unexpected events.
planning standards	The metrics selected as performance targets for a system's operation.
PLEXOS	An hourly and sub-hourly chronological production simulation model that utilizes mixed-integer programming (MIP) to simulate unit commitment of resources at a day-ahead level, and then simulate the re-dispatch of these resources in real-time to match changes in supply and demand on a 5-minute basis.
PM	particulate matter
PNUCC	Pacific Northwest Utilities Coordinating Committee
PNW	Pacific Northwest
portfolio	A specific mix of resources to meet gas sales or electric load.
PPA	Purchased power agreement. A bilateral wholesale or retail power short-term or long-term contract, wherein power is sold at either a fixed or variable price and delivered to an agreed-upon point.
PRP	Pipeline Replacement Program
PSE	Puget Sound Energy
PSIA	Pipeline Safety Improvement Act (2002)
PSM	Portfolio screening model, a model PSE uses for integrated resource planning, which tests electric portfolios to evaluate PSE's long-term revenue requirements for those portfolios.
PSRC	Puget Sound Regional Council
PTC	Production Tax Credit, a federal subsidy for production of renewable energy that applied to projects that began construction in 2013 or earlier. When it expired at the end of 2014, it amounted to $23 per MWh for a wind project's first 10 years of production.
PTP	Point-to-point transmission service, meaning the reservation and transmission of capacity and energy on either a firm or non-firm basis from the point of receipt (POR) to the point of delivery (POD).
PTSA	Precedent Transmission Service Agreement
PUD	public utility district
pumped hydro	Pumped hydro facilities store energy in the form of water, which is pumped to an upper reservoir from a second reservoir at a lower elevation. During periods of high electricity demand, the stored water is released through turbines to generate power in the same manner as a conventional hydropower station.
PV	photovoltaic
R&D	research and development
RAM	Resource Adequacy Model. RAM analysis produces reliability metrics (EUE, LOLP, LOLH) that allow us to asses physical resource adequacy.

Term/Acronym	Definition
rate base	The amount of investment in plant devoted to the rendering of service upon which a fair rate of return is allowed to be earned. In Washington state, rate base is valued at the original cost less accumulated depreciation and deferred taxes.
RCRA	Resource Conservation Recovery Act
RCW	Revised Code of Washington
RCW 19.285	Washington's state's Energy Independence Act, commonly referred to as the state's renewable portfolio standard (RPS)
RCW 80.80	Washington state law that sets a generation performance standard for electric generating plants that prohibits Washington utilities from building plants or enteringinto long-term electricity purchase contracts from units that emit more than 970 pounds of GHGs per MWh.
REC	Renewable energy credit. RECs are intangible assets which represent the environmental attributes of a renewable generation project – such as a wind farm – and are issued for each MWh of energy generated from such resources.
REC banking	Washington's renewable portfolio standard allows for RECs unused in the current year to be "banked" and used in the following year.
redirected transmission	"Redirecting" transmission means moving a primary receipt point on BPA's system. According to BPA's business practice, PSE can redirect an existing long-term or short-term, firm or non-firm transmission that it has reserved on BPA's transmission system. BPA will grant the redirect request as long as there is sufficient capacity on the system to accommodate the change.
regulatory lag	The time that elapses between establishment of the need for funds and the actual collection of those funds in rates.
REM	Residential Energy Management sector, in energy efficiency programs.
repowering	Refurbishing or renovating a plant with updated technology to qualify for Renewable Production Tax Credits under the PATH Act of 2015.
revenue requirement	Rate Base x Rate of Return + Operating Expenses
RFP	request for proposal
RPS	Renewable portfolio standard. It requires electricity retailers to acquire a minimum percentage of their power from renewable energy resources. Washington state mandates 3 percent by 2012, 9 percent by 2016 and 15 percent by 2020.
RTO	regional transmission organization
SCADA	supervisory control and data acquisition
SCCT	Simple-cycle combustion turbine, natural gas-fired unit used for meeting peak resource need (also called a "peaker")
scenario	A consistent set of data assumptions that defines a specific picture of the future; takes holistic approach to uncertainty analysis.
SCR	selective catalytic reduction

Key Definitions and Acronyms

Term/Acronym	Definition
SENDOUT	The deterministic gas portfolio model used to help identify the long-term, least-cost combination of integrated supply- and demand-side resources that will meet stated loads.
sensitivity	A set of data assumptions based on the Base Scenario in which only one input is changed. Used to isolate the effect of a single variable.
SEPA	Washington State Environmental Policy Act
SIP	State Implementation Plan
SNCR	selective non-catalytic reduction
SO2	sulfur dioxide
SOFA system	separated over-fire air system
Solar PV	solar photovoltaic technology
Stochastic analysis	Stochastic risk analysis deliberately varies the static inputs to the deterministic analysis, to test how different portfolios perform with regard to cost and risk across a wide range of potential future power prices, gas prices, hydro generation, wind generation, loads, plant forced outages and CO2 prices.
supply-side resources	Resources that generate or supply electric power, or supply natural gas to gas sales customers. These resources originate on the utility side of the meter, in contrast to demand-side resources.
T&D	transmission and distribution
TAG	Technical Advisory Group
TailVar90	A metric for measuring risk defined as the average value of the worst 10 percent of outcomes.
TCPL-Alberta	TransCanada's Alberta System (also referred to as TC-AB)
TCPL-British Columbia	TransCanada's British Columbia System (also referred to as TC-BC)
TC-Foothills	TransCanada-Foothills Pipeline
TC-GTN	TransCanada-Gas Transmission Northwest Pipeline
TC-NGTL	TransCanada-Nova Gas Transmission Pipeline
TEPPC	WECC Transmission Expansion Planning Policy Committee
TF-1	Firm gas transportation contracts, available 365 days each year.
TF-2	Gas transportation service for delivery or storage volumes generally intended for use during the winter heating season only.
thermal resources	Electric resources that use carbon-based fuels to generate power.
TOP	transmission operator
transmission redirect	"Redirecting" transmission means moving a primary receipt point on BPA's system. According to BPA's business practice, PSE can redirect an existing long-term or short-term, firm or non-firm transmission that it has reserved on BPA's transmission system. BPA will grant the redirect request as long as there is sufficient capacity on the system to accommodate the change.

Term/Acronym	Definition
Transport customers	Customers who acquire their own natural gas from third-party suppliers and rely on the gas utility for distribution service.
UPC	use per customer
VectorGas	An analysis tool that facilitates the ability to model price and load uncertainty.
VERs	Variable energy resources
WAC	Washington Administrative Code
WACC	weighted average cost of capital
WCI	Western Climate Initiative
WCPM	Wholesale Market Curtailment Model
WECC	Western Electricity Coordinating Council
WECo	Western Energy Company
WEI	Westcoast Energy, Inc.
Westcoast	Westcoast Energy, Inc
Wholesale market purchases	Generally short-term purchases of electric power made on the wholesale market.
WSPP	Western Systems Power Pool
WUTC	Washington Utilities and Transportation Commission
ZLD	zero liquid discharge

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2017 PSE Integrated Resource Plan

Executive Summary

The IRP is best understood as a forecast of resource additions that appear to be cost effective given what we know today about the future. We know these forecasts will change as the future unfolds and conditions change. PSE's commitments to action are driven by what we learn through the planning exercise. These commitments are embodied in the Action Plans.

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1. OVERVIEW

The resource plan forecast presented in the 2017 IRP presents exciting changes in resource outlook and preserves a strategic agility that will allow PSE to respond to rapidly changing conditions as renewable and storage technologies mature, as the impacts of carbon regulation and climate change become clearer, and as customer behavior changes. The forecast relies on additional transmission to market to meet peak capacity need, continued strong investment in conservation, utility-scale solar to meet renewable resource need, and energy storage. While many of these changes have been on the horizon for some time and discussed extensively in the media and by advocacy groups, this is the first time that some appear to truly be part of a low-cost, low-risk resource plan for PSE's customers.

Exciting Changes in Resource Outlook

- **EMERGENCE OF SOLAR POWER**. Wind has dominated new renewable resource additions in the Pacific Northwest. This IRP finds solar power in eastern Washington appears to be a cost-effective renewable resource for the first time.
- **ENERGY STORAGE AND DEMAND RESPONSE INSTEAD OF FOSSIL FUEL GENERATION**. Energy storage and demand response resources can help push PSE's need for capacity resources out eight years, to 2025. This is a low-cost and low-risk strategy that helps avoid locking PSE's customers into a long-lived fossil fuel plant while alternative technology is evolving rapidly and greenhouse gas policies are being developed.
- **REDIRECTING TRANSMISSION TO INCREASE MARKET ACCESS**. PSE can reassign some transmission from intermittent wind resources to the Mid-C market in a way that will allow PSE to expand its access to short-term bilateral markets on a firm basis, while still allowing us to deliver that wind energy to our customers. Increasing market reliance is low cost alternative for our customers. This IRP includes a comprehensive analysis of market risk in relation to Pacific Northwest's resource adequacy outlook, built on Northwest Power and Conservation Council (NPCC), Bonneville Power Administration (BPA) and Pacific Northwest Utilities Conference Committee (PNUCC) analyses. It finds the region is nearly meeting its resource adequacy target, and with continued strong conservation programs, it may become even more reliable in the future. This is not without risk, but PSE has analyzed these risks extensively and concluded the risks are reasonable. Redirecting transmission supports the strategy to push out the need for additional fossil fuel plants to 2025, while rapidly evolving technology drives down the

costs of resource alternatives and uncertainty in greenhouse gas regulation can be resolved.

- **ENERGY EFFICIENCY.** One thing remains the same in this IRP – PSE's commitment to strong investment in encouraging customers to use energy more efficiently. Devoting significant resources to help our customers use energy more wisely is a tried and true way of reducing costs, cost risks and the environmental footprint of PSE's operations as well as our customers'.
- **NATURAL GAS UTILITY RESOURCE PLAN.** Strategic agility is also the hallmark of the natural gas utility resource plan. Continued conservation investment, completion of the Tacoma LNG peaking facility and the option to upgrade PSE's propane peaking facility (Swarr) push out the need to lock our natural gas customers into lengthy contracts to expand regional pipeline infrastructure. Again, this is a low-cost and low-risk resource strategy for our gas customers.

Impact of Uncertainty in Carbon Regulation

PSE recognizes the importance of mitigating climate change. The Base Scenario in this IRP models the impacts of Washington state's Clean Air Rule (CAR) and the federal Clean Power Plan (CPP). Even though the fate of both regulatory programs is uncertain at this time, some form of carbon regulation is likely to be enacted during the next 20 years, so it is important to reflect this possibility in the analysis. We expect these rules to evolve and for new ones to be developed. The resource plan presented here gives us the flexibility and agility to adapt to changes without having to commit our customers to long-lived fossil fuel resources at this time.

The design of carbon regulation is critically important to achieving meaningful carbon reductions and avoiding unintended consequences. For instance, the IRP analysis indicates that CPP rules may distort the value of peaking plants, making them appear more economic than energy storage. And, it is likely that the CAR will shift dispatch to less carbon-efficient plants by focusing only on Washington gas-fired plants, which are some of the most carbon-efficient in the Western Energy Coordinating Council (WECC), increasing carbon emissions in the region even though emissions in Washington state decline.

PSE is committed to working with policy makers and others to help modify and create approaches to greenhouse gas regulation that are effective at reducing carbon emissions in a way that minimizes the impact of costs on our customers. See Chapter 3, Planning Environment, for further discussion of this issue.

The Future of Colstrip

The coal-fired Colstrip plant emits a significant amount of greenhouse gasses, but it has historically been a very low cost resource, and PSE is obligated to minimize costs to customers within existing legal frameworks. The multiple ownership structure of Colstrip includes an independent power producer and utilities that serve load in six states, which creates a very complex decision-making process.

Units 1 & 2 are scheduled to retire no later than July, 2022, and the analysis indicates that retiring those plants earlier would be uneconomic. After Units 1 & 2 retire, additional conservation, demand response, energy storage batteries and firm transmission to market are expected to meet resource needs until 2025.

The continued operation of Units 3 & 4 is highly dependent on future environmental regulation. Analysis in this IRP demonstrates that a carbon regulation policy that adds to the dispatch cost of Colstrip would challenge its continued economic operation. Absent such a policy, Colstrip 3 & 4 appear to be economic to operate for the foreseeable future.

In the absence of Colstrip Units 3 & 4, the analysis currently indicates that peaking plants are the most cost-effective alternative to meeting need, but this conclusion will be revisited as the entire region continues to invest heavily in energy efficiency, emerging technologies continue to evolve, and the impacts of carbon regulation become clearer.

A Forecast, Not a Prescription

The IRP process is a legal mandate that requires PSE to identify the least cost combination of energy conservation and energy supply resources to meet the needs of our customers. Specific energy efficiency and supply-side resource decisions are not made in the context of the IRP. The primary value of the IRP is what we learn from the opportunity to do three things: develop key analytical tools to aid in making prudent decision making for long-term energy efficiency and energy supply, create and manage expectations about the near future, and think broadly about the next two decades.

The portfolio analysis presented in the IRP is best understood as a forecast of resource additions that appear to be cost effective given what we know today about the future. We know these forecasts will change as the future unfolds and conditions change. PSE's commitments to action are driven by what we learn through the planning exercise. These commitments are embodied in the Action Plans presented next.

2. ACTION PLANS

Action Plans vs. Resource Plan Forecasts

In recent years, the IRP has attracted more attention from policy makers, the public and advocacy groups. Many tend to interpret the resource plans produced in the IRP analysis as the plan that PSE intends to execute against. This is not the case. The resource plans are more accurately understood as forecasts of resource additions that look like they will be cost effective in the future, given what we know about the future today. What we learn from this forecasting exercise determines the Action Plan. The Action Plans describe the activities PSE will execute resulting from the forecasting exercise.

Electric Action Plan

1. Acquire Energy Efficiency

Develop two-year targets and implement programs that will put us on a path to achieve an additional 374 MW of energy efficiency by 2023 through program savings combined with savings from codes and standards.

2. Demand Response

Clarify the acquisition, prudence criteria and cost recovery process for demand response programs. Issue a demand response RFP based on those findings. Re-examine the peak capacity value of demand response programs in the 2019 IRP to include day-ahead demand response programs, and use the sub-hourly flexibility modeling capability developed in this IRP to value sub-hourly demand response programs.

Pursuant to the 2015 IRP action plan, PSE issued an RFP for demand response programs in 2016. That led PSE to identify policy issues that need to be resolved with regard to demand response programs.

POLICY ISSUES. Demand response is a portfolio of programs that involves relationships with customers. Some programs are pricing structures that require revised tariffs and updates to metering and billing systems. Thus, in terms of program planning, demand response is more like conservation programs than power plants. However, demand response has been excluded from the program planning design and cost recovery process used for conservation. The current processes for establishing prudence related to acquiring power plants or contracts and recovering costs through a Power Cost Only Rate Case (PCORC) do not fit for a portfolio of demand response programs that build over time. The WUTC has begun exploring these issues. PSE will be fully engaged, as this is a critical path item for being able to execute demand response to meet resource need and an essential component for postponing the need to build fossil fuel generation.

DEMAND RESPONSE RFP. Once there is line of sight on resolving policy barriers, PSE will issue a demand response RFP. This IRP applied the PSE resource adequacy modeling framework used for other kinds of resources to demand response. These findings will be included in the demand response RFP to provide better guidance to bidders on the value of duration, frequency, and the interval between demand response events.

VALUING ADDITIONAL TYPES OF DEMAND RESPONSE PROGRAMS. Fast-acting demand response is able to respond quickly, creating additional sub-hourly flexibility value in addition to potentially offsetting or delaying the need for a peaking generator. PSE will use its sub-hourly flexibility modeling capability to value sub-hourly demand response programs in the 2019 IRP. Another category of demand-response to examine in more detail is day-ahead programs. Although day-ahead demand response programs will not deliver the same benefit, they may still be a valuable resource, so PSE will also examine the peak capacity value of day-ahead demand response programs in its 2019 IRP.

3. Energy Storage

Install a small-scale flow battery to gain experience with the operation of this energy storage system in anticipation of greater reliance on flow batteries in the future.

4. Supply-side Resources: Issue an All-source RFP

Issue an all-source RFP in the first quarter of 2018 that includes updated resource needs and avoided cost information.

PSE has a need for renewable and capacity resources as early as 2022, after cost-effective conservation and demand response are accounted for.

RENEWABLE RESOURCES. Bringing on future additional renewable resources, whether in PSE's balancing authority or in BPA's, may require transmission system upgrades that will require long lead times to study, design, permit and construct. While this IRP finds eastern Washington solar power is more cost effective than wind, the results are close. Montana wind would be a "qualifying renewable resource" if it were delivered to Washington state on a real-time basis without shaping or storage. Addressing this qualification constraint will likely require a complex set of transmission studies, coordinated with Northwestern in Montana, BPA and possibly the WECC. Issuing an RFP in 2018 for delivery beginning in 2022 will provide potential respondents time to address such transmission issues.

SUPPLY-SIDE RESOURCES FOR CAPACITY. While we believe that demand response and energy storage will be a reasonable, cost-effective resource that is sufficient to meet the capacity need that appears in 2022, this assumption will be investigated further in an RFP. Issuing an RFP in 2018 for delivery in 2022 is reasonable because the regional transmission system is becoming constrained, and potential respondents may need time to address these constraints, depending on the location of the proposed resources. Furthermore, some resources, like pumped hydro storage, may have long lead times. Finally, some kinds of renewable resources can contribute to meeting peak capacity, so considering capacity resources in this RFP will help align valuation processes.

5. Develop Options to Mitigate Risk of Market Reliance

Develop strategies to mitigate the risk of redirecting transmission and increasing market reliance.

PSE relies heavily on the short-term market to meet the energy and peak capacity needs of our customers. Risk associated with this exposure to market is managed in the short term; long term, however, regional resource adequacy cannot be addressed without adding new resources. If regional resource adequacy assessments are off or unexpected demand-side or supply-side shocks happen that render the region short of resources, the burden of the resulting deficits would fall on PSE's customers. Therefore, PSE will develop strategies mitigate this risk. These strategies may include:

- maintaining options to build capacity resources quickly;
- re-examining PSE policies with regard to how much of its market reliance should be managed via short-term purchases versus long-term contracts; and
- working with others in the region on options for PSE to join or to help develop functioning wholesale markets that incorporate, energy, capacity and flexibility services.

6. Energy Imbalance Market (EIM)

Continue to participate in the California Energy Imbalance Market for the benefit of our customers.

PSE's participation in the EIM allows PSE to purchase sub-hourly flexibility at 15- and 5-minute increments from other EIM participants to meet our flexibility needs when market prices are cheaper than using our own resources. Participation also gives PSE the opportunity to sell flexibility to other EIM participants when we have surplus flexibility. The benefits of lower costs on the one hand and net revenue from EIM sales on the other reduces power costs to our customers.

7. Regional Transmission

Examine regional transmission needs in the 2019 IRP in light of efforts to reduce the region's carbon footprint.

Future progress on reducing the region's carbon footprint will necessarily involve both retirement of less carbon-efficient thermal resources and the addition of renewable resources. This will make the ability of the region's transmission resources to move power to where it is needed an increasingly important issue. This examination will include the following.

- Assess the operational risk associated with redirecting transmission from PSE's existing wind resources and address those risks if necessary.
- Coordinate with the WUTC, other utilities and stakeholders to study the alternatives for re-purposing transmission used for Colstrip 1 & 2 as these units are retired.
- Begin to coordinate with other utilities and transmission providers to understand alternatives for re-purposing transmission from Colstrip 3 & 4, so that PSE will be prepared should the plant be retired earlier than anticipated.

Natural Gas Sales Action Plan

1. Acquire Energy Efficiency

Develop two-year targets and implement programs to acquire conservation, using the IRP as a starting point for goal-setting. This includes 14 MDth per day of capacity by 2022 through program savings and savings from codes and standards.

2. LNG Peaking Plant

Complete the PSE LNG peaking project located near Tacoma.

Construction of the facility is under way and should be completed in time for the storage project to be filled for the 2019/20 heating season. This resource is essential to delaying investment in additional interstate and international year-round pipeline capacity.

3. Option to Upgrade Swarr

Maintain the ability upgrade the Swarr propane-air injection system in Renton, which the plan forecasts will be needed by the 2024/25 heating season.

Upgrading the Swarr LP-Air facility's environmental safety and reliability systems to return the facility to its maximum output of 30 MDth per year was selected as least cost in all but the low demand scenarios in the IRP analysis. This short lead time project is also within PSE's control, and the timing of the upgrade can be fine-tuned by PSE in response to load growth.

3. ELECTRIC RESOURCE PLAN FORECAST

Electric Resource Need

PSE must meet the physical needs of our customers reliably. For resource planning purposes, those physical needs are simplified and expressed in terms of peak hour capacity for resource adequacy, hourly energy and sub-hourly flexibility. Operating reserves are included in physical needs; these are required by contract with the Northwest Power Pool and by the North American Electric Reliability Corporation (NERC) to ensure total system reliability. Beyond operating reserves, sub-hourly flexibility is also required. The robust sub-hourly analytical framework implemented in this IRP determined that PSE has sufficient sub-hourly flexibility at this time, although we will continue to refine this analysis. In addition to meeting customers' physical and sub-hourly flexibility needs, Washington state law (RCW 19.285) also requires utilities to acquire specified amounts of renewable resources or equivalent renewable energy credits (RECs). There are details in the law such that complying with RCW 19.285 may not directly correspond to meeting reliability needs, so this is expressed as a separate category of resource need.

- Figure 1-1 presents electric peak hour capacity need.
- Figure 1-2 presents the electric energy need (the annual energy position for the 2017 Base Scenario).
- Figure 1-3 presents PSE's renewable energy credit need.

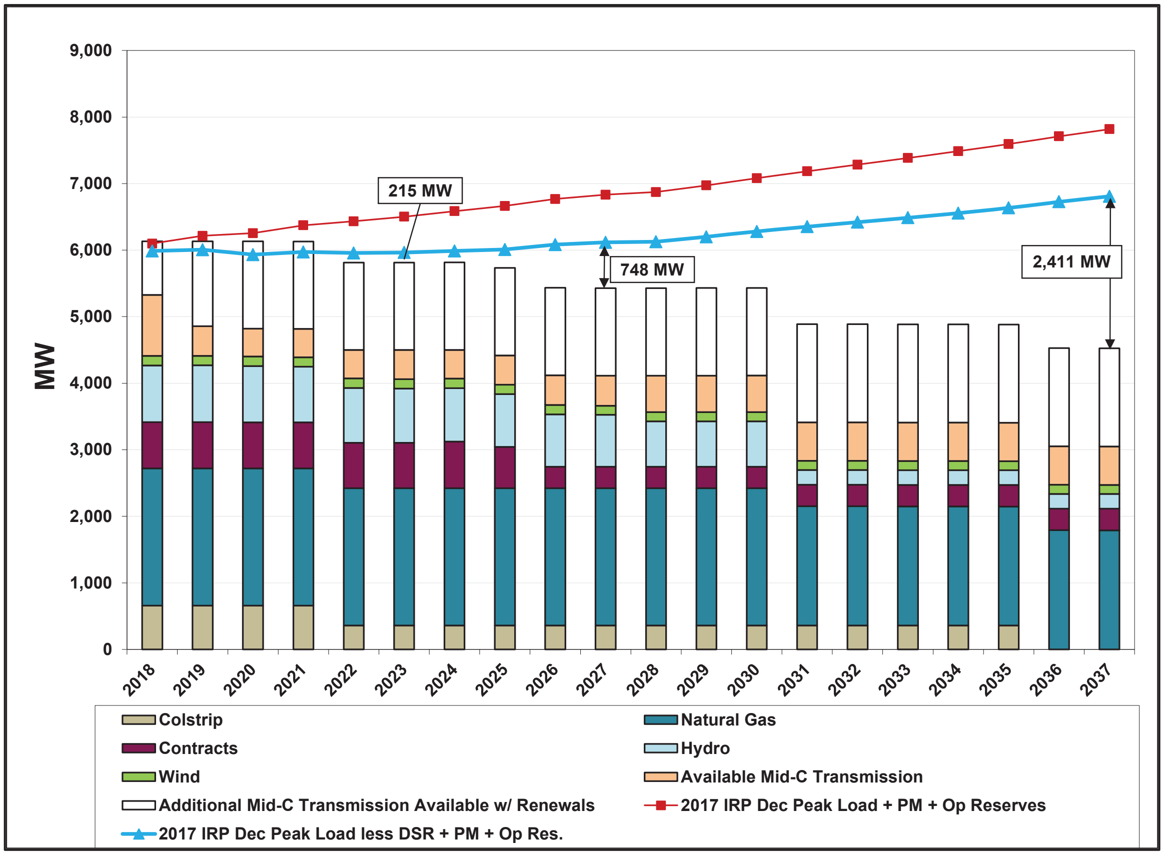
Electric Peak Hour Capacity Need

Figure 1-1 compares the existing resources available to meet peak hour capacity[1] with the projected need over the planning horizon. The electric resource outlook in the Base Scenario indicates the initial need for an additional 215 MW of peak hour capacity by 2023. This includes a 13.5 percent planning margin (a buffer above a normal peak) to achieve and maintain PSE's 5 percent loss of load probability (LOLP) planning standard. Figure 1-1 shows four noticeable drops in PSE's resource stack. The first, in 2022, is caused by retirement of Colstrip 1 & 2, approximately 300 MW of capacity. The second is at the end of 2025, when PSE's 380 MW coal-transition contract with Transalta expires upon retirement of the Centralia coal plant.[2] The third occurs in 2031, when PSE contracts with Chelan PUD for 481 MW of hydro output expire. The final significant drop is in 2035, the year that the Base Scenario assumes retirement of Colstrip Units 3 & 4, of which PSE owns 370 MW. This could occur sooner, depending on how future

1 / Resource capacities illustrated here reflect the contribution to peak, not nameplate capacity, so PSE's approximate 130 MW update with Skookumchuck of owned and contracted wind appear very small on this chart. Refer to Chapter 6, Electric Analysis, for how peak capacity contributions were assessed.
2 /PSE entered the coal transition contract with Transalta under RCW 80.80 to facilitate the retirement of the only major coal-burning power plant in Washington state.

environmental regulations affect the economics of running the plant. The important role demand-side resources play in moderating the need to add supply-side resources in the future can be seen in the peak load lines in Figure 1-1; the lower line includes the benefit of DSR while the upper line does not.

Figure 1-1: Electric Peak Hour Capacity Resource Need
(Projected peak hour need and effective capacity of existing resources)



Electric Energy Need

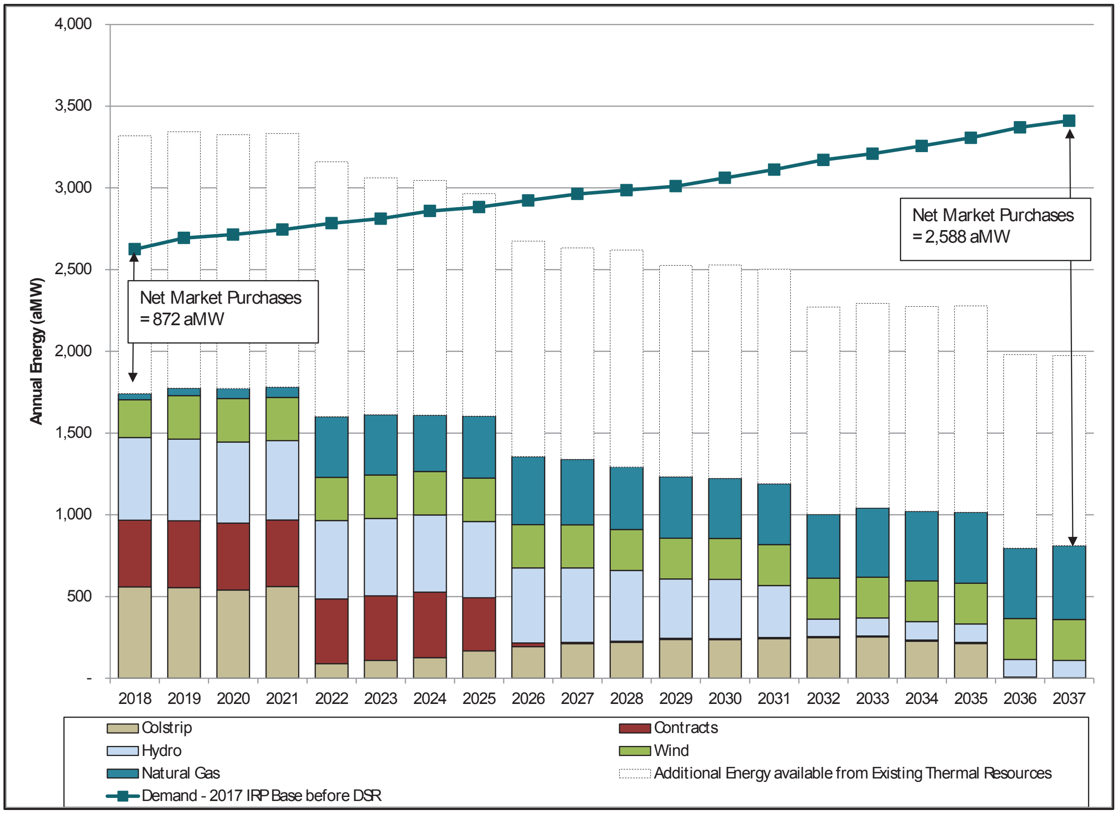
Compared to the physical planning constraints that define peak resource need, meeting customers' "energy need" for PSE is more of a financial concept that involves minimizing costs. Portfolios are required to cover the amount of energy needed to meet physical loads, but our models also examine how to do this most economically, and this includes the ability to purchase energy from the wholesale market.

Unlike utilities in the region that are heavily dependent on hydro, PSE has thermal resources that can be used to generate electricity if needed. This resource diversity is an important difference. In fact, on an average monthly or annual basis, PSE could generate significantly more energy than needed to meet our load, but it is often more cost effective to purchase wholesale market energy than to run our high-variable cost thermal resources. We do not constrain (or force) the model to dispatch resources that are not economic; if it is less expensive to buy power than to dispatch a generator, the model will choose to buy power in the market. Similarly, if a zero (or negative) marginal cost resource like wind is available, PSE's models will displace higher-cost market purchases and use wind to meet the energy need.

Figure 1-2 illustrates the company's energy position across the planning horizon, based on the energy load forecasts and economic dispatches of the 2017 IRP Base Scenario presented in Chapter 4, Key Analytical Assumptions.[3] The dashed box at the top indicates the total energy available from PSE's thermal resources if they were run without regard to economic dispatch. This chart shows that without any additional demand-side or supply-side resources, PSE could generate enough energy on an annual basis through 2025 to make wholesale market purchases unnecessary. The challenge for PSE is shaping that energy into peak hours. Should regional resource deficits in the future result in periods where market purchases were unavailable, PSE's thermal resources would be able to ramp up to minimize the number of non-peak hours that PSE customers were affected, but we would still face peak need constraints. This is why PSE has a peak capacity constraint, not an energy constraint.

3 / Wind in this chart shows more prominently in Figure 1-5 than in the peak capacity need chart, because this reflects the expected annual generation of wind, not just what can be relied upon to meet peak capacity needs.

Figure 1-2: Annual Energy Position, Economic Resource Dispatch from Base Scenario



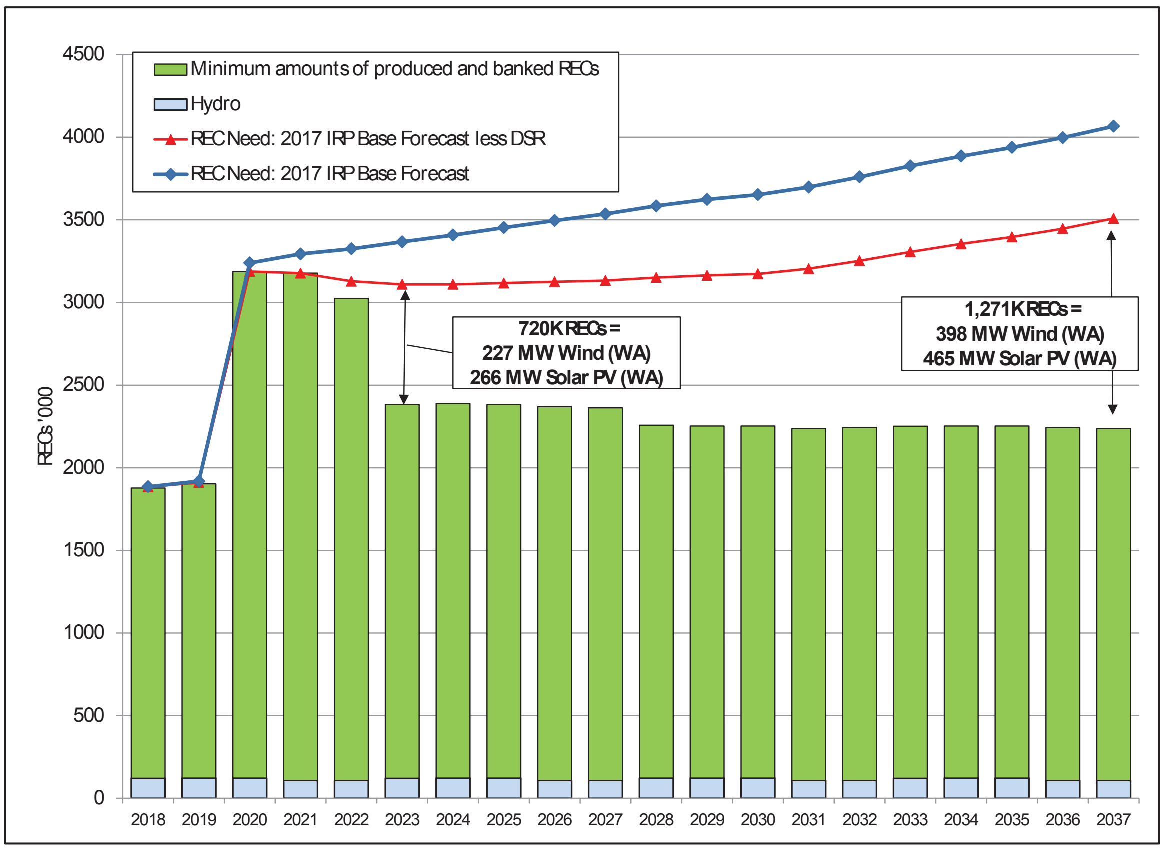
Renewable Need

In addition to reliably meeting the physical needs of our customers, RCW 19.285 – the Washington State Energy Independence Act – establishes 3 specific targets for qualifying renewable energy, commonly referred to as the state's renewable portfolio standard. Sufficient "qualifying renewable energy" must equal at least 3 percent of retail sales in 2012, 9 percent in 2016, and 15 percent in 2020. Figure 1-3 compares existing qualifying renewable resources with these targets, and shows that PSE has acquired enough eligible renewable resources and RECs to meet the requirements of the law until 2022. By 2023, PSE will need approximately 720,000 qualifying renewable energy credits. To put that need into context, it would equate to approximately 227 MW of Washington wind or 266 MW of eastern Washington solar power.[4]

4 / Slightly more MW of solar are needed because the annual output of solar in eastern Washington is slightly less than wind, so more MW of installed capacity are needed to generate the same quantity of energy in MWh.

Qualifying renewable energy is expressed in annual qualifying renewable energy credits (RECs) rather than megawatt hours, because the state law incorporates multipliers that apply in some cases. For example, generation from PSE's Lower Snake River wind project receives a 1.2 REC multiplier, because qualifying apprentice labor was used in its construction. Thus the project is expected to generate approximately 900,000 MWh per year of electricity, but contribute about 1,080,000 equivalent RECs toward meeting the renewable energy target. Note this is a long-term compliance view. PSE has sold surplus RECs to various counterparties in excess of those needed for compliance and will continue to do so as appropriate to minimize costs to customers.

Figure 1-3: Renewable Resource/REC Need



Electric Portfolio Resource Additions Forecast

As explained above, the lowest reasonable cost portfolio produced by the IRP analysis is not an action plan; rather, it is a forecast of resource additions PSE would find cost effective in the future, given what we know about resource and market trends today. It incorporates significant uncertainty in several dimensions.

Figure 1-4 summarizes the forecast for additions to the electric resource portfolio in terms of peak hour capacity over the next 20 years. This forecast is the "integrated resource planning solution."[5] It reflects the lowest reasonable cost portfolio of resources that meets the projected capacity, energy and renewable resource needs described above. Similar to prior IRPs, it accelerates acquisition of energy conservation and calls for additional demand response resources; however, it also includes significant changes. This IRP finds energy storage to be part of the lowest reasonable cost solution. It also finds that eastern Washington solar power may be more cost effective than wind. Additionally, it includes redirecting some firm transmission from existing wind resources to the Mid-C market in the resource plan forecast. Taken together, the "early" actions in this resource plan push the need to acquire additional fossil-fuel peakers out beyond 2024. This should not be interpreted to mean PSE *will* acquire new fossil fuel resources in 2025. Rather, this strategy provides a significant amount of time for technological innovations in energy efficiency, demand response, energy storage and renewable resources to develop, in the hope that additional fossil-fuel peaking generation plants will not be needed for our customers. Also, the resource plan shown here should not be interpreted as a statement of the ownership structure of resource additions; more accurately, it is a forecast of what technologies will appear cost effective in the future. For example, instead of PSE developing additional renewables or purchase power contracts, it may be lower cost and lower risk for customers to acquire unbundled RECs from independent power producers, who would then shoulder the technology and market price risk, instead of PSE's customers.

5 / Chapter 2 includes a detailed explanation of the reasoning that supports each element of the resource plan.

Figure 1-4: Electric Resource Plan Forecast,
Cumulative Nameplate Capacity of Resource Additions

	2023	2027	2037
Conservation (MW)	374	521	714
Demand Response (MW)	103	139	148
Solar (MW)	266	378	486
Energy Storage (MW)	50	75	75
Redirected Transmission (MW)	188	188	188
Baseload Gas (MW)	0	0	0
Peaker (MW)	0	717	1,912

Demand-side Resources (DSR): Energy Efficiency

This plan – like prior plans – includes aggressive, accelerated investment in helping customers use energy more efficiently. That is, significant changes in avoided cost had little impact on how much conservation could be acquired cost effectively. PSE's analysis indicates that although current market power prices are low, accelerating acquisition of DSR continues to be a least-cost strategy.

Demand-side Resources: Demand Response

In this IRP, we continue to find a ramp-up in demand response programs is part of the lowest reasonable cost portfolio. Demand response includes voluntary interruptible rate schedule programs for residential customers.

Renewable Resources

The timing of renewable resource additions is driven by requirements of RCW 19.285, as renewable resources still do not appear to be an effective or cost effective way to manage the financial risk of market exposure. This IRP found that eastern Washington solar power is expected to be more cost effective than wind from the Pacific Northwest or in Montana; however, costs between wind and solar are very close, especially in the first half of the planning horizon. As in prior IRPs, PSE's analysis shows we anticipate remaining comfortably below the four percent revenue requirement cap in RCW 19.285. PSE has acquired enough eligible renewable resources and RECs to meet the requirements of the law until 2022.

Energy Storage

This IRP finds energy storage, specifically flow batteries, to be a cost-effective part of the resource plan. While batteries are more expensive than peakers on a dollars per kW basis, batteries are more scalable, so they fit well in a portfolio with a small, flat need, as shown above in Figure 1-1 (Peak Capacity Need). Also, batteries provide more sub-hourly flexibility value than peakers, and this value is reflected in the IRP forecast.

Redirected Transmission to Market

In all future scenarios, redirecting 188 MW of BPA transmission from PSE's Hopkins Ridge and Lower Snake River wind facilities was shown to be part of the least cost solution. PSE will still be able to deliver the wind energy to our customers, but do so in a way that also helps to push the need for new generation into the future, which provides risk mitigation benefits as well. However, redirecting transmission and increasing PSE's reliance on wholesale market does entail financial and physical resource adequacy risk. Those risks were comprehensively examined in this IRP and determined to be manageable.[6]

Baseload Natural Gas Plants

The Pacific Northwest appears flush with renewable energy – hydro power, wind power and surplus solar power from California. Building additional baseload gas plants in PSE's service territory appears cost effective under only a few unlikely scenarios. Therefore, the resource plan includes no baseload gas plants.

Peakers

Beyond 2025, dual fuel peaking units appear to be the most cost-effective resource to meet larger capacity resource needs. These are units that can run off either natural gas, fuel oil or a blend of both. These peakers act as a low cost insurance policy, in case they are needed to meet loads due to extremely cold weather conditions, when another unit experiences a forced outage, or very low regional hydro conditions. A key reason why these units are so cost effective, is that backup fuel oil tanks negate the need for firm natural gas pipeline capacity. The resource adequacy implications of relying on peakers with backup fuel were examined rigorously in this IRP. The analysis shows the reliability risk of relying on backup fuel is extremely low. While PSE hopes technology innovations in energy efficiency, demand response, energy storage and renewable resources will eclipse the need for additional fossil-fuel plants of any kind in the future, dual fuel peakers appear to be the least cost resource in the later part of the planning horizon, except in unlikely scenarios where baseload natural gas plants appear cost effective.

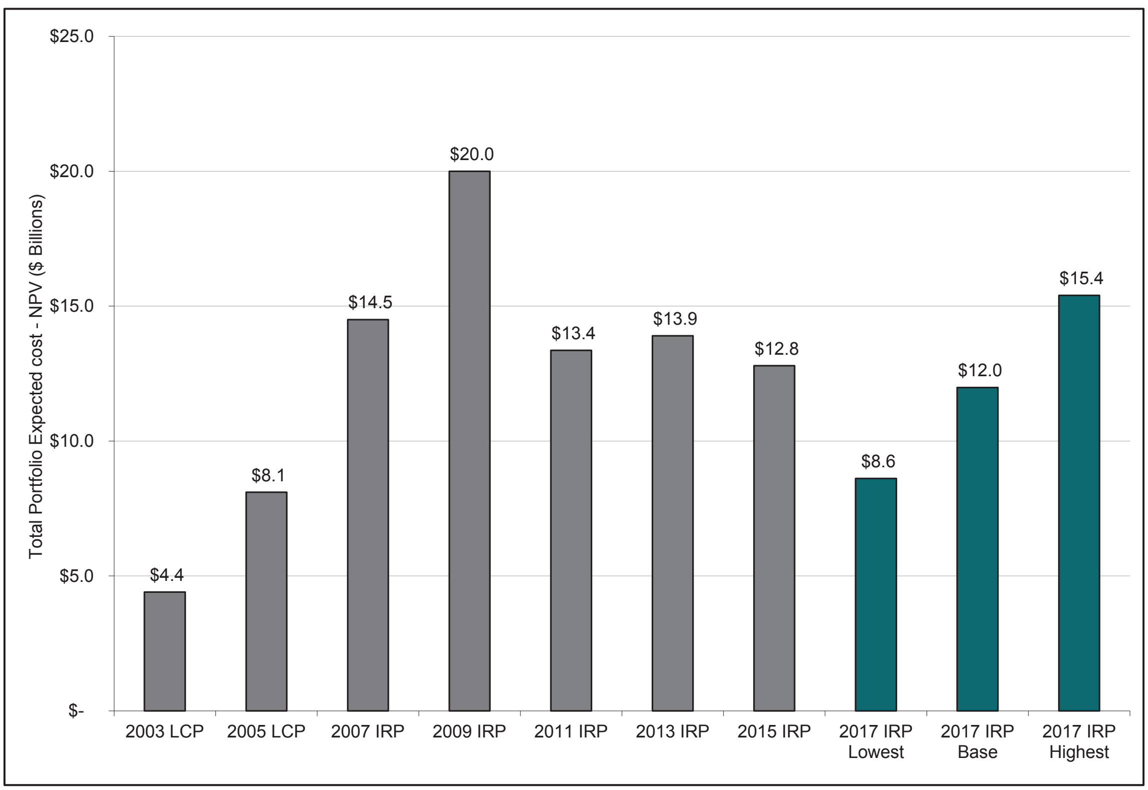
6 / See Appendix G, Wholesale Market Risk.

Portfolio Cost and Carbon Emissions

Portfolio Costs

The long-term outlook for incremental portfolio costs has been dynamic across IRP planning cycles since 2003, driven by changing expectations about natural gas prices and costs associated with potential carbon regulation. Figure 1-5 illustrates how incremental portfolio costs have changed over time, along with the context for the range of costs examined in this IRP. This figure shows the long-tem cost projection is down slightly from the 2015 IRP. This is primarily due to lower natural gas prices and lower capital costs for generation plants. Note that in this IRP, carbon costs on baseload natural gas and coal plants are applied across the entire WECC in the IRP Base Scenario assumptions, to simulate the effect of the Clean Power Plan if interstate carbon trading was adopted.

Figure 1-5: Incremental Portfolio Costs Over Time



Portfolio Carbon Emissions Associated with Electric Service

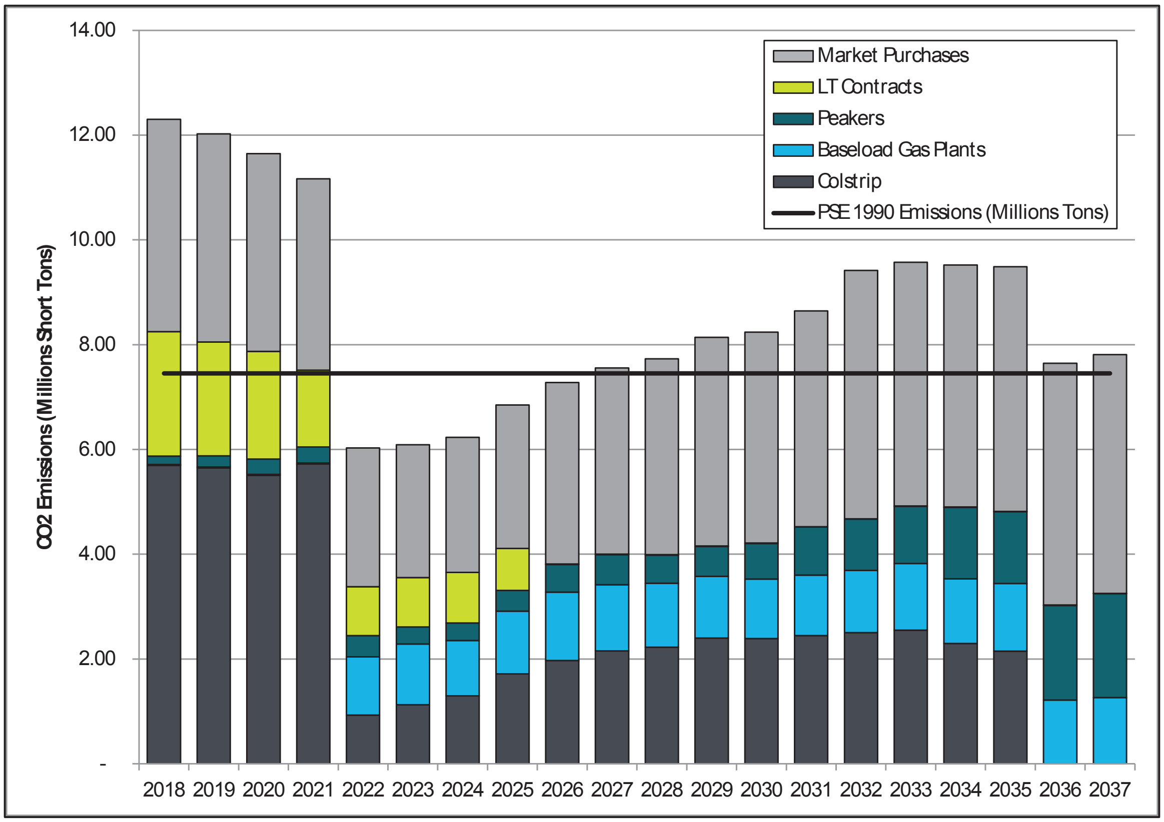
We are keenly aware of our customers' interest in reducing PSE's carbon emissions, and we share their concern and commitment to achieving meaningful carbon reduction that will mitigate climate change. Although PSE's portfolio carbon emissions can yield helpful insights, achieving the kind of results we all want will also require region-wide coordination as we continue this effort. The carbon emission profile presented in this section does not represent PSE's "preferred" outcome – we would prefer emissions to be lower. These emissions result from policies that require PSE to serve customers with the least cost combination of demand- and supply-side resources and carbon regulation policies that have been or may be enacted.

In estimating portfolio carbon emissions, PSE evaluates each of the resources in its portfolio. This is fairly straightforward when dealing with PSE-owned resources, but evaluating the wholesale market purchases that make up nearly a third of PSE's portfolio is more complicated because those purchases come from an integrated WECC-wide electric system. PSE's approach to addressing this carbon accounting issue is to calculate a WECC-wide average carbon intensity forecast in tons of CO_2 per MWh for each year in the planning horizon, and apply that average to market purchases. This is similar to the method used by the WUTC's compliance protocol, but that protocol uses the Northwest Power Pool average instead of the WECC average. Averages may satisfy reporting rules, but using an average emission rate is not appropriate for estimating how different policies or resource alternatives will affect greenhouse gas emissions. In reality, changes in emissions will be impacted by marginal resource decisions (i.e., which resources are being dispatched), not average resource dispatch. To understand how different factors will affect greenhouse gas emissions in total, one must examine impacts across the entire WECC. This kind of analysis is presented in Chapter 6 in the discussion on cost of carbon abatement.

Figure 1-6 illustrates the portfolio carbon emissions resulting from the resource plan forecast under the Base Scenario economic dispatch. The horizontal line shows PSE's estimated 1990 emissions. The stacked bars are the annual carbon emissions by resource type. The top of each stack does not represent direct PSE emissions – these are average emissions associated with market purchases. The rest of the stack relates directly to PSE resources or specific contracts. The first large drop in emissions occurs in 2022. This is caused by retirement of Colstrip 1 & 2, but also by the assumed implementation of a WECC-wide carbon price on coal and baseload gas plants, which significantly curtails the economic dispatch of Colstrip 3 & 4. From 2022 through 2034, direct emissions rise as natural gas prices increase relative to coal costs, causing the economic dispatch of Colstrip 3 & 4 to increase despite the WECC-wide carbon price. By 2037, PSE's direct emissions will be quite low, as all four units of Colstrip will have been retired – this drop would occur earlier if Colstrip 3 & 4 were retired sooner.

While this chart appears to show PSE's emissions will be in line with 1990 emissions by 2035, this is misleading. The Base Scenario assumes the most important and most difficult policy change is enacted in 2022 – the imposition of a WECC-wide carbon market. Policy makers, environmental advocates and those concerned about greenhouse gas emissions (including PSE) should not be comforted by this chart.

Figure 1-6: Projected Annual Total PSE Portfolio CO_2 Emissions and Savings from Conservation



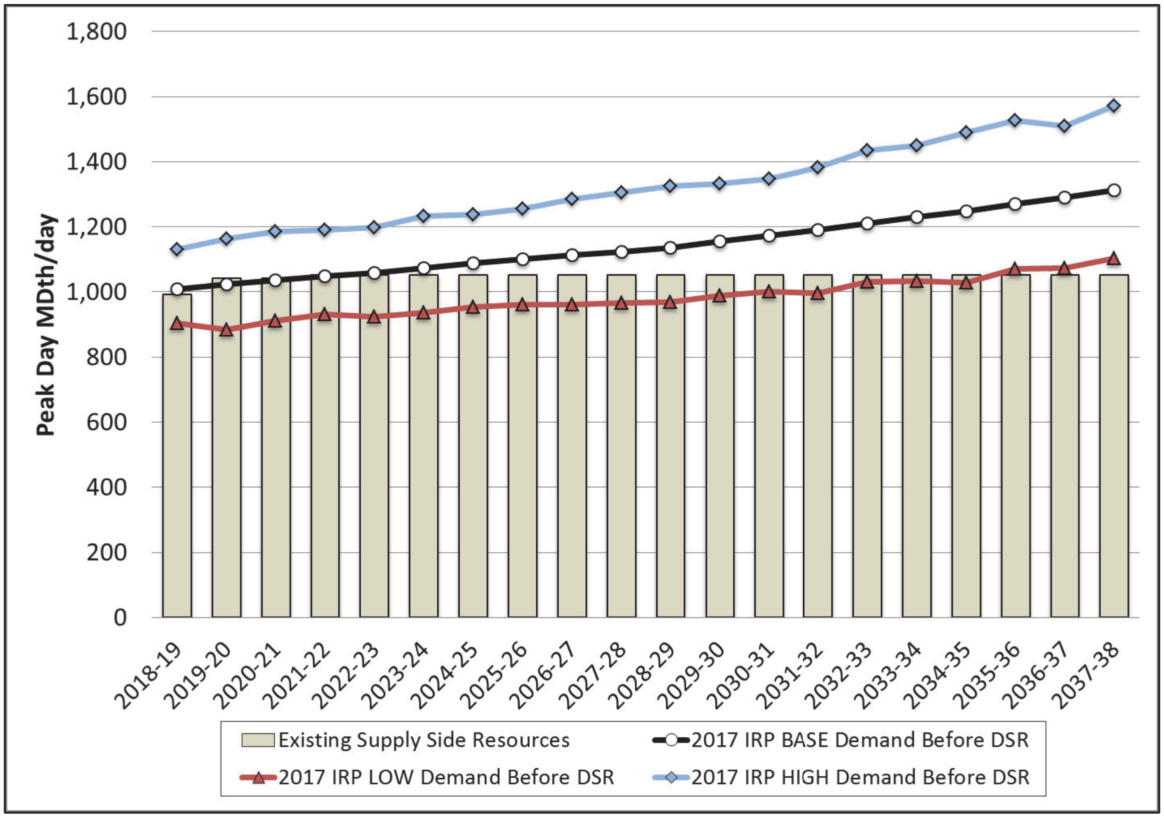
4. NATURAL GAS SALES RESOURCE PLAN FORECAST

PSE develops a separate integrated resource plan to address the needs of more than 800,000 retail natural gas sales customers. This plan is developed in accordance with WAC 480-90-238, the IRP rule for natural gas utilities. (See Chapter 7 for PSE's gas sales analysis.)

Gas Sales Resource Need – Peak Day Capacity

Gas sales resource need is driven by design peak day demand. The current design standard ensures that supply is planned to meet firm loads on a 13-degree design peak day, which corresponds to a 52 Heating Degree Day (HDD). Like electric service, gas service must be reliable every day, but design peak drives the need to acquire resources. Figure 1-7 illustrates the load-resource balance for the gas sales portfolio. The chart demonstrates PSE has a small resource need in 2018, but the LNG storage facility in Tacoma is expected to come online for the 2019/20 heating season, which will meet the peak capacity needs of our customers until the winter of 2023/24. The 2018 need can be met with a one-year capacity contract on Northwest Pipeline, rather than investing in a long-lived resource to meet need for a single year.

Figure 1-7: Gas Sales Design Peak Day Resource Need



Gas Sales Resource Additions Forecast

Figure 1-8 summarizes the gas resource plan additions PSE forecasts to be cost effective in the future in terms of peak day capacity and MDth per day. As with the electric resource plan, this is the “integrated resource planning solution.” It combines the amount of demand-side resources that are cost effective with supply-side resources in order to minimize the cost of meeting projected need. Again, this is not PSE’s action plan – it is a forecast of resource additions that look like they will be cost effective in the future, given what we know about resource trends and market trends today.

Figure 1-8: Gas Resource Plan Forecast, Cumulative Additions in MDth/Day of Capacity

	2025/26	2029/30	2037/38
Conservation (DSR)	27	49	84
Swarr	30	30	30
LNG Distr Upgrade	0	16	16
Additional NWP + Westcoast	0	53	133

Demand-side Resources (DSR)

Analysis in this IRP applies a 10-year ramp rate for acquisition of DSR measures. Analysis of 10- and 20-year ramp rates in prior IRPs has consistently found the 10-year rate to be more cost effective. Ten years is chosen because it aligns with the amount of savings that can practically be acquired at the program implementation level.

Swarr Upgrade

This IRP finds that upgrading the Swarr LP-Air facility's environmental safety and reliability systems and returning its production capacity to Swarr's original 30 MDth per day capability would be a cost effective resource as early as the 2024/25 heating season. Swarr is a propane-air injection facility on PSE's gas distribution system that operates as a needle-peaking facility. Propane and air are combined in a prescribed ratio to ensure the mixture injected into the distribution system maintains the same heat content as natural gas. Upgrading Swarr is a short lead time project that is totally within PSE's control (it does not require the regional coordination needed for large, mainline pipeline expansion) so the project also adds strategic agility to the resource plan. If needed sooner, PSE could move quickly to upgrade Swarr, and if need is delayed, PSE could defer the upgrade. In either circumstance, the upgrade would put off the need for large, long-lived mainline pipeline expansions.

PSE LNG Distribution Upgrade

The PSE LNG peaking facility currently under construction in Tacoma allows the company to withdraw gas from the storage tank and deliver it directly into PSE's local distribution system. This upgrade is not an expansion of the LNG facility itself, but an expansion of the distribution network's capacity east of Tacoma that will allow more gas to flow from the LNG facility into PSE's gas supply network. The analysis forecasts that this will be needed and cost effective by the 2027/28 heating season. As with Swarr, this resource provides the portfolio with the strategic agility to determine timing based customer need as it develops.

Northwest Pipeline/Westcoast Expansion

Additional transportation capacity from the gas producing regions in British Columbia at Station 2 south to PSE's system on the Westcoast pipeline is also forecast as cost effective beginning in the 2029/30 heating season.

5. THE IRP AND THE RESOURCE ACQUISITION PROCESS

The IRP is not a substitute for the resource-specific analysis done to support specific acquisitions, though one of its primary purposes is to inform the acquisition process. The action plans presented here help PSE focus on key decision-points it may face during the next 20 years so that we can be prepared to meet needs in a timely fashion.

Figure 1-9 illustrates the relationship between the IRP and activities related to resource acquisitions. Specifically, the chart shows how the IRP directly informs other acquisition and decision processes. In Washington, the formal RFP processes for demand-side and supply-side resources are just one source of information for making acquisition decisions. Market opportunities outside the RFP and self-build (or PSE demand-side resource programs) must also be considered when making prudent resource acquisition decisions. Figure 1-9 also illustrates that information from the IRP provides information to the local infrastructure planning process.

Figure 1-9: Relationship of IRP to Resource Decision Processes