Rye Development

Rye Development, LLC
830 NE Holladay Street
Portland, Oregon 97232

Chair Pam Marsh
House Energy and Environment Committee
Oregon Legislature
900 Court St. NE,
Salem Oregon 97301

March 22, 2021

Chair Marsh, Vice Chairs Helm and Brock Smith, and members of the committee:

My name is Michael Rooney and I am providing this testimony in my capacity as Vice President of Project Management at Rye Development. Rye Development is the developer of the Swan Lake Pumped Storage project in Klamath Falls. The project is owned by Copenhagen Infrastructure Partners (CIP), an energy infrastructure investment company based in Denmark that is focused on greenfield and renewable energy projects.

**Summary**

The Swan Lake project is a 400 megawatt, long-duration clean energy, closed-loop pumped storage facility. To meet the 100% clean energy goal, storage, and particularly long-duration storage, is the most important resource needed. If we are to provide for resource adequacy to meet growing needs and anticipated capacity shortfalls, legislation must include provisions requiring Oregon IOUs to begin investing in short and long-duration storage.

**Need to Address Energy Storage Now**

As Oregon moves towards 100 percent clean and non-emitting resources, there is an increasing awareness of the challenge to meet resource adequacy needs, that is - keeping the lights on when the wind is not blowing and sun not shining. This resource adequacy concern was heightened by recent events in California and Texas. Projections show that the Pacific Northwest faces a capacity shortfall of 7,000-10,000 megawatts by 2025. Clean and renewable energy storage is a critical cornerstone of a clean, cost-effective, affordable and reliable grid.

Other states are already moving forward to take concrete steps to address the growing need for energy storage in a 100% clean energy grid. After examining California's 100% clean legislation, that state's Public Utility Commission last year approved a grid planning proposal calling for 1,000 MWs of long-duration pumped energy storage by 2026. Virginia passed 100% clean legislation in 2020 that included the requirement for over 3,000 MWs of long-duration energy storage by 2035.

Once coal is displaced, it is either natural gas or storage that will address resource adequacy and the capacity shortfall in Oregon. The first two clean energy bills filed this session approached the issue from different perspectives - HB 2995 focused on emissions reduction targets and HB 3180 focused on accelerating the RPS. Both bills recognized the importance of resource adequacy and included provisions requiring Oregon IOUs to begin investing in short and long-duration storage. ***This crucial piece has been deleted from the current version of the bill and we ask that it be put back into the bill.***

**Swan Lake Project Background**

The Swan Lake project is a 400 megawatt, long-duration clean energy, closed-loop pumped storage facility. Swan Lake has received a full FERC-approved license to begin construction and we've also entered into an MOU with the Southern Oregon Building and Construction Trades Council to build the project under a Project Labor Agreement. After a decade of environmental studies and design work, the Swan Lake Project has secured the necessary permits to begin construction.

Pumped storage is the most cost-effective long-duration storage option available in the Pacific Northwest, but pump storage projects do not fit neatly into existing IRP processes because of their long-lead time for construction. For instance, Swan Lake will take 3-5 years to construct. However, it will produce over $800 million in investment, create thousands of family-wage jobs, and create over $2 million in annual tax revenue for Klamath County. To emphasize this point, proponents of HB 3180 had ECONorthwest analyze the potential jobs that could be created by the bill, and the study concluded around 1,000 construction jobs per year could be created. These 1,000 jobs are the aggregate of all solar and wind projects across the state each year. **Swan Lake – one energy storage project – would create over 1,000 construction jobs annually in each of its 3-5 construction years.**

**Conclusion**

Oregon stands at a critical crossroads in determining our energy future. There is shared commitment to moving away from fossil fuels to achieve an emissions-free electrical power base. This is the right move for our economy, our environment, and social equity. The task before you today is ensuring this transition occurs in a way that garners public support for this transition, protects the stability and reliability of our energy supply, and provides for economic development and good prevailing wage jobs in Oregon. We urge you to re-introduce the provision requiring long-duration energy storage that was part of HB 2995 to achieve these goals.

Sincerely,

*/s/ Michael Rooney*

Michael Rooney
Vice President of Project Management
Rye Development, LLC

**Attachments to this testimony include:**

- One page overview of the Swan Lake Energy Storage Project
- MOU with the Southern Oregon Building and Construction Trades Council
- E3 December 2019 Analysis "Capacity Needs of the Pacific Northwest—2019 to 2030"
- ECONorthwest Analysis of Economic and Fiscal Impacts from Operations and Construction at Swan Lake North

# Swan Lake Energy Storage

## We are committed to cleaner energy.

The Swan Lake Energy Storage Project is a 393 MW closed-loop energy storage project in Klamath County, Oregon. The project will be a critical component of the Pacific Northwest's decarbonized electrical infrastructure, while also producing thousands of well-paying jobs under a Project Labor Agreement with Southern Oregon Building and Construction Trades Council. Additionally, the project will have substantial economic benefits to Southern Oregon.

Located 11 miles northeast of the city of Klamath Falls. The project is separated from and will have no adverse impact on the Klamath River or the Klamath River Basin. Renewable electricity stored at the facility would be transmitted from the powerhouse to the Malin Substation.

Closed Loop Pumped Storage represents a safe, reliable, and environmentally sound way to support the successfully integration of large amounts of new wind and solar power projects in the Pacific Northwest. Simply stated, the renewable energy the Swan Lake Energy Storage Project stores will provide carbon-free fuel for the daily lives of Oregonians and is essential to moving to a 100 percent clean electricity grid.

### What is pumped storage hydropower?

Pumped storage hydropower is a time tested technology and is currently the most common type of energy storage in use in our country.

Pumped storage projects have two reservoirs. During periods of low electricity demand, excess wind and solar energy can be stored by pumping water uphill. When electricity demand increases or wind and solar production drops, water is released from the upper reservoir to the lower reservoir via an underground pipe. The water feeds through turbine generators that generate electricity.

### What does pumped storage mean for the region?

**Creates 3,000 family wage jobs over the 3-5 year project construction period**

**More than $2 million annual tax revenue for Klamath County**

**Generates 393 MW of carbon-free hydroelectricity**

**Allows the region to store clean energy to be used when we need it most**

**Oct 2015**
Formal Application Filed with FERC

**Aug 2018**
FERC Draft Environmental Impact Statement Issued

**Jan 2019**
FERC Final Environmental Impact Statement Issued

**Apr 2019**
FERC 50-year Construction and Operational License Issued

**2019-2020**
Post-License Pre-Construction Activities

**2022**
Begin Construction

**2026**
Begin Commercial Operation

For more information and to sign up for our e-newsletter, visit *www.slenergystorage.com*

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MEMORANDUM OF UNDERSTANDING
Between
SWAN LAKE NORTH HYDRO, LLC
And
SOUTHERN OREGON BUILDING AND CONSTRUCTION TRADES COUNCIL

Regarding
SWAN LAKE PROJECT

WHEREAS Swan Lake North Hydro, LLC is in the development process for a project in Klamath County Oregon to provide clean and reliable energy – the Swan Lake Project;

WHEREAS the Southern Oregon Building and Construction Trades Council is in support of the project, which will bring clean and renewable energy to Oregon, and provide jobs with union wages, benefits and working conditions.

NOW THEREFORE, the parties agree as follows:

1. Swan Lake North Hydro, LLC commits that the Swan Lake project will be built pursuant to a project labor agreement (PLA) between the Southern Oregon Building and Construction Trades Council and the project's contractor.

2. The project's contractor and all subcontractors who perform covered construction work will be required to subscribe to or otherwise agree to be bound by the terms of the PLA.

3. The PLA will require contractors and subcontractors on the Swan Lake project to recognize the Southern Oregon Building and Construction Trades Council, and appropriate member unions, as the sole and exclusive bargaining representative of the employees who perform the covered work as defined within the scope of the PLA.

4. The Southern Oregon Building and Construction Trades Council and its member unions agree to prioritize and support the Swan Lake project as one of its key opportunities to provide jobs to the members of certain of its member unions.

Agreed this 6th day of February, 2020.

Rye Development

Swan Lake North Hydro, LLC

RON LEE

Southern Oregon Building and Construction Trades Council, President

Nathan

Swan Lake North Hydro, LLC

DREW WAITS

Southern Oregon Building and Construction Trades Council, Secretary-Treasurer

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# Capacity Needs of the Pacific Northwest—2019 to 2030

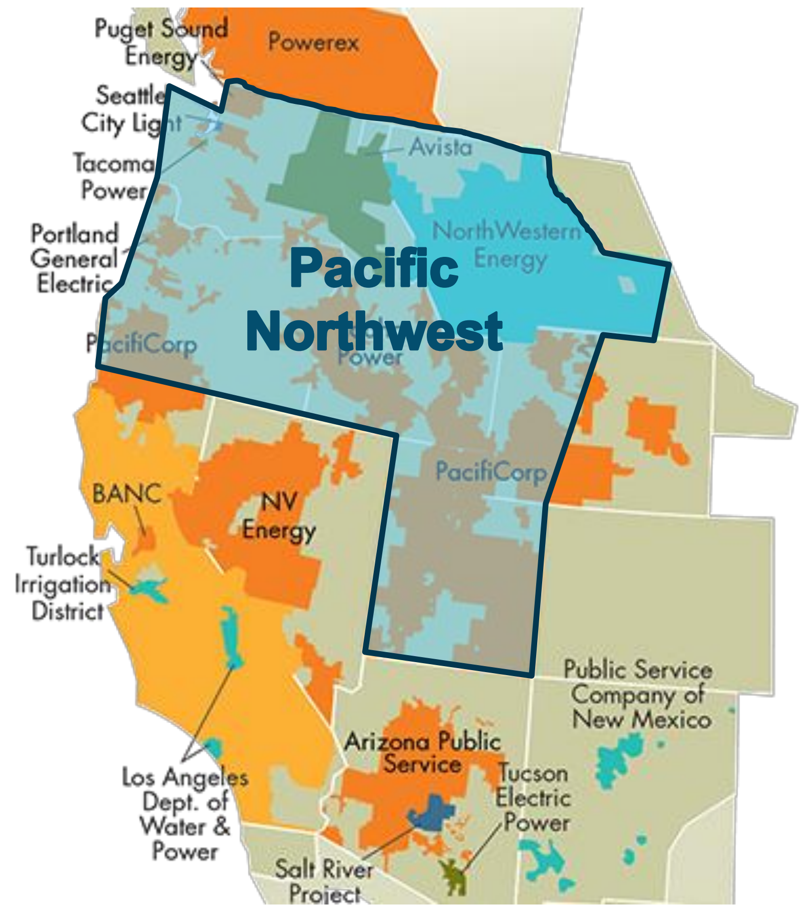
December 2019

# Outline

- **Project Background**
- **Key Takeaways**
- **Analysis**
  - Key policy drivers and resource adequacy approach
  - Near-term view
  - Mid-term view
  - Long-term view
- **Appendix**

# Project Background

- E3 analyzed a fundamentals-based view of the Pacific Northwest (PacNW) regional capacity need and generated this public report on behalf of Rye Development
- Study Approach
  - **Top down view**: Compares regional level studies on capacity need, which included updating a previous E3 study based on latest public information and comparing it against other regional studies
  - **Bottom up view**: Aggregates capacity need and planned additions from utility integrated resource plans (IRPs) across the region
  - The study region is defined as the "Greater NW," consisting of the US portion of the Northwest Power Pool, excluding Nevada
    - Other studies of regional need utilizing smaller regions are noted
- The views contained herein are solely those of the authors and based on public information as well as E3's analysis for its own study



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# Key Takeaways

# The PacNW is Facing a Significant Capacity Shortfall

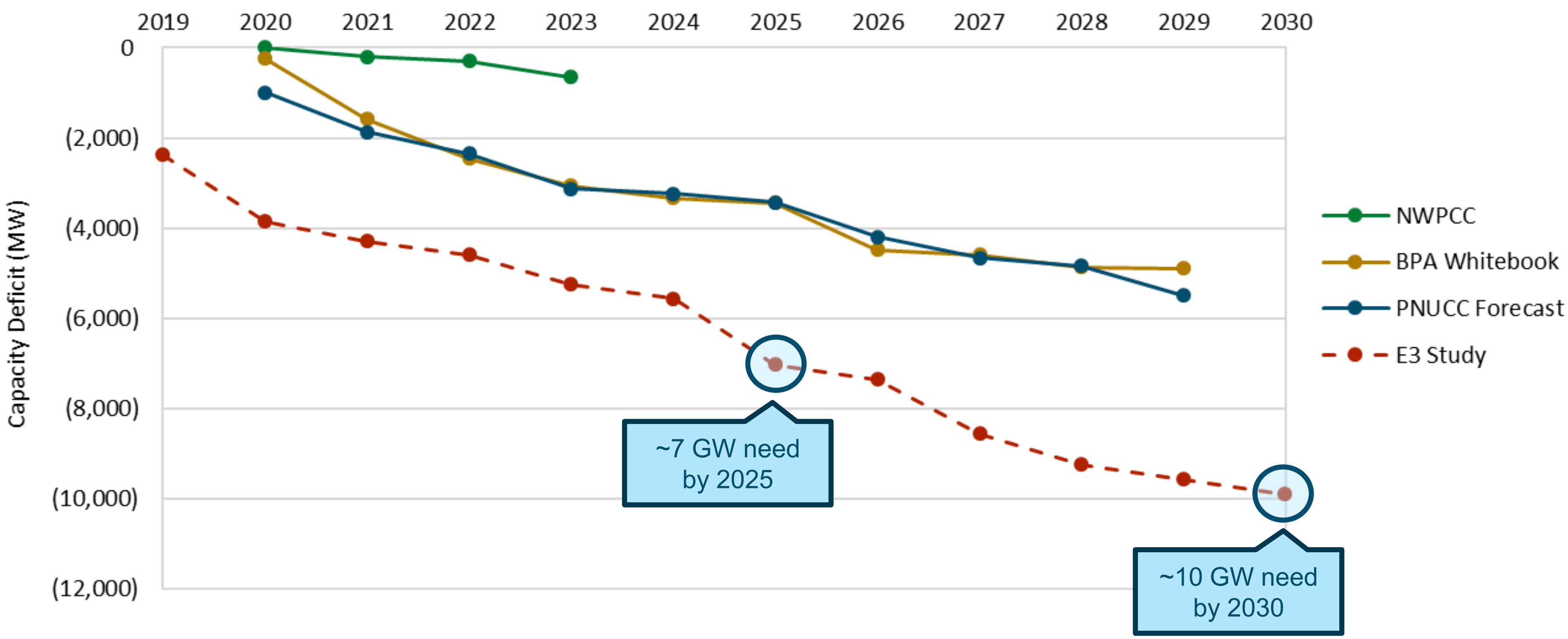
- **Near-term (today-2025): the Pacific Northwest faces a near-term capacity shortfall of 3-7 GW**
- **Mid-term (2025-2030): capacity need grows to as much as 10 GW as additional firm capacity retires and this need is not fully replaced by planned additions**
  - All planned capacity additions, and significantly more, are required by 2030
  - Even in an optimistic scenario (if all planned capacity additions detailed in the reviewed utility IRPs are approved and constructed), the region remains approximately 3 GW short by 2030
- **Long-term (2030-2050):** the region needs to grow or maintain firm dispatchable capacity to address the energy sufficiency challenges created by a deeply decarbonized grid

| | | Near-term (today-2025) | Mid-term (2025-2030) | Long-term (2030-2050) |
|---|---|---|---|---|
| **Pacific Northwest** | **Capacity Need** | **Immediate capacity shortfall of 0-1.2 GW, rising to 3-7 GW by 2025** | **Growing capacity shortfall of ~10 GW in 2030** (higher if more coal retires than currently planned for) | **Capacity shortfall grows to ~20 GW by 2050**, possibly even higher under high electrification scenarios |
| | **Key Drivers** | • Increasing winter and summer peak demand<br>• Coal retirements w/ few firm replacements<br>• Consideration of a regional RA program | • Continued load growth and coal retirements<br>• Renewable and storage additions with diminishing capacity benefit<br>• Additional capacity additions needed | • Energy sufficiency-based reliability planning challenge<br>• Decarbonization policies further drive renewables/ storage; do not avoid need for firm capacity<br>• Electrification loads could drive even higher winter peak |

# PacNW Near to Mid-Term Capacity Need

## Top-Down Forecast

+ **Multiple regional assessments point to a near-term shortfall of winter-peaking physical capacity in the Northwest region**
  - Shortfall grows to ~5,000-10,000 MW over next 10 years




- Key differences are driven by PRM requirements, capacity counting methodologies, and resource additions (*see appendix for comparison of key assumptions*).
- E3 and NWPCC are truly “top-down” stochastic views, while PNUCC and BPA are closer to regional “bottom-up” analyses of utility IRPs.
- E3 study based on 2018 and 2030 RECAP LOLE modeling, shaped between those years based on forecasted coal-retirement schedules. This study updated previous analysis to include coal retirements from PacifiCorp’s 2019 Draft IRP. E3’s need does not incorporate any planned additions.

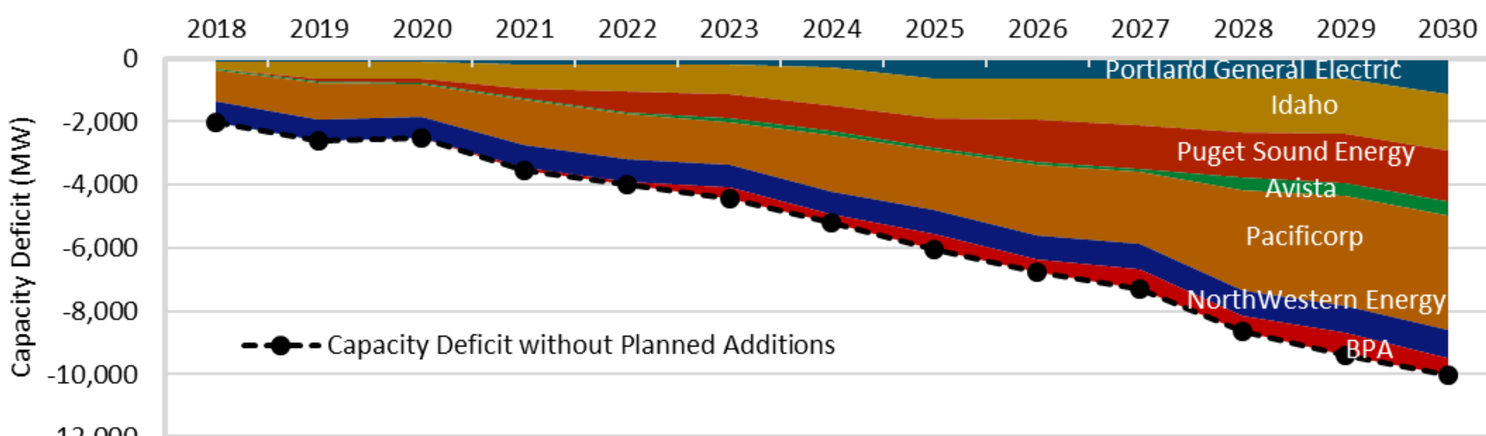
# PacNW Near to Mid-Term Capacity Need

## Bottom-Up Capacity Need vs. Planned Additions

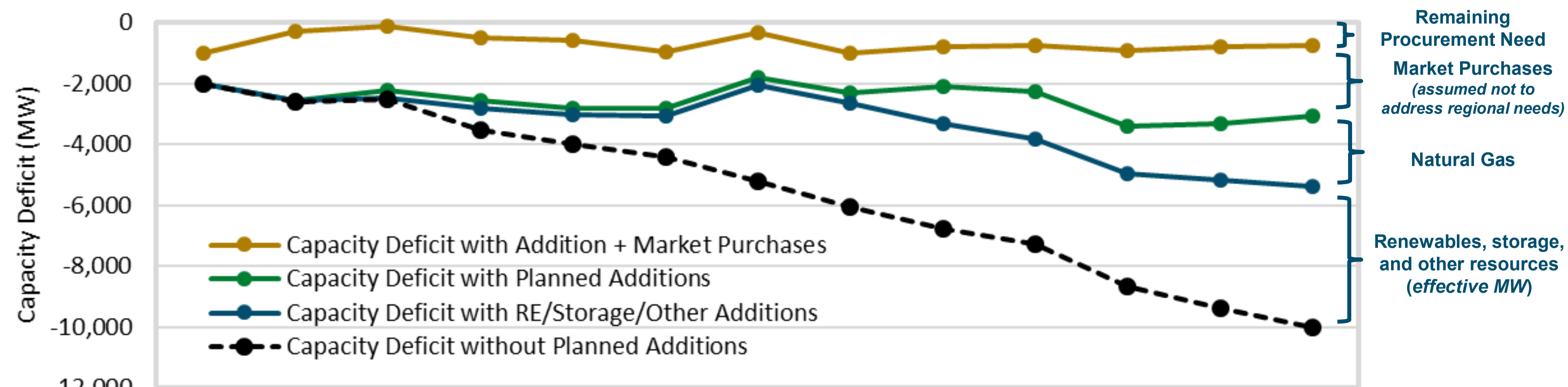
+ **Through their IRPs, individual utilities have identified their capacity needs over a 20-year horizon**
  - Aggregate "bottom-up" need reaches ~10,000 MW by 2030
  - IRP planned additions do not adequately address full capacity need, leaving ~3,000 MW of additional need

**Summary of Utility IRP-based Capacity Needs**

**Needs Identified in IRPs**



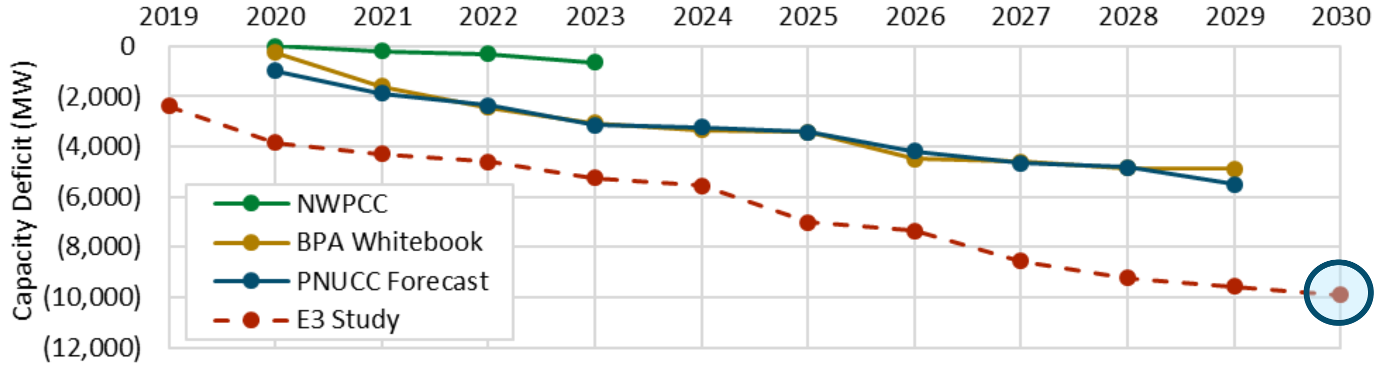

**Post-Addition Needs Identified in IRPs**




*E3 also considered Grant, Chelan, and Douglas Counties but they do not report a shortage in capacity

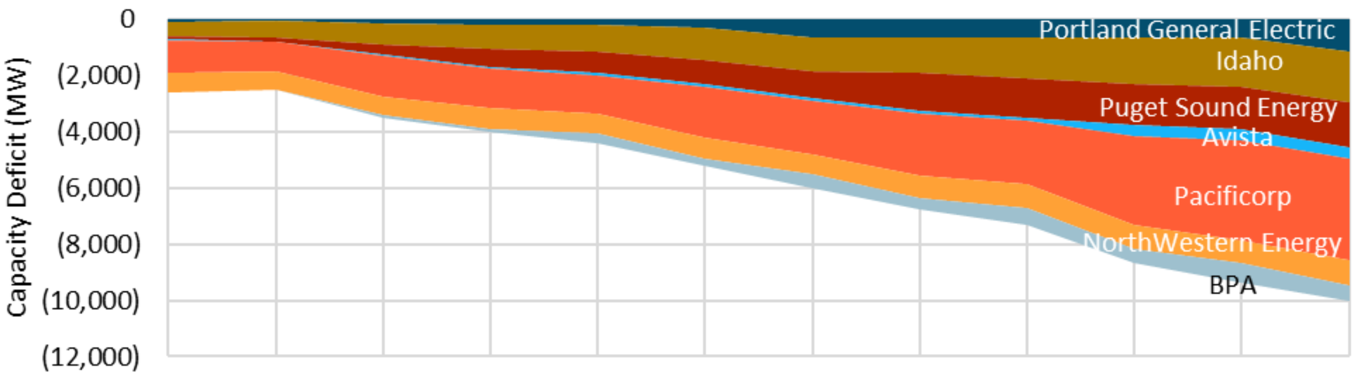
# PacNW Capacity Need vs. Planned Additions

**By 2030, the region faces a 10,000 MW need that is not adequately met by currently planned additions**



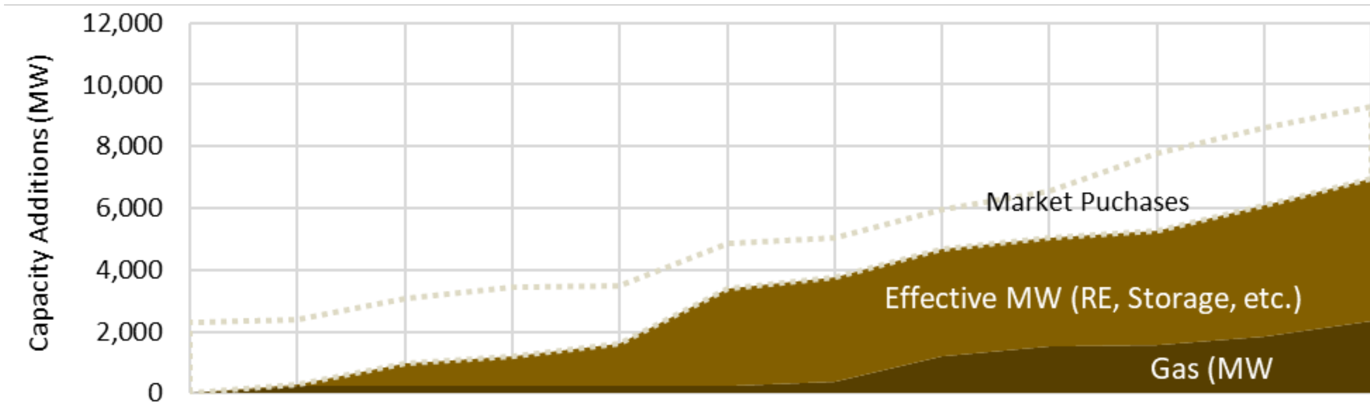

## "Top-Down" Regional Assessments

5,000 – 10,000 MW capacity need by 2030




## "Bottom-Up" Review of Utility IRPs

10,000 MW capacity need by 2030, before planned additions




## IRP Planned Resource Additions

Only ~7,000 MW effective capacity additions…
2,300 MW of market purchases generally do not address regional need

*Note: E3 top-down assessment utilizes RECAP modeling results from E3's 2019 study Resource Adequacy in the Pacific Northwest. This study further shapes the annual capacity need based on the latest proposed coal retirements schedules (as of Oct 2019). E3's capacity deficit does not include any planned additions.*

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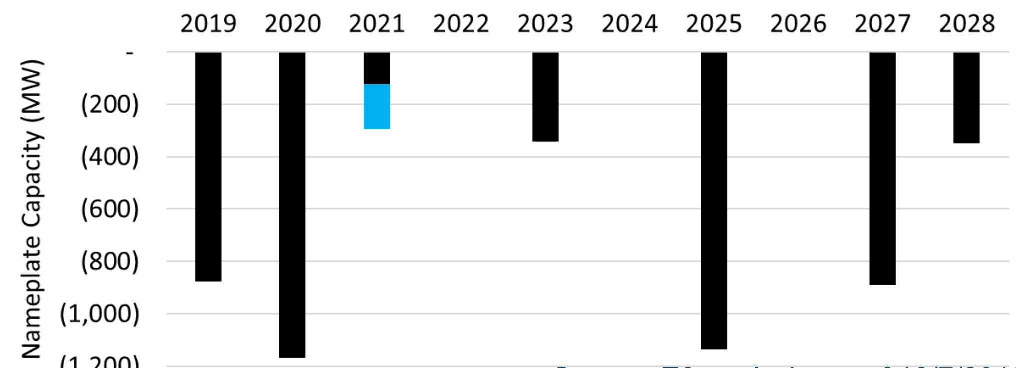
# PacNW Capacity Need Drivers and Analysis

# PacNW Key Policy Drivers

- **Coal retirements are driven by policy, planning, and politics**
  - 4.5 GW by 2030
- **Clean energy legislation and voluntary goals are expanding**
  - WA/OR coal prohibitions
  - WA 100% carbon-free by 2045 - OR may follow
  - Idaho Power voluntary goal of 100% clean energy by 2045
- **Economy-wide GHG reductions will drive additional impacts**
  - Electrification of transportation and building loads may significantly increase peak loads

## Planned PacNW Coal Retirements

| Units to Retire | | | | | | |
|---|---|---|---|---|---|---|
| 2019 | 2020 | 2021 | 2023 | 2025 | 2027 | 2028 |
| Colstrip 1,2<br>Naughton 3 | Boardman<br>Centralia 1 | North Valmy 1<br>Klamath Hydro | Jim Bridger 1 | Centralia 2<br>North Valmy 2<br>Naughton 1,2 | Colstrip 3,4<br>Johnston 1-4 | Jim Bridger 2 |



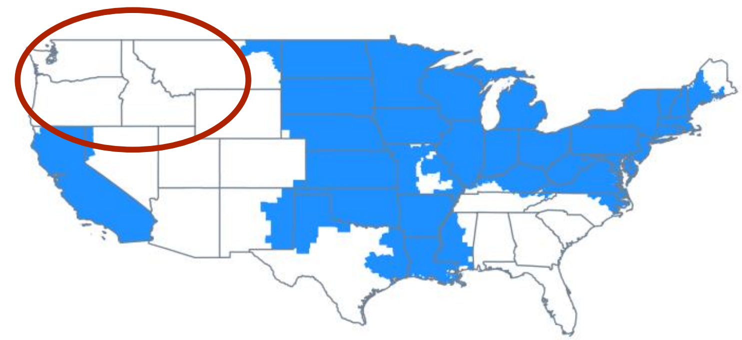

Source: E3 analysis, as of 10/7/2019

*NOTE: includes coal retirements in PacifiCorp's draft 2019 IRP*

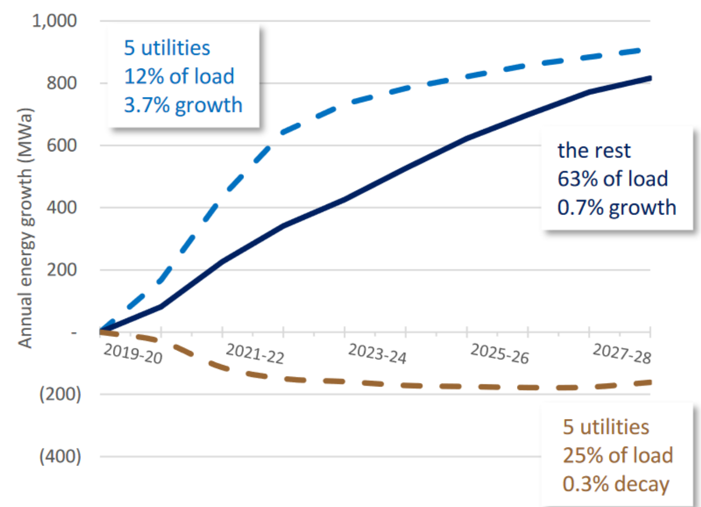
| | RPS or Clean Energy Standard? | Coal Prohibition? | Carbon price? | Voluntary Goals? |
|---|---|---|---|---|
| WA | ✓ Carbon neutral by 2030, 100% by 2045 | ✓ Eliminate by 2025 | ✓ SCC in utility planning | ✓ Corporations + Cities |
| OR | ✓ 50% by 2040 | ✓ Eliminate by 2035 | ✗ | ✓ Utilities + Cities |
| ID | ✗ | ✗ | ✗ | ✓ Idaho Power 100% by 2045 |
| MT | ✓ 15% by 2015 | ✗ | ✗ | ✗ |
| UT | ✓ 20% by 2025 | ✗ | ✗ | ✓ SLC + other cities |
| WY | ✗ | ✗ | ✗ | ✗ |

# PacNW Resource Adequacy Approach

- **The Northwest has no existing regional RA program**
  - There are independent regional RA assessments (BPA, PNUCC, etc.), but no regulatory program to coordinate RA planning and procurement
- **Reliability planning done through utility IRPs**
  - Lack of consistency in assumptions (e.g. load growth, capacity contributions)
  - Lack of consistency in reliability standards (e.g. PRM vs. LOLE vs. other reliability metrics)
- **Top-down view of regional need may not match the bottom-up (IRP-based) view**
  - Reliance in IRPs on market purchases (aka front-office transactions) may lead to double counting
- **The region (led by the Northwest Power Pool) is considering developing a regional RA program**




## Different Loads Forecast in Utility IRPs




Source: PNUCC 2019 Northwest Regional Forecast

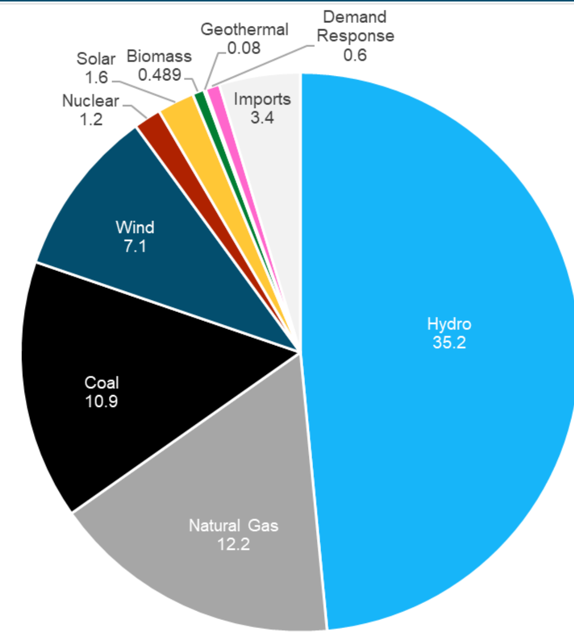
# PacNW Existing Resources
## 2018

### Load + Resource Balance (Greater NW = WA, OR, ID, parts of UT, WY)

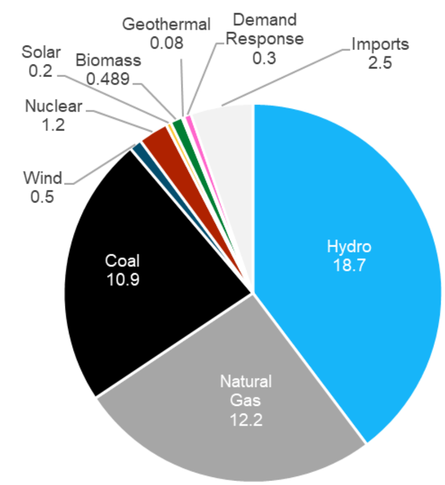
| Load | | | Load GW |
|---|---|---|---|
| Peak Load | | | 42.1 |
| Firm Exports | | | 1.1 |
| PRM (12%) | | | 5.2 |
| **Total Requirement** | | | **48.4** |
| **Resources** | **Nameplate GW** | **Effective %** | **Effective GW** |
| Coal | 10.9 | 100% | 10.9 |
| Gas | 12.2 | 100% | 12.2 |
| Biomass & Geothermal | 0.6 | 100% | 0.6 |
| Nuclear | 1.2 | 100% | 1.2 |
| Demand Response | 0.6 | 50% | 0.3 |
| Hydro | 35.2 | 53% | 18.7 |
| Wind | 7.1 | 7% | 0.5 |
| Solar | 1.6 | 12% | 0.2 |
| Storage | 0 | — | 0 |
| **Total Internal Generation** | **69.1** | | **44.7** |
| Firm Imports | 3.4 | 74% | 2.5 |
| **Total Supply** | **72.5** | | **47.2** |
| **Surplus/Deficit** | | | |
| **Capacity Surplus/Deficit** | | | **-1.2** |

Source: E3 Resource Adequacy in the Pacific Northwest, 2019
Note: other top-down analyses (e.g. NWPCC) suggest need starting in the 2020-2021 timeframe.

### Nameplate GW




### Effective GW



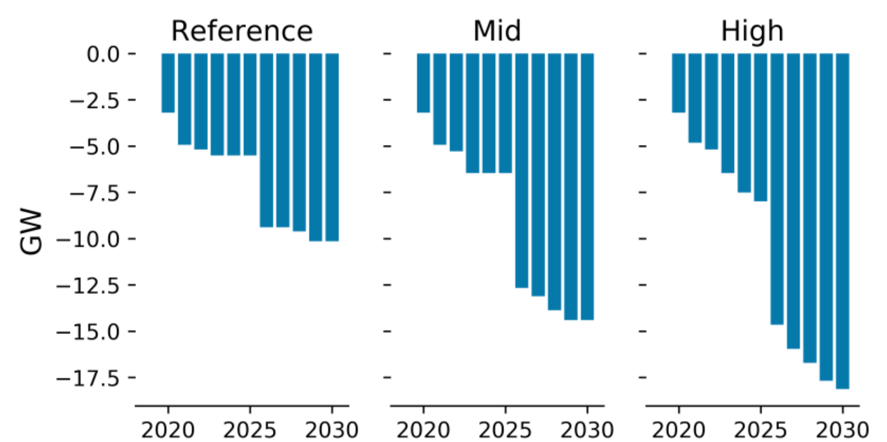

Fossil units are 1/3 of nameplate but 1/2 of effective GW

# PacNW Near-Term Capacity Need

## Key Drivers

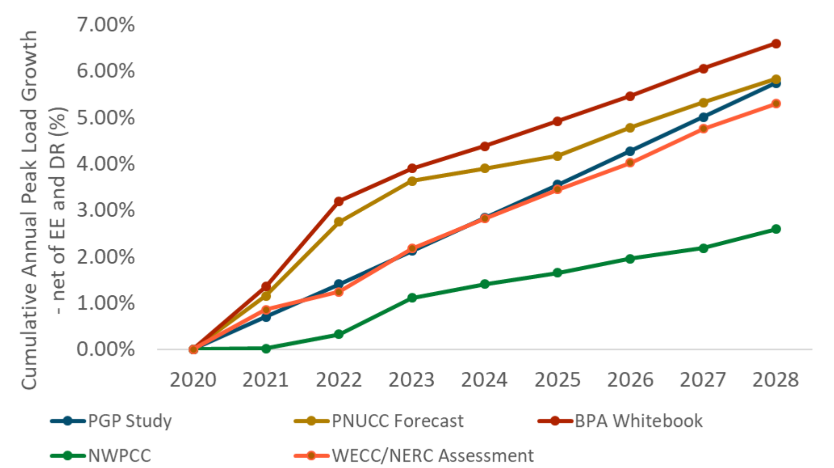
- A combination of departing industrial loads, generation additions, and sustained attention to energy efficiency left the Northwest with excess capacity for nearly two decades
- Two key drivers of the Northwest's capacity challenges have been identified in recent studies:
  1. Thermal (largely coal) resource retirements
  2. Peak load growth
- Both trends are expected to continue across the West as states and provinces continue to pursue decarbonization of both the economy and the electric supply

**WECC Coal Retirement Scenarios (cumulative)**




*NOTE: in 2019, ~35 GW coal in WECC (11 GW in Greater NW)*

**NW Peak Load Growth in Recent Studies**



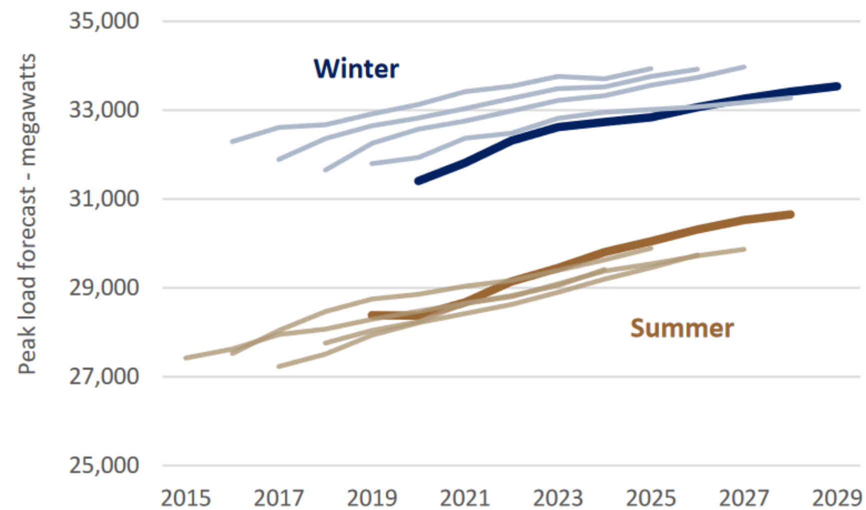
# PacNW Near-Term Capacity Need

## Winter vs. Summer Needs

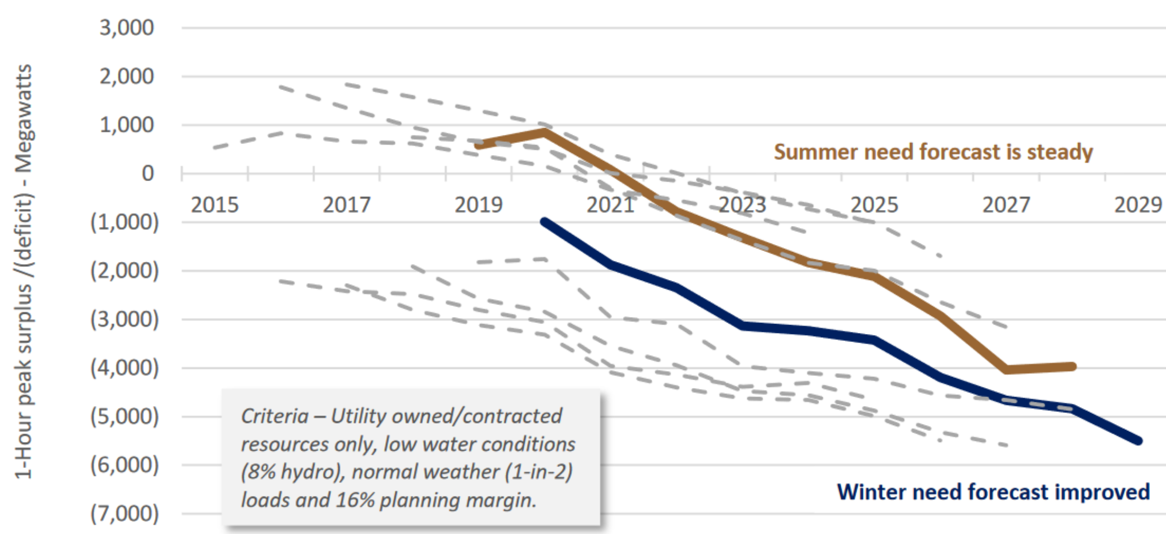
- **PacNW is a winter peaking region***
  - Summer peak is significant and continues to climb ("dual peaking")
  - Hydro resources and imports are generally less available in summer

- **The region faces both winter and summer load-resource balance deficits**

### PNUCC Summer vs. Winter Peak Demand




### PNUCC Summer vs. Winter Need Forecast



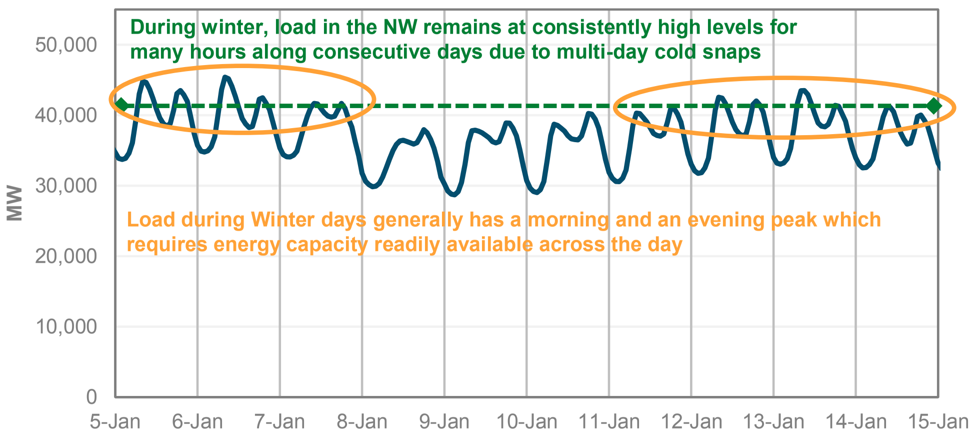

* NOTE: various definitions are used for the Northwest Region. The Northwest Power Pool ("Greater Northwest" region) exhibits a dual winter/summer peak, while the PNUCC region shown here has a stronger winter peak.

# PacNW Near-Term Capacity Need

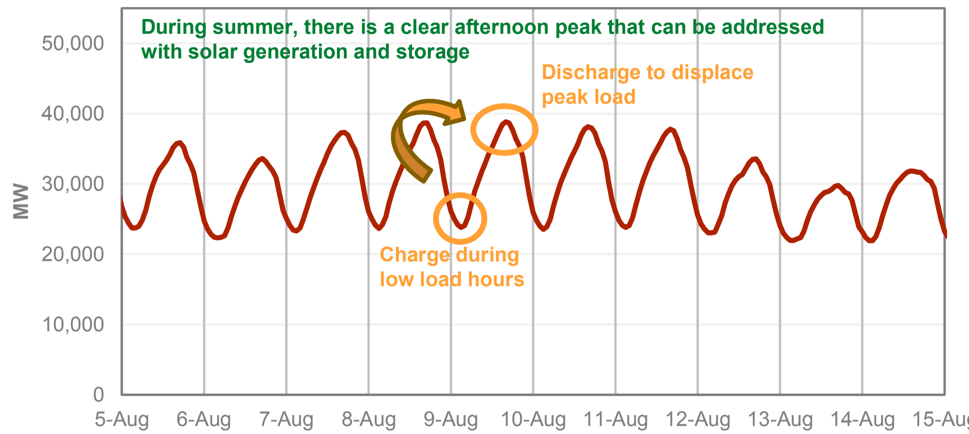
## Winter vs. Summer Needs

+ **Reducing the winter peak in the NW is challenging due to its multi-day duration & daily dual-peak nature coupled with inconsistent wind and solar availability**

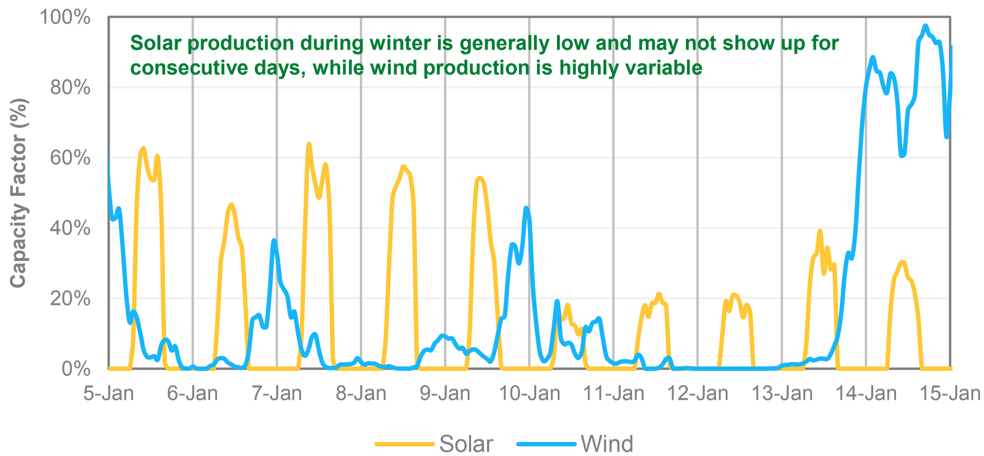
### Winter Peak Load



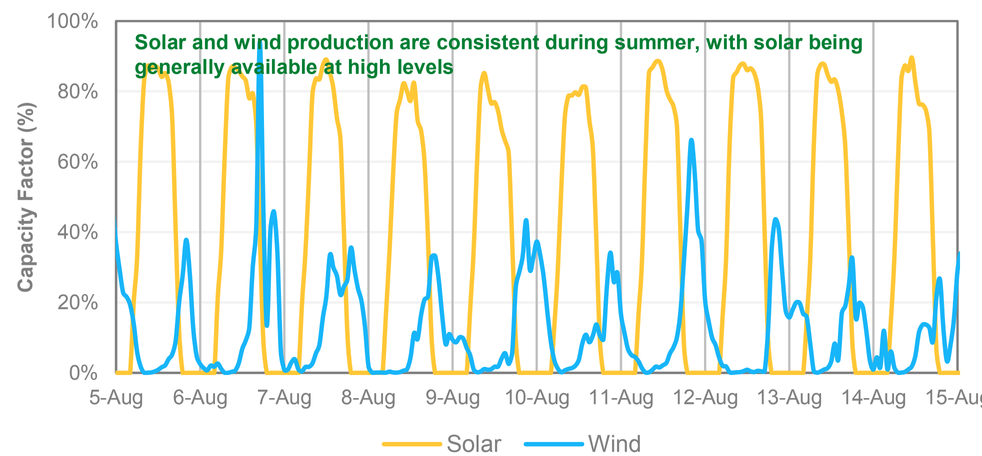

### Summer Peak Load




### Renewables Winter Profile

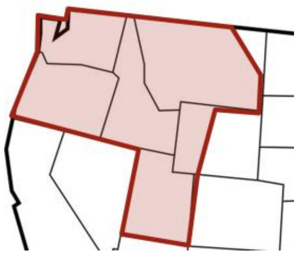



### Renewables Summer Profile

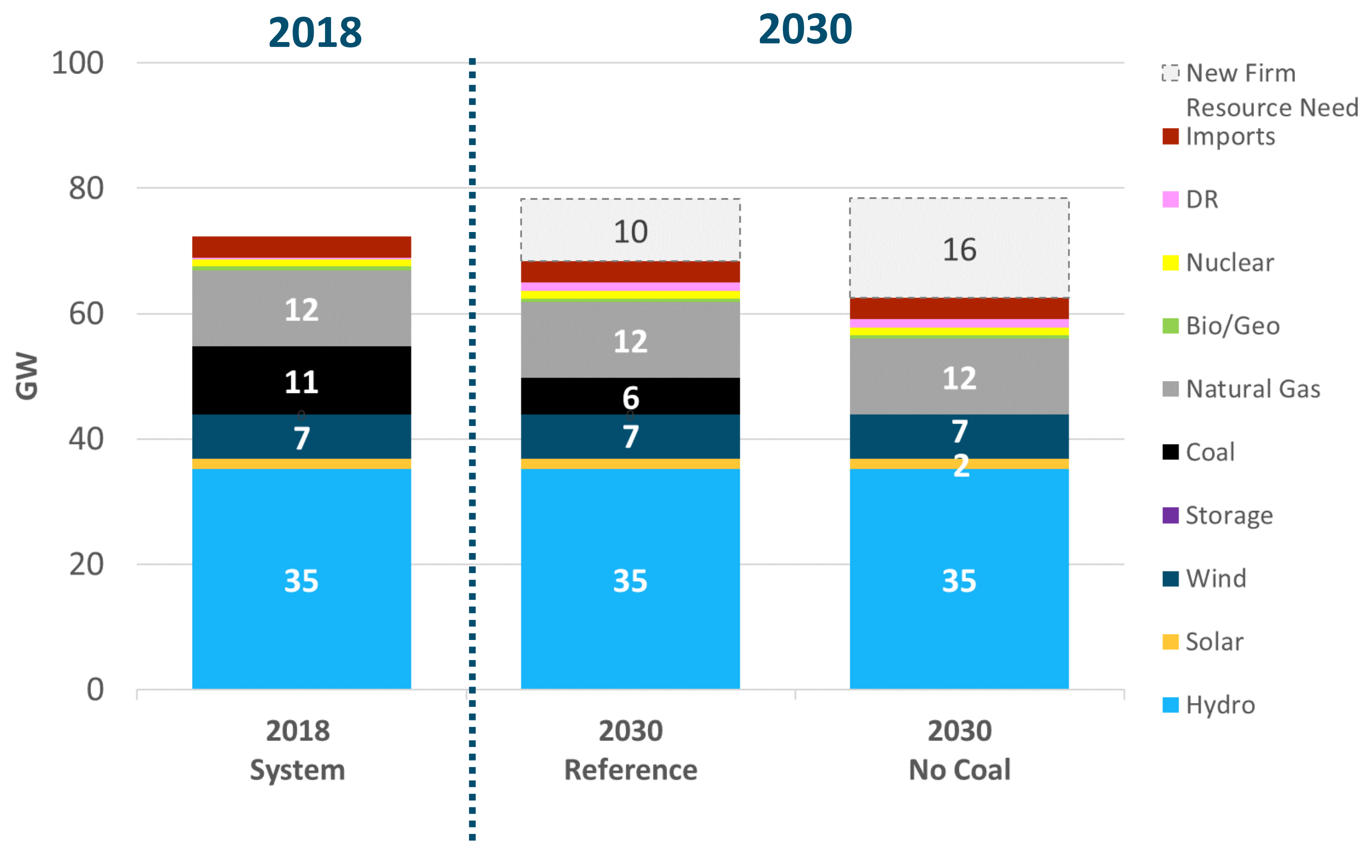


# PacNW Near to Mid-Term Capacity Need

## 2019 E3 Study Details



- E3 2019 RA study considered Greater NW capacity needs under changing resource portfolios
- The study region consists of the U.S. portion of the Northwest Power Pool (excluding Nevada)
- Did NOT consider high electrification loads, which may further increase capacity needs




| | | | |
|---|---|---|---|
| Peak Demand (+ firm exports + PRM) | 48 GW | 53 GW | 53 GW |
| Coal Capacity | 11 GW | 6 GW | 0 GW |
| Capacity Shortfall | **1.2 GW** | **10 GW** | **16 GW** |
| Annual Additions ('18-'30) | n/a | ~600 MW/yr | ~1,300 MW/yr |

By 2030, load growth + coal retirements lead to a 10-16 GW capacity need

*Note: utilizes RECAP modeling results from E3's 2019 study Resource Adequacy in the Pacific Northwest, but includes the latest proposed coal retirements schedules (as of Oct 2019).*

# PacNW Near to Mid-Term Capacity Need
## Bottom-Up Planned Additions (By Technology)

+ **Planned capacity additions reach over 13,000 MW by 2030**
  - Most new additions are wind and solar
  - Little new firm capacity online before 2025
  - Over-reliance on "market purchases" may stress the region's available physical capacity

| Planned Addition By Resource (Nameplate MW) | 2020 | 2025 | 2030 |
|---|---|---|---|
| Gas | 247 | 362 | 2326 |
| Coal | 0 | 0 | 0 |
| Hydro | 0 | 0 | 0 |
| Solar | 121 | 2951 | 5176 |
| Wind | 0 | 4068 | 4068 |
| Storage | 20 | 297 | 930 |
| Others (BPA + NWE) | 0 | 735 | 798 |
| Total Planned Additional Capacity (MW) | 388 | 8413 | 13298 |
| Market Purchases | 2101 | 1288 | 2332 |

Limited firm capacity additions before 2025

Resource types TBD

Effective capacity only ~7,000 MW*

High reliance on the market may double count physical resources

**2030 "top-down" regional need vs. "bottom-up" planned additions:**

**9.9 GW need – 7.0 GW effective additions = 2.9 GW remaining**

* Estimate of effective capacity estimated using marginal ELCCs from E3's RECAP Study of 25% for solar, 40% for wind, 98% for storage
Note: storage's ELCC quickly declines after the first tranche of additions

# PacNW Near to Mid-Term Capacity Need

## Bottom-Up Planned Additions (By Utility)

- **Multiple utilities are planning large capacity additions to address their needs**
  - Utilities subject to strong clean energy policies may seek or require non-emitting new capacity
  - PacifiCorp has the majority of the regional capacity need / planned additions, after their planned coal retirements
- **A PacNW regional RA program may further facilitate utility coordination needed for new large infrastructure investments in new resource adequacy capacity**

| Planned Addition By Utility (Nameplate MW) | 2020 | 2025 | 2030 |
|---|---|---|---|
| Portland General Electric | 0 | 805 | 805 |
| Idaho | 0 | 276 | 967 |
| Puget Sound Energy | 126 | 430 | 1170 |
| Avista | 15 | 15 | 360 |
| Pacificorp | 247 | 6153 | 9198 |
| NorthWestern Energy | 0 | 735 | 798 |
| Bonneville Power Administration | 0 | 0 | 0 |
| Municipal Utilities | 0 | 0 | 0 |
| **Total Planned Additional Capacity (MW)** | **388** | **8413** | **13298** |

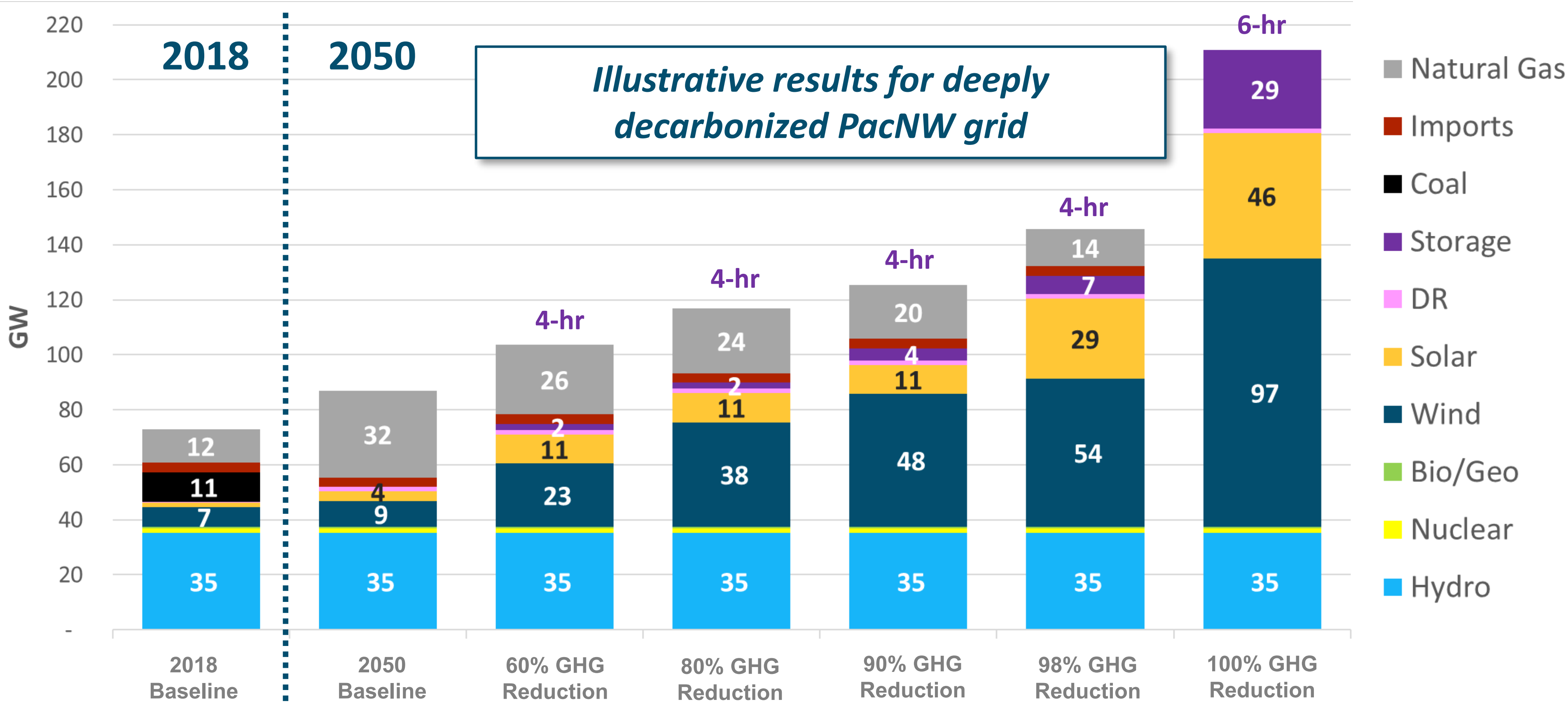
*Does not include EE and DSM

- Significant need by 2025 for utilities w/ mandatory or voluntary clean energy policies
- Market opportunity for non-emitting capacity, though some gas may be needed for reliability

# PacNW Long-Term Capacity Need

## 2019 E3 Study: 2050 Portfolios

+ Firm dispatchable resources are built and maintained for reliability in low carbon scenarios
+ Relatively low storage demand (0-7 GW) in all scenarios (except zero-carbon)…driven by low ELCCs




| | 2050 Baseline | 60% GHG Reduction | 80% GHG Reduction | 90% GHG Reduction | 98% GHG Reduction | 100% GHG Reduction |
|---|---|---|---|---|---|---|
| GHG Free Generation (%)[1] | 60% | 80% | 90% | 95% | 99% | 100% |
| Annual Renewable Curtailment (%) | Low | Low | 4% | 10% | 21% | 47% |
| Annual Cost Delta ($B/yr) | Base | $0 - $2 | $1 - $4 | $2 - $5 | $3 - $9 | $16 - $28 |
| Additional Cost ($/MWh) | Base | $0 - $7 | $3 - $14 | $5 - $18 | $10 - $28 | $52 - $89 |
| Gas Capacity Factor (%) | 46% | 27% | 16% | 9% | 3% | 0% |

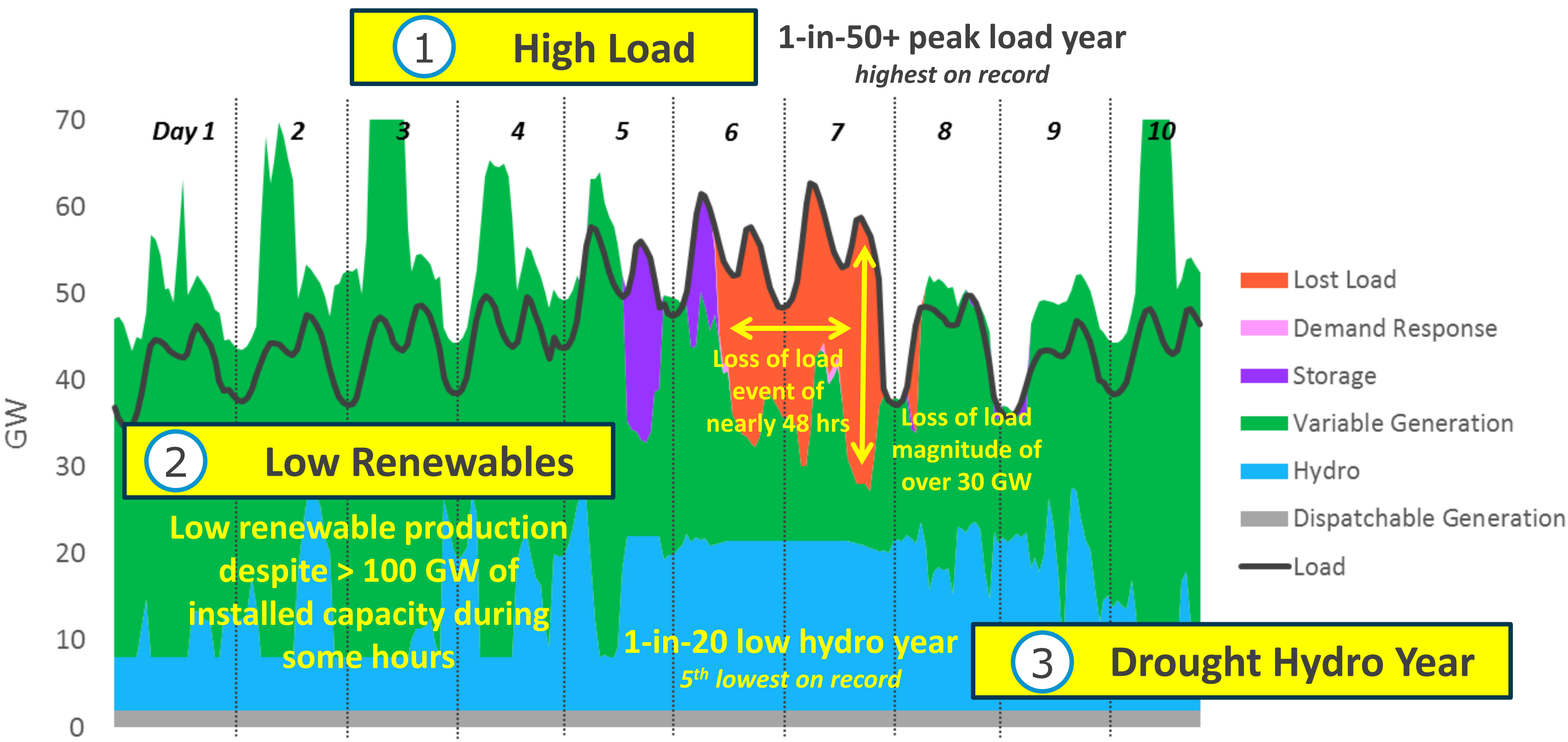
[1]*GHG-Free Generation % = renewable/hydro/nuclear generation, minus exports, divided by total wholesale load*

*Source: https://www.ethree.com/wp-content/uploads/2019/06/E3_Long_Run_Resource_Adequacy_CA_Deep-Decarbonization_Final.pdf*

# PacNW Long-Term Capacity Need

## 2019 E3 Study: The 2050 Reliability Planning Challenge

+ **2050 reliability challenge is driven by high load and low renewable periods in low hydro years**
  - Multi-day, high magnitude loss-of-load events require firm dispatchable resources (high energy + capacity need)
  - Even multiday storage limited by energy availability to address loss-of-load
  - Seasonal storage may be able to address, but technology is not yet commercialized and likely to be costly



Energy+Environmental Economics

# Appendix

# PacNW Near-Term Capacity Need

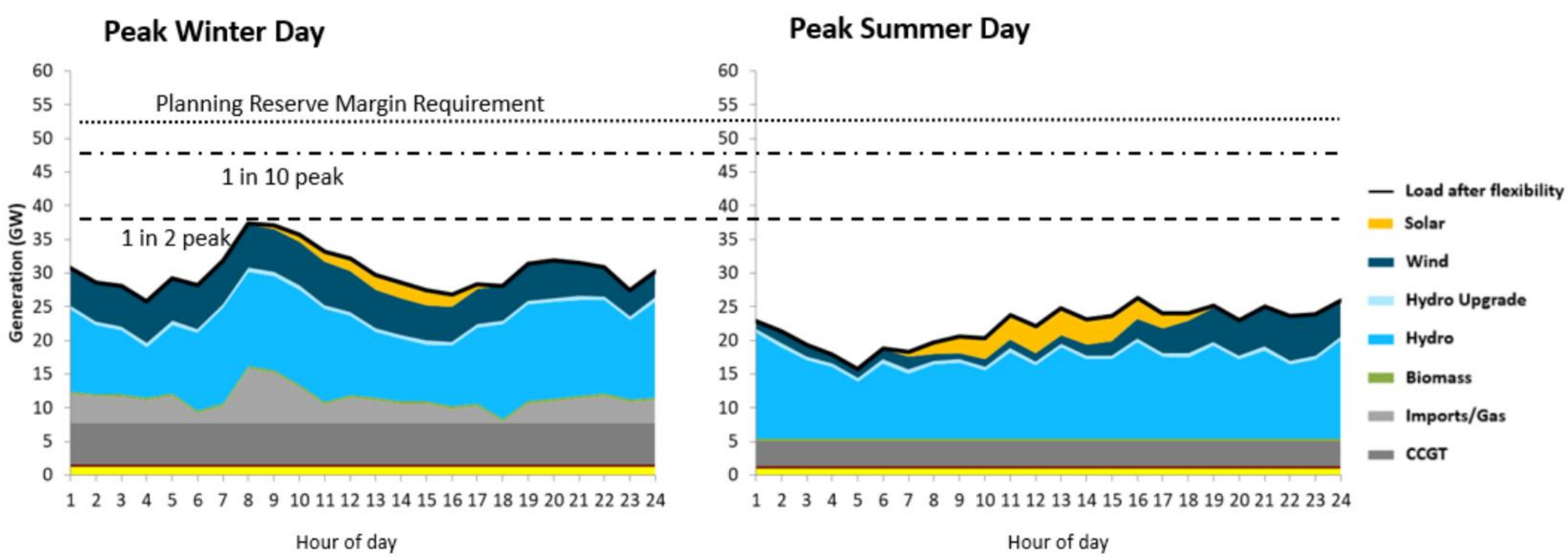
## Details of Top-Down Regional Studies

| Characteristic | E3 Study | NWPCC | BPA WB | PNUCC |
|---|---|---|---|---|
| **Study Year** | 2019 | 2018 | 2018 | 2019 |
| **Region** | GNW (WA, OR, ID, UT, MT, WY) | PNW (ID, MT, OR, WA) | PNW (ID, MT, OR, WA) | OR, WA, ID; portions of MT (west), NV, UT, WY |
| **Resources Included** | Existing | Existing & Planned | Existing & Planned | Existing & committed excludes non-contracted from load/resource balance |
| **Import / Exports** | Imports: 2.5 GW<br>Exports: 1.1 GW | 1.5 – 3 GW | 1.2 GW | 2.5 GW |
| **Coal Retirements** | 3 GW in GNW 2019-2028 | 2.1 GW by 2022 | 2.1 GW by 2022<br>3 GW by 2026 | 3.6 GW |
| **Hydro ELCC** | 53% | 80 years of water availability | 120-hour sustained capacity (44%) | 8th percentile of monthly average conditions (67%) |
| **Peak Load** | CP of all utilities in dataset | Distribution of peak loads for 80 temperature years | BPA load forecasts | NCP of all participating utilities |
| **Peak Load Growth** (2020-2028) | 0.70% CAGR | 0.32% CAGR | 0.80% CAGR | 0.71% CAGR |
| **ELCC** (2018) | Endogenously calculated in RECAP<br>- Thermal (outages)<br>- DR 50%<br>- Wind 7%<br>- Solar 12% | Endogenously calculated in GENESYS | Renewables do not count for firm capacity | Existing projects<br>- Wind 5%<br>- Solar 8% |
| **PRM** | 12% | Annual LOLP of 5% | ~12% | 16% |

# Potential Peak Demand Impacts of Building Electrification in the PacNW

+ **Long-term GHG reduction may drive electrification loads in the Northwest that will further increase peak loads**
  - 2018 E3 PATHWAYS study considered impact on "Core NW" (WA, OR, parts of ID+MT)
+ **Electric space heating drives significantly higher peak demand in cold climates**
  - "Peak heat" drives very high 1 in 10 peak demand
    - Requires increased planning reserve margins
    - Core NW peak + PRM increases >50% compared to today with high heat pump loads
+ **Expanded transportation electrification loads may also increase capacity needs**

**Hourly loads, peak winter day and peak summer day in 2050, Cold-Climate Heat Pump Scenario**




Source: E3 Pacific Northwest Pathways to 2050, assumes 96% fuel switching of space/water heating to electric

# Key Terms & Abbreviations

- BPA: Bonneville Power Administration
- CAGR: Compound Annual Growth Rate
- CP: Coincident Peak
- DSM: Demand Side Management
- EE: Energy Efficiency
- ELCC: Effective Load Carrying Capability
- GHG: Greenhouse Gas
- GW: Gigawatt
- LOLE: Loss of Load Expectation
- LOLP: Loss of Load Probability
- MW: Megawatt
- NCP: Non-Coincident Peak
- NWPCC: Northwest Power and Conservation Council
- PNUCC: Pacific Northwest Utilities Conference Committee
- PRM: Planning Reserve Margin
- RA: Resource Adequacy
- RECAP: E3's Renewable Energy Capacity Planning Tool: www.ethree.com/recap
- SCC: Social Cost of Carbon

Energy+Environmental Economics

# Thank You

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# Swan Lake North Pumped Storage Project

## Economic and Fiscal Impacts from Operations and Construction

January 2015

Prepared for:

EDF Renewable Energy

ECONorthwest
ECONOMICS • FINANCE • PLANNING

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# Table of Contents


**1 Introduction ... 1**

1.1 Input-Output Modeling Terms ... 3

1.2 Limitations of this Analysis ... 5

**2 Economic Impacts from Construction ... 6**

2.1 Construction Timing ... 6

2.2 Estimated Construction and Project Costs ... 7

2.3 Methodology for Modeling Construction Impacts ... 8

2.4 Direct Employment at Swan Lake North ... 9

2.5 Economic Impacts from Construction Spending ... 10

2.6 Fiscal Impacts of Construction Spending ... 12

**3 Economic Impacts from Operations ... 13**

3.1 Annual Economic Impacts ... 13

3.2 The Multiplier Effect ... 14

3.3 Fiscal Impacts of Operations ... 16

**4 Conclusion ... 17**

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# 1 Introduction

EDF Renewable Energy commissioned ECONorthwest to conduct an analysis of the economic impacts resulting from the construction and operations of the proposed Swan Lake North Pumped Storage Project (Swan Lake North), in Klamath County, Oregon, approximately 12 miles northeast of Klamath Falls. The Swan Lake North facility will have the capacity to deliver a proposed 400 megawatts of electricity for up to ten hours a day, using a closed-loop pump-turbine system that connects two newly-constructed reservoirs.[1]

Hydroelectric pumped storage works as an energy storage system. A pipe connects two dedicated reservoirs, and reversible pump-turbines use electricity to pump water from the lower reservoir to the upper reservoir. When power is needed, the water can be released back to the lower reservoir through the turbines to generate on-demand electricity. This creates a reliable way to integrate energy into the system when it is needed.

Pumped storage helps stabilize the transmission grid, reduces the need for costly transmission upgrades, and supports the development of variable renewable such as wind and solar. As development of renewable resources continues to grow, a reliable method for integration and storage becomes more important.

[1] A 400 MW project was used as the base case for this analysis. Subsequent market analyses will refine actual project size, and related economic impacts. Ultimately, customer requirements will determine the project size, which could range from 300-450 MW.

EDF Renewable Energy expects the Swan Lake North construction project to occur over approximately six calendar years, after the multi-year pre-construction design phase. This analysis relies on operating and construction cost data provided by EDF Renewable Energy, as well as additional research by ECONorthwest about pumped storage projects throughout the United States.

ECONorthwest uses IMPLAN (for IMpact Analysis for PLANning) economic impact modeling software to measure economic and fiscal impacts. IMPLAN is widely respected and used by over 1,500 public and private agencies. The United States Department of Agriculture (USDA) recognizes the IMPLAN modeling framework as "*one of the most credible regional impact models used for regional economic impact analysis*." It selected IMPLAN as its analysis framework to monitor job creation associated with the American Recovery and Reinvestment Act of 2009.

In this analysis, ECONorthwest measured the economic and fiscal impacts of the facility's construction phase, as well as the impacts associated with a typical year of operations. The analysis considers impacts for Klamath County and for the state of Oregon as a whole. All monetary impacts are shown in 2014 dollars.

## 1.1 Input-Output Modeling Terms

**Direct Impacts.** Economic impact analysis employs specific terminology to identify the different types of economic impacts. Using a project-oriented perspective, the *direct impacts* consist of the economic output, income, and jobs generated by the companies, contractors, and workers that are:

- Building or operating the Swan Lake North facility;
- Providing specialized engineering, management, and testing services;
- Manufacturing equipment to be installed on site; and
- Selling retail goods and services, such as lodging and restaurant food, to non-local workers who spend their *per diem* allowances in the local community.

**Indirect Impacts.** Contractors, service providers, and manufacturers will purchase a range of goods and services, including construction materials, spare parts and equipment, repair services, electricity, water and sewer, etc. This spending generates the first round of *indirect impacts*. Their suppliers and vendors for the project will also have to purchase goods and services. This spending leads to additional rounds of indirect impacts. Because they represent interactions among businesses, these indirect effects are often referred to as "supply-chain" impacts.

**Induced Impacts.** The direct and indirect increases in employment and income enhance the overall purchasing power in the economy, thereby inducing further consumption and investment spending. Workers on Swan Lake North, for example, will use their income to purchase groceries or take their children to the doctor. If these workers are from Oregon, then this spending benefits the Oregon economy. If these workers are from out of state, then their income is repatriated and their spending benefits their home states. Spending by workers whose incomes are directly or indirectly tied to Swan Lake North will generate *induced impacts* for workers and businesses in other sectors of the economy. These induced impacts are often referred to as "consumption-driven" impacts.

**Secondary Impacts.** This is the sum of indirect and induced impacts or, simply, the economic effects on sectors outside of direct work on the project.

The IMPLAN model reports the following measures of economic impacts:

- **Output** represents the value of goods and services produced, and is the broadest measure of *economic activity*.
- **Labor income** consists of employee compensation and proprietary income.
    - **Employee Compensation** includes workers' wages and salaries, as well as benefits such as health, disability, and life insurance; retirement payments; employer paid payroll taxes; and non-cash compensation.
    - **Proprietary Income** is earnings by small-business owners, family farmers, and the self-employed.
- **Jobs**, according to IMPLAN's methodology, are measured in terms of full-year-equivalents (FYE). One FYE job, as defined by the U.S. Bureau of Labor Statistics (BLS), equals work over twelve months in a given industry. For example, two jobs that last six months each in 2014 count as one FYE job in 2014. A job can be full- or part-time, seasonal or permanent; IMPLAN counts jobs based on the duration of employment, not the number of hours a week worked. For impact analysis, one construction project job is twelve monthly paychecks. It may be a mix of several individuals holding a position one at a time throughout one year. More common, it is a mix of positions. A carpenter working for five months, followed by an electrician working six months, and a painter working one month would equal one FYE job, according to the BLS and IMPLAN.
- **State and local taxes and fees** include production business taxes; personal income taxes; social insurance (employer and employee contributions) taxes; and various other taxes, fines, licenses, and fees paid by businesses and households.

## 1.2 Limitations of this Analysis

The goal of this research is to assess how construction of Swan Lake North will contribute to the state and national economies. The analysis relies on EDF Renewable Energy's construction and operating cost estimates, and uses economic impact modeling techniques to measure the linkages between this spending and other industry sectors in the state and national economies.

This analysis does not measure the potential impacts of counterfactual scenarios. A counterfactual considers how scarce resources would have been allocated had the Swan Lake North project not occurred, or how funding Swan Lake North could potentially divert spending away from other businesses (referred to as a "substitution effect" in economics).

In addition, this analysis does not measure the potential economic development impacts of Swan Lake North. Large investments in infrastructure can start a cycle of economic expansion. Economists call this impact an expansion of the "production possibilities frontier" of the economy. Although it is difficult to quantify this effect, it could be an important dimension to Swan Lake North.

# 2 Economic Impacts from Construction

The cumulative economic impacts for Oregon over the construction cycle are estimated at $523 million in output, which includes $167 million in labor income, and 3,360 jobs.

This analysis includes the impacts from both capital and operational expenditures. We report these impacts separately because capital expenditures will occur unevenly over the construction timeframe, while operating expenditures will be relatively stable from year to year. We report the total impacts of construction for the duration of the construction period. We report the impacts of operations for one representative year.

## 2.1 Construction Timing

EDF Renewable Energy estimates that pre-construction planning for the Swan Lake North project will take approximately nine years. Construction will likely begin in the late 2010s, and will take approximately five calendar years.[2] In this section, we report the total impacts for the pre-construction and construction phases together. We report the construction jobs impacts for each year of construction to show how the jobs impacts will be spread out over time.

[2] Construction begins in the summer of the first calendar year of the construction phase.

## 2.2 Estimated Construction and Project Costs

EDF Renewable Energy will spend approximately $1.1 billion on the Swan Lake North project for engineering, equipment procurement, permitting, and construction (this also includes contingencies) over the nine-year pre-construction phase and the five-calendar-year construction phase.[3] Pre-construction spending will go primarily to licensing, marketing and design services. We report cumulative construction impacts for both phases of construction, and for Klamath County and the rest of Oregon, in Table 1.

**Table 1: Swan Lake North Construction and Project Costs (2014 Dollars)**

| Major Expenditure Component | Klamath County | Rest of Oregon | Outside of Oregon | Total All |
|---|---|---|---|---|
| Construction labor | $20,456,718 | $54,710,059 | $17,297,937 | $95,341,014 |
| Other labor | $1,051,729 | $37,140,474 | $10,311,070 | $50,012,065 |
| Materials & equipment | $617,633 | $162,419,930 | $571,432,582 | $757,317,308 |
| **Construction Costs** | **$22,126,080** | **$254,270,463** | **$599,041,589** | **$902,670,387** |
| Transfers | $27,839,889 | $0 | $35,764,297 | $65,582,722 |
| Contingency | $5,152,026 | $26,218,005 | $65,455,279 | $93,904,232 |
| **Total Project Costs** | **$55,117,995** | **$280,488,469** | **$700,261,166** | **$1,062,157,340** |

We do not include spending on contingencies in our calculation of economic impacts. The contingency allowance buffers against spending overages on project construction; this spending will not necessarily occur. For the remainder of this report, we do not include transfers or contingencies in our construction cost figures.

Klamath County will benefit from approximately $22.1 million of construction spending. Labor spending comprises the majority of this impact.

[3] Contingencies are not included in the construction costs for purposes of impact analysis. This is a conservative assumption.

Most of the construction spending will benefit other parts Oregon and the United States. EDF Renewable Energy will spend approximately $254 million on goods and services from sources inside Oregon but outside of Klamath County, for the construction of this project. This spending includes wages and benefits for workers who reside outside the county.

Swan Lake North construction spending outside of Oregon totals $599 million. Much of it is on equipment not made in the state. The project's out-of-state workers will benefit area businesses by spending some of their income and nearly all of their *per diems* in Klamath County. Although local businesses will experience some impact from non-resident labor spending, these workers will remit the majority of their earnings back to their home states.

### 2.3 Methodology for Modeling Construction Impacts

The Swan Lake North project involves major purchases of specialized equipment manufactured elsewhere in the U.S. and overseas, as well as some out-of-state labor. Such non-local inputs have smaller impacts on the state and county economies. To account for these factors, we need to adjust the modeling assumptions in IMPLAN.

ECONorthwest used data from EDF Renewable Energy on the location of contractors, craftspeople, service providers, and manufacturers for the project, to determine the share of spending on materials and labor in Klamath County.

Using this information, ECONorthwest constructed an expenditure function, which tracks direct inputs by source for IMPLAN, specific to the Swan Lake North project. This function allows us to report direct impacts based on the location of vendors where purchases occur, and residencies of workers.

Without adjustment, Swan Lake North's direct economic output in Klamath County would equal the total value of construction — the sum of spending on labor, capital, materials, and other inputs—which amounts to approximately $903 million.[4]

With adjustment, Klamath County will capture $22.1 million of the project's direct output – or total construction cost of $903 million. The rest of Oregon captures $254 million. Most of the direct construction output ($599 million, or 68 percent) accrues to places outside the state.

### 2.4 Direct Employment at Swan Lake North

By definition, all on-site jobs associated with construction are *direct jobs* in Klamath County. These workers include craftspeople, engineers, project managers, and others who provide on-site support services. Direct jobs at Swan Lake North will also benefit employees in other parts of Oregon and elsewhere in the U.S.

As described in the previous section, our analytical approach categorizes job impacts according to where workers reside. Of the 1,440 total direct FYE jobs supported by construction spending, current residents of Klamath County would hold 170. We allocate only those jobs, and their associated labor income, as directly occurring in the county. Workers from elsewhere in Oregon, who would either commute or occupy temporary housing in the county, would fill an additional 1,270 FYE jobs.

[4] Spending excluding asset transfers and budget contingencies.

Table 2 summarizes the direct employment associated with the Swan Lake North by geographic perspective.

**Table 2: Swan Lake North Direct Employment**

| Geographic Perspective | Direct Jobs (Full-Year Equivalents) | Types of Jobs |
|---|---|---|
| Klamath County | 170 | These are direct jobs for Klamath County workers. This figure includes construction jobs and other jobs supported by spending in Klamath County. |
| Rest of Oregon | 1,270 | Jobs for workers from the rest of Oregon. This figure includes construction jobs accruing to rest of Oregon workers and other jobs for vendors in rest of Oregon. |
| Total for Oregon | 1,440 | These are direct jobs for Oregonians. All construction jobs are in Oregon. Other jobs include manufacturing, engineering, management, and other services in Oregon. |

Given Klamath County's relatively small non-residential construction sector (464 jobs, $11.6 million in income, and $54.2 million in output in 2013), we allocated only basic construction services labor to the county. We assumed all technical construction services would come largely from elsewhere in Oregon (between 60 and 80 percent, depending on the year). Residents from outside of Oregon would hold the remaining jobs.

### 2.5 Economic Impacts from Construction Spending

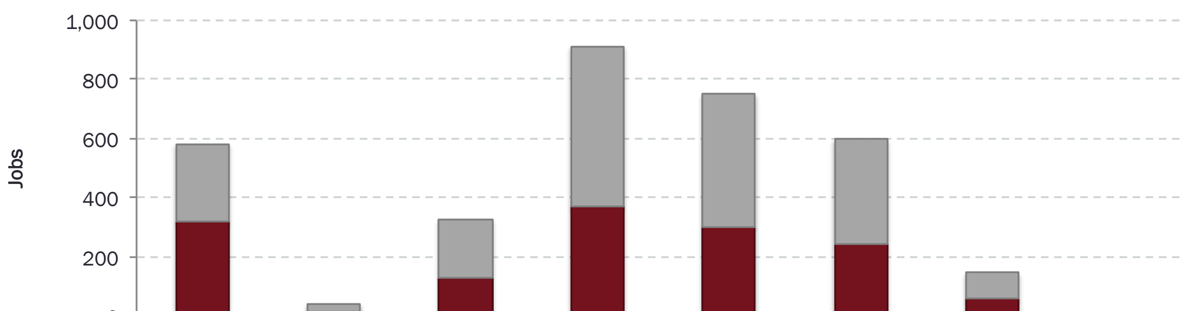
Swan Lake North spending will produce significant direct impacts in the Oregon economy that benefit businesses and employees in this state. The cumulative economic impacts for Oregon over the construction cycle are estimated at $523 million in output, which includes $167 million in labor income, and 3,360 job-years of employment (see Figure 1 for allocation of job impacts over construction schedule). Table 4 shows the economic impacts by location and type.

**Table 3: Economic Impacts from Construction Lifespan (2014 Dollars), and FYE Jobs**

| Study Area / Impact Measure | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| **Klamath County** | | | | |
| Output | $22,047,900 | $5,965,300 | $25,113,200 | $53,126,400 |
| Labor Income | $5,749,600 | $1,987,400 | $7,850,200 | $15,587,200 |
| Jobs | 170 | 60 | 250 | 480 |
| **Rest of Oregon** | | | | |
| Output | $252,344,300 | $113,511,900 | $104,426,600 | $470,282,800 |
| Labor Income | $75,379,700 | $40,169,700 | $35,986,600 | $151,536,000 |
| Jobs | 1,270 | 730 | 880 | 2,880 |
| **Total Oregon** | | | | |
| Output | $274,392,200 | $119,477,200 | $129,539,800 | $523,409,200 |
| Labor Income | $81,129,300 | $42,157,100 | $43,836,800 | $167,123,200 |
| Jobs | 1,440 | 790 | 1,130 | 3,360 |

Construction impacts are temporary in nature and unfold as project spending occurs, therefore, job impacts do not occur consistently throughout the construction period. Figure 1 shows how the 3,360 direct and secondary (indirect and induced) FYE jobs in Oregon occur over the project schedule.

**Figure 1: Direct and Secondary (Indirect and Induced) Jobs in Oregon During the Swan Lake North Construction Project**




| | 9-Year Pre-Const. Phase | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Total |
|---|---|---|---|---|---|---|---|---|
| Secondary | 263 | 26 | 196 | 545 | 449 | 357 | 87 | 1,923 |
| Direct | 320 | 17 | 132 | 368 | 303 | 241 | 59 | 1,440 |

The project pre-construction and construction phases will support 1,440 direct FYE jobs. Pre-construction will support 320 direct FYE jobs, at an annual average of 35.5 direct jobs. The actual number of jobs in each year depends on the timing and mix of construction spending.

### 2.6 Fiscal Impacts of Construction Spending

Together, the direct and secondary impacts of the pre-construction and construction phases of Swan Lake North will generate state and local government revenues of $15 million in Oregon. These revenues come from a variety of sources, namely taxes, fees, licenses, and permits.

# 3 Economic Impacts from Operations

In one year of operations, the Swan Lake North facility will generate an estimated $6.2 million in economic activity, including $1.7 million in labor income, and about 35 jobs in Oregon.

This section summarizes the economic and fiscal impacts generated by one year of operations.

## 3.1 Annual Economic Impacts

In one year of operations, the Swan Lake North facility will generate an estimated $6.2 million in output, $1.7 million in labor income, and 35 jobs in Oregon (Table 4). These impacts will occur each year as long as the Swan Lake North remains in operation.

**Table 4: Economic Impacts from Swan Lake North Operations (2014 Dollars)**

| Study Area / Impact Measure | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| **Klamath County** | | | | |
| Output | $3,370,700 | $1,486,300 | $1,110,200 | $5,967,200 |
| Labor Income | $874,800 | $455,800 | $341,900 | $1,672,500 |
| Jobs | 11 | 12 | 10 | 33 |
| **Rest of Oregon** | | | | |
| Output | $0 | $47,300 | $186,700 | $234,000 |
| Labor Income | $0 | $15,000 | $59,600 | $74,600 |
| Jobs | 0 | 0.3 | 1.4 | 1.7 |
| **Total Oregon** | | | | |
| Output | $3,370,700 | $1,533,600 | $1,296,900 | $6,201,200 |
| Labor Income | $874,800 | $470,800 | $401,500 | $1,747,100 |
| Jobs | 11 | 13 | 12 | 35 |

All of the direct impacts of operations will occur in Klamath County. Swan Lake North will provide approximately $875,000 in labor income to 11 workers, which equates to $80,000 per employee. The average pay (excluding benefits) will be $60,000. Wages in Swan Lake North are very competitive. According to the Oregon Employment Department, the average annual wage in Klamath County was $35,924 in 2014;[5] the average wage of a Swan Lake North employee will be 80 percent higher than the average employee in Klamath County.

Swan Lake North will employ Klamath County residents to operate Swan Lake North, and it will purchase most of its goods and services for operations from businesses in the county. In fact, the analysis indicates that about 96 percent of the total operations impacts on Oregon's economy will occur in Klamath County. This activity will trigger additional spending and jobs within Klamath County, thus supporting the secondary impacts of operations.

### 3.2 The Multiplier Effect

The direct spending attributable to Swan Lake North operations will have a multiplier spending effect, benefiting workers and business owners in all industries of the local and state economies. In essence, multipliers are a shorthand way of explaining the link between an activity and the rest of economy. In this analysis, we consider the multiplier effects for labor income and jobs.

We can sum all of the impact measures described previously across direct, indirect, and induced impact categories using mathematical formulas to measure this effect. The larger the multiplier, the greater the connection is between an activity (in this case, Swan Lake North operations) and the rest of the local and state economies.

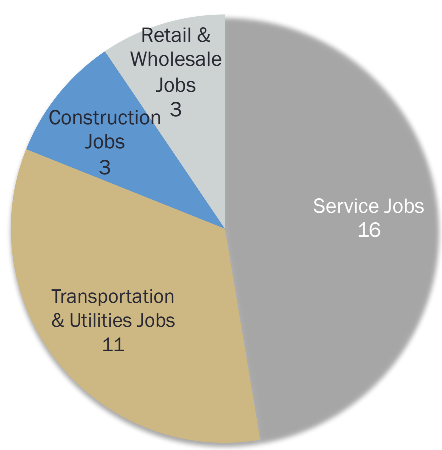
[5] Covered employment payroll does not include employee benefits or employers' share of payroll taxes. Thus, removing benefits and payroll taxes for employees at the Swan Lake provides an apples-to-apples comparison of average wages. See www.olmis.org.

- **The labor income multiplier is 1.9.** This means every $1.0 million in compensation to Swan Lake North employees generates another $900,000 in income for workers in other sectors of the Klamath County economy, for a total of $1.9 million in income.

- **The employment multiplier is 3.2.** This means, for every job at Swan Lake North, another 2.2 jobs are necessary elsewhere in the local economy, for a total of 3.2 jobs.

Figure 2 provides another perspective on the multiplier effect by showing how the direct spending associated with Swan Lake North operations generates job impacts in other industry sectors. The Swan Lake North facility will directly employ 11 workers in the transportation & utilities industry. The spending and income associated with these employees will support another 24 jobs in Klamath County, composed of approximately 16 service sector jobs, 3 construction jobs and 3 jobs in retail and wholesale trade. Therefore, Swan Lake North operations will support 33 total jobs in the county.

**Figure 2: Distribution of Total Job Impacts in Klamath County by Industry**



## 3.3 Fiscal Impacts of Operations

ECONorthwest estimates that Swan Lake North operations will generate $2.1 million per year in property tax revenue for Klamath County.

Development of the Swan Lake North facility will result in benefits to local taxing districts beginning in the first year of operations.

Swan Lake North may be eligible for property tax abatement through the State of Oregon's Strategic Investment Program (SIP), a tax incentive program created to encourage traded sector businesses to locate in Oregon. This is accounted for in the fiscal impact analysis.[6]

Using assumptions and inputs from SIP-approved electric generation projects in rural Oregon, ECONorthwest estimates that Swan Lake North could generate approximately $31.5 million in property tax revenues for Klamath County over a 15-year SIP exemption period. This amounts to $2.1 million per year.

The spending and income associated with Swan Lake North operations will add another $200,000 in annual tax and fee revenues to state and local taxing jurisdictions.

[6] SIP was adopted by the Oregon Legislature in 1993. It allows businesses and local governments to negotiate alternative property tax agreement if these businesses invest over $25 million in rural and $100 million in urban areas. The program attracts investments that provide good jobs and is used to attract capital intensive developments that set the stage for many years of employment.

# 4 Conclusion

ECONorthwest's analysis indicates that over its fourteen-year **pre-construction and construction phases**, the Swan Lake North project will have *cumulative* direct, indirect and induced economic impacts in Oregon of **$523 million in output, $167 million in labor income, and 3,360 full-year-equivalent jobs**. These impacts will be spread unevenly over time based on when spending occurs.

Once the pumped storage facility is up and running, **operating impacts** will total **$6.2 million in output, $1.7 million in labor income, and 35 jobs** annually. About 96 percent of the impacts would occur in Klamath County and the remainder elsewhere in Oregon. These impacts will continue into the future, providing a sustainable source of employment for the local community.