Northwest **Power** and **Conservation** Council

April 1, 2025

MEMORANDUM

TO: **Council Members**

FROM: **Kevin Smit, Manager of Power Planning Resources**

SUBJECT: **Ninth Plan Rooftop Solar Potential**

BACKGROUND:

Presenter: Kevin Smit

Summary: The Ninth Power Plan will include potential estimates for both residential and commercial rooftop solar (photovoltaic or PV systems). While we have always accounted for installed rooftop PV systems in our load forecasts, recent plans have not included them as a resource option alongside other generating and demand side resources, primarily due to their high cost. This presentation will summarize the regional potential amount and estimated cost for solar PV systems on homes and businesses in the Pacific Northwest.

Relevance: The power plan considers electricity generating and demand-side resources to meet future power needs. Per the Power Act, Bonneville is to acquire resources through conservation and renewable resources which are installed by residential or small commercial consumer to reduce load consistent with the Council's power plan (Section 6(a)(1)). With the costs of rooftop PV systems becoming more competitive with other resources, staff recommend analyzing this potential to inform potential acquisition strategies for the region and Bonneville.

Workplan: B.2.4. Develop demand side supply curves and related assumptions for plan analysis.

Background: Direct application renewables have been treated in a variety of ways throughout the history of the Council's Power Plans. PV systems have been consistently included as a deduction in our regional load forecasts but have not always been included as a resource compared with other resources in the planning process, primarily because of their historically high costs. However, in recent years, the costs for rooftop PV systems have come down into the range where they are more competitive on a levelized cost basis. Photovoltaic rooftop solar systems are being installed throughout the region at a relatively strong pace, and for the Ninth Plan, these distributed energy resources will be included as both a reduction in load at the end-use and as a potential resource to meet future needs.

By 2046, the region is expected to have over 5.6 million single family homes and nearly 400,000 commercial buildings, with most of these rooftops able to host a PV system. Typical production rates are approximately 6,000 kWh to 11,000 kWh per home, and approximately 36,000 kWh per commercial building. The presentation will summarize the key assumptions, methods, and the potential estimates for these resources.

More info: Distributed Solar for the Ninth Plan, August 2024 Council meeting

Rooftop Solar Potential for the Ninth Power Plan

April 2025 Council Meeting

Kevin Smit

Northwest **Power** and **Conservation** Council

Agenda

- Rooftop Solar Background
- Key Assumptions for Estimating Potential
- Rooftop Solar Potential Estimates

Solar PV in the 9th Plan: Overview

Utility-Scale Solar PV

Small Scale/ Community Solar PV

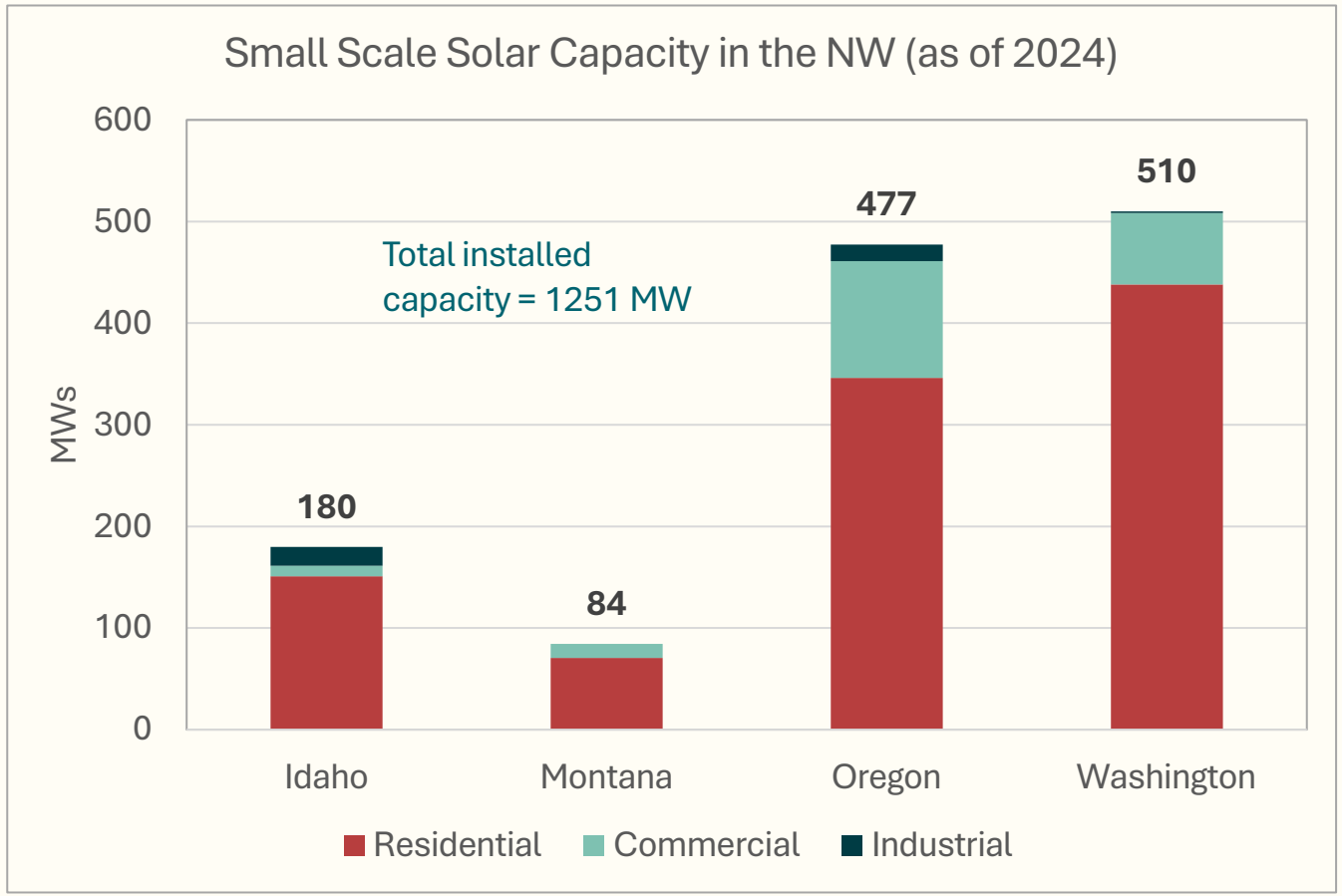
Residential Rooftop Solar PV

Covering these today

Commercial Rooftop Solar PV

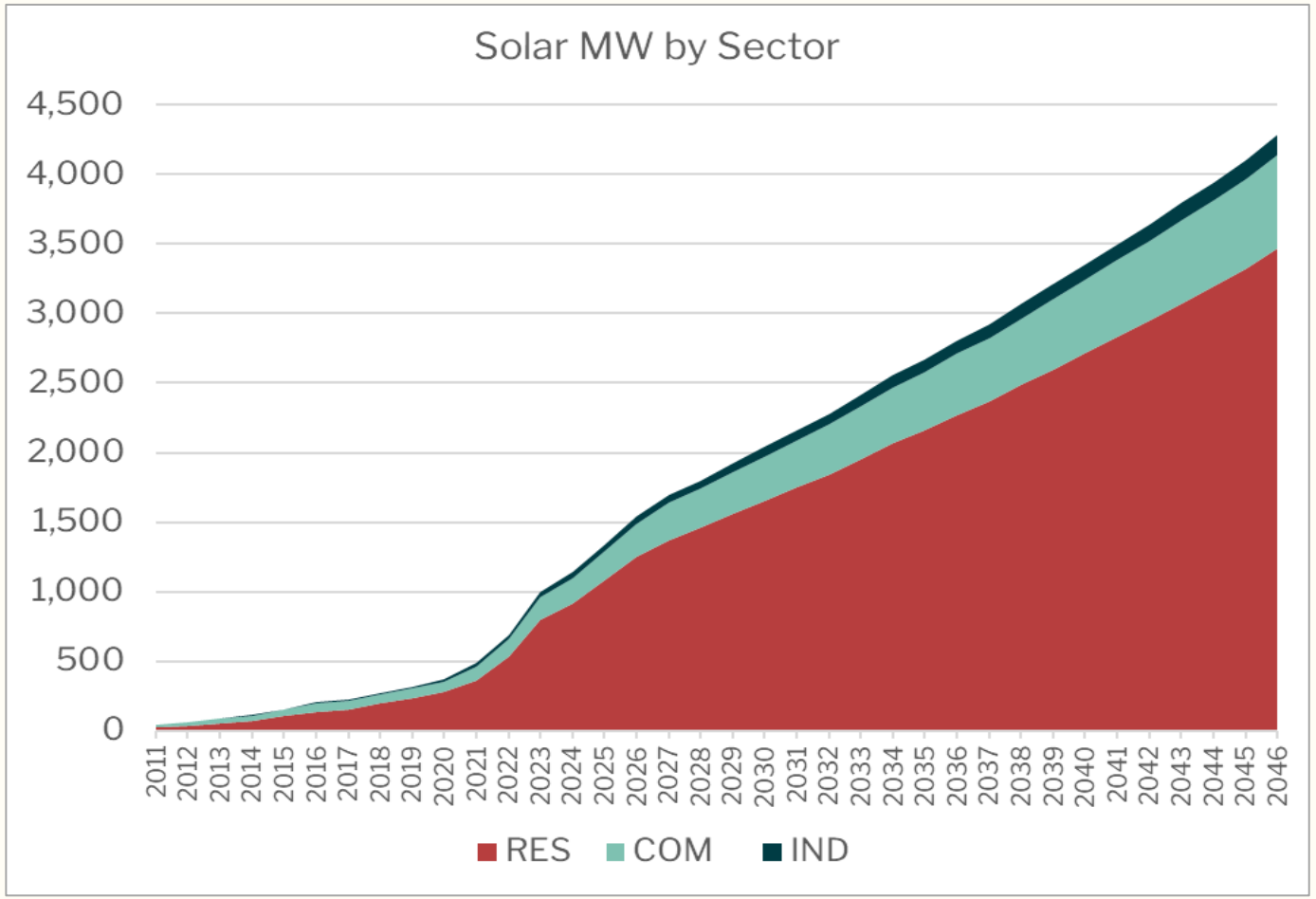
Installed Capacity

- The region has 1251 MW of installed rooftop solar capacity in the region
- This amounts to about 120 aMW of annual energy production



Rooftop Solar Forecast

- Rooftop solar is included in our baseline forecast
- Additional potential will be estimated above this moderate forecast



Estimating the Potential

Residential

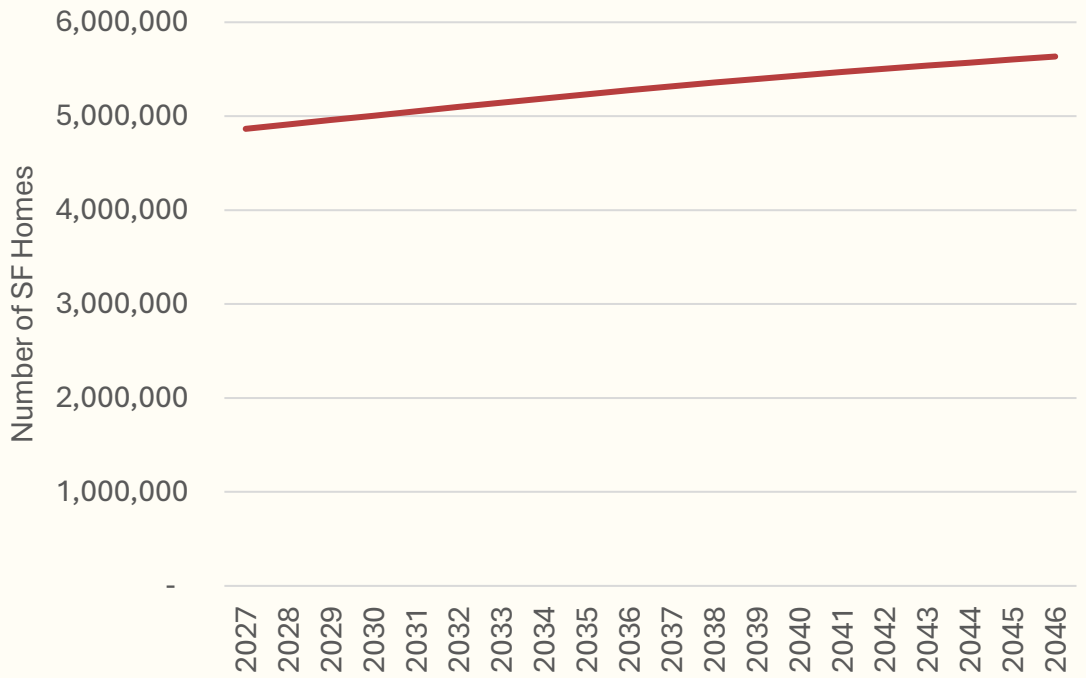
- Number of homes in the region
- Average kWh per home per year
  - Varies by state
  - Varies by panel orientation
  - kW to kWh – capacity factors; shapes
- Applicability factors
  - How many homes could this apply to?
- Saturation factors
  - How many homes already have rooftop PV?
  - How much is in the load forecast?

Commercial

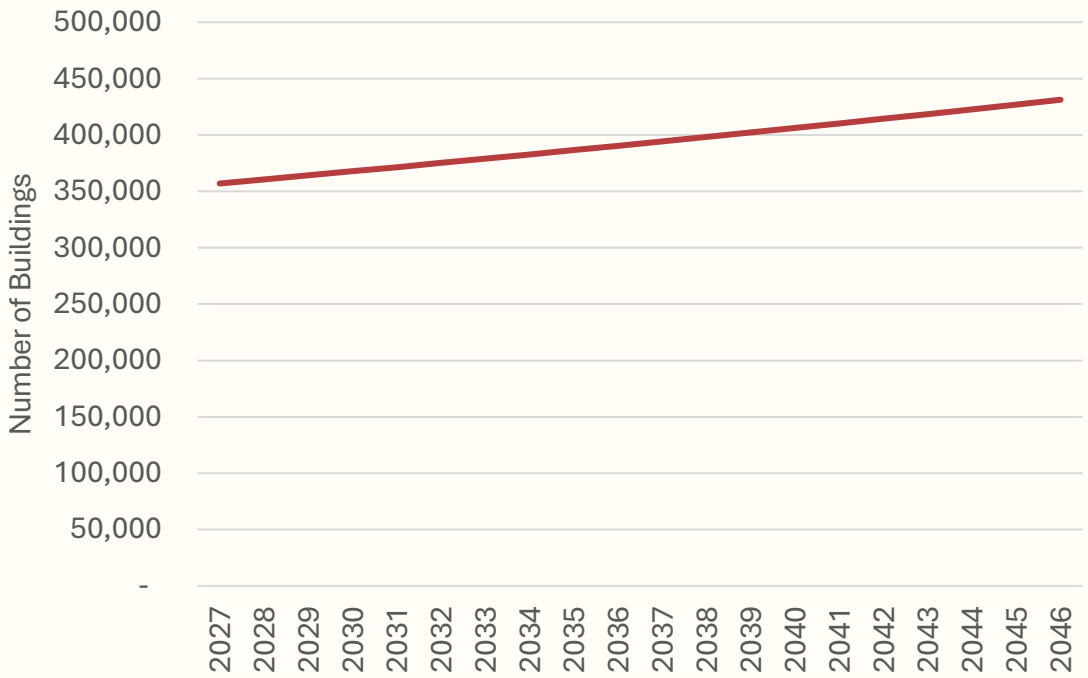
- Number of commercial buildings
- Available roof area:
  - Small buildings
  - Large buildings
- Average kWh per building per year
  - Varies by state
  - Varies by size
- Applicability
  - Applicable roof area
- Saturation factors

Number of Homes and Commercial Buildings

Over 5.6 million single-family homes by 2046

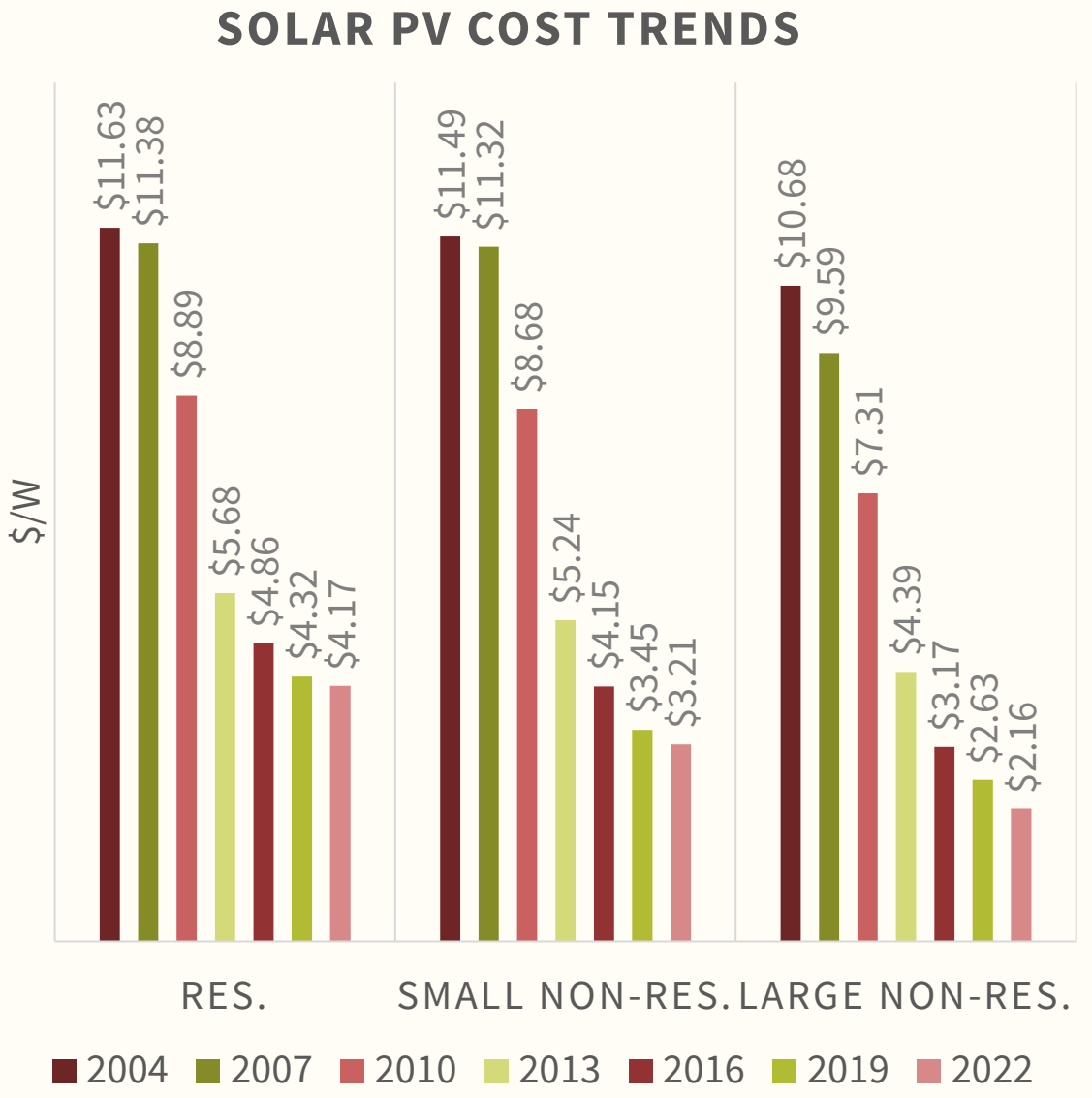


Over 430,000 commercial buildings by 2046



Cost Trends

- Rooftop solar costs have declined significantly since 2004
  - Res now $4.17 per watt, was $11.63
  - Commercial now $3.21 per watt, was $11.49
  - Large Commercial/Industrial now $2.16 per watt, was $10.68
- Costs are projected to continue to decline, but at a much slower rat



Source: LBNL Tracking the Sun

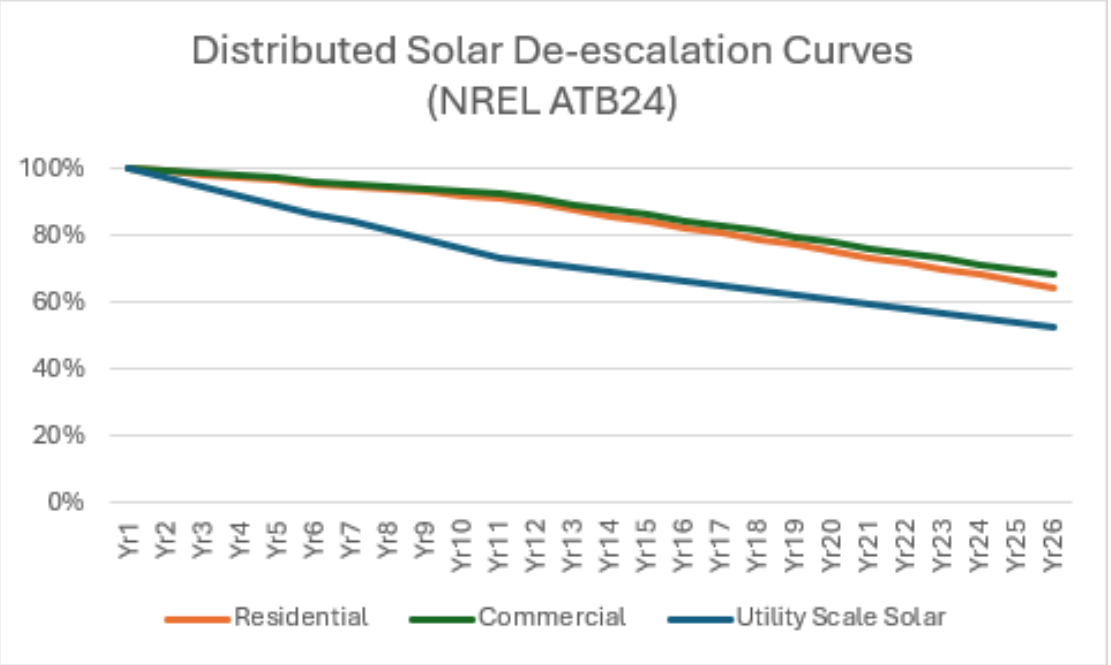
Cost Data

- PV costs are significantly higher for rooftop applications, compared with utility-scale
- Including the Investment Tax Credit
  - There will also be a sensitivity that excludes the ITC
- Costs are expected to decline modestly

Type	State	2023 Median Cost with ITC ($/Watt)	2023 Median Cost ($/Watt)
Large Non-Residential	OR	$1.5	$2.1
	WA	$1.6	$2.3
	ID	$1.6	$2.3
	MT	$1.6	$2.3
Small Non-Residential	OR	$2.2	$3.1
	WA	$3.1	$4.4
	ID	$2.2	$3.2
	MT	$2.2	$3.2

	Levelized Cost in 2025	Levelized Cost in 2030
Utility PV	$52.9/MWh	$47.2/MWh
Commercial PV	$98.5/MWh	$94.9/MWh
Residential PV	$146.2/MWh	$140.0/MWh

Source: NREL Annual Technology Baseline



Residential System Capacity and Energy

- Energy and Capacity Factors include
  - Annual sunlight hours
  - Panel efficiency
  - Average capacity and energy by state
  - Cell type and color, interconnection of the cell, shade, orientation, location, tilt
  - Time of year (e.g., weather conditions and position of the sun)
  - Contamination (e.g., dust, dirt, bird droppings, debris
- Leverage historical installations to determine average size by state

State	Average kW
Idaho	8.44
Oregon	8.87
Washington	9.47
Montana	10.80

State	Average kWh
Idaho	8,150
Oregon	6,700
Washington	6,630
Montana	10,707

Commercial System Capacity and Energy

- Most commercial building solar capacity ranges from 35 – 43 kW (small buildings), 115 – 226 (large buildings)
- Energy production varies by location, based on annual sunlight hours

Annual Sunlight Hours	
State	**State Average**
Idaho	1,916
Montana	1,592
Oregon	1,124
Washington	1,020

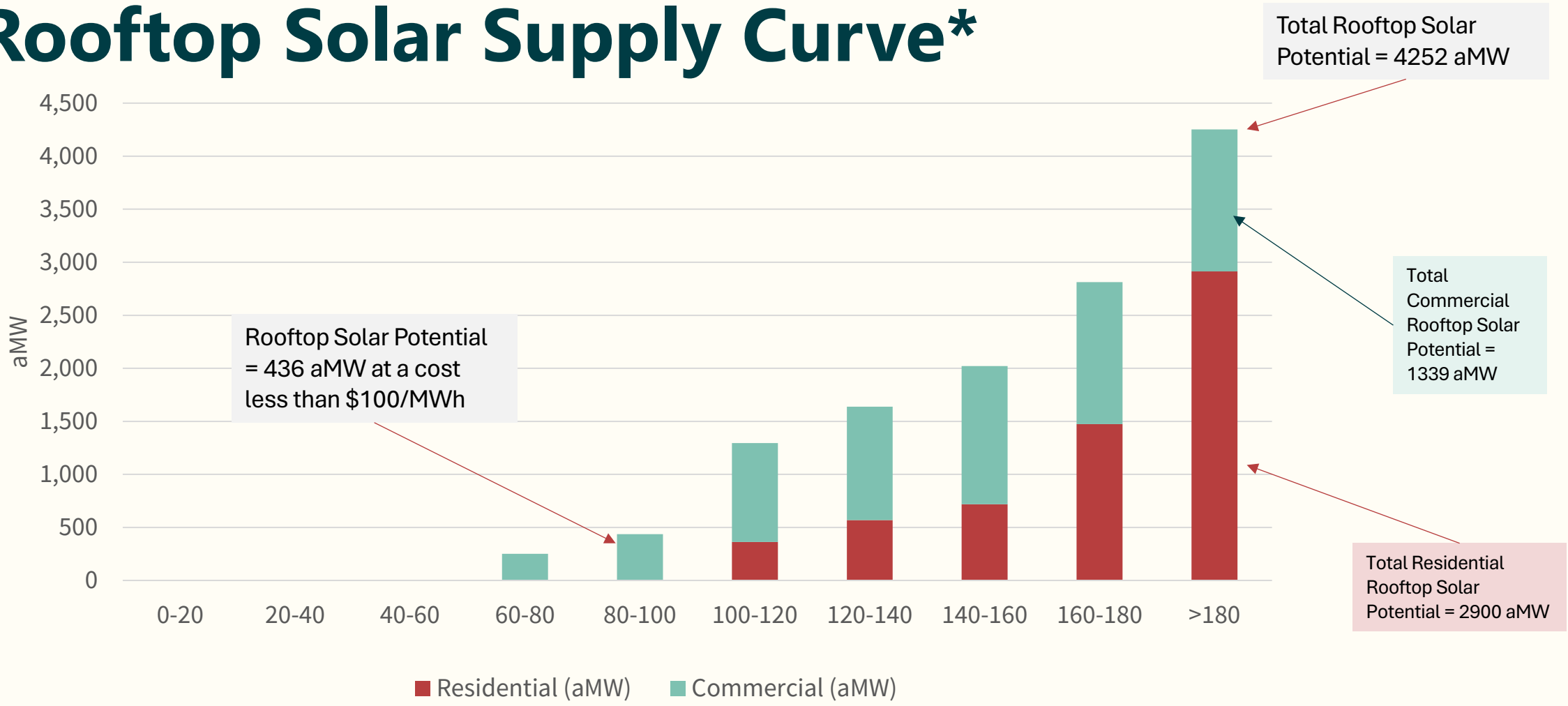
State	Product	Average Capacity (kW)	Average Energy (kWh)
Idaho	Large Non-Residential	169.2	273,496
	Small Non-Residential	38.2	61,731
Montana	Large Non-Residential	225.8	239,206
	Small Non-Residential	37.2	39,457
Oregon	Large Non-Residential	115.3	98,327
	Small Non-Residential	42.7	36,384
Washington	Large Non-Residential	135.0	117,899
	Small Non-Residential	35.3	30,868
Grand Total		**91.7**	**91,752**

Solar Production Varies Throughout the Region

- This table shows how solar production can vary throughout the region
  - Idaho has the highest kWh production from residential rooftop solar (11,273 kWh per year)
  - Western Washington has the lowest kWh production at 5,291 kWh per year
- Our model also includes 3 different orientations which result in more variability (this table times 3)

Measure Applicability	Annual Sunlight Hours	Capacity (kW)	Energy (kWh)	Set up Cost
Rooftop PV-AVA	1,296	9.5	7,921	$39,452.93
Rooftop PV-BPA_WA	1,296	9.5	7,921	$39,452.93
Rooftop PV-CCPUD	1,280	9.5	7,820	$39,452.93
Rooftop PV-DCPUD	1,280	9.5	7,820	$39,452.93
Rooftop PV-GCPUD	1,280	9.5	7,820	$39,452.93
Rooftop PV-PSE_North	955	9.5	5,837	$39,452.93
Rooftop PV-PSE_Central	955	9.5	5,837	$39,452.93
Rooftop PV-SCL	955	9.5	5,837	$39,452.93
Rooftop PV-TPWER	866	9.5	5,291	$39,452.93
Rooftop PV-PSE_Olympia	866	9.5	5,291	$39,452.93
Rooftop PV-BPA_OR	1,024	8.9	5,863	$36,957.33
Rooftop PV-PACW	1,279	8.9	7,319	$36,957.33
Rooftop PV-PGE	926	8.9	5,303	$36,957.33
Rooftop PV-BPA_IDMT	1,338	10.8	9,323	$44,992.62
Rooftop PV-NWMT	1,338	10.8	9,323	$44,992.62
Rooftop PV-IPCO	2,070	8.4	11,273	$35,160.83
Rooftop PV-PACE	2,011	8.4	10,951	$35,160.83

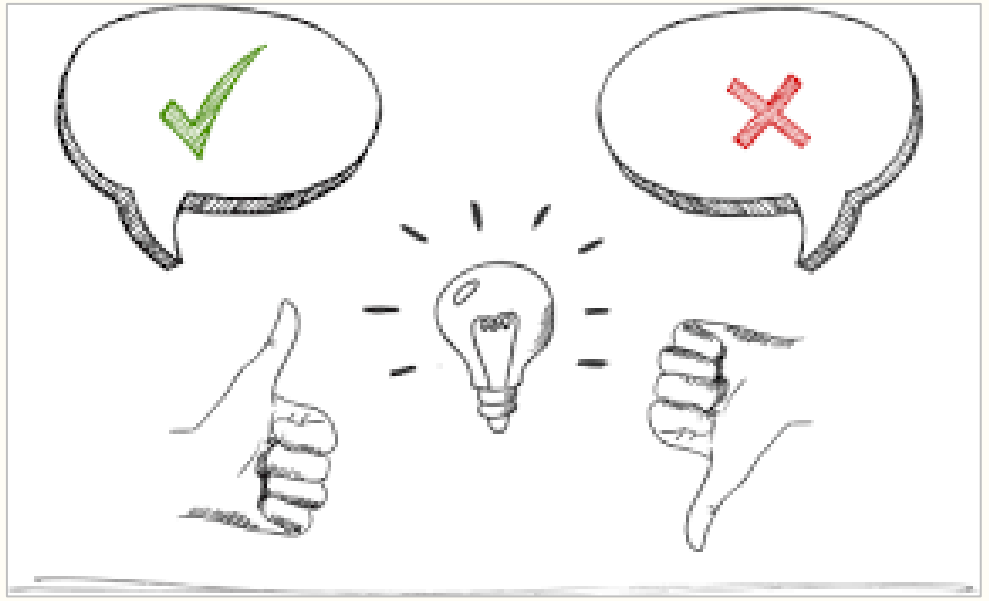
Rooftop Solar Supply Curve*



*Small changes to this are likely over the next couple months as we receive additional feedback from reviewers

Status of Rooftop Solar Supply Curves

- The workbooks are finished and out for review by the CRAC and GRAC
- Received feedback on the residential potential assessment assumptions
  - Ramp rates are too conservative
  - Costs need to be in 2024$
  - Additional specificity by location
- The commercial assessment has been released for review; no comments received to date
- Will update solar shapes to be consistent with utility solar shapes



Questions? Comments?

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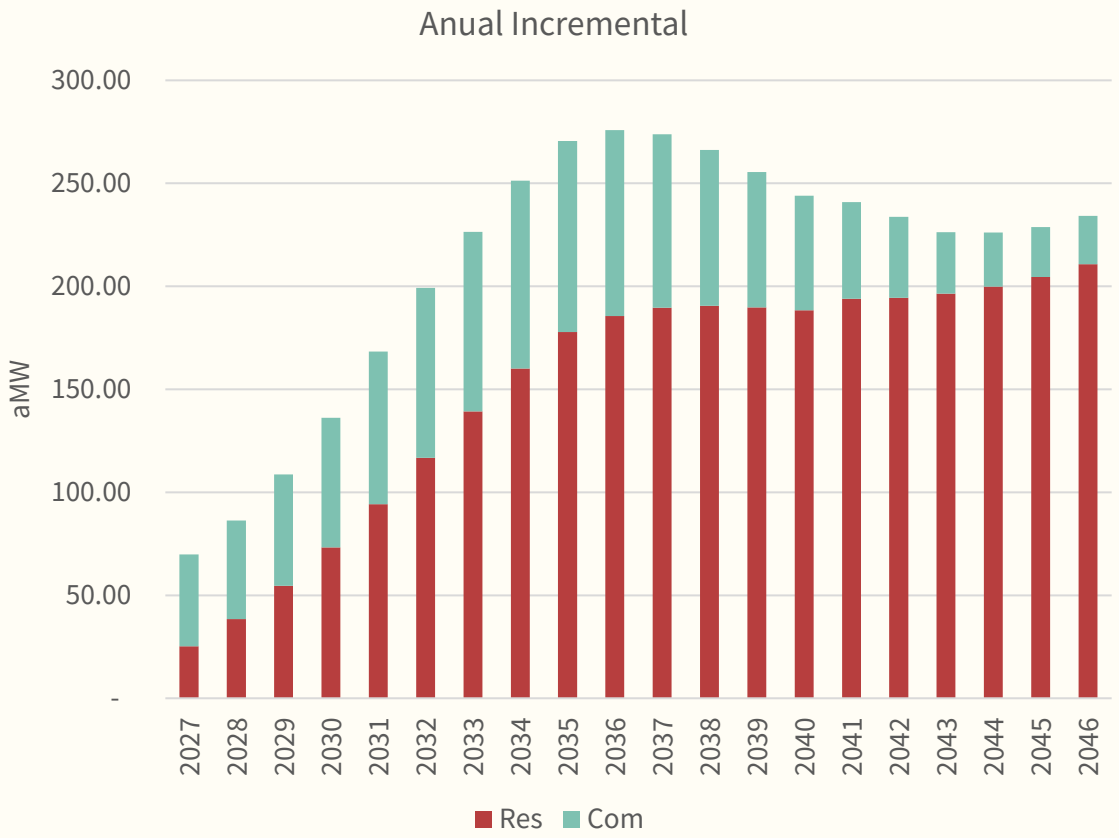
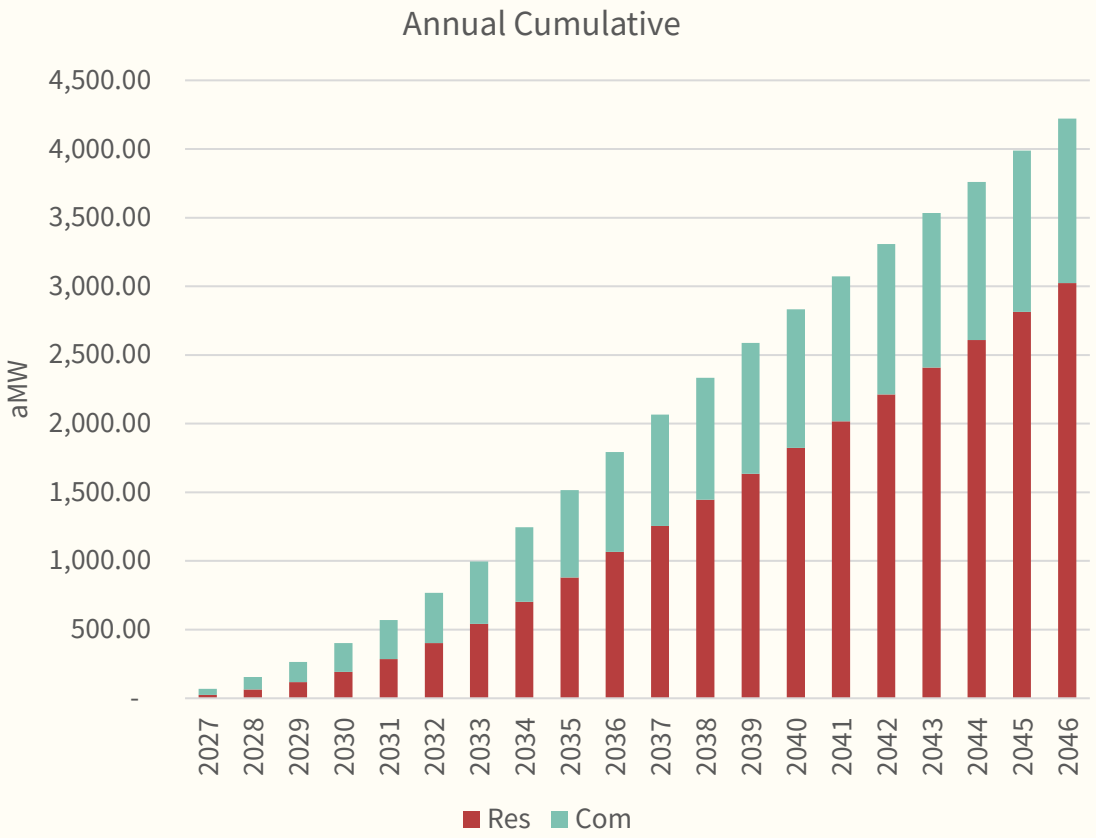
Rooftop Solar Potential – Incremental, Cumulative – All Cost Bins





Includes Proposed revised ramp rates: faster ramps for lower cost applications