The Economic Benefits of Rooftop Solar to Washington

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Prepared on behalf of
the Washington Solar Energy Industries Association

January 2024

EXECUTIVE SUMMARY

Rooftop solar is well-suited to help Washington meet its 2030 net zero carbon target while creating economic benefits to the state. Yet Washington has been a laggard in rooftop photovoltaics (PV) adoption, with per capita installation just 17% of the national average. Only 1.4% of households have rooftop solar.

Puget Sound Energy (PSE), the state's largest investor-owned utility, has issued plans calling for 550 megawatts (MW) of distributed solar by 2030 while also adding 700 megawatts (MW) of utility scale power.[1] Seattle City Light plans on 175 MW of utility-scale solar and 24 MW of solar rooftops.[2] A recent study commissioned by Washington's utilities suggests that collectively rooftop solar capacity could more than double over the next 16 years, rising from about 320 megawatts (MW) in 2022 to upwards of 1,375 MW by 2030, but only **if current net energy metering rate tariffs are preserved.**

On average it takes just 60 days to fully install a rooftop PV system.[3] In contrast, utility-scale solar needs an average of 1,330 days. Based on this data, **2,200 MW of rooftop solar could be installed in the time it would take to build a 100 MW utility-scale project.**

The economic benefits from achieving high rooftop PV adoption levels would be substantially greater than relying on utility-scale solar or wind to supply the same amount of capacity. Based on the analysis presented here, **total net benefits that accrue to the state's economy compared to installing utility-scale solar could reach $275 million by 2030**. All of these net benefits were ignored by the utility-commissioned net energy metering study.[4]

Rooftop solar creates **4.4 to 8.4 times more jobs per installed MW** than utility-scale solar based on two data sources. As a result, **rooftop solar** will sustain as many as **1,792 jobs in 2024** compared to a high estimate of **290** jobs associated with **utility-scale solar** and **239** for **wind** for the same installed capacity, as shown in Figure 1. By 2030 maintaining existing net metering regulations would result in as many as **6,650 jobs** for **rooftop solar** compared to a high of **1,077** for **utility-scale solar** and **886** for **wind**.

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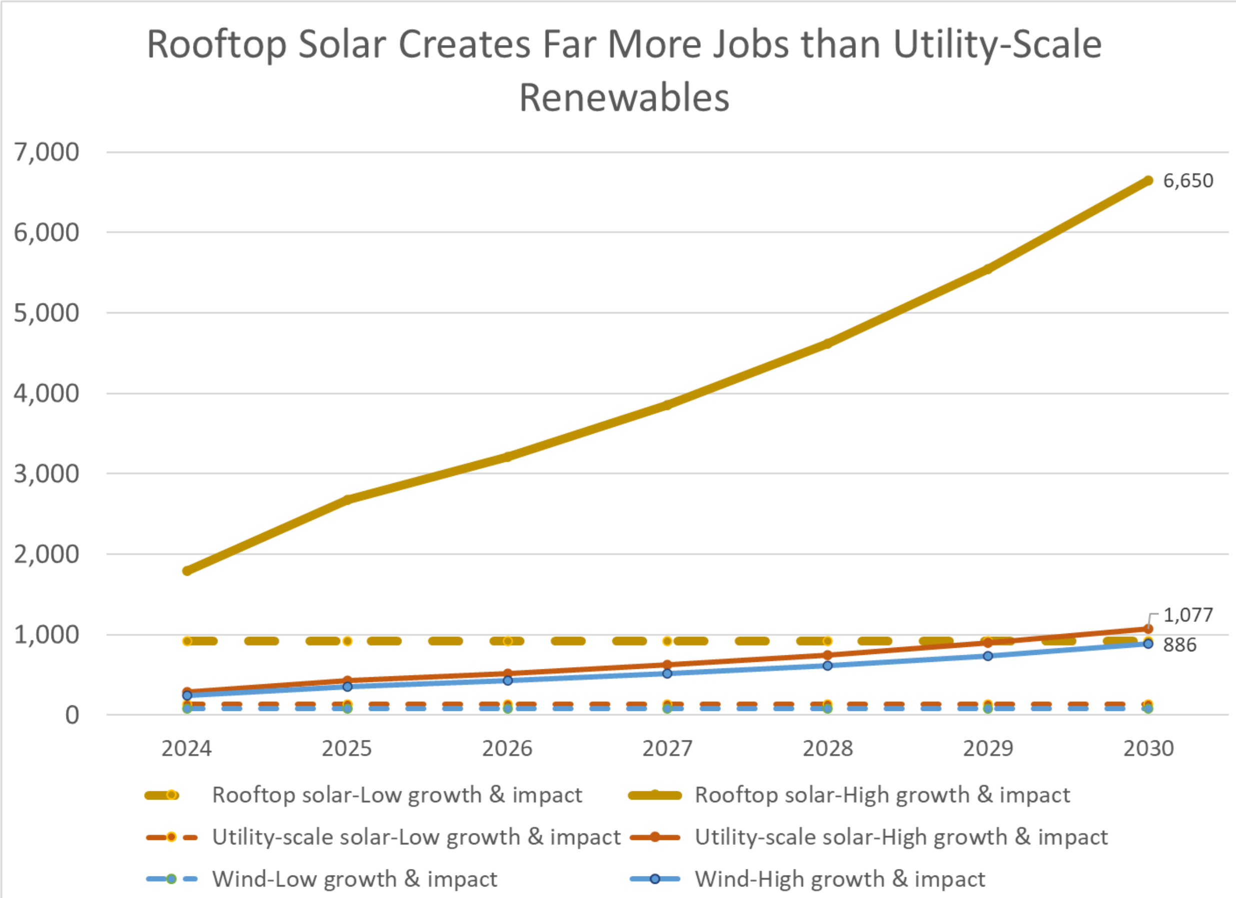
[1] PSE, *2023 Electric Progress Report*, March 2023.

[2] SCL, *2022 Integrated Resource Plan*, 2022.

[3] NREL, *A State-Level Comparison of Processes and Timelines for Distributed Photovoltaic Interconnection in the United States*, https://www.nrel.gov/docs/fy15osti/63556.pdf, 2015.

[4] E3, *Benefits and Costs of Net Energy Metering in Washington*, December 2023.

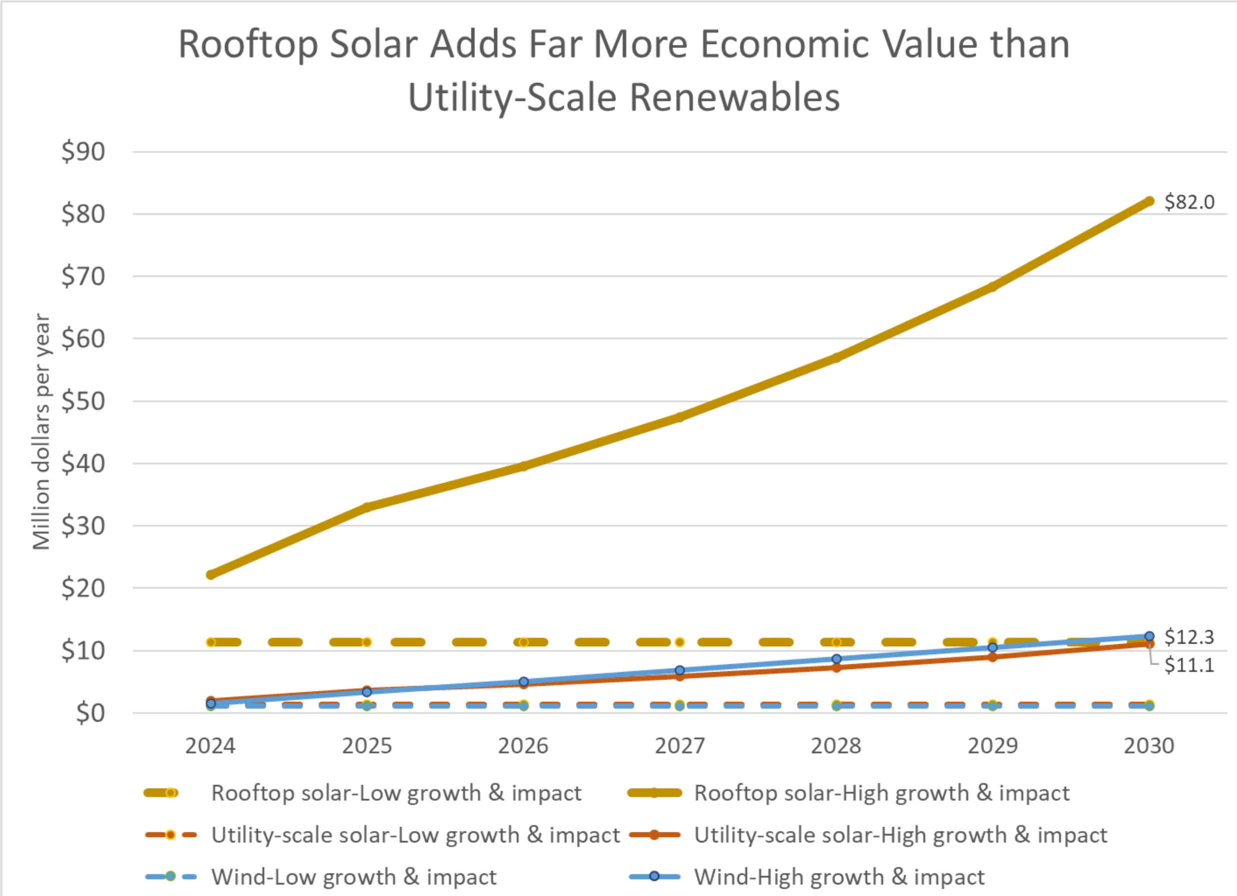
Figure 1



Rooftop solar also supports more locally-retained business and personal income[5] because it relies on neighborhood businesses to install the panels, as shown in Figure 2. Rooftop PV could add upwards of **$22.1 million in 2024** compared to **$2.1 million from utility-scale solar** and **$3.3 million for wind** for the same amount of installed capacity. By **2030** that could grow to **$82 million for rooftop sola**r compared to **$11.1 million for utility-scale solar** and **$12.3 million for wind**.

[5] Direct economic benefits are the sum of business profits and employees' income. Purchased goods (e.g., solar panels or steel from China) are simply a passed through cost to buyers as no value is added by businesses. Other economic benefits not addressed and quantified here include environmental, risk mitigation and social transformation.

Figure 2



Small-scale systems also bring in more federal dollars to Washington state taxpayers. Rooftop solar systems could garner **$39 million in income tax refunds through the** Inflation Reduction Act (IRA) **in 2024** and **$203 million by 2030.** Utility-scale projects are likely to secure just **$10 million in 2024** and **$53 in 2030**, one-quarter of what can be harvested from the smaller systems. Under high-growth scenarios, rooftop PV would also save Washington ratepayers upwards of **$54 million a year** in transmission costs by 2030.

These findings point to the need for a closer examination of the preferred path for adding more renewable generation to meet the state's ambitious carbon reductions. Further, action should be taken to ensure that the rooftop solar industry is sufficiently robust to deliver the capacity that will be required.

INTRODUCTION

Washington has lagged well behind the rest of the nation in installing solar power of any kind, and rooftop solar in particular. The state has only 17% of the installed solar per capita of the national average, ranking 34th among all states.[6] Just 1.4% of Washington's households have rooftop solar installed—*39% of the national average*.[7]

Washington's tepid rooftop PV penetration is due to its generally low electric rates. Washington's solar industry is in its infancy compared to other states, representing a so-far missed opportunity to secure federal tax credits and bolster jobs well-suited to fill-in the gaps caused by declining employment in other industries, such as mining and foundries.

Washington needs rooftop PV as an essential tool to combat climate change. The state has one of the most stringent greenhouse gas (GHG) emission programs in the nation, targeting a 45% reduction by 2030.[8] In comparison California has *ten times* as many solar rooftops, which has reduced demand for metered electricity served by centralized fossil-fueled generators.

Changes to the state's net energy metering (NEM) tariff could undermine the state's progress in adding the renewable generation needed to achieve the state's ambitious GHG reduction goals. No new significant wind generation capacity has been built since 2014. The amount of large utility-scale solar generation is anemic, supplying even less than rooftop solar.[9] Rooftop solar[10] is an important element in reducing carbon emissions because it can be built much more quickly than utility-scale renewables that require substantial additional transmission investment.

Rooftop solar is a far better job-generator than utility-scale solar. The smaller-scale projects employ four to nine times more per installed megawatt.[11]

This report examines the implications to the state's economy of a thriving rooftop solar industry if state policies continue to foster development.

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[6] Solar Energy Industries Association, "Solar State by State," https://www.seia.org/states-map, retrieved January 2024.

[7] SEIA (2024).

[8] Department of Ecology, "Washington's cap-and-invest program," https://ecology.wa.gov/Air-Climate/Climate-Commitment-Act/Cap-and-invest, retrieved January 2024.

[9] U.S. EIA, "Washington State Energy Profile", https://www.eia.gov/state/?sid=WA; and Washington State University Energy Program.

[10] As part of the broader portfolio of small-scale "distributed energy resources" (DERs) such as biomass and biogas generators, energy storage batteries and demand response technologies.

[11] A megawatt equals 1,000 kilowatts.

MORE JOBS CREATED BY ROOFTOP VERSUS UTILITY-SCALE SOLAR

The rooftop solar industry is a potentially significant source of well-paid jobs in Washington. Solar installers earn 11% more than the average construction wage, with more benefits.[12] The National Solar Jobs Census 2022 shows nationally that rooftop solar creates 8.4 times as many jobs per MW as utility-scale solar.[13] The National Renewable Energy Laboratory *JEDI* economic model estimates that 4.4 times as many jobs are generated from installing rooftop solar compared to utility-scale.[14] These findings indicate **for every 100 MW installed, rooftop solar creates 2,080 to 3,700 jobs while utility-scale solar supports only 440 to 470 jobs.**

Rooftop solar jobs are much more likely to be filled by locals than large utility-scale projects, which are often designed and constructed by national companies that bring in labor from out of state. Rooftop PV is usually installed by local companies that have ongoing relationships within the communities in which they work.

Based on available data sets, this report estimates the number of new jobs and economic value, as measured by added business and personal income, created by focusing on rooftop solar compared to utility-scale solar or wind generation for three scenarios.[15]

Projected Jobs Created by Rooftop Solar Based on NEM Study Forecast

Benefits and Costs of Net Energy Metering in Washington, prepared by E3, reflects two simple forecasts of potential growth in installed rooftop solar capacity from 2023 to 2030.[16] One forecast assumed a constant addition of 44 MW per year, reaching 678 MW by 2030. The other assumed an accelerating rate of growth, starting at 62 MW in 2024 and adding 229 MW in 2030 to reach 1,375 MW in total.

Table 1 compares projected employment increases for the constant and accelerated growth scenarios using two different economic data sets. Rooftop solar creates between 923 and 1,792 jobs in 2024 compared to a range of 137 to 290 from utility-scale solar for the same installed capacity and 79 to 239 for wind. The range in 2030 is 923 to 6,650 jobs for rooftop solar compared to 137 to 1,077 for utility-scale solar and 79 to 886 for wind.[17]

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[12] E2, *Clean Jobs, Better Jobs*, https://e2.org/wp-content/uploads/2020/10/Clean-Jobs-Better-Jobs.-October-2020.-E2-ACORE-CELI.pdf, October 2020.

[13] IREC, "National Solar Jobs Census 2022," https://irecusa.org/census-solar-job-trends/, July 2023.

[14] NREL, "Jobs & Economic Development Impact Models," https://www.nrel.gov/analysis/jedi/, retrieved December 2023. (The JEDI model is based on the widely-used IMPLAN Regional Economic Impacts Model.)

[15] Estimates are based on the NREL JEDI model in one case and IREC Solar Jobs Census in the other.

[16] E3, *Benefits and Costs of Net Energy Metering in Washington*, December 2023.

[17] More details on the scenarios are included in the Appendix.

Table 1 – Projected Jobs Created by Technology for Different Scenarios

	2024		2030	
Jobs created	**Low**	**High**	**Low**	**High**
Rooftop Solar				
Constant growth (678 MW in 2030)	923	1,288	923	1,288
Accelerated growth (1,375 MW in 2030)	1,284	1,792	4,765	6,650
Utility-scale Solar				
Constant growth (678 MW in 2030)	137	209	137	209
Accelerated growth (1,375 MW in 2030)	190	290	706	1,077
Utility-scale Wind				
Constant growth (678 MW in 2030)	79	172	79	172
Accelerated growth (1,375 MW in 2030)	110	239	410	886

Table 2 compares the added economic value or income to the state's economy for each technology for the constant and accelerated growth scenarios using the two different economic data sets. Rooftop solar adds between $11.4 and $22.1 million in 2024 compared to a range of $1.4 to $2.1 million from utility-scale solar for the same installed capacity and $1.1 to $3.3 million for wind. The range in 2030 is $11.4 to $82 million for rooftop solar compared to $1.4 to $7.3 million for utility-scale solar and $1.1 to $12.3 million for wind.

Table 2– Projected Economic Value Added by Technology for Different Scenarios

	2024		**2030**	
Business & personal income added	**Low**	**High**	**Low**	**High**
Rooftop Solar				
Constant growth (678 MW in 2030)	$11.4	$15.9	$11.4	$15.9
Accelerated growth (1,375 MW in 2030)	$15.8	$22.1	$58.8	$82.0
Utility-scale Solar				
Constant growth (678 MW in 2030)	$1.4	$2.1	$1.4	$2.1
Accelerated growth (1,375 MW in 2030)	$2.0	$3.0	$7.3	$11.1
Utility-scale Wind				
Constant growth (678 MW in 2030)	$1.1	$2.4	$1.1	$2.4
Accelerated growth (1,375 MW in 2030)	$1.5	$3.3	$5.7	$12.3

The state gets far more employment "bang for its buck" with rooftop solar. Utility-scale solar would produce just 23% of the jobs created by rooftop solar and 19% of the economic value for the same amount of energy capacity. Similarly, utility-scale wind would support only 9% of the jobs and 10% of the economic value for the same amount of installed capacity. The IREC data indicates even worse outcomes for utility-scale solar, with just 11% of the jobs and 9% of the value while wind does somewhat better but still not great, with 13% of the jobs and 15% of the value.

FASTER CAPACITY INSTALLATION FOR ROOFTOP VERSUS UTILITY-SCALE GENERATION

Rooftop solar offers a faster means of achieving Washington's greenhouse gas emission reduction objectives. As of November 2023, only two adjacent 88 MW solar farms have officially started the permit process in Washington. Outside these two potential solar farms, additional utility solar resources are unlikely to energize before 2028. PSE alone is counting on 700 MW of According to NREL, the average amount of time from first filing a **rooftop solar** permit to interconnecting with the utility grid was **60 days** (with a median of 52 days) or about two months.[18] In the case of **utility-scale solar** in Washington, the average time to interconnection has been **1,330 days** (with a median of 1,460 days) or about 44 months based on seven projects larger than 3 MW.[19] ***The state could build 2,200 MW of rooftop solar in the amount of time it would take to construct a 100 MW utility-scale project*.**

LOSS OF POTENTIAL FEDERAL MONEY IF ROOFTOP SOLAR IS STYMIED

Along with bringing more jobs and added economic value, rooftop solar also increases the flow of federal tax credits compared to utility-scale solar, thus keeping more in the state rather than flowing to Washington D.C.

Residential Solar Rooftop Tax Credits

The federal Inflation Reduction Act (IRA) significantly increased the income investment tax credit (ITC), from 26% to 30%, with a phaseout starting in 2033, reducing to 0% in 2036.[20] To be ITC eligible, a rooftop system must be owned by the customer or building owner; leased systems do not qualify. Assuming an average installed cost of $2,682 per kilowatt (kW),[21] the typical ITC will be $885 per kilowatt. If **44 MW** is installed as in a low-deployment forecast, the annual total tax credit to Washington taxpayers would be **$39 million**; for **229 MW** in 2030 as in a higher deployment forecast**,** the credit rises to **$203 million per year**. **These funds represent a net flow of income from outside the state directly into the pockets of citizens, making rooftop PV a valuable economic development mechanism.**

Utility-scale Solar Tax Credits

While the IRA also increased the tax write-off and expanded the ITC's scope for utility-scale projects, it made securing the credit more complex, with a series of threshold conditions, including environmental justice standards, required to achieve maximum credits. Reaching the same 30% level ITC as residential

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[18] NREL, *A State-Level Comparison of Processes and Timelines for Distributed Photovoltaic Interconnection in the United States*, https://www.nrel.gov/docs/fy15osti/63556.pdf, 2015.

[19] See Appendix for summary.

[20] U.S. DOE, " Homeowner's Guide to the Federal Tax Credit for Solar Photovoltaics," https://www.energy.gov/eere/solar/homeowners-guide-federal-tax-credit-solar-photovoltaics, March 2023.

[21] NREL, *U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2023*, 2023, p. vi.

solar will be a more difficult task for utility-scale projects. The credit follows the same schedule as applied for residential solar, with a phasedown beginning in 2033.

For utility-scale projects, labor standards must be met to receive the full ITC; otherwise the incentive is reduced to a base rate of 6%. Construction wages must be at or above the prevailing rates of that location as determined by the Secretary of Labor. Wage rates vary by several factors, including location, type of construction job, hours worked, and more. Prevailing wage requirements can be retroactively met by paying the difference to the affected employees plus a fine. Additionally, a percentage of total construction hours must be performed by an apprentice, a requirement- that can be lifted if a good faith effort is made to comply or if a penalty is paid. Achieving labor conditions qualifies a project for the full rate ITC.

To qualify for the 10% domestic content bonus, all steel must be produced, and a percentage of other manufactured products need to be mined, produced, or manufactured, in the United States. The 10% energy community bonus can be claimed by building on a brownfield site or in an area with high unemployment or that is historically or currently reliant on fossil fuel production. These bonuses can be stacked together.

In Washington, unless the projects are built on Native American tribal land, most utility-scale projects will qualify for an ITC of 10% to 20% rather than a full 30%.[22] Based on a reported average cost of $1,161 per kW, and assuming an average of a 20% ITC, 44 MW of utility-scale solar would generate **$10 million** in tax credits for Washington projects or about one-quarter of the amount for residential projects discussed above. Even with 229 MW by 2030 only **$53 million** in tax credits would be generated.

Importantly, most of those credits would accrue to the out-of-state renewable energy development companies that build those projects, **whereas the residential ITC goes directly to either homeowners or the rental building owners who predominantly live locally.**

REDUCED SPENDING ON TRANSMISSION WIRES THAT REDUCES RATES FOR EVERYONE

Transmission costs to accommodate new generation located distant from demand has become an important issue.[23] Properly valuing rooftop solar requires accounting for how it displaces transmission for utility-scale renewables. Incremental transmission costs in the CAISO and PJM balancing

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[22] To further incentivize the Justice 40 principles, the ITC offers two low-income bonus tax credits beyond the full rate. An additional 10% tax credit is available for projects in LMI communities (capacity maximum 700 MW) or Indian land projects (capacity maximum 200 MW). An additional 20% tax credit is available for qualified low-income residential projects (capacity maximum 200 MW) and qualified low-income benefit projects (capacity maximum 700 MW). These two low-income bonuses can be stacked together with the other bonuses and the full ITC, creating a maximum tax credit of 80% (full rate 30% + domestic energy content bonus 10% + energy community bonus 10% + LMI/Indian bonus 10% + low income residential/benefit projects bonus 20%).

[23] Doug Karpa, "Exploding transmission costs are the missing story in California's regionalization debate," *Utility Dive*, https://www.utilitydive.com/news/exploding-transmission-costs-are-the-missing-story-in-californias-regional/526894/, July 5, 2018.

authorities is $37 per megawatt-hour or 3.7 cents per kilowatt-hour. [24] This added expense about doubles the cost of utility-scale renewables compared to distributed resources.[25]

Based on the quantified avoided cost for transmission, Washington ratepayers would save $18 million annually by 2030 in the constant growth scenario and $54 million per year with accelerated growth.

M.Cubed, founded in 1993, provides economic and public policy consulting services to public and private sector clients. Practice areas include water energy utility resource planning, ratemaking, water and resource use efficiency, conservation measures, project impact analysis, natural resource allocation policies, and environmental plan preparation and review. Dr. Richard McCann has testified over fifty times on electricity, air quality, water supply and other regulatory and planning matters. He can reached at mccann@mcubed-econ.com and 530.757.6363.

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[24] "Testimony of Richard McCann, Ph.D. on Behalf of the Agricultural Energy Consumers Association and the California Farm Bureau Federation," CPUC Rulemaking 20-08-020, June 18, 2021, pp. 15-16; and "Prepared Supplemental Testimony Of Richard McCann, Ph.D. on Behalf of the Kentucky Solar Energy Industry Association," before the Public Service Commission of the Commonwealth of Kentucky, Kentucky Power Company Case No. 2020-00174, February 25, 2021, pp. 9-10.

[25] The rapid rise in transmission rates over the last decade is consistent with these findings. If transmission networks got cheaper as they expanded then those rates should be stable or falling. That is not the case.

APPENDIX – DESCRIPTIONS OF EACH ECONOMIC PROJECTION SCENARIO

For the **constant growth scenario** applying the **NREL JEDI model**, adding **44 MW** of rooftop solar would create **923 jobs** and **$114 million** in added value to the state's economy each year from 2024 to 2030. In comparison, the same amount of utility-scale solar would add **209 jobs** and **$21.5 million** in added economic value. Utility-scale wind would add **79 jobs** and **$1.1 million** in added economic value.

Using the **IREC jobs census** and assuming that economic value is proportional to jobs, the number of rooftop solar jobs rises to **1,288** in 2024 and 2030 with **$15.9 million** in added economic value. Utility-scale solar would add **137 jobs** with **$1.4 million** in added value, and utility wind would add **172 jobs** and **$2.4 million** to the state's economy.

For the **accelerating growth scenario** applying the NREL JEDI model, adding **62 MW** of rooftop solar in 2024 and **229 MW** in 2030 would create **1,284 jobs** and **$15.8 million** in added value to the state's economy in 2024 and **4,765 jobs** and **$58.8 million** in value in 2030. In comparison, the same amount of utility-scale solar would add **290 jobs** and **$30 million** in added economic value in 2024 and **1,077 jobs** with $111 million in value in 2030. Utility-scale wind would add 110 jobs and $15 million in added economic value in 2024 and 410 jobs with **$57 million** in value in 2030.

Using the IREC jobs census, the number of rooftop solar jobs rises to **1,792** in 2024 and **6,650** in 2030 with **$22.1 million** in added economic value in 2024 and **$82 million** in 2030. Utility-scale solar would add **190 jobs** with **$2 million** in added value in 2024 and 706 jobs with $7.3 million in 2030, while utility wind would add **239 jobs** and **$3.3 million** to the state's economy in 2024 and **886 jobs** with **$12.3 million** in value in 2030.

APPENDIX – COMPARISON OF ENERGIZATION TIMELINES FOR ROOFTOP AND UTILITY-SCALE SOLAR

Residential and Small Commercial Solar[26]

- Total days from first submitting paperwork to utility interconnection: <10kw median = 52, 10-50 kw median = 62
- Utility Interconnection Application Review and Approval: 38 days for the residential sector and 39 days for the small commercial sector.
- PV Construction: 2 and 4 days respectively
- Final Building Inspection and PTO (permission to operate) Paperwork Submittal to Utility: 4 days
- Utility PTO (final authorization for system operation): 10 and 12 days respectively

Table 1. Total Days for Utility Interconnection for Full U.S. Sample, by Project Size

System Size	Mean	Median	Std. Dev	Sample Size
Residential (up to 10 kW)	60	52	39	7,489
Small Commercial (10–50 kW)	74	62	44	740
Full Sample (up to 50 kW)	63	53	41	8,229

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Utility-Scale Solar

- Current utility-scale solar in WA (> 3 MW)[27]
  - Lund Hill Solar 150 MW = (1565 days, aka 4 years, 3 months, 12 days)
    - Request for comment on EIS submitted 11/16/18
    - Commercial operation completed 2/28/23
  - Horn Rapids Solar, Storage, and Training 3.2 MW (1859 days, aka 5 years, 1 month, 2 days)
    - First land Transfer: 9/30/2015
    - Energized: 11/2020
  - Adams Nielson Solar 19.2 MW (406 days, aka 1 year, 1 month, 11 days)
    - PSC application 10/31/2017
    - Energized 12/11/2018
  - Camas Solar Project: 5 MW (1383 days, aka 3 years, 9 months, 14 days)
    - 8/18/2018 first permit considered
    - 06/01/22 Comes online (EIA Generator Report)
  - Urtica Solar Project: 5 MW (1536 days, aka 4 years, 2 months, 14 days)
    - 8/18/2018 first permit considered
    - 11/01/22 Comes online (EIA Generator Report)
  - Penstemon Solar Project: 5 MW (1232 days, aka 3 years, 4 months, 14 days)

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[26] NREL, A State-Level Comparison of Processes and Timelines for Distributed Photovoltaic Interconnection in the United States, https://www.nrel.gov/docs/fy15osti/63556.pdf, (2015)

[27] SEIA, "Major Solar Projects List," https://www.seia.org/research-resources/major-solar-projects-list, 2023.

- 8/18/2018 first permit considered
- 01/01/2022 comes online (EIA Generator Report)
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Name	MW	Days From First Mention to Completion
Lund Hill	150	1,565
Horn Rapids Solar, Storage, and Training	3.2	1,859
Adams Nielson Solar	19.2	406
Camas Solar Project	5	1,383
Urtica Solar Project	5	1,536
Penstemon Solar Project	5	1,232
Mean		**1,330**
Median		**1,460**