CleanTech Alliance™

Why We Should Continue to Fund the Clean Energy Fund

- **Leverages State Investments** – The Clean Energy Fund requires awardees to secure matching funds for at least 50% of the total cost of a project. The required match generates creative partnerships and ensures projects leverage state dollars to assist state-based businesses, utilities, homeowners, and communities and catalyzes additional public/private investments in research, development, commercialization, and adoption of clean energy technologies.

  In the first two cycles of CEF funding alone, Washington invested $76.4 million and attracted $166 million in matching funds: A $2.47 return for every $1 the state invested. While the minimum non state-to-state funding match ratio is 1:1, several projects have seen a greater than 10:1 ratio. Zunum Aero's hybrid aircraft project boasted an investment of $45.07 of non-state funding for every $1 of state funding.

- **Sparks Innovation for the Future** – From finding new ways to recycle composite fiber material to generating electricity from supercritical carbon dioxide to developing bio-derived plastics for the food products industry, the Research, Development, and Deployment Program is sparking clean energy and clean tech innovations that support the state's key economic sectors and communities.

  The CEF assists in strategic RD&D partnerships in sectors such as renewable energy, cleantech manufacturing, energy efficiency, recycling, and applied projects. Funded projects have advanced knowledge and accelerated innovation in energy storage and generation, recycling, waste management, manufacturing, and more.

- **Creates Clean Energy Innovation, Businesses, and Jobs** – The Clean Energy Fund has created and retained thousands of high-quality, family-wage jobs in our state. Washington is home to over 82,800 clean energy jobs equating to 13x more clean energy jobs in Washington as compared to fossil fuel jobs. These jobs put dollars back into local economies and help to revitalize communities.

  CEF investments and the matching public and private investments play complementary roles in the commercialization of new clean energy technologies, industry competitiveness and development of new businesses. The CEF incentivizes higher risk, longer-term investments required for our state's future in clean energy, building, and transportation infrastructure and related jobs.

- **Builds Energy Efficient Communities**– Through the Energy Revolving Loan Fund, nonprofit lenders have leveraged millions of state CEF dollars to support homeowner and local business projects that make residential homes and commercial buildings more energy efficient. These loans also help to drive down energy costs and facilitate greener communities.

- **Improves Our Electric Power Grid**– CEF funded grid modernization projects have led to ground-breaking innovations such as the development of ride-through technology, which allows for microgrids within the electricity grid to sync and un-sync seamlessly to improve efficiency. Microgrids provide backup power storage in the event of unplanned emergencies such as storms and earthquakes and allow for reliable energy when it's needed most.

  Other projects have focused on improved energy storage and ways to better absorb sudden spikes in energy demand. These improvements result in a more resilient electricity grid that provides reliable power to businesses and residential communities alike.

- **Keeps Washington Evergreen**– Washington's CEF investments ensure our state continues to lead in the following areas:
  - Conducting energy research, development, and demonstration/ deployment
  - Implementing effective energy efficiencies, and
  - Supporting globally competitive businesses dedicated to supplying clean energy products and processes. This includes improved energy storage, waste reduction, recycling, and related areas of clean technology development that will benefit the state now and in the future.

    The CEF provides a unique public/private funding framework and demonstrates that funding clean energy isn't just good for the environment, it's good for the economy.

Impactful CEF Projects

Beta Hatch Waste-Heat Recovery

Beta Hatch insects are grown indoors, in controlled environments that are kept warm and humid. The CEF project supports the development of a novel waste-heat recovery approach, using low-grade waste heat from a neighboring data center to heat the Beta Hatch insect farming operation.

In the United States, waste heat represents 5-13 quadrillion British thermal units per year of potential energy to be harvested (Department of Energy). With the cheapest electricity in the country, Washington hosts millions of square feet of data centers, many concentrated in Chelan and Douglas counties. These facilities often have extremely high energy capacity and consumption rates (with an average of 9 MW/facility) but provide very few jobs. For this and other reasons, in 2018 Chelan County passed a moratorium on cryptocurrency mining and other high-density load applications. Co-locating Beta Hatch insect production with data centers would remove some of these energy-economy tradeoffs by creating jobs in conjunction with server facilities.

Beta-Hatch

Mission Statement: Beta Hatch creates insect-rearing technology that converts mealworms and their waste into high-value proteins, oils, and nutrients for agriculture. Beta Hatch's IP enables insects to cost-effectively meet the global scale of demand for animal feed and crop fertilizer.

Location: Wenatchee, Washington

Number of Employees: About six employees

Funding: Beta Hatch has raised over $4.8 million in grants and investments

Total Match to CETF funded project(s): $937,800

Source

Impact Bioenergy Food Waste Biocycling

Impact Bioenergy will implement systematic, community-scale food waste biocycling on Vashon Island, WA. The decentralized system will eliminate the need to ship out food waste materials and bring in amendments like compost and fertilizer. Food waste will be converted to energy for heat, power and alternative fuel vehicles, liquid organic fertilizer and sequestered CO2 used in agriculture and horticulture.

The goal is to demonstrate a highly-repeatable model for hyperlocal food "waste" conversion to renewable resources at a community scale (up to 5,000 lbs./day), that stimulates climate action and a circular economy, while promoting food and energy independence.

Impact Bioenergy

Mission Statement: Impact Bioenergy™ launched in 2013, with the mission to construct and deliver the best bio-conversion technologies and services available, which will empower communities by making renewable energy and soil products locally through organic materials recycling

Location: Headquarters are located in Shoreline, Washington

Number of Employees: Approximately 15

Annual Revenue: $4.3 million in estimated annual revenue

Total Match to CETF funded project(s): $936,800

Source

Orcas Power and Light Co-Op Decatur Island Microgrid

The grant will help fund integration of a .5 MW (or 2 mWh) vanadium flow battery into OPALCO's grid, to condition and time-shift community solar array output, improve load shape, absorb sudden spikes in energy demand, and backup critical substation and fiber optic systems. This will help the co-op save money and improve grid reliability.

The energy storage and community solar systems on Decatur Island generate seven discreet benefits to OPALCO: demand charge reduction, load shaping charge reduction, transmission charge reduction, transmission deferral, energy cost reduction, Volt-VAR/CVR, and outage mitigation.

Source

Orcas Power and Light Co-Op

Mission Statement: Orcas Power & Light Cooperative (OPALCO) serves its membership with safe, reliable, sustainable and cost effective essential utility services with a commitment to the utilization of renewable resources and carbon reduction.

Location: They have offices in Eastsound, Friday Harbor, and Lopez Island, Washington but provide service to over 20 of the San Juan Islands.

Number of Employees: 51

Customers Served: 11,316

Total Match to CETF funded project(s): $3,600,000

Energy Northwest

Mission Statement: Energy Northwest's provides its public power members and regional customers with safe, reliable, cost-effective, responsible power generation and energy solutions.

Location: Richland, Washington

Number of Employees: Over 1,100

Customers Served Their consortium of 27 public utility districts and municipalities across Washington takes advantage of economies of scale and shared services that help utilities run their operations more efficiently and at lower cost, to the benefit of more than **1.5 million customers.**

Total Match to CETF funded project(s): $7,053,262

Energy Northwest Horn Rapids Project

The Horn Rapids Solar, Storage & Training Project in Richland provides Washington state its first opportunity to integrate a large-scale solar and storage facility into its clean mix of hydro, nuclear and wind resources. This first-of-its-kind facility combines solar generation with battery storage and technician training.

The site is just north of Richland, on land owned by the International Brotherhood of Electrical Workers. The project will be a 4-megawatt electric, 20-acre solar generating array of photovoltaic panels that will provide enough energy to power 600 Richland homes. The project will also include a 1-MW battery storage system; and serve as a training ground for solar and battery technicians throughout the nation. The combination of photovoltaic solar with battery storage will provide a predictable, renewable generating resource.

Source

Pacific Northwest National Lab (PNNL) Transactive Campus Energy Systems Project

The fundamental purpose of transactive energy management is to seamlessly coordinate the operation of large numbers of new intelligent assets—such as distributed solar, energy storage and responsive building loads—to provide the flexibility needed to operate the power grid reliably and at minimum cost, particularly one filled with intermittent renewable generation such as the Pacific Northwest. It addresses the key challenge of providing smooth, stable, and predictable "control" of these assets, despite the fact that most are neither owned nor directly controlled by the power grid.

Source

Pacific Northwest National Lab (PNNL)

Mission Statement: PNNL advances the frontiers of knowledge, taking on some of the world's greatest science and technology challenges. Distinctive strengths in chemistry, earth sciences, and data analytics are the heart of our science mission, laying a foundation for innovations that improve America's energy resiliency and enhance national security.

Location: Their main campus is located in Richland, Washington and includes two dozen facilities including a Marine Sciences Laboratory located in Sequim and a Bioproducts, Sciences, and Engineering Lab located on Washington State University's Tri-Cities campus.

Number of Employees: PNNL employs 4,414 scientists, engineers, and professional staff

Research Funding: PNNL has an annual operating budget of $960 million

Total Match to CETF funded project(s): $4,190,134

Avista

Mission Statement: Avista is an energy company involved in the production, transmission and distribution of energy as well as other energy-related businesses.

Location: Based in Spokane, Washington, Avista has a service area that covers 30,000 square miles across four states.

Number of Employees: 1,982 employees

Customers Served: Avista provides electricity to nearly 340,000 customers and natural gas to about 300,000 customers

Total Match to CETF funded project(s): $16,018,494

Avista Energy Storage Project in Pullman

Avista's Energy Storage project is testing new batteries that can store power when it's abundant and distribute energy when it's needed, providing reliable energy regardless of weather patterns. The goal of the project is to explore how energy storage can help our electrical grid become more flexible, more reliable, and more resilient. When the project went online in 2015, it was the largest- capacity, vanadium-flow battery system in North America and Europe. The one- megawatt, 3.2 MWh large-scale battery storage system has the capacity to power 750 homes for 3.2 hours.

Source

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About the Author

Lindsay McCormick was born and raised in Omaha, Nebraska. She attended Western Washington University and graduated in only 3 years with a degree in Biology with an Ecology, Evolutionary, and Organismal emphasis. She is passionate about biology, the environment, and politics and wants to make the world a better place by working to fight climate change. For further inquiries or employment opportunities, she can be reached at lindsaymccormick44@gmail.com or by phone at 402-707-3902.

Executive Summary

Overview

The Clean Energy Fund (CEF) funds the development, demonstration and deployment of clean energy technology in Washington State. Since its launch in 2013, Governor Jay Inslee and the Washington State Legislature have championed the fund – appropriating more than $150 million to fund innovative cleantech projects across the Evergreen State. These investments have resulted in the reduction of carbon emissions, implementation of proven energy efficiencies, and the advancement of Washington State as a leader in cleantech innovation and adoption.

To receive a CEF investment, project sponsors are required to match[1] the state's investment with additional private and federal dollars. In effect, this requirement means that the state's seed funding can unlock additional capital to benefit our state's communities and residents. The result has been a statewide coalescing of research and development, innovation-based projects in clean technologies, and applied projects in the field that have informed ongoing economic development in clean energy adaptation and adoption.

The authorizing legislation for Clean Energy Fund requires fairness in evaluating proposals, awarding contracts, and monitoring projects. The legislation also mandates how state dollars are allocated into each of the distinct programs within the Clean Energy Fund and the criteria that recipients must meet in order to be eligible for funding.

Clean Energy Fund programs

In the four rounds of Clean Energy Fund, the state's investment has been divided up amongst numerous programs intended to target different capital gaps. Those programs – not all of which existed in each round of funding – have included:

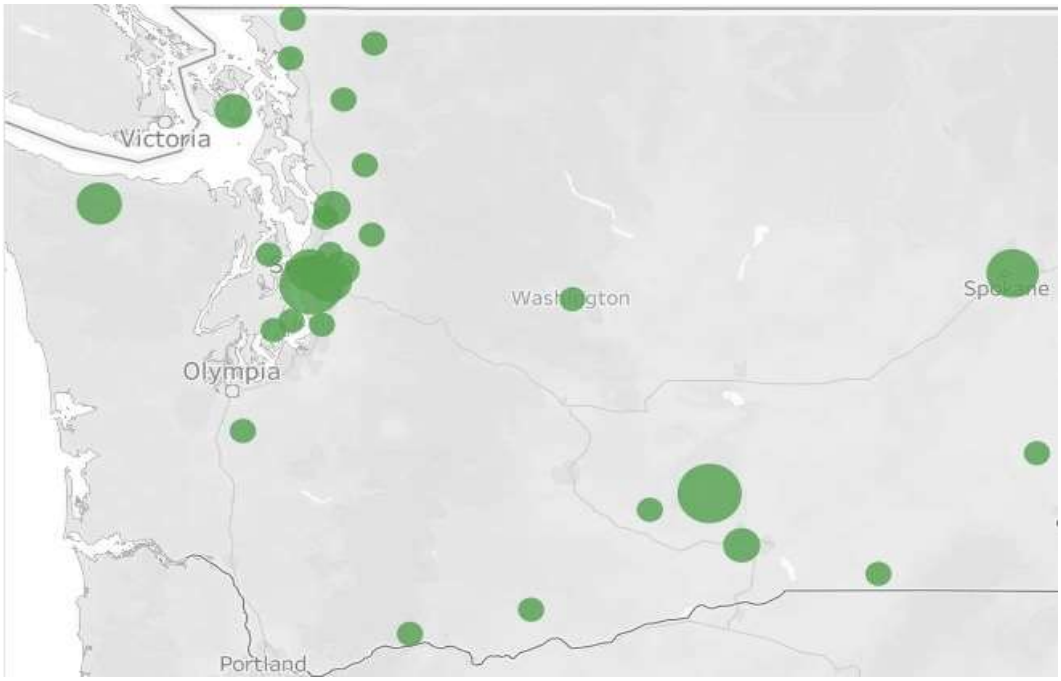
- *Grid Modernization;*
- *Research, Development, and Demonstration (RD&D);*
- *Grants to Nonprofit Lenders;*
- *Greenhouse Gas Reduction;*
- *Electrification of Transportation Systems (ETS); and*
- *Solar Deployment.*

Additionally, in several rounds, legislators used Clean Energy Fund appropriations to allocate money to specific, high-impact energy savings and research projects in the state.

[1] Required match varies by program, though is never less than 1:1.

Impact and Map of Sites

- Over $110 million in CEF funding has already been deployed and leveraged to advance the state's clean energy economy. An additional $42 million was appropriated for the fourth round of Clean Energy Transition Fund (CETF4) – but has yet to be invested by the state.
- In CEF1-3, the *Grid Modernization* program has allocated around $37 million to seven utility companies for 13 projects. These projects have led to ground-breaking innovations such as the development of ride-through technology, which allows microgrids within the electricity grid to sync and un-sync seamlessly to improve efficiency.
- The *RD&D* program has resulted in over $25 million in awards over 2 rounds of funding to 23 innovative projects, many of which are being conducted by researchers at the University of Washington and Washington State University. The state's investment was critical to attracting additional federal and private research dollars.
- The *Grants for Nonprofit Lenders* program provides critical access-to-capital for clean energy projects undertaken by businesses, nonprofits, affordable housing developers, and individual homeowners. Three recipients have now deployed a total of $30.3 million as loans, which – as they are repaid – will revolve and continue to benefit the state.
- Two newer programs, *Electrification of Transportation* and *Solar Deployment*, will see investment before the close of calendar year 2020.



Click here to interact with the map and learn more about each project

Grid Modernization

Overview

Modernization of the electric grid is an area where Washington state is already a global research and development leader. Investments through the Clean Energy Fund's *Grid Modernization* program to public and private utilities have improved our understanding of battery chemistry, implemented microgrids, and integrated solar and other renewable power into the grid.

In CEF1, during the 2013 biennium, three electric utilities were awarded a total of $14.3 million to evaluate different battery and storage systems and deploy both Lithium Ion and Vanadium Redox Flow battery systems.

In CEF2, during the 2015 biennium, five electric utilities were awarded a total of $12.5 million to develop microgrids that combined solar power generation with storage, load controls and other elements. These projects provide energy resiliency while further expanding the innovations in battery energy storage first demonstrated in CEF1.

In CEF3, during the 2017 biennium, four electric utilities were awarded a total $10.67 million to fund projects focusing on the advancement of clean and renewable energy technologies, transmission and distribution control systems, support of renewable energy source integration, deployment of distributed energy resources, sustainable microgrids, and increased utility customer options for energy sources, energy efficiency, energy equipment and utility services.

In CETF4, during the 2019 biennium, $7.7 million will be awarded to yet-to-be-named electric utilities to further the objectives outlined in CEF3.

Success Stories

The Puget Sound Energy (PSE) Glacier Battery Storage project in Glacier, WA included the installation of a two megawatt (MW)/ 4.4 megawatt-hour (MWh) lithium-ion battery system. The battery system is tied to PSE's electric distribution power grid and serves as a short-term backup energy source during power outages and aims to reduce system load during periods of high demand and balance energy supply and demand. The project received $3.8 million in CEF1 funding, which was matched by $7.4 million in capital from PSE. The battery system is now fully functional and two phases of testing have been performed by the Pacific Northwest National Laboratory (PNNL) to determine the benefits of the battery and to identify future applications.

Energy Northwest's Horn Rapids Project in Richland, WA received a $3 million investment from CEF2, which was matched by an additional $3.5 million in non-state funding. The funding will be used to construct a first-of-its-kind facility that combines solar generation, battery storage, and technician training. Construction will be completed by early 2020. The result will be a 1MW/4MWh battery storage system with the capacity to power 150 homes for four hours. The training program will cover plant construction, operations, maintenance and hazard prevention and is expected to generate over $3 million in economic benefit to the Tri-Cities annually.

Research, Development, & Demonstration (RD&D)

Overview

The RD&D program supports and leverages the University of Washington, Washington State University, Pacific Northwest National Lab, and a host of other state institutions and clean energy organizations to conduct research that advances:

- *Energy storage and solar and other renewable energy technologies,*
- *Bioenergy and biofuels,*
- *Understanding of new earth abundant materials or lightweight materials, engineering advanced energy storage materials, and*
- *Innovative approaches for recycling of battering components, developing new renewable energy and energy efficient technologies.*

CEF investments into individual researchers and research programs leverage highly-competitive federal R&D funds and private matching dollars – and demand has far outstripped availability.

In CEF2, during the 2015 biennium, eight projects were awarded a total of $10 million to support clean energy research and development

In CEF3, during the 2017 biennium, funds for RD&D attracted 52 applicants and $51 million in proposed projects for only $8.2 million in available capital. Out of the 52 applicants, ten applicants have been conditionally awarded grants.

CETF4 has $8.1 million allocated for RD&D in the 2019 Capital Budget. Awardees have not yet been announced.

Notable Projects

University of Washington Mechanical Engineering Department MEBARC program received $1.1 million in funding from CEF3 to help make composites manufacturing more-economically viable by improving quality, reducing energy costs, and minimizing waste and scrap. The program is also developing college graduates with skills in advanced manufacturing, a vitally important economic sector to the state of Washington.

Corumat, a materials science company, has been conditionally awarded $2.3 million from CEF3 to develop bio-derived plastics for the food industry. The company intends to replace solid plastic with as little as one-third of the material, which will lower material costs and dramatically reduce the carbon emissions through the use of bioplastic pellets.

Grants to Nonprofit Lenders

Overview

To grow a robust cleantech ecosystem and reduce energy use, entrepreneurs, nonprofits, and homeowners alike require access to capital. The Clean Energy Fund's *Grants to Nonprofit Lenders* program provides capital to competitively-selected, mission-focused nonprofit lending institutions. Those institutions then invest in proven building energy efficiency and renewable energy technologies that currently lack access to capital – whether in the residential or commercial sectors.

The Clean Energy Fund has allowed lenders to leverage other private financing from utilities, contractor incentives, and other sources to allow homeowners and businesses to complete clean energy projects that reduce energy usage and improve quality of life including the installation of efficient windows, insulation, ventilation, and high-efficiency water heaters, seal ducts, and replacing boilers.

Over three rounds of funding, three lenders have received investments – Craft3, Puget Sound Cooperative Credit Union, and Washington State Housing Finance Commission.

Success Stories

Craft3 is a regional nonprofit that makes loans in Oregon and Washington that strengthen the resiliency of businesses, families, and nonprofits, including those without access to traditional financing. With Clean Energy Fund capital, it offers affordable home energy upgrade loans to homeowners that live in Seattle City Light, NW Natural, and Pacific Power service territory. It also has invested CEF dollars in twenty-five small business and nonprofit projects that have reduced energy consumption, generated renewable energy, and boosted cleantech manufacturing. Those commercial loans – made with over $14 million in CEF capital – were matched by $9.7 million in Craft3's own funds and leveraged $68.4 million in private capital.

Washington State Housing Finance Commission (WSHFC) is a publicly accountable, self-supported organization that is dedicated to increasing housing access and affordability in Washington. In 2009, the state legislature empowered WSHFC to create a Sustainable Energy Trust (SET) to help non-profit facilities and multi-family become more energy efficient. Thanks to two separate CEF investments that totaled $1.9 million, WSHFC has already leveraged an additional $2 million to help eight non-profit organizations perform substantial energy efficiency retrofits to their outdated facilities. These retrofits free up a significant amount of operating revenue that can subsequently be used for an organization's mission instead of their utility payments. For example, a SET/CEF

loan helped Valley Cities rebuild their Seattle Recovery Center, where utility costs are now approximately 70% less than their Auburn facility.

Puget Sound Cooperative Credit Union (PSCCU) received $2.9 million for residential energy upgrades in the 2013 biennium from CEF1. Recently, they received additional CEF grant money for loan loss reserves to support energy-smart loans, which includes renewables and electric vehicles. PSCCU leverages funds at a ratio of 20:1 and has turned over $8.5 million in funds to nearly $75 million in loans. These loans have put money back into our local economies, created living wage jobs, and have helped homeowners, farmers, and small business owners from Aberdeen to Zillah. Every day, PSCCU is using Clean Energy Fund capital to make an impact on Washingtonians by making someone more comfortable in their home, helping a small business use less energy, creating a job, and protecting our environment for future generations.

Acknowledgements

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Thank you to Ann Goos, Carl Seip, and Jill Nordstrom for their input in revising and editing this paper.

CEF1 Breakdown

$36 million total to fund three competitive programs from the 2013-2015 Capital Budget. Smart Grid Grants to Utilities ($15 million). Energy Revolving Loan Fund Grants ($15 million). Federal Clean Energy Matching Funds ($6 million).

Grid Modernization

- *Snohomish County PUD MESA1 and MESA2- **$7.3 million** total for two demonstration projects. The PUD is working with Seattle-based 1Energy Systems to implement Modular Energy Storage Architecture, a set of nonproprietary design and connectivity standards that provide a scalable approach for energy storage control system integration and optimization.*
- *Avista- **$3.2 million** grant to field test a 1-MW, 3.2-MWh UniEnergy vanadium flow battery assembly in a three-year demonstration project at a substation in Pullman.*
- *Puget Sound Energy- **$3.8 million** to help deploy a 2-MW, 4.4-MWh lithium-ion/phosphate battery assembly in Glacier.*

Federal Clean Energy Matching Funds

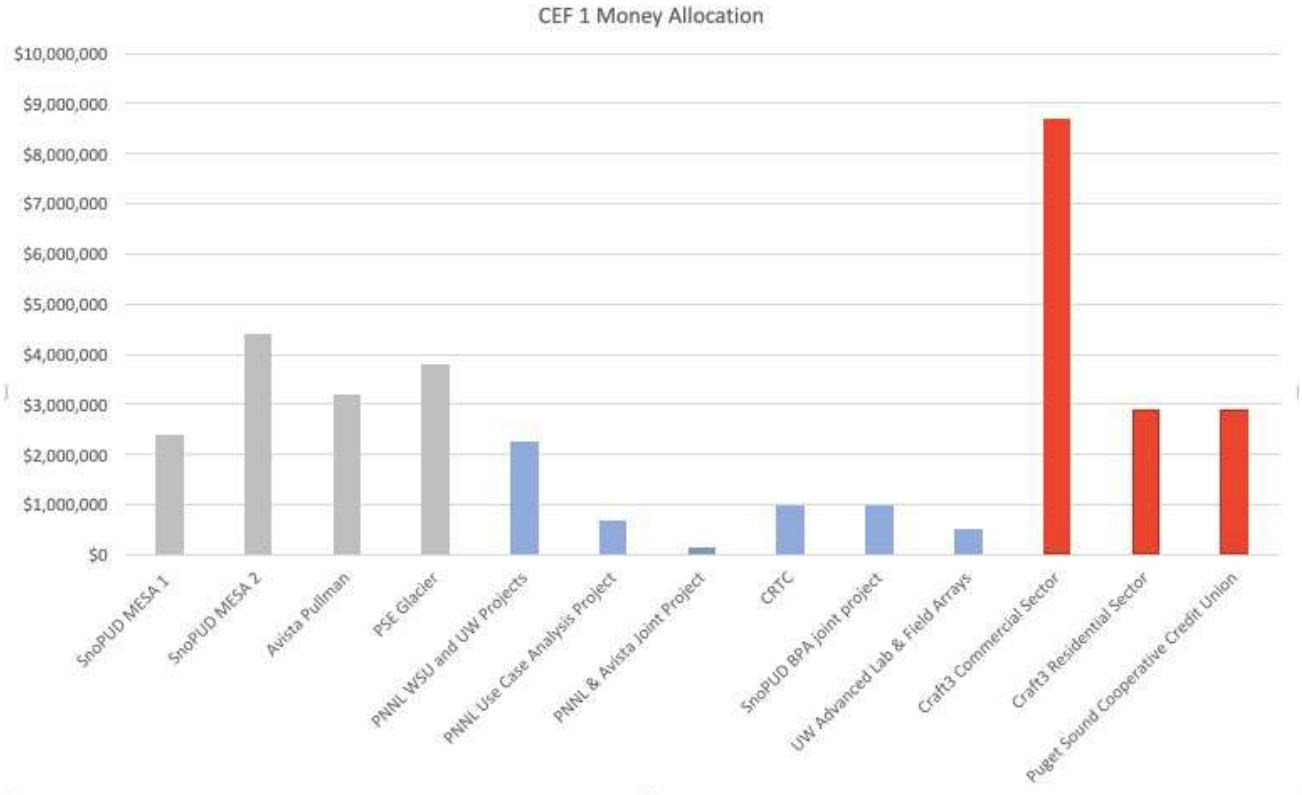
- *Pacific Northwest National Lab (PNNL)- Pacific Northwest National Lab (PNNL)- **$2.25 million** ($1.1 million to WSU, $783,000 to UW and $367,000 to PNNL) to address the key challenge of providing smooth, stable, and predictable "control" of PNNL, UW, and WSU "smart" assets via a regional renewables integration resource and R&D testbed*
- *PNNL - **$695,000** to collect data from Avista, PSE, & SnoPUD Smart Grid battery projects and perform the analytics on the Smart Grid Use Case Analysis further documenting the economic viability and grid resiliency values of energy storage systems (batteries).*
- *PNNL - **$145,000** joint project with Avista for development of energy storage control strategies through controls optimization for the battery control software algorithms.*
- *Composite Recycling Technology Center- **$1 million** to renovate their industrial & workforce training facility used to recycle composite materials.*
- *SnoPUD BPA joint project- **$1 million** for a joint project with Bonneville Power Administration (BPA) entitled, "Support Using Distribution-Level Energy Assets to Help Optimize Regional Transmission Systems". This project provides pricing schemes that could incentivize utilities to respond to BPA congestion and renewable power loads by Using Distribution-Level Energy Assets to Help Optimize Regional Transmission Systems.*
- *University of Washington - **$518,000** accelerate the development of next-generation arrays of wave energy conversion (WEC) and tidal energy conversion (TEC) devices through a suite of field-focused R&D activities by the Northwest National Marine Renewable Energy Center developed Advanced Laboratory and Field Arrays.*

Grants to Nonprofit Lenders

- *Craft3- **$8.7 million** for commercial sector; **$2.9 million** for residential sector*
- *Puget Sound Cooperative Credit Union (PSCCU)- **$2.9 million** for residential sector*

CEF1 Money Allocation		
Project	Amount Awarded	Total per Program
SnoPUD MESA 1	$2,400,000	$15,000,000
SnoPUD MESA 2	$4,400,000	
Avista Pullman	$3,200,000	
PSE Glacier	$3,800,000	
PNNL WSU and UW Projects	$2,250,000	$6,000,000
PNNL Use Case Analysis Project	$695,000	
PNNL & Avista Joint Project	$145,000	
CRTC	$1,000,000	
SnoPUD BPA joint project	$1,000,000	
UW Advanced Lab & Field Arrays	$518,000	
Craft3 Commercial Sector	$8,700,000	$15,000,000
Craft3 Residential Sector	$2,900,000	
Puget Sound Cooperative Credit Union	$2,900,000	
Grand Total in CEF1		**$36,000,000**

Key
Grid Modernization
Federal Clean Energy Matching Funds
Research, Development and Deployment (RD&D
Grants to Nonprofit Lenders
Electrification of Transport Program
Solar Deployment Program
Greenhouse Gas Reduction Program
Shore Power Electrification at Terminal 5
Dairy Digester Biofertilizer Projects
Washington Maritime Innovation Center
PNNL
Port of Grays Harbor
Credit Enhancement... Program
John Day Pool (reappropriation)



CEF2 Breakdown

$36 million to fund four competitive programs from the 2015-2017 Capital Budget. Grid Modernization ($13 million). Research, Development, and Demonstration ($10 million). Grants to Nonprofit Lenders ($13.6 million). Credit Enhancement for Renewable Energy Manufacturing Funds ($200,000).

Grid Modernization

- *Snohomish County PUD - **$3.5 million** for a micro-grid & clean energy technology center in Arlington*
- *Avista - **$3.5 million** for a micro transactive grid project called Spokane Urbanova.*
- *Energy Northwest **$3 million** for the Horn Rapids Solar, Storage & Training Project*
- *Seattle City Light - **$1.5 million** for the resilience focused Miller Community Center solar & storage microgrid pilot*
- *Orcas Power & Light Co. **$1 million** for the Decatur Island solar & storage microgrid project*

RD&D

- *Composite Recycling Technology Center (CRTC) **($1.7 million**) to demonstrate viable commercial processes for recycling carbon fiber.*
- *Edaleen Cow Power (**$273K**) for an advanced solids and nutrient recovery system converting manure into fertilizer and cow bedding.*
- *Impact Bioenergy (**$550K**) to demonstrate conversion of food waste into biogas*
- *Janicki (**$283K**) for a bio-digester that will produce clean water and renewable natural gas and from farm waste.*
- *Polydrop (**$449K**) for conductive polymer additives to improve the fuel efficiency of vehicles and planes*
- *Microsoft (**$675K**) for fuel cells in a data center environment*
- *Oscilla Power **($1 million**) to build and test community scale wave energy conversion*
- *Dresser Rand (**$870K**) will test HydroAir™, a variable radius turbine system that generates electric power from ocean waves.*
- *Demand Energy (**$630K**) to develop a platform that will help evaluate new battery technologies and optimize renewables and energy storage.*
- *Battery Informatics (**$135K**) for next generation lithium ion battery management systems to maximize battery efficiency*
- *Zunum Aero (**$800K**) to develop the first commercial-class hybrid aircraft.*
- *Battelle (Pacific Northwest National Lab) **($2 million**) to further develop*

transactive technology allowing building owners to dynamically control energy use.

Grants to Nonprofit Lenders

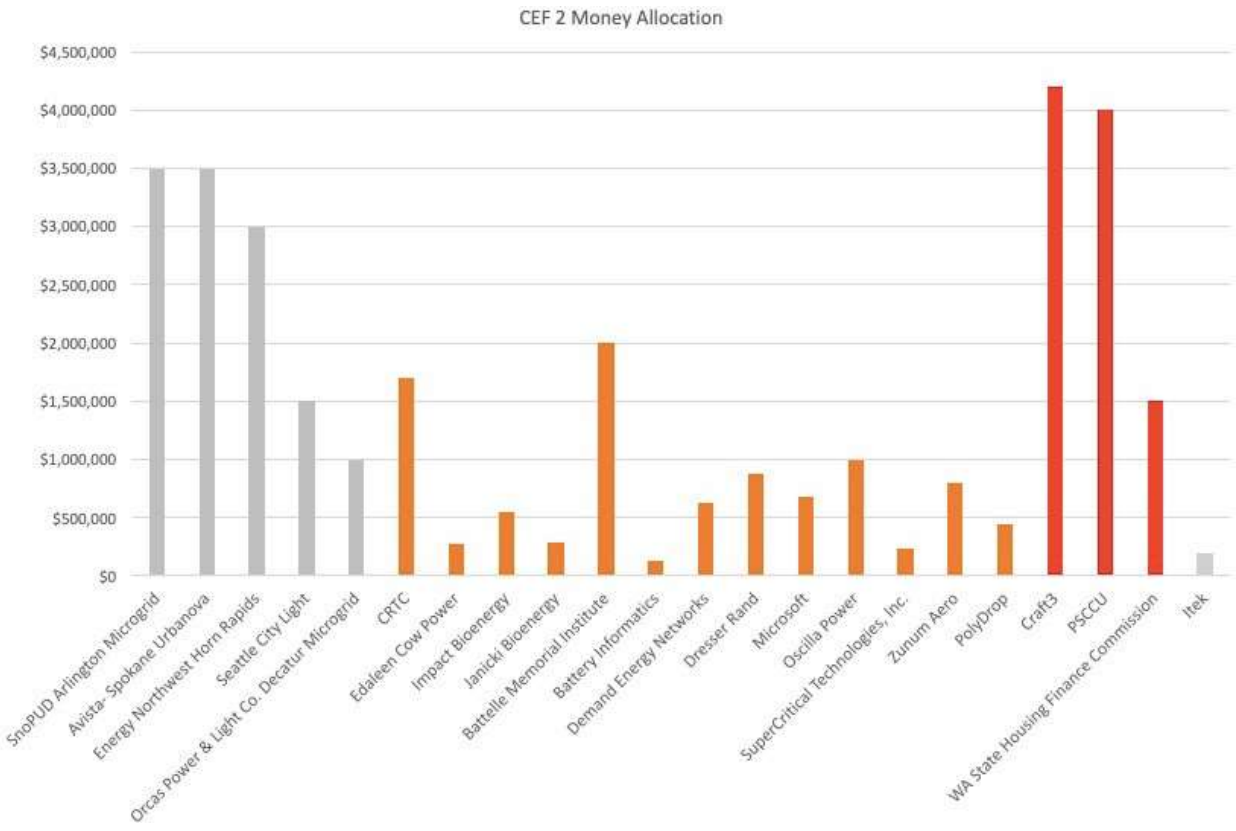
- *Craft3- **$4.2 million***
- *PSCCU- **$4 million***
- *Washington State Housing Finance Commission- **$1.5 million***

Credit Enhancement Grants

- *Itek - **$200,000** providing credit enhancement incentive for the enlargement of an advanced energy technology manufacturing site.*

CEF2 Money Allocation		
Project	Amount Awarded	Total per Program
SnoPUD Arlington Microgrid	$3,500,000	$13,000,000
Avista- Spokane Urbanova	$3,500,000	
Energy Northwest Horn Rapids	$3,000,000	
Seattle City Light	$1,500,000	
Orcas Power & Light Co. Decatur Microgrid	$1,000,000	
CRTC	$1,700,000	$10,000,000
Edaleen Cow Power	$273,360	
Impact Bioenergy	$550,000	
Janicki Bioenergy	$283,158	
Battelle Memorial Institute	$2,000,000	
Battery Informatics	$135,000	
Demand Energy Networks	$630,000	
Dresser Rand	$870,000	
Microsoft	$675,000	
Oscilla Power	$1,000,000	
SuperCritical Technologies, Inc.	$238,158	
Zunum Aero	$800,000	
PolyDrop	$449,000	
Craft3	$4,200,000	$13,600,000
PSCCU	$4,000,000	
WA State Housing Finance Commission	$1,500,000	
Itek	$200,000	$200,000
Grand Total in CEF2		**$36,800,000**

Key
Grid Modernization
Federal Clean Energy Matching Funds
Research, Development and Deployment (RD&D)
Grants to Nonprofit Lenders
Electrification of Transport Program
Solar Deployment Program
Greenhouse Gas Reduction Program
Shore Power Electrification at Terminal 5
Dairy Digester Biofertilizer Projects
Washington Maritime Innovation Center
PNNL
Port of Grays Harbor
Credit Enhancement... Program
John Day Pool (reappropriation)


CEF 2 Money Allocation
$4,500,000
$4,000,000
$3,500,000
$3,000,000
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$0
SnoPUD Arlington Microgrid
Avista- Spokane Urbanova
Energy Northwest Horn Rapids
Seattle City Light
Orcas Power & Light Co. Decatur Microgrid
CRTC
Edaleen Cow Power
Impact Bioenergy
Janicki Bioenergy
Battelle Memorial Institute
Battery Informatics
Demand Energy Networks
Dresser Rand
Microsoft
Oscilla Power
SuperCritical Technologies, Inc.
Zunum Aero
PolyDrop
Craft3
PSCCU
WA State Housing Finance Commission
Itek

CEF3 Breakdown

$36 million to fund five competitive programs from the 2017-2019 Capital Budget. Grid Modernization Grants to Utilities ($11 million). Electrification of Transportation Systems ($11 million). Research, Development, and Demonstration ($7.85 million). Solar Deployment ($4 million). Greenhouse Gas Reductions ($2.4 million). ***All awards inclusive of final grant amount are contingent on grantee requirements and are subject to renegotiation.**

Grid Modernization

- **Avista** is involved in developing Spokane's University District, including the 150,000-square-foot Catalyst Building. The building will generate the energy it uses through solar panels and other renewable energy technologies – a "net zero" design. It will be connected to an eco-district powered by a centrally located power plant. Avista's shared energy economy pilot allows buildings to share energy resources to more efficiently generate and use energy, and to store excess energy created by the buildings for future use. This Clean Energy Fund grant will support further evaluation of this and other similar grid utilization strategies. It expands on a separate solar plus microgrid research, development and demonstration project funded in part with a $3.5 million grant in 2017. The new work will assess how this cluster of buildings performs and what infrastructure will be needed for these types of developments in the future.

- **Orcas Power & Light (OPALCO)** proposes to develop a hybrid energy storage system Combined with state-of-the-art switch gear, the system will use a mix of flow (longer lasting) and lithium ion (more rapid responding) battery technology to provide rapid response and long life at moderate cost. A prior community solar project enabled with a $1 million grant from the Clean Energy Fund in 2017 was used to demonstrate a similar microgrid application on remote Decatur Island. The new project will be co-located with a community solar project (separately funded) near the Lopez Island town center, providing opportunities for customers to participate in new service programs around green energy. Additionally, OPALCO seeks to maximize economic benefit to the community and will look at a variety of other uses, including back-up power to improve outage response.
- **Puget Sound Energy** is planning an innovative microgrid project in Tenino, Thurston County. PSE's Blumauer substation will be the host site for the first utility scale solar plus storage microgrid project in PSE's service area. In partnership with the Tenino School District, PSE will use solar power, along with new energy storage and customer load controls, to increase reliability and resilience for Tenino High School. Another battery

will also be installed at the end of a distribution feeder line in the rural community, which will enable the demonstration of reliability improvement. With funding from a Clean Energy Funds grant, PSE previously deployed a battery energy storage solution to provide a variety of grid support services including back-up power to customers in the rural community of Glacier, near Mt. Baker.

- **Tacoma Power** proposes partnering with a large industrial customer, to construct an 850,000-gallon liquid nitrogen storage tank for use as liquid air energy storage. It will have equivalent large capacity for a 15 megawatt/450-megawatt hour demand response. Combined with automation and control strategies, the liquefied air tank will benefit both the company and Tacoma Power by unlocking new ways to deliver the consistent, reliable, high power loads needed. This type of thermal energy storage system can provide many economic and grid benefits for utilities and their industrial customers.

RD&D

- **Beta Hatch** to design and build Washington's first commercial insect farm, with air handling systems to optimize waste heat use from a data center. The project will develop modular insect farms as a novel end-use for low-value waste heat in rural Washington.
- **Corumat** for development of bio-derived plastics relevant to the food industry. This project allows the replacement of solid plastic with as little as 1/3 the material.
- **Composite Recycling Technology Center (CRTC) t**o develop lightweight products from recycled aerospace scrap for multiple applications to include marine cabling and lightweight advanced cross-laminated timber.
- **Insitu** for development of a transportable hydrogen generation and liquefaction system to produce clean hydrogen from a renewable power source.
- **Oscilla Power** to determine the optimal system configuration and parameters of the Triton wave energy converter (WEC) needed in order to be able to capture energy from ocean waves at the lowest level cost of electricity (LCOE) possible.
- **Pacific Northwest National Laboratory (Solid Phase)** to scale up ShAPE processing of Mg and other lightweight alloys, a severe plastic deformation-assisted method that results in a fine and uniform grain structure and requires less energy than state of the art methods for extrusion of lightweight alloys.
- **Sironex Composite** to convert waste products of thermal power plants containing impurities that are hazardous to the environment, into fire resistant light weight structural materials.

- **Spokane Eco** for developing machine-learning-based control methods that would enable optimal use of multiple energy conversion and storage devices in managing a building complex.
- **University of Washington Applied Physics Laboratory** to demonstrate an improvement in wave energy converter (WEC) performance (efficiency and peak to average ratio) utilizing future wave excitation information provided by state-of-the-art measurement and control techniques during testing in the ocean.
- **University of Washington Mechanical Engineering Department (MEBARC)** to make composites manufacturing economically viable by ensuring high part quality, lowering energy costs, and minimizing waste and scrap. The project will demonstrate how to predictably design and produce complex (hi-contour) thermoplastic composite parts using automated robotic systems.

Solar Deployment Program
(A second competitive round is under development)

- **One Energy Development** to support the Sunnyside Solar Project. The Project will provide power to the distribution side of PacifiCorp's network in, reducing the need to acquire additional electricity to meet peak demand.
- **Peninsula Light Company** to use grant funds to support the Peninsula Light Company's solar power system. Located in the Peninsula Light service area on the Gig Harbor Peninsula, the Project will provide subscriptions with no upfront participation costs to multiple low-income members along with billing credits.
- **TUUSSO Energy** to use grant funds to support the Urtica Solar project. The Project is a solar panel power project, currently under development in Ellensburg, WA. Once operational, the project will supply power to Puget Sound Energy.

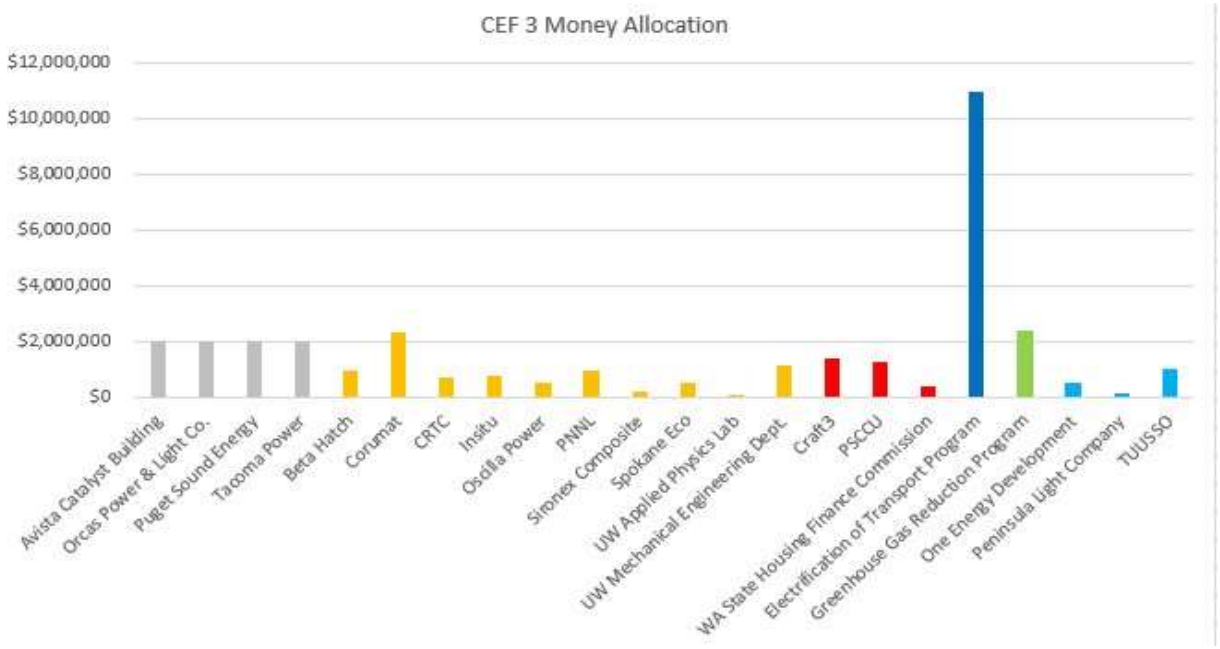
Electrification of Transport Program– Currently in development

Greenhouse Gas Reduction Program– Applications for competitive round are currently in review

Grants to Nonprofit Lenders- $3 million total to 3 financial institutions.

- *Craft3-* ***$1,431,735***
- *PSCCU-* ***$1,295,611***
- *Washington State Housing Finance Commission-* ***$376,654***

CEF3 Money Allocation		
Project	Amount Awarded	Total per Program
Avista Catalyst Building	$2,000,000	$10,600,000
Orcas Power & Light Co.	$2,000,000	
Puget Sound Energy	$2,000,000	
Tacoma Power	$2,000,000	
Beta Hatch	$937,800	$7,850,000
Corumat	$2,344,500	
CRTC	$707,570	
Insitu	$803,196	
Oscilla Power	$555,737	
PNNL	$937,800	
Sironex Composite	$234,450	
Spokane Eco	$515,790	
UW Applied Physics Lab	$93,309	
UW Mechanical Engineering Dept.	$1,125,360	
Craft3	$1,431,735	$3,000,000
PSCCU	$1,295,611	
WA State Housing Finance Commission	$376,654	
Electrification of Transport Program	$11,000,000	$11,000,000
Greenhouse Gas Reduction Program	$2,400,000	$2,400,000
One Energy Development	$500,000	$4,000,000
Peninsula Light Company	$139,860	
TUUSSO	$1,000,000	
Grand Total in CEF3		**$38,850,000**



CEF4 Breakdown (latest cycle of funding)

$42 million to fund seven programs from the 2019-2021 Capital Budget. Grid Modernization Grants to Utilities ($7.7 million). Research, Development, and Demonstration Matching Funds ($7.1 million). Energy Revolving Loan Fund ($7.907 million). Northwest Sea Port Alliance Electrification at terminal five ($4.4 million). Washington Maritime Innovation Center ($5 million). PNNL ($8.3 million). Grays Harbor ($593,000).

Grid Modernization- Program under development

RD&D- Program under development

Grants to Nonprofit Lenders–Program under development

CETF4 Money Allocation			
Project	Amount Awarded	Total per Program	
Grid Modernization projects TBA		$7,700,000	
Shore Power Electrification at Terminal 5		$4,400,000	
RD&D Program		$7,100,000	
Grants to Nonprofit Lenders TBA		$7,907,000	
Dairy Digester Biofertilizer Projects		$1,000,000	
Washington Maritime Innovation Center		$5,000,000	
PNNL		$8,300,000	
Port of Grays Harbor		$593,000	
Solar Deployment Prgm (reappropriation)	$4,000,000		
Greenhouse Gas Reduction Program (reappropriation	$2,400,000		
John Day Pool (reappropriation)	$1,100,000		
Grand Total in CETF4		**$42,000,000**	***Programs still in development***

CLEAN JOBS WASHINGTON

82,859 CLEAN ENERGY JOBS ACROSS WASHINGTON STATE[1]

LIVING UP TO THE EVERGREEN NAME

When it comes to clean energy jobs, the Evergreen State is beginning to live up to its nickname—and with plenty of room for growth.

More than 82,800 Washingtonians now work in clean energy—wind, solar, energy efficiency and related industries. That makes the clean energy industry a bigger employer in the state than Boeing (around 65,800 employees), Microsoft (46,000) or Amazon (50,000).

The state is now in the nation's Top 10 for renewable energy jobs (No. 10) and wind energy jobs (No. 9). And when it comes to all clean energy jobs, Washington is No. 13 in the country.

Along with consumer and business demand for energy savings and cleaner energy sources, smart state policies—beginning with the 2006 passage of a renewable portfolio standard and recent updates to energy efficiency programs—are driving the clean energy job growth in Washington.

Other initiatives designed to reduce carbon emissions in the state would help level the playing field for clean energy—sending a market signal that will drive more demand for renewable energy and efficiency, and in turn create more clean energy jobs.

CLEAN ENERGY JOBS IN PERSPECTIVE

13X There are 13X more clean energy jobs in Washington than fossil fuel jobs

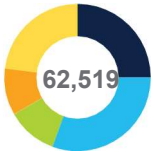
8,500 RURAL JOBS rural Washingtonians now work in clean energy, more than every Washington metro area except Seattle

10.9% VETERANS of Washington clean energy workers are veterans

All 39 COUNTIES in Washington employ workers in clean energy

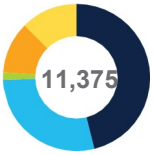
#9 Washington state ranks 9th in the U.S. for wind energy jobs, 16th in solar energy jobs, and 13th in total clean energy jobs

INDUSTRY BREAKDOWN: JOBS



ENERGY EFFICIENCY:

- ENERGY STAR & Lighting: **15,689**
- Trad. HVAC: **19,186**
- High-Efficiency HVAC & Renewable H&C: **6,837**
- Adv Materials: **6,502**
- Other: **14,305**



RENEWABLE ENERGY:

- Solar: **5,246**
- Wind: **3,228**
- Geothermal: **201**
- Bioenergy/CHP: **1,279**
- Low-Impact Hydro: **1,422**

GRID & STORAGE:

- Storage: **3,291**
- Smart Grid: **343**
- Micro-Grid: **368**
- Other Grid Modernization: **397**

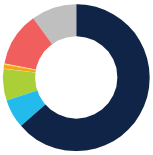
CLEAN VEHICLES:

- Hybrid Electric Vehicles: **1,300**
- Plug-In Hybrid Vehicles: **526**
- Electric Vehicles: **716**
- Natural Gas Vehicles: **160**
- Hydrogen & Fuel Cell: **140**

FUELS:

- Other Ethanol/ Non-Woody Biomass: **91**
- Other Biofuels: **1,632**

BREAKDOWN BY VALUE CHAIN



- Construction: **63.6%**
- Manufacturing: **6.5%**
- Trade: **6.8%**
- Agriculture: **0.9%**
- Utilities: **0.2%**
- Professional Services: **12.1%**
- Other: **9.8%**

WWW.E2.ORG/CLEANJOBSWA
WWW.CLEANJOBSCOUNT.ORG
#CLEANJOBSWA
#CLEANJOBSAMERICA

For more information, contact E2 Western States Advocate **Andy Wunder** at **awunder@e2.org**.

For questions regarding this report, visit E2's Clean Jobs America FAQ at **www.e2.org/cleanjobsamerica/FAQ**.

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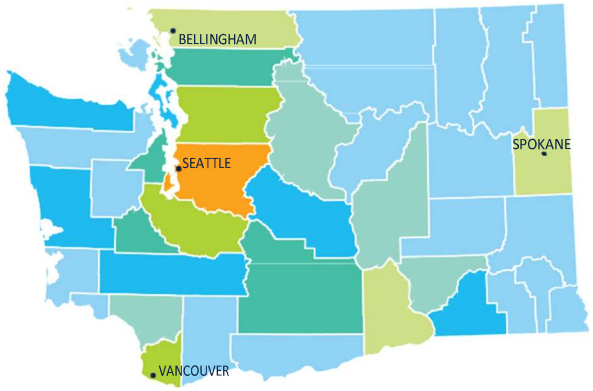
E2FS: 18-09-D

CLEAN JOBS WASHINGTON STATE

CLEAN ENERGY JOBS COUNTY HEAT MAP



TOP METRO AREAS FOR CLEAN ENERGY JOBS

Metro Area (MSA)	Clean Energy Jobs*	Renewable Energy Jobs	Energy Efficiency Jobs
Seattle-Tacoma-Bellevue,	45,820	6,840	34,088
RURAL WA	8,588	1,008	6,629
Spokane	6,308	710	4,900
Portland-Vancouver-Beaverton	5,335	641	4,105
Olympia	2,943	345	2,270
Bremerton-Silverdale,	2,902	330	2,248
Kennewick-Richland-Pasco	2,206	255	1,707
Yakima	2,022	255	1,545
Mount Vernon-Anacorte	1,308	153	1,010
Wenatchee	1,287	145	1,002
Longview	968	115	746
Lewiston	185	20	144

*Includes all clean energy jobs categories, including solar, wind, EE, clean vehicles, battery storage, advanced biofuels, low-impact hydro and other areas.

WASHINGTON STATE CLEAN ENERGY JOBS BY DISTRICT

Data shows that distribution of clean energy jobs in Washington crosses all political boundaries, with clean energy jobs in every congressional and state legislative district.

US CONGRESSIONAL DISTRICTS

District	Clean Energy Jobs	Renewable Energy Jobs	Energy Efficiency Jobs
1 (Rep. DelBene)	14,532	2,340	10,662
2 (Rep. Larsen)	6,879	980	5,156
3 (Rep. Herrera)	8,003	954	6,170
4 (Rep. Newhouse)	6,041	723	4,650
5 (Rep. McMorris)	7,504	849	5,820
6 (Rep. Kilmer)	9,360	1,071	7,249
7 (Rep. Jayapal)	14,999	2,237	11,164
8 (Rep. Reichert)	8,136	1,171	6,092
9 (Rep. Smith)	3,831	637	2,792
10 (Rep. Heck)	3,574	412	2,764

STATE SENATE DISTRICTS

District	Clean Energy Jobs
1 (Sen. Palumbo)	3,829
2 (Sen. Becker)	2,055
3 (Sen. Billig)	4,057
4 (Sen. Padden)	1,401
5 (Sen. Mullet)	3,108
6 (Sen. Baumgartner)	606
7 (Sen. Short)	1,095
8 (Sen. Brown)	1,827
9 (Sen. Schoesler)	1,457
10 (Sen. Bailey)	3,131
11 (Sen. Hasegawa)	4,855
12 (Sen. Hawkins)	1,543

District	Clean Energy Jobs
13 (Sen. Warnick)	1,335
14 (Sen. King)	2,082
15 (Sen. Honeyford)	150
16 (Sen. Walsh)	247
17 (Sen. Wilson)	2,995
18 (Sen. Rivers)	928
19 (Sen. Takko)	1,997
20 (Sen. Braun)	1,763
21 (Sen. Liias)	1,859
22 (Sen. Hunt)	697
23 (Sen. Rolfes)	2,561
24 (Sen. Van De Wege)	1,328

District	Clean Energy Jobs
25 (Sen. Zeiger)	1,664
26 (Sen. Angel)	1,244
27 (Sen. Darneille)	2,117
28 (Sen. O'Ban)	1,080
29 (Sen. Conway)	504
30 (Sen. Miloscia)	1,855
31 (Sen. Fortunato)	126
32 (Sen. Chase)	847
33 (Sen. Keiser)	462
34 (Sen. Nelson)	943
35 (Sen. Sheldon)	644
36 (Sen. Carlyle)	6,235

District	Clean Energy Jobs
37 (Sen. Saldaña)	2,435
38 (Sen. McCoy)	1,727
39 (Sen. Wagoner)	1,352
40 (Sen. Ranker)	2,588
41 (Sen. Wellman)	4,495
42 (Sen. Ericksen)	949
43 (Sen. Pedersen)	1,583
44 (Sen. Hobbs)	<10
45 (Sen. Dhingra)	1,943
46 (Sen. Frockt)	365
47 (Sen. Fain)	<10
48 (Sen. Kuderer)	<10
49 (Sen. Cleveland)	795

CLEAN JOBS WASHINGTON STATE

STATE HOUSE DISTRICTS

District	Clean Energy Jobs
1 (Rep. Stanford and Rep. Kloba)	3,830
2 (Rep. Barkis and Rep. Wilcox)	2,056
3 (Rep. Riccelli and Rep. Ormsby)	4,075
4 (Rep. Shea and Rep. McCaslin)	1,407
5 (Rep. Rodne and Rep. Graves)	3,113
6 (Rep. Volz and Rep. Holy)	608
7 (Rep. Maycumber and Rep. Kretz)	1,100
8 (Rep. Klippert and Rep. Haler)	1,835
9 (Rep. Dye and Rep. Schmick)	1,463
10 (Rep. Smith and Rep. Hayes)	3,183
11 (Rep. Hudgins and Rep. Bergquist)	4,992
12 (Rep. Condotta and Rep. Steele)	1,549
13 (Rep. Dent and Rep. Manweller)	1,340
14 (Rep. Johnson and Rep. Mosbrucker)	2,113
15 (Rep. Chandler and Rep. Taylor)	151
16 (Rep. Jenkin and Rep. Nealy)	248
17 (Rep. Kraft and Rep. Harris)	3,047
18 (Rep. Vick and Rep. Pike)	932
19 (Rep. Walsh and Rep. Blake)	2,005
20 (Rep. DeBolt and Rep. Orcutt)	1,779
21 (Rep. Peterson and Rep. Ortiz-Self)	1,860
22 (Rep. Dolan and Rep. Doglio)	701
23 (Rep. Appleton and Rep. Hansen)	2,573
24 (Rep. Chapman and Rep. Tharinger)	1,333
25 (Rep. Stambaugh and Rep. McDonald)	1,664

District	Clean Energy Jobs
26 (Rep. Young and Rep. Caldier)	1,244
27 (Rep. Jinkins and Rep. Fey)	2,120
28 (Rep. Muri and Rep. Kilduff)	1,081
29 (Rep. Sawyer and Rep. Kirby)	<10
30 (Rep. Pellicciotti and Rep. Reeves)	1,854
31 (Rep. Stokesbary and Rep. Irwin)	126
32 (Rep. Ryu and Rep. Kagi)	847
33 (Rep. Orwall and Rep. Gregerson)	479
34 (Rep. Cody and Rep. Fitzgibbon)	949
35 (Rep. Griffey and Rep. MacEwen)	647
36 (Rep. Frame and Rep. Tarleton)	6,289
37 (Rep. Tomiko Santos and Rep. Pettigrew)	2,447
38 (Rep. Robinson and Rep. Sells)	1,728
39 (Rep. Kristiansen and Rep. Eslick)	1,353
40 (Rep. Lytton and Rep. Morris)	2,569
41 (Rep. Senn and Rep. Clibborn)	4,500
42 (Rep. Van Werven and Rep. Buys)	953
43 (Rep. Marci and Rep. Chopp)	1,605
44 (Rep. Lovick and Rep. Harmsworth)	<10
45 (Rep. Goodman and Rep. Springer)	1,945
46 (Rep. Pollet and Rep. Valdez)	366
47 (Rep. Hargrove and Rep. Sullivan)	<10
48 (Rep. Slatter and Rep. McBride)	<10
49 (Rep. Wylie and Rep. Jurado Stonier)	799

1 Unless otherwise stated, all data is from the 2018 U.S. Energy and Employment Report, May 2018, NASEO and EFI. See Pages 15-17 for methodology questions. For more questions regarding methodology, visit www.e2.org/cleanjobsamerica/FAQ.

E2 is a national, nonpartisan group of business leaders, investors and other professionals who advocate for smart policies that are good for the environment and good for the economy.

Clean Jobs Count is a campaign to raise awareness of the economic importance of the clean economy. Visit www.cleanjobscount.org to join thousands of business leaders, workers and others to tell lawmakers and policymakers that clean jobs count.