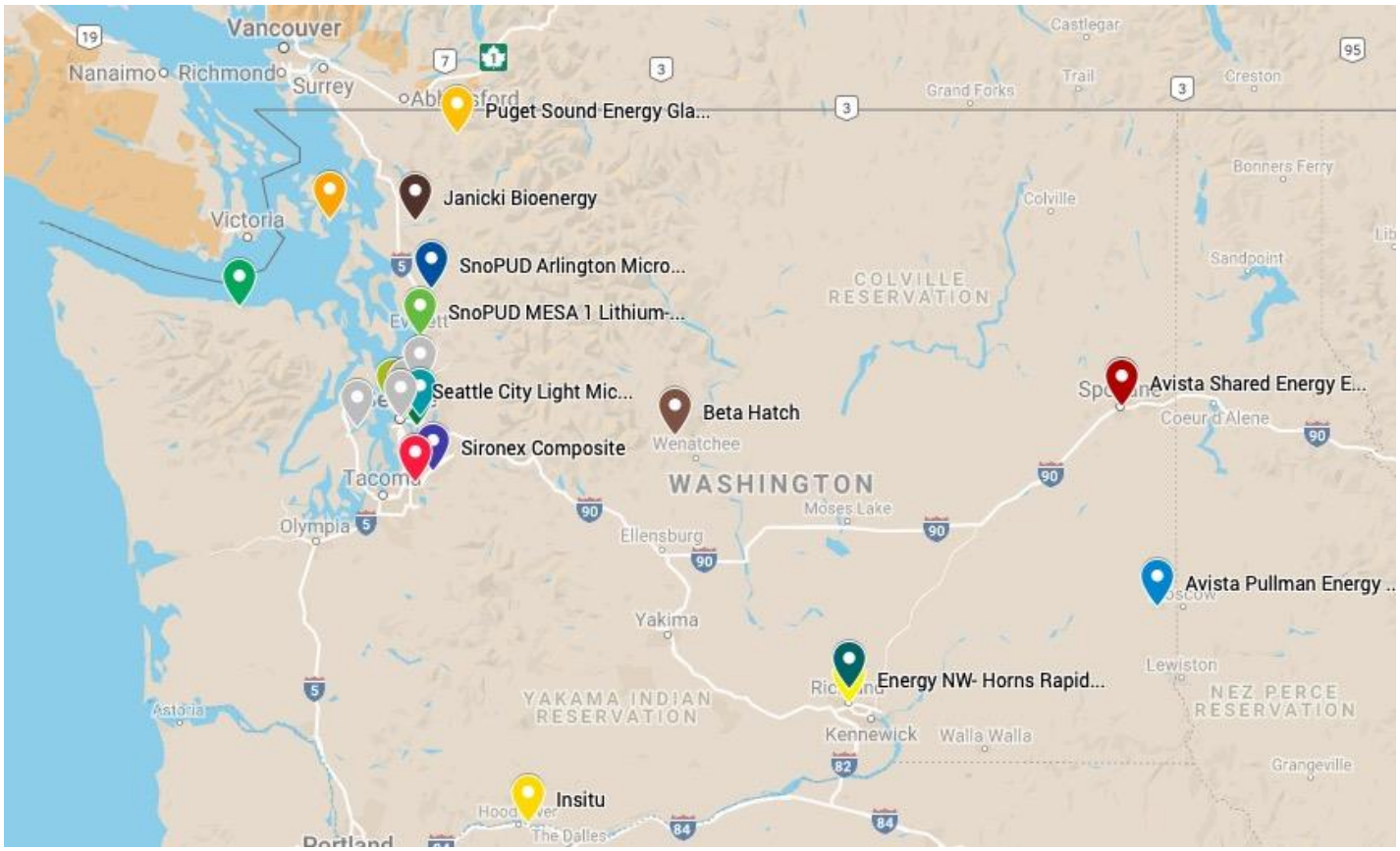
Research for Clean Energy Fund
By Lindsay McCormick

Clean Energy Fund Project Sites



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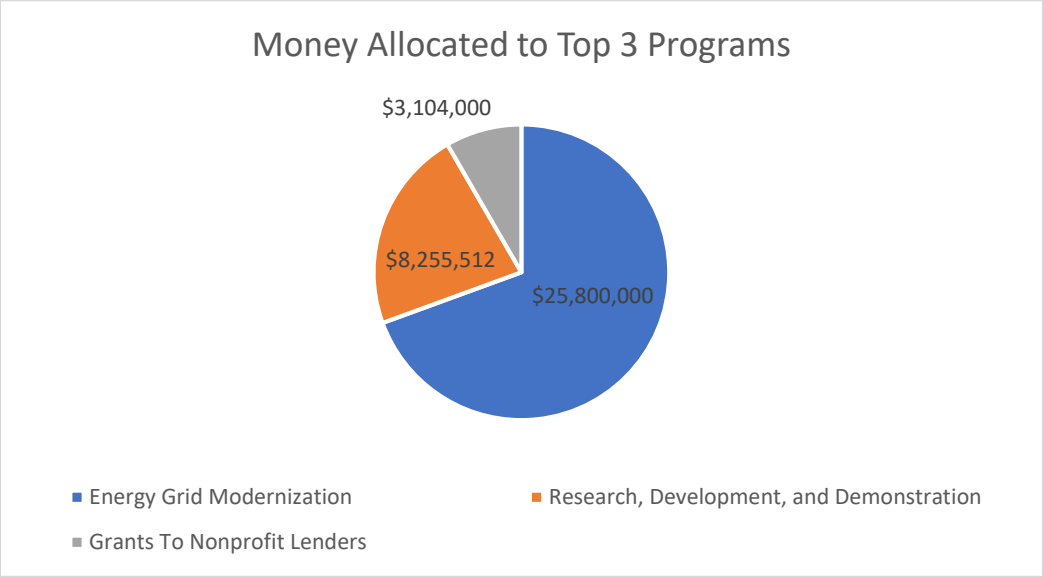
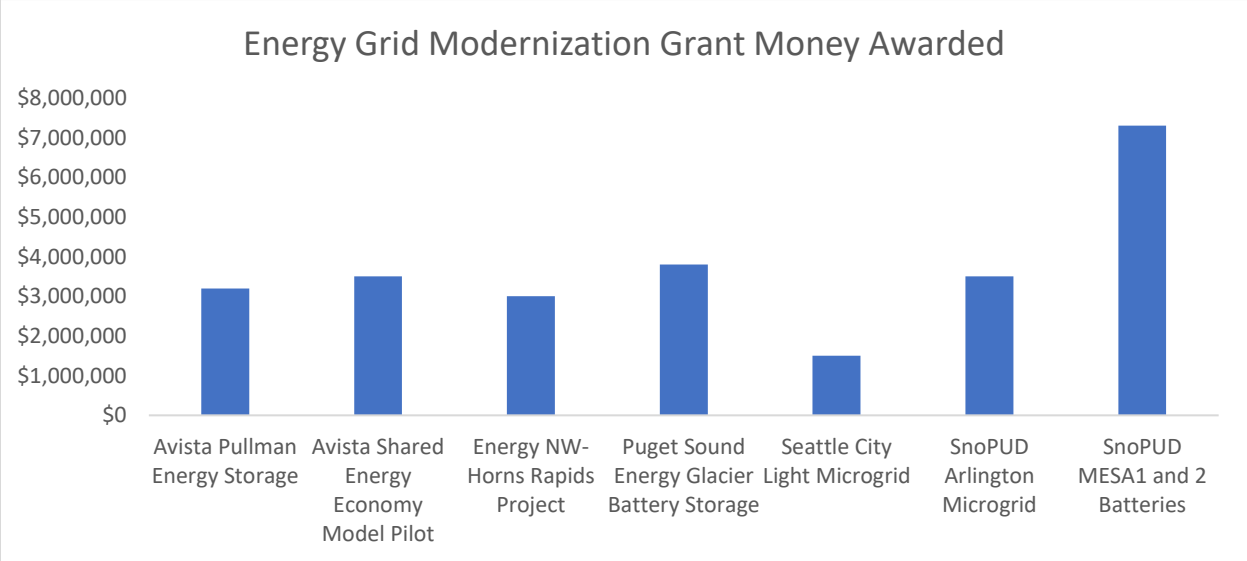
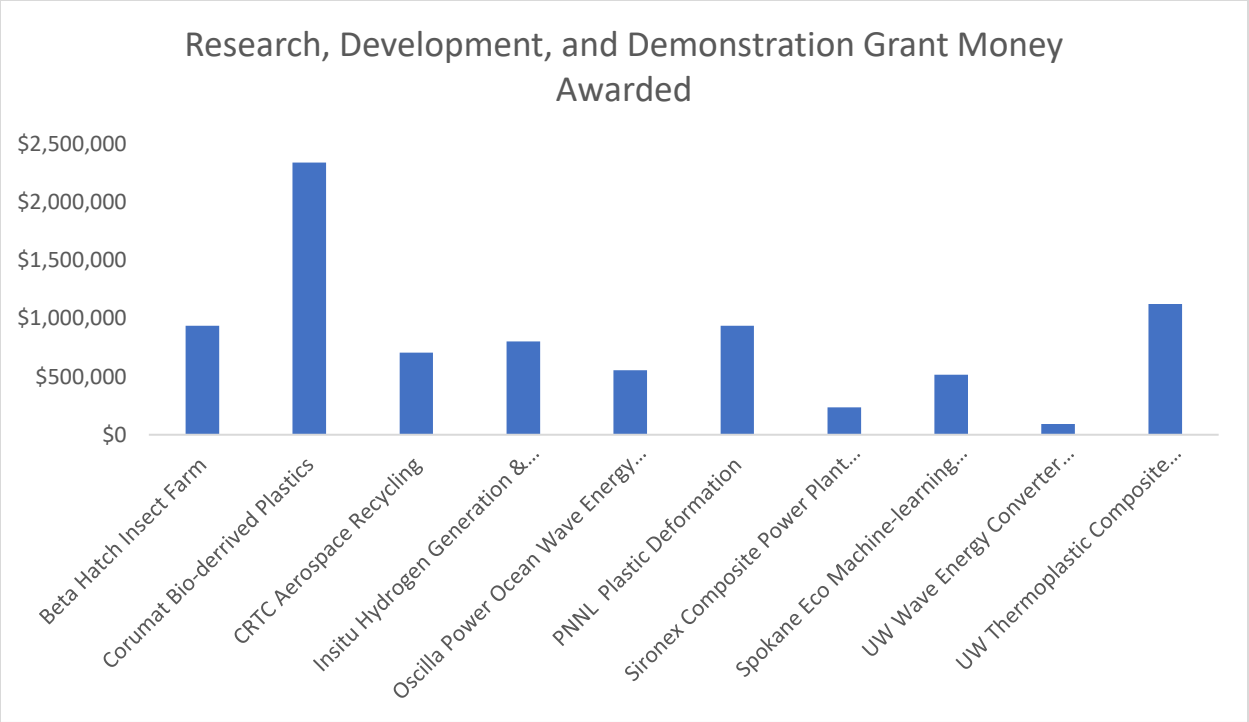
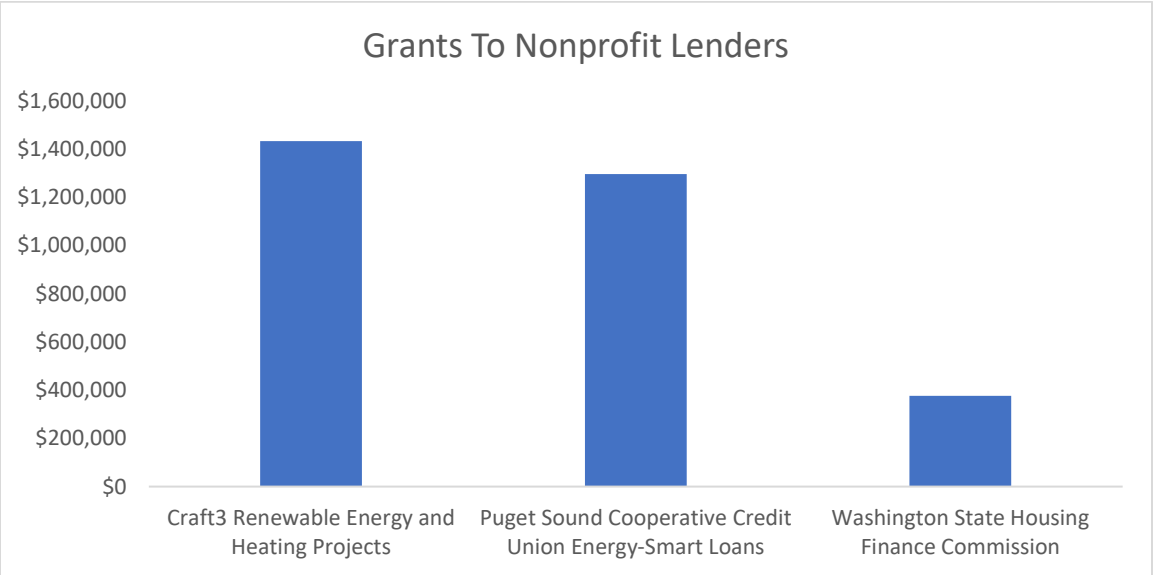
Charts and Graphs






Research, Development, and Demonstration Grant Money Awarded
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$0
Beta Hatch Insect Farm
Corumat Bio-derrived Plastics
CRTC Aerospace Recycling
Insitu Hydrogen Generation &...
Oscilla Power Ocean Wave Energy...
PNNL Plastic Deformation
Sironex Composite Power Plant...
Spokane Eco Machine-learning...
UW Wave Energy Converter...
UW Thermoplastic Composite...


Grants To Nonprofit Lenders
$1,600,000
$1,400,000
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$0
Craft3 Renewable Energy and Heating Projects
Puget Sound Cooperative Credit Union Energy-Smart Loans
Washington State Housing Finance Commission

Energy Grid Modernization

Overview: State investments have encouraged public-private partnerships on a diverse range of projects, leading the way in electrical grid modernization. From different battery chemistry to energy storage to microgrids and solar, Clean Energy Fund project data and business case analyses are transforming how utilities and communities view energy systems and resiliency.

CEF1- $15 million in 2013-14 budget. $14.3 million in grants awarded to three electric utilities.

- Focused on different batteries and energy storage systems
- Multiple battery and software control technology providers provided components to deploy both Lithium Ion and Vanadium Redox Flow systems.
- All systems are operational and undergoing evaluation by the Pacific Northwest National Lab (PNNL)
- Using federal job calculations, it is estimated that the funds provided in CEF1 will generate as many as **391 jobs.**

CEF1 Grid Projects

- Snohomish County PUD MESA1 – multiple Lithium-Ion battery manufacturers within a single substation.
- Snohomish County PUD MESA2 – Vanadium Flow battery within an urban substation.
- Avista Pullman – Vanadium Flow battery deployed at the Schweitzer Engineering manufacturing facility.
- PSE Glacier – Lithium-ion battery storage deployed in a remote community.

CEF2- $13 million in 2015-16 budget. $12.5 million in grants awarded to five electric utilities.

- Focused on microgrids combining solar with storage, load controls etc. to provide resiliency benefits in addition to many of use cases for battery energy storage that were demonstrated in CEF1.
- Projects expected to have deployments in 2019 and 2020.
- It is estimated that the funds provided in CEF2 will generate as many as **430 jobs.**

CEF2 Grid Projects

- Snohomish County PUD – Arlington Microgrid.
- Avista Utilities – Spokane Urbanova, multiple microgrids.
- Energy Northwest – Horn Rapids solar and storage.
- Seattle City Light – Miller Community Center solar & storage microgrid pilot.
- Orcas Power And Light Co. – Decatur Island solar & storage microgrid.

CEF3- $ 11 million in 2017-19 budget. $10.6 million in grants awarded to four electric utilities.

- Commerce will make grants of up to $10.67 million to public and private utilities
- The amount of the individual grants will be between $1 million and $3 million.
- Commerce grants will fund no more than 50% of the total project cost associated with obtaining eligible assets.

Project Profiles

Avista Pullman Energy Storage

Location: Pullman, WA

Summary: 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.

Goal: To explore how energy storage can help our electrical grid become more flexible, more reliable, and more resilient

Funding: Avista received $3.2 million from the Clean Energy Fund and used $3.8 million in Avista matching funds to complete the $7 million project.

Results: 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.

Avista Shared Energy Economy Model Pilot

Location: Spokane's University District

Summary: This program aims to test the integration of energy assets – from rooftop solar and battery storage to building energy management systems – that can be shared and used for multiple purposes.

Goal: To demonstrate how both the customer and the utility can benefit from this shared energy economy model and demonstrate that the electric grid can become more reliable, efficient, resilient and flexible.

Funding: Avista was awarded a $3.5 million matching grant from the Clean Energy Fund.

Results: While the program is still ongoing, Avista has installed 2 100KW rooftop solar arrays on two Washington State University buildings as well as two battery storage systems near the arrays. The pilot project will test and measure all possible outcomes and benefits of a shared energy economy.

Energy NW- Horns Rapids Project

Location: Richland, WA

Summary: 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 kind facility combines solar generation with battery storage and technician training.

Goal: The combination of photovoltaic solar with battery storage will provide a predictable, renewable generating source and also serve as a training ground for solar and battery technicians throughout the nation.

Funding: The Clean Energy Fund provided $3 million of the $6.5 million project. Construction is expected to begin in fall 2019 and end in early 2020.

Results: The 1MW/4MWh battery storage system will have the capability to power 150 homes for 4 hours. The training program will cover plant construction, operations, maintenance, and safety and hazard prevention and will bring about $3 million into the Tri-Cities annually. Energy Northwest's partners will monitor and analyze data from the project to develop improved battery designs and advanced tools for forecasting load, price, and solar in-feed.

Puget Sound Energy Glacier Battery Storage

Location: Glacier, WA

Summary: The Glacier battery storage pilot project entails installation of a 2 megawatt (MW) / 4.4 megawatt-hour (MWh) lithium-ion battery system. The state-of-the-art system is tied to PSE's electric distribution power grid and located in the existing Glacier substation.

Goal: The Glacier battery storage pilot project will serve as a short-term backup power source to a portion of the local Glacier circuit during outages. Additionally, it aims to reduce system load during periods of high demand and balance energy supply and demand, helping to support greater integration of intermittent renewable energy generation on PSE's grid.

Funding: The project received $3.8 million from the Department of Commerce in addition to $7.4 million invested by Puget Sound Energy.

Results: The battery system is fully functional and 2 phases of testing have been performed the Pacific Northwest National Laboratory (PNNL) to determine the benefits of the battery technology for PSE's local system and identify future applications for the technology for PSE and other utilities.

Orcas Power and Light Co-op

Location: Decatur Island, WA

Summary: 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.

Goal: To help the co-op save money and improve grid reliability.

Funding: $1 million from CEF1 for grid modernization.

Results: 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.

Seattle City Light Microgrid

Location: Miller Community Center, Seattle, WA

Summary: Seattle City Light is partnering with Seattle Parks and Recreation to implement a microgrid project at Miller Community Center. The project will include the installation of a battery energy storage system, kilowatt (kW) sized solar panels and microgrid controls.

Goal: The microgrid will provide backup power storage for the community center during unplanned emergency events, such as a storm or earthquake.

Funding: $1.5 million from the Clean Energy Fund provided a portion of the funding for the project.

Results: City Light will empower a community to recover quickly from unplanned emergency events and gain technical knowledge on the installation and operation of a microgrid system.

SnoPUD Arlington Microgrid

Location: Arlington, WA

Summary: The PUD is designing a Microgrid and Clean Energy Technology Center, located east of the Arlington Airport. It will demonstrate multiple new energy technologies, including energy storage paired with a solar array. It will form a Microgrid, a system that can be "islanded" and run independently from the electrical grid. It will also demonstrate how PUD electric fleet vehicles can be used to benefit the electric grid via a vehicle-to-grid system that allows both charging and discharging into the grid.

Goal: The Clean Energy Technology Center (CETC) will serve as the test load for the Microgrid and will showcase the technology to the public, the business sector, researchers and other local agencies. The project's multiple uses include grid resiliency and disaster recovery, renewable energy integration, grid support and ancillary services and vehicle-to-grid components.

Funding: The project is supported by a $3.5 million grant from the Clean Energy Fund.

Results: When completed, the project will demonstrate how energy storage in combination with a renewable energy resource and a microgrid control system can be utilized for disaster recovery and grid resiliency as well as renewable energy integration and grid support. In addition, the project will demonstrate how intelligent solar PV controllers and vehicle-to-grid (V2G) systems can benefit the grid.

SnoPUD MESA 1 Lithium-Ion Battery

Location: Everett, WA

Summary: In 2015, Snohomish County PUD deployed its first energy storage system comprised of two lithium-ion batteries, sited at a South Everett substation. The system was the first to be based on the innovative Modular Energy Storage Architecture (MESA).

Goal: The lithium ion system, along with other PUD storage projects, aims to transform the marketplace and how utilities manage grid operations. They are designed to improve reliability and the integration of renewable energy sources

Funding: The project, along with a second vanadium flow battery system, is supported by a $7.3 million grant from the Clean Energy Fund.

Results: The project demonstrates a variety of use cases, including peak shifting, energy arbitrage, managing transmission constraints, maximizing best market purchases and mitigating energy imbalance. Controls integration and optimization software is one of the keystones of the PUD storage program.

SnoPUD MESA 2 Vanadium Flow Battery

Location: Everett, WA

Summary: In summer 2017, Snohomish County PUD deployed an energy storage system comprised of multiple advanced vanadium-flow batteries at its Everett Substation. By capacity, it is the world's largest containerized vanadium-flow battery system. The system is housed in 20 shipping containers, each 20 feet in length, packed with tanks of liquid electrolyte solution.

Goal: The vanadium flow battery system, along with other PUD storage projects, aims to transform the marketplace and how utilities manage grid operations. They are designed to improve reliability and the integration of renewable energy sources

Funding: The project, along with the lithium-ion battery system, is supported by a $7.3 million grant from the Clean Energy Fund.

Results: The project demonstrates a variety of use cases, including peak shifting, energy arbitrage, managing transmission constraints, maximizing best market purchases and mitigating energy imbalance. The Modular Energy Storage Architecture (MESA) includes standard electrical and communications interfaces that connect batteries, power converters and software components. Its standardization will help barriers to growth in the energy storage industry.

Research, Development, and Demonstration Program (RD&D)

Overview: The purpose of RD&D is to support Washington's research institutions, organizations and clean energy technology companies. Eligible projects include, but are not limited to:

- Advancing energy storage and solar technologies
- Advancing bioenergy and biofuels
- Development of new earth abundant materials or lightweight materials
- Engineering advanced energy storage materials
- Implementing innovative approaches for recycling of battery components
- Developing new renewable energy and energy efficiency technologies

Commerce has announced over $8.2 million in grants from the state's Clean Energy Fund to ten projects that will promote the development of research, development, and demonstration (RD&D) of clean energy projects in Washington.

Beta Hatch

Location: Cashmere, WA

Summary: Beta Hatch wants 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.

Funding: They were awarded $937,800 from the Clean Energy Fund

Corumat

Location: Mercer Island, WA

Summary: Corumat received funding 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. Replacing petroleum pellets with bioplastic pellets also dramatically reduces carbon dioxide emissions.

Funding: $2,344,500 from the CEF

Composite Recycling Technology Center (CRTC)

Location: Port Angeles, WA

Summary: CRTC wants to develop lightweight products from recycled aerospace scrap for multiple applications to include marine cabling and lightweight advanced cross-laminated timber.

Funding: $707,570 in grant money.

Insitu

Location: Bingen, WA

Summary: Insitu received a grant for development of a transportable hydrogen generation and liquefaction system to produce clean hydrogen from a renewable power source. The project proposes to use water and electricity to produce LH2 fuel for powering zero-emission hydrogen-electric vehicles and machines, dramatically reducing petroleum use.

Funding: $803,196 from the Clean Energy Fund

Impact Bioenergy

Location: Based out of Auburn, WA. The project will take place on Vashon Island.

Summary: 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.

Funding: $550,000 from CEF

Janicki Bioenergy

Location: Sedro-Woolley, WA

Summary: Janicki Bioenergy will demonstrate their innovative vapor recompression distillation system that produces clean, potable water from dairy manure wastewater using thermal evaporation, steam compression, vapor recovery and water treatment. This grant will

demonstrate the commercial viability of Janicki's technology, which has the potential to provide global sanitation in places with no public water or sewer systems.

Funding: $283,158

Oscilla Power (2017)

Location: Seattle, WA

Summary: Oscilla Power will use grant funds to design, build and test a community-scale wave energy converter. The project will validate a cost-effective approach to unlock the untapped potential of ocean waves to generate massive amounts of renewable electricity around the world. Partners in the project are Glosten Associates, a Seattle-based naval architecture and marine engineering firm, and Janicki Industries, an advanced composite materials tooling and manufacturing firm based in Sedro-Woolley.

Funding: $1 million

Oscilla Power (2019)

Location: Seattle, WA

Summary: Oscilla Power intends to use the money 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.

Funding: They received $555,737 in grant money

Pacific Northwest National Laboratory (Solid Phase)

Location: Richland, WA

Summary: They intend to scale up ShAPE processing of magnesium 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.

Funding: $937,800 from the CEF

Sironex Composite

Location: Covington, WA

Summary: The money will be used to convert waste products of thermal power plants containing impurities that are hazardous to the environment, into fire resistant light weight structural materials.

Funding: $234,450 in grant money from the CEF.

Spokane Eco

Location: Spokane, WA

Summary: The money will be used for developing machine-learning-based control methods that would enable optimal use of multiple energy conversion and storage devices in managing a building complex. Machine learning is a method used to develop models and algorithms, known as predictive analytics, to assist buildings in more efficiently responding to electrical grid needs. Besides transportation, commercial buildings are a major contributor to carbon dioxide emissions.

Funding: $515,790 from the Department of Commerce

SuperCritical Technologies, Inc.

Location: Bremerton, WA

Summary: They are developing ways to use supercritical carbon dioxide (sCO2) instead of steam to generate electricity. They are investigating use of CO2 hydrodynamic bearings and related technologies such as tiny turbines and lubricants, to develop compact power plants. Modular units the size of shipping containers could generate electricity at the point of consumption, such as converting waste heat to power operations at an industrial facility, for example.

Funding: $283,158

University of Washington Applied Physics Laboratory

Location: Seattle, WA

Summary: UW intends 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.

Funding: $93,309 from the CEF

University of Washington Mechanical Engineering Department (MEBARC)

Location: Seattle, WA

Summary: UW will aim 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.

Funding: $1,125,360 in funding from the CEF

Zunum Aero

Location: Bothell, WA

Summary: Zunum planned to fly a prototype in 2019 or 2020. Under the revamped FAR Part 23 rules for electric aircraft standards expected by 2018 and with first type certification by 2020, a 19-seat design optimized for a 700 nmi (1,300 km) range, viable on a battery specific energy of 300 watt hours per kilogram available in 2017, was to begin service in the early 2020s. Range might increase to beyond 1,000 nmi (1,900 km) by 2030 with in-service aircraft upgrades made possible by technology advances. The project has since been put on hold as Zunum had difficulty securing funding and laid off nearly all of its 70-person staff.

Funding: An $800,000 research and development grant from the Clean Energy Fund matches funding raised from Boeing and JetBlue. To date, only $281,683 of that state grant had been disbursed to Zunum, as it achieved specific milestones and delivered on technology goals outlined in the contract.

All of these competitive grant awards are conditional upon execution of final project agreements and performance-based contracts with Commerce. These ten conditional awardees were among 52 applicants, totaling over $51 million in projects, competing for $8.2 million in available funding.

Commerce consulted and coordinated with clean energy institutions of higher learning, national laboratories, and other clean energy organizations to design the RD&D Grant program to support Washington's research institutions, organizations, and clean energy technology companies.

The applicant must match the RD&D funds with non-state dollars at a 1:1 or greater ratio. A higher ratio is desired and additional consideration may be given during the application review process based on this. Matching funds may be sought from lending institutions, investors, federal awards, non-state awards, or the applicant.

- Applicants are expected to notify Commerce of all applicable non-state award decisions.
- Applicants who do not receive their non-state match funding within 12 months of receipt of their award letter may apply for future funding pending new opportunity announcements.
- An additional six months to secure required match, for a total of 18 months following the date on the award letter, may be provided on a case-by-case basis.
- Successful applicants that secure less than 1:1 match will have the award reduced to the secured match amount.

Grants to Nonprofit Lenders

Overview: Revolving Loan Fund grants show that a modest public investment can promote private investment. This drives economic activity and jobs for Washingtonians and helps our state lead the nation in energy efficiency.

Funding Purpose: These matching grants finance loan-loss reserves or interest-rate buy downs for proven building energy efficiency and renewable energy technologies that currently lack access to capital, generating opportunities within the residential and commercial sectors. The funds have allowed lenders to leverage other private financing from utilities, contractor incentives, and other sources to allow homeowners and businesses to complete projects that install efficient windows, insulation, ventilation, and high-efficiency water heaters, seal ducts, and replace boilers.

Project Grantees to Date

Craft3

Location: Seattle, WA

Summary: Craft3 received money from the CEF to fund renewable energy and heating projects, commercial and industrial energy efficiency retrofits and clean technology manufacturing.

Funding: $8.7 million for commercial sector; $2.9 million for residential sector in the Energy Revolving Loan Fund from CEF1. In CEF3 $1,431,735 was awarded.

Leverage Ratio: Craft3's commercial lending leverage ratio is 4:1, and Craft3's residential lending ratio is 1:1.

Puget Sound Cooperative Credit Union

Location: Bellevue, WA

Summary: They received grant money for loan loss reserves to support Energy-Smart loans, which includes renewables and electric vehicles.

Funding: $2.9 million for the residential sector in the Energy Revolving Loan Fund from CEF1 and $1,295,611 from CEF3

Leverage Ratio: Puget Sound Cooperative Credit Union leverages funds at a ratio of 20:1

Washington State Housing Finance Commission:

Location: Seattle, WA

Summary: They received money for energy retrofit loans to projects in multifamily housing and buildings owned by nonprofit organizations.

Funding: $376,654 in CEF3

Leverage Ratio: Housing Finance Commission anticipate they will leverage over $108 million in non-state funds, an 11:1 match for state funding.

Clean Energy Fund Background

Overview: The Clean Energy Fund (CEF) funds the development, demonstration and deployment of clean energy technology. Established in 2013, Gov. Inslee has continued to champion the fund, and the legislature again invested capital budget in these grant programs.

The money in the CEF can only be used for projects that provide a benefit to the public through development, demonstration, and deployment of clean energy technologies that save energy and reduce energy costs, reduce harmful air emissions, or increase energy independence for the state.

Written into the legislation is language that requires fairness in evaluating proposals, awarding contracts, and monitoring projects so that due diligence is performed and there are no conflicts of interest. The legislation also included detailed language on how much money is allocated into each of the programs within the Clean Energy Fund and the necessary criteria that recipients must meet in order to be eligible for funding.

The Clean Energy Fund provides matching funds for eligible projects so that the Fund is paying for, at most, half of the total cost and the project and the recipient provides the other half or more of the funding.

Over the past 6 years, the Clean Energy Fund has provided the funding for world-changing research and projects that otherwise might never have proceeded. Washington is leading the way and setting an example for other states by prioritizing and investing in clean energy. Hopefully other states will follow Washington's good example and adopt similar programs so we can move towards a cleaner and greener future that's sustainable for generations to come.

Sources:

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