



Fleet Electrification Technologies

Professors James Long and Xin Wang, OREC-affiliated faculty, are currently working with two Oregon companies, KersTech Vehicles Systems and GreenLite Motors, on hybrid vehicle technologies. Each company has unique challenges. GreenLite Motors is developing engine control technology for its new three-wheeled hybrid vehicle that handles like a motorcycle, with the weather protection of a car. KersTech and Oregon Tech will work together on developing an efficient electric motor idle for use in garbage trucks and buses. Both applied research projects will produce innovative control systems and reduce carbon emissions.

OREC's Contribution to the 10-Year Energy Plan

• Contribute to applied research and innovation in energy efficiency and conservation.

- Design, build, test, and patent energy efficiency devices and processes.
- Participate in State Building Innovation Lab

• Develop energy generation and demonstration projects.

- Advise state agencies on renewable energy resources and development
- Expand geothermal technical assistance
- Fully utilize energy demonstration projects for teaching and learning

• Conduct Applied Research in Hybrid and Electric Vehicles.

- Enable fleet conversion through Hybrid and Electric Vehicle research and technology applications

• Produce energy engineers and professionals for Oregon companies and communities.



Oregon TECH

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How does OREC achieve its future plans? *With your help!*

- Invest \$2.5M in state funds to appoint top-notch, innovative applied research faculty, expand OREC's applied research and economic development capabilities, and contribute to the State Building Innovation Lab.
- Raise funding from grants and sponsored projects.
- Build OREC's image as an accomplished applied research center and economic development engine that delivers results for companies and communities.

OREC's Plan for Renewable Energy Education and Innovation

Sept 2012

2.0
EXECUTIVE
SUMMARY

Energy is THE Issue....

"Energy is THE issue of our time – both globally and here in Oregon – and no single issue will have a greater impact on our state's economy, environment and quality of life in the coming decade. The central question is whether we will shape our energy future through intentional investment and development, or whether it will shape us."

- Governor John Kitzhaber,
10-Year Energy Plan, 2012

OREC

Oregon Renewable Energy Center

Oregon **TECH**

Plan for Renewable Energy Education and Innovation

OREC's History

The Oregon Renewable Energy Center (OREC) was established by the Oregon State Legislature in 2001 to promote energy conservation and renewable energy use in Oregon through applied research, educational programs, and practical information. OREC's activities are founded on the principle that wise energy use is the foundation for a sustainable economy, good jobs, and economic prosperity. OREC and its affiliated faculty and students play a critical role in Oregon and the Northwest as a facilitator, advisor, and action-oriented solutions developer to address the Northwest's energy and economic challenges. <http://www.oregonlaws.org/ors/352.221> Oregon's elected leaders had the vision to establish an energy research center at OIT in 2001, prior to the dawn of the "green revolution." They based the center at Oregon Tech due to its history of advancing renewable energy solutions in Oregon for over 30 years.

This report highlights accomplishments and plans for the Oregon Renewable Energy Center (OREC) at Oregon Tech and charts a course for the next decade, OREC 2.0, under

Executive Summary

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the leadership of Dean Charlie Jones. OREC looks to the future with an expanded partnership, research, tech transfer, and innovation infrastructure at Oregon Tech, and an emerging academic plan that focuses on expanding OREC's key strengths in multidisciplinary education, applied research that enriches the teaching and learning experience at Oregon Tech, and stronger industry partnerships. OREC is the home of Oregon Tech's Centers of Expertise in Renewable Energy, encompassed in many engineering and natural science disciplines, which enable OREC to fulfill its mission, helping companies and communities apply renewable energy technologies.

ORS 352.221 states: (1) Pursuant to ORS [351.870 \(Findings and policy for ORS 351.865 to 351.890\)](#), there is created within the Oregon University System the Oregon Renewable Energy Center. The Oregon Renewable Energy Center shall be administered by the Oregon Institute of Technology.
(2) The purpose of the Oregon Renewable Energy Center is to engage in renewable energy system engineering and applied research.
(3) The Oregon University System may receive moneys from any public or private source to support the Oregon Renewable Energy Center. Gifts and grants received to support the Oregon Renewable Energy Center shall be credited to the appropriate fund at the Oregon Institute of Technology by the Oregon University System. [2001 c.818 §2; 2009 c.762 §80]

The Geo-Heat Center Story

The OREC Geo-Heat Center is the only one of its kind in the United States, and provides a unique service to enhance the use of geothermal energy on a national and an international level. The Geo-Heat Center has produced:

- *Information dissemination through a Quarterly Bulletin on the uses of geothermal energy, sent free to 2,000 subscribers, technical publications, and web site.

- *Training in the form of workshops, seminars and lectures on and off campus.

- *Maintenance of a geothermal library with over 5,000 publications and an extensive website of over 1900 files; a 12,000 well and hot spring data base for 16 western states; a U.S. direct-use data base of 2,345 projects; 172 PDF articles; accessed by 1,350 users downloading over 2,000 files daily.

- *Applied research and development for geothermal equipment and their use.

Current Geo-Heat Center projects include:

- *Consulting on Oregon Tech's two geothermal power plants and supporting facility engineering
- *Boise State University – geothermal database, digitizing library
- *USDOE subcontract for technical assistance, bulletin, state reports
- *University of Nevada Reno Geothermal Training Center
- *Kenyan Training Project-offering technical assistance to a delegation from Kenyan on the development of their nation's geothermal resources.

Under the guidance of the Geo-Heat Center, Oregon Tech installed its 280kW geothermal plant in 2010 that will produce electricity to supply 10% of the campus energy needs. In 2009, Oregon Tech drilled a 5,300 foot well to power a 1750kW plant to supply another 60% of electricity needs. Combined with a planned large scale solar installation, Oregon Tech will achieve Net Zero energy annually. OREC will use the new power plants as teaching labs for students and community partners.



"OREC has produced a 10-year ROI for Oregon of 4.3-to-1, raising \$10.3 million in public and private funds to leverage the state's \$2.4 million investment. That's an outstanding deal for Oregon."

- Charlie Jones
OREC Director

OREC's Key Accomplishments 2001-2012

1. Applied Research to Support Companies and Enrich the Teaching and Learning Environment

OREC helped develop capabilities at Oregon Tech in power conversion and storage, by testing renewable technologies such as solar, fuel cells, and geothermal heat pumps and developing control systems to integrate renewable technologies smoothly into existing facilities and electrical distribution networks. **To date, just under \$1 million, or approximately 7% of Oregon Tech and OREC's leveraged resources have been generated for applied research.**

Examples of Sponsored Research Projects:

- Green Lite Motors: Funded through commercialization grants from Oregon BEST and OTREC, researchers James Long, Hugh Currin, and James Zipay are working with GreenLite CEO, Tim Miller, to research and develop the electronics, software, and hardware that will enable the vehicle's existing electric motor and gas engine to work in combination off a single throttle to optimize efficiency and performance. This is the last critical element in creating a fully functional prototype, and will position the company to obtain private investment capital for commercialization.

- Oregon Tech is a member of the National Institute for Transportation and Communities (NITC) and contributes to its mission through applied research projects. Oregon Tech's partnership with KersTech Vehicle Systems received a grant for \$139,174 to research Combined Traction and Energy Recovery Motor for Electric Vehicles.

- National Renewable Energy Lab (NREL) and Oregon BEST: Collaborated with researcher Hugh Currin at Oregon Tech to develop Free Vortex Wake Model to improve wind turbine technology. The model will lead to further research for FAST/AeroDyn applications.

- Powin Energy: Powin and Oregon Tech joined forces to develop a Battery Testing and Energy Storage Lab at the Wilsonville Campus. Powin Energy is providing lithium ion batteries and \$40,000 of energy storage equipment for the 40-month project. The Oregon Tech team will conduct a series of tests designed to assess the performance characteristics of Powin Energy's lithium ion battery cells.

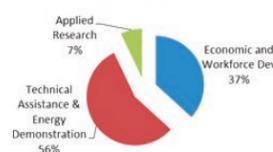
2. Technical Assistance In Systems Engineering and Centers of Expertise

The Oregon Renewable Energy Center (OREC) works with industry and electric utilities in Oregon and the region to make renewable energy the future energy choice of the nation. **Over \$7 million OREC and Oregon Tech's energy-related resources, approximately 56% of the total, have been applied to technical assistance and energy demonstration projects.**

OREC is currently providing technical assistance to the Oregon Military Department (OMD) for Christmas Valley/OREC Consulting. OREC was first awarded a \$169,000 subcontract from the Oregon Department of Energy to do a

feasibility study for developing an R&D center at Christmas Valley. It has been awarded another contract to provide technical assistance for the development of the agency's renewable energy program. OREC's efforts will focus on planning and outreach for the OMD's Christmas Valley facility.

OREC Funds by Activity 2001 - 2012

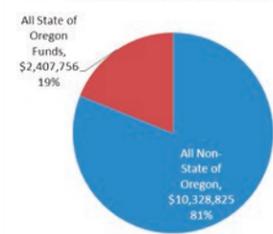


The Geo-Heat Center: In its fourth decade of operation, the Geo-Heat Center expands the use of geothermal energy on a national (to all 50 states) and international level through technical assistance for developers and operators of geothermal direct-use, small scale power generation and geothermal heat pump projects. The Geo-Heat Center helped design and review the geothermal heating system for two facilities in Oregon: the Oregon State Work Camp in Lakeview and a brewery/restaurant in Klamath Falls, the first geothermally heated brewery in the nation.

3. Economic and Workforce Development for Energy and Technology Companies

Renewable energy holds enormous promise for economic prosperity in the regions around the state, driven by rural and regional economic development plans. OREC offers technical, planning, and analytic

OREC Funds by Source



expertise to support this activity. **Since 2001, approximately \$4.7 million, 37% of OREC and Oregon Tech's energy-related resources, have been spent on economic and workforce development activities.**

- OREC has received three grants from the U.S. Department of Agriculture to assist small businesses and agriculture in applying for the Rural Energy for America Program (REAP) and Renewable Energy Development Assistance (REDA) grants, providing funds for up to 25% of project cost for energy efficiency improvements and renewable energy to improve business operations and save energy.

OREC's outcomes: 26 companies have been assisted; \$219,000 has been awarded to businesses in southern Oregon and northern California. In the last grant award period, OREC's clients garnered about 80% of the USDA funds allotted to the state of Oregon for energy related projects.

Workforce Development

Oregon Tech has received national recognition for its leadership in renewable energy engineering.

Cited in the New York Times, Clean Edge reports, national energy blogs and the Oregonian, Oregon Tech launched the first Bachelor of Science in Renewable Energy Engineering in the nation in 2006 and was the first to be ABET accredited. Based on input from its active Industry Advisory Council, the program offers a rigorous foundation of math and physics, provides courses in both mechanical and electrical engineering, and offers a full array of renewable-energy specific courses.

The program grew from 5 students in 2006 to 250 students in 2012.

Oregon Tech began offering a Master of Science in Renewable Energy Engineering in Fall 2012 at its urban campus in Wilsonville.

Other grants awarded for workforce development:

- U.S. Dept. of Energy STEPS Grant: \$2,491,100 to educate the next generation of energy engineers;

- U.S. Dept. of Labor STEM Subgrant: \$150,000 for energy internships;

- NSF: S-STEM: Technology, Access, Diversity – PCC awarded \$599,384 in partnership with Oregon Tech for students pursuing pathways from PCC AS in Engineering into Electronics Engineering Technology or Electrical Engineering at Oregon Tech.

OREC's Future

1. **Applied Research: Build OREC's capabilities in applied research.** While OREC has raised over \$12 million to support its mission, only 7% has been committed to applied research collaborations, where OREC could catalyze economic activity and jobs. OREC's future rests on developing into a preeminent applied research center of expertise in renewable energy, which can be accomplished with a \$2,500,000 state investment. A portion of the state's investment would enable OREC to participate in the State Building Innovation Lab, fund faculty and students to audit state buildings, provide energy-saving recommendations, and identify innovative technologies to save energy in state buildings.
2. **Technical Assistance: Expand OREC's capacity to deliver technical assistance and economic development activities in rural communities.**
3. **Demonstration: Utilize Oregon Tech's soon-to-be-completed geothermal power plants and demonstration project** as Oregon's teaching and learning laboratory for students, community partners, and companies.
4. **Workforce Development: Continue Oregon Tech's innovation in developing new majors and degrees** to meet the emerging needs of the renewable energy industry.

OREC's Value Proposition

OREC has proven over the past 10 years that it can achieve significant ROI for the state. OREC anticipates that the \$2,500,000 state investment this biennium will generate matching public and private investment of over \$10,000,000 in five years. OREC needs state support, like other university-led research centers, to build the infrastructure to fulfill OREC's mission in applied research, technical assistance, and workforce development, and take it to a level of national prominence.

Oregon Tech will appoint six current or new post-doctoral faculty to applied research positions to create an applied research ecosystem to support companies in Oregon and the U.S. After this initial investment, faculty members will support their positions through grants and contracts. OREC will collaborate with other universities to become a hub for energy and power research in the Pacific Northwest.

OREC's Applied Research ROI will be measured by:

- BS and MS-level degrees awarded by Oregon Tech in energy-related fields
- Technical Assistance that results in contracts, grants or revenue for companies
- Federal and private money attracted to OREC
- Increase in state's portfolio of dominant patents in energy technologies
- Licensing revenue