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Oregon BEST FEST '11

Sparking Collaboration for the Green Economy.

September 12 | Portland, Oregon

9:00-9:30am	WELCOME & PROGRAM OVERVIEW David Kenney, *Oregon BEST*	Ballroom
9:30-10:30am	KEYNOTE ADDRESS: SunShot Initiative Minh Le, *Solar Energy Technologies Program, U.S. Dept. of Energy*	
10:30-11:00am	COMMERCIALIZATION CASE STUDY: STORY OF A UNIVERSITY SPIN-OUT Terri Fiez, *Oregon State University and Azuray Technologies*	
11:00-11:15am	Coffee Break	
11:15-12:15pm	**SIMULTANEOUS RESEARCH TRACKS**	
	ENERGY TECHNOLOGIES: SOLAR Jamie Hudson, *Tau Science*; Steve Kevan, *University of Oregon* Carl Wamser, *Portland State University*; Glenn Montgomery, *OSEIA*	Ballroom
	WATER: INNOVATION TOWARD NET ZERO Todd Jarvis, *Oregon State University*; Mark Owen, *Puralytics* Pete Muñoz, *Natural Systems International*; Katie Spataro, *Cascadia Green Building Council*	327-329
	SMARTGRID /ENERGY STORAGE Bob Bass, *Portland State University*; Guy AlLee, *Intel Labs* Lee Hall, *Bonneville Power Association*; Jeff Hammerlund, *Portland State University*	333
12:15-1:30pm	LUNCH	Ballroom
12:30-1:30pm	RESEARCH POSTER SESSION	
1:30-2:30pm	**SIMULTANEOUS RESEARCH TRACKS**	
	DESIGN INNOVATIONS FROM BUILDING SCIENCE John Breshears, *Architectural Applications*; Lucas Hamilton, *CertainTeed* Sergio Palleroni, *Portland State University*; Corey Griffin, *Portland State University*	Ballroom
	GREEN CHEMISTRY & GREEN MATERIALS Jordan Palmeri, *Oregon DEQ*; Jim Hutchison, *University of Oregon* Dan Haas, *Skanska*; Erin Moore, *University of Oregon*	327-329
	ENERGY TECHNOLOGIES: BIOENERGY David Hackleman, *Oregon State University*; Ganti Murthy, *Oregon State University* Steve Potochnik, *Trillium FiberFuels*; Susan Safford, *Oregon BEST*	333
2:30-2:45pm	COFFEE BREAK	
2:45-3:45pm	**SIMULTANEOUS INTERACTIVE SESSIONS**	
	THE OREGON BEST INNOVATION COLLABORATION CHALLENGE Johanna Brickman, *Oregon BEST* and Ralph DiNola, *Green Building Services*	Ballroom
	STUDENT INNOVATORS *Student-Industry Project Presentations & Opportunities*	327-329
3:45-4:30pm	NATURAL RESOURCES PANEL *Capitalizing on Oregon's Natural Resources to Create a Competitive Advantage* Catherine Mater, *OSU's Sustainability Programs*; Bob Rogers, *Oregon Institute of Technology* Adam Zimmerman, *Enterprise Cascadia*; Michelle Girts, *EnTranRight LLC*	Ballroom
4:30-6:00pm	RECEPTION & NETWORKING SESSION Ongoing Research Poster Session Beverages generously provided by Full Sail Brewing Company and Mahonia Vineyards.	Ballroom

RESEARCH & PRODUCT DEVELOPMENT DISPLAYS/ POSTER PRESENTATIONS

RENEWABLE ENERGY & ENERGY EFFICIENCY

Wave Energy Research

Meleah Ashford, Program Manager, meleah.ashford@oregonstate.edu, (541)737-6138

The Northwest National Marine Renewable Energy Center (NNMREC), led by OSU, would like to present a poster to provide an overview of the research efforts that support the wave energy industry including recent work conducted at OSU's wave energy testing facilities. NNMREC is a USDOE-sponsored virtual center established to develop a full range of capabilities to support marine energy development for the US. Our research is focused in the areas of technology, environment and the human dimension of wave energy to increase the knowledge base for marine energy.

Research to be displayed includes wave energy converter reference modeling, and results of wave forecasting efforts combined with power generation models to produce a realistic power time series for an array of wave energy buoys off the coast of Oregon. In addition, we will highlight recent work with wave energy developers to test their devices from small-scale to large scale prototypes, including recent tests in our Hinsdale Wave Research Lab of 1:33 up to 1:15th scale devices for individual devices and device arrays. Lastly we will provide an update of efforts towards an open ocean testing berth off Newport, Oregon including environmental baseline data collection.

Biomass to Drop-in Transportation Fuels for Oregon

Nick Wannenmacher, Jeff Garver and Dan Euhus
Oregon State University, dan.euhus@oregonstate.edu, 541-737-4831

Oregon has a substantial biomass natural resource base between its forests and its agricultural land. What Oregon does not have is a petroleum industry to provide transportation fuel for everything from personal vehicles to farm equipment. This means we are dependent on our neighbors to the north and south to provide this critical energy supply to our state. At Oregon State University, we are working with internally developed research in the area of next generation bio-diesel using non-traditional oil feedstocks and new ester groups and new reaction methods to address historical complaints from industry regarding bio-diesel as a drop-in petroleum diesel replacement. Oregon State is also working with industrial partners such as Payette River Green Energy (a start-up technology company with staff in Oregon and Idaho) to develop and, if practical, commercialize their ideas for an ultra-low (1 %) oxygen pyrolysis process. This poster will present results from on-going work for these two projects. Experimental results for cloud point and cetane number for several different fatty acid esters (methyl, ethyl, iso-propyl and t-butyl) will be presented as well as pseudo-reaction rates and current status of the technology commercialization for both processes.

Synthesis of Cu_2ZnSnS_4 Nanoparticle Inks for Thin Film Solar Cell

Brendan Flynn, Richard Oleksak, Gregory S. Herman, Wei Wang, Changqing Pan, and Chih-Hung Chang
Oregon State University, and Oregon Process Innovation Center For Sustainable Solar Cell Manufacturing , flynnb@onid.orst.edu, 907-831-0104

The solution-based syntheses of nanoparticle inks offer a low cost route for the production and integration of these materials into thin film solar cells. Solution-based methods avoid the requirement of costly and inefficient vacuum processes and afford the possibility of roll-to-roll processing, an attractive option for high-volume commercialization. Our efforts focus on the microwave and microreactor-enhanced synthesis of binary, ternary and quaternary colloidal nanoparticle semiconductors with the focus on earth abundant materials from the Cu_2ZnSnS_4 system. Microwave heating offers rapid, uniform volumetric heating that reduces reaction times and offers precise control of the nucleation and growth environment for nanoparticles. Microreactors offer the advantage of continuous flow synthesis and large surface area to volume ratios, which allow increased material utilization and tight control of processing conditions. We have found significant control in size, morphology, and stoichiometry by modifying the precursors, solvent, temperature, pH, and reaction time. Stable dispersions are formed which will prevent the incorporation of impurities into the resulting films. Annealing studies have been performed to analyze optimal preparation of thin films. The nanoparticles and films have been characterized using a variety of techniques, including x-ray diffraction, Raman spectroscopy, energy dispersive x-ray spectroscopy, transmission electron microscopy, secondary ion mass spectroscopy, and UV-vis spectroscopy.

Characterization of Thin Film Solar Cell Processes Using Flash Quantum Efficiency

Katherine Han, Wei Wang, Chih-Hung Chang, Jaana Saranya Rajachidambaram, Gregory S. Herman, James Hudson, and Greg Horner
Oregon State University, Oregon Process Innovation Center For Sustainable Solar Cell Manufacturing, Tau Science Corporation , kathyhan4@gmail.com , 503-312-1024

Flash Quantum Efficiency is a technique used to simultaneously measure full spectrum external quantum efficiency (EQE), reflectance (R), and transmittance (T). This technique uses a novel architecture to simultaneously modulate a bank of solid state light sources (typically 40-60) and measure, in real time, the solar cell's response to each wavelength. The unique speed, stability, and mapping capabilities of this technique make it an excellent candidate for application in the qualification and monitoring of deposition processes in the photovoltaic (PV) solar manufacturing environment. Here we present an overview of the technique, describe potential role to support the development of in-line monitoring in thin-film manufacturing processes, and describe its role in the development and scale-up of new processes. To the latter, we present a case study qualifying the industrial scalability of processes developed at the Oregon Process Innovation Center.

Nanostructured Antireflection Coatings for PV Applications

Seung-Yeol Han, Richard R. Oleksak, Babak Lajevardi, Micah S. Houck, Scott Weaver, Jong-Jan Lee, Brian K. Paul, Gregory S. Herman, Chih-hung Chang
Oregon State University, hanse@engr.orst.edu, 541-737-9302

The natural structure of moth-eye inspired the idea for low reflectance and enhance the solar efficiency with high transmittance. We have developed a novel nanostructred AR coatings based on nanoparticles (NPs) and organic-inorganic hybrid polymer. The novel nanoarchitecture consist a sandwich of organic-inorganic polymers and NPs to retain the moth-eye like nanostructures with strong mechanical strength. The nanostructured AR coatings mimicked moth-eye like structure using our low-cost solution-based process. The glass substrate with nanoARCs was prepared and tested as solar cell cover glass. Vivid view is obtained from nanoAR coated glass. The effect of nanoARCs on light transmitancy was tested as solar cover glass. High transmittance over 98 %, which is about 6% higher than the bare glass of 92%, in the wavelength range of 400 ~ 750 nm was

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obtained. Quantum efficiency (QE) was measured and compared using multicrystalline Si PV, PV with bare cover glass, and PV with nanoARCs cover glass. NanoARCs coated cover glass enhance the QE from 86% (bare cover glass) to 90.5 ~ 92.5 % which are 4.5 ~ 6.5% increase. More detail description and improvement of effect of nanoARCs on solar cell efficiency will be presented.

Community Renewable Energy Fits

Diane Henkels and Jack Jacobs, Cleantech Law Partners, LLC, dhenkels@cleantechlawpartners.com, 541-270-6001

In 2007, Oregon set a goal that by 2025 at least 8% of Oregon's retail electrical load would come from small-scale renewable energy projects with a capacity of 20 megawatts or less. Community renewables can fit where a utility-scale project is too big, and a backyard project is too small. The poster will focus on community-scale or community-based renewable energy in Oregon.

--Community-based renewable energy projects in Oregon (e.g. PaTu Wind, Ashland's Community Solar project, Biomass One, Klamath Falls geothermal, Solarize Portland) links and summaries.

--Academia (e.g. Oregon State University, Oregon Institute of Technology, Southern Oregon University, perhaps Mt. Hood Community College) supports these projects either by direct partnering or providing crucial support.

--Micro-siting may enable locating a community energy project in a place where permitting a large-scale project is impossible or impractical.

--Interconnection decisions may include net-metering or power purchase agreements, connecting to an investor-owned utility regulated by the OPUC, or a consumer-owned facility regulated mostly by federal law.

--The "multiplier-effect" increases the economic value of a community project relative to the community.

--Still, community projects must pencil out using rates paid for the power produced, state and federal incentives.

VRF Heat Pump Measure Development Roadmap: initial results from a collaborative process to address R&D gaps for NW energy efficiency

Ibrahim Iskin, Jack Callahan, and Mira Vowles, Bonneville Power Association, ixiskin@bpa.gov, 503-230-5525

The Variable Refrigerant Flow (VRF) Heat Pump Measure Development Roadmap is one of the first outcomes of a new process to address gaps in R&D for Northwestern (NW) regional energy efficiency. The Bonneville Power Administration (BPA) Energy Efficiency Group launched a process in 2009 to systematically develop a portfolio of energy efficiency measures. Three main components of this process were developed collaboratively with academic partners to identify, assess and prioritize R&D gaps, in order to allocate resources more rationally. Supported by the Portland State University Department of Engineering and Technology Management (PSU-ETM) and Washington State University Extension Energy Program, 35 experts from 20 organizations have participated to date.

The Northwest Energy Efficiency Roadmap is a publicly available snapshot of stakeholders' current perspectives regarding a shared research agenda for the next twenty years. As a living document, it will be updated periodically based on the Energy Efficiency Emerging Technologies (E3T) Framework. The E3T Framework is a database that supports ongoing identification, assessment and prioritization of emerging energy efficiency technologies in the NW. The VRF Heat Pump Measure Development Roadmap, an outcome from this process, was developed with technical support from a graduate student at PSU-ETM.

Going Green One Little Baby Step at a Time: Transforming Modern Power Production through Microscale Hydropower

Kendra Sharp, Jennifer A. Holderman , and W. Todd Jarvis, Oregon State University and Lower Nehalem Watershed Council , todd.jarvis@oregonstate.edu, 541-737-4032

Microscale hydropower, facilities that produce between 1 kW and 1 MW of power, has the potential to revolutionize modern power production with little impact on the environment. Microscale hydropower technology is available and robust, but the initial expense can be a significant obstacle to entry in the sector. These limitations can lead to projects that are not financially feasible. Additionally small water resources tend to be ungauged; understanding power production feasibility requires straightforward ways to estimate flow. These water resources are typically very intermittent. Consequently technology and infrastructure must be designed to optimize year round power production.

Few case studies exist on evaluating the feasibility of sites for microscale power. This Oregon case study examines the legal, policy, science and engineering questions that need to be considered in the development of a microscale hydropower facility. This case study reveals that small water resources can be developed as viable and economically feasible sources for residential use. For these resources to contribute clean and green power to the grid, the great potential of microscale hydropower must be recognized. Legal and policy reforms along with new technologic innovations can address these limitations and support wide scale application.

Oregon Greenhouse Gas Inventory Analysis

Grant Kendall, University of Phoenix, glelandk@yahoo.com, 503.508.7898

Oregon set goals to reduce Greenhouse Gas (GhG) Emissions to 10% below 1990 levels by 2020 and 75% below 1990 levels by 2050. To meet the 2020 goal require a reduction on GhG's of nearly 30% from current emissions levels. In 2010, the Governor´s Global Warming Commission adopted a Roadmap of recommendations to meet these goals to reduce Oregon´s greenhouse gas emissions. This study evaluates the statistical likelihood of accomplishing these goals with current policy and the voluntary recommendations in the Roadmap. All indications are that these goals will not be met considering the following policies are implemented:

a) Renewable Portfolio Standard requiring investor owned utility generation be 25% renewable resources by 2025,
b) Public purpose charges providing incentives for energy efficiency in investor owned utility (gas and electric) service territories,
c) Similar energy efficiency and renewable resource incentives and activity in consumer owned utility service territories,
d) Replacement of Boardman Coal Electric Power Facility with renewable resources,
e) Adoption of the Low Carbon Fuel Standard,
f) Oregon's diminished capacity to provide tax incentives for efficiency, and
g) Implementation of the voluntary Roadmap recommendations.

Grant Kendall is a full time MBA student and Associate with Kendall Energy Consulting, LLC.

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Renewable Geopressure

Kevin Kerlin, Helidyne LLC , kkerlin@helidynepower.com, 360-573-0811

Oil wells located in the Gulf Coast contain an untapped and relatively unknown form of renewable energy called geopressure. Fluids from these types of wells rise to the surface naturally under extreme hydraulic pressure (4,000 -12,000psi) as evidenced by large gushers accompanying new oil discovery. Presently, this form of energy is but a nuisance to well operators, being released to the atmosphere through a series of pressure letdown stages. Helidyne's geopressure reduction generator (PRG) is able to convert this hydraulic form of energy into useful, emission free electricity. It's patent pending helical rotor design allows for direct processing of the geofluids in a self-cleaning manner. Scale and other containments that tend to build-up on part surfaces are cleaned away with its novel rotor sweeping action. In addition, fluid pressure is fully contained within the rotor cavity itself, allowing critical shaft seals and bearings to be completely isolated and protected from this harsh operating environment. Helidyne is the only company to offer a design that can likely harness this form of energy. Owners of abandoned wells will now be able to re-tap this once forgotten resource and reap value created by this technology. In addition, on and off-shore oil wells currently in production can satisfy their remote power needs in a cheaper greener way.

Status of Biomass Use at the Boardman Power Plant

Wayne Lei, Scott Russell and Jaisen Mody , Portland General Electric Company, Wayne.Lei@pgn.com, 503-464-8988

In December 2010, the Oregon Environmental Quality Commission revised its rule relating to regional haze pollution control equipment for coal facilities in Oregon. This rule requires Portland General Electric's ("PGE") coal-fired facility located near Boardman, Oregon, to cease burning coal no later than by Dec. 31, 2020. While that date is nearly ten years away, in utility terms, planning for that date, and a time where 380 MW of baseload generation resource will be removed from PGE's resource stack, begins now.

With a requirement to meet 25% of its load with renewable power generation sources by 2025 and a need to back up the predominantly intermittent renewable resources currently available with reliable, baseload power in order to serve normal load, PGE is investigating operating the Boardman facility on a renewable biomass fuel. In 2011, PGE obtained sufficient planting material and arranged for contracted farming operations in the Boardman region to plant 85 acres of Giant Cane (Arundo donax). PGE has also made strides in assessing torrefaction capabilities from market offerings. Torrefaction of the harvested Giant Cane will be needed in order to make the biomass sufficiently friable for fuel movement and presentation in the current power plant fuel handling system.

The DMP - Energy from the Bottom Up

Cameron McNatt, H. Tuba Ozkan-Haller, Michael Morrow, and Michael Delos-Reyes, Oregon State University, cmcnatt@coas.oregonstate.edu, 410-610-1173

M3 Wave Energy Systems LLC., founded in Corvallis, Oregon, has invented a novel technique for harnessing energy from coastal waves. Their device, the DMP (Delos-Reyes, Morrow Pressure device), is mounted near the sea floor and uses the dynamic pressure differences in waves to push a pipe of air back and forth through a turbine. The concept is straight-forward and has been proven to work effectively in preliminary tank testing. With funding from the Department of Energy, M3 engaged H. Tuba Özkan-Haller's research group at Oregon State University (OSU). Research at OSU has resulted in a better understanding of the environmental resource and analytical device models. M3 has also secured funding from Oregon Wave Energy Trust which is purposed to tank testing of a medium-scale DMP in OSU's Hinsdale Wave Research Laboratory. Tank testing will validate or disprove analytical models, will measure performance as a function of various parameters, and will help M3 to estimate full-scale power output. The DMP has great advantages in its simplicity, cost, survivability, and unobtrusiveness. Current research at OSU has provided valuable analytical models of the environmental resource and device performance. Future research in the Hinsdale Wave Lab will be major step in device development.

Environmental Impact of Wind Energy and Supplemental Energy Sources in Northern Oregon

Preedanood Prempreeda , Gorka Rodrigo Asensio, Karl R. Haapala, and Ted K.A. Brekken , Oregon State University , premprep@onid.orst.edu, 503-688-0109

Wind energy is a promising alternative energy source due to its environmental, economic and social benefits and, as such, has garnered public support and government incentives for its development and implementation. According to the National Renewable Energy Laboratory (NREL), Oregon has the potential for over 27,000 megawatts of installed onshore wind power. With the growing number of wind parks in Oregon, a life cycle assessment (LCA) study for a representative new wind park has been performed. The location of the new wind park was selected based on predicted energy generation for several sites in northern Oregon using data from the Bonneville Power Administration (BPA) and information from a wind turbine manufacturer. One of the major drawbacks of wind energy generation is its variability due to the stochastic nature of wind. Thus, natural gas and hydropower are examined as potential supplemental energy sources, also using an LCA approach. These results are compared to those for coal-based energy, which would be replaced by the new system. From the analysis, either option would result in lower impacts than coal energy generation. It appears that hydropower would be the better option to supplement wind power from an environmental perspective.

Simple, Inexpensive, and Effective Regenerative Braking

Stephen Rosenstock, SR Design Consulting, Inc., steve.srdesign@gmail.com, 503-318-1582

PLUS Kinetic Energy Recovery System TM is a patent pending system that allows use on most non-hybrid motor vehicles. Please review patent: http://www.google.com/patents/about?id=V4WEAAAAEBAJ&dq=stephen+Rosenstock. This system is the basis for Class 8 trucks (2-3 trailer units) to generate up to 17Kwatt hours per day trip for the federally required 10 hour layovers as a portable shorepower system. Other uses that have been successfully tested are utility truck free electric energy generation to reduce or eliminate gas generator use, enhancement of PV solar power trailers for events and contractors, RV use, V2G and over 5 years as a Light P.H.E.V. system with lighter automobiles to allow for significant increase in fuel mileage as well as significant reduction in emissions as per C.A.R.B. lab EPA/FTP test in 2008 viewable at bottom of www.srdesignconsulting.com/howitworks.php.

Bio-Crude From Bio-Waste

Michael Vevera , Mercurius Biofuels, michaelv@mercuriusbiofuels.com, 503 314 2102

Mercurius Biofuels has a patent pending exclusive license to a novel Biorefinery process using Renewable Ethanolysis And Catalytic Hydrotreating (REACH) technology for producing diesel, jet fuel, and green chemicals from cellulosic materials. The process uses several components that are found in both the pulp and paper industry and the petrole-

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um refining industry. The journey begins with the delivery of cellulosic material (MSW, agricultural or forestry production residues, waste paper) to the Biorefinery. The first step is to treat the material in an acid catalyst Ethanolysis unit (similar to pulp and paper mills) to create what could be called a bio-crude and a solid char product. It is at this stage of the process that several bio-chemicals can be extracted for sale at a very low cost of production. This bio-crude is then processed through a Condensation unit into usable carbon chains resembling the liquid fuel products desired. The final step is a Hydrotreating process to remove oxygen and add stability to the molecules produced from the previous step. Both the Condensation and Hydrotreating steps of the Mercurius process using REACH technology are similar to those used in the petroleum refining industry and do not represent scale-up commercialization risk. The final products are drop-in blend ready for use in the general liquid fuels market.

Solution-deposited highly efficient Chalcopyrite $Cu(InxGa_{1-x})Se_2$ Thin Film Solar Cells

Wei Wang, Seung-Yeol Han, Dae-Hwan Kim, Shi-Joon Sung, Chih-hung Chang, Oregon State University, wangw@onid.orst.edu

The conversion efficiency of CIGS solar cells has reached up to a 20.3% record value. It is desirable to reduce the CIGS cell cost by lowering down the manufacturing cost to enable its broader applications in the market place. Solution-based deposition offers an opportunity to fabricate CIGS thin film solar cells at a more competitive cost compared to the conventional vacuum-based process. In order to achieve decent conversion efficiency, the ideal chalcopyrite CIGS absorber layer should be free of secondary phases, contaminations and defects. In addition, safety and simplicity of processing technologies need to be concerned as well. Herein, a novel solution-based process using low cost precursors that is capable to fulfill these requirements is reported. Copper acetate, Indium acetate and Gallium acetylacetonate dissolved in alcohols were used as metal precursors which were transformed to CIGS phase by a post-selenization process. This simple precursor ink reduces not only the fabrication cost but also the use of toxic and flammable solvents. Besides, the obtained high-quality CIGS films show high-quality crystallinity without contaminations such as amorphous carbon and Cu2-xSe confirmed by various analytical characteristics. The final devices with a standard ZnO/CdS/CIGS/Mo structure show up to 8% efficiency which can be improved by further optimization.
This work was supported by MEST & DGIST (10-BD-0101, Convergence Technology with New Renewable Energy and Intelligent Robot), OSU Venture fund and US Department of Energy, Industrial Technologies Program, through award #NT08847, under contract DE-AC-05-RL01830.

Studies On Zinc Bromine Battery Graphite Electrodes: An Assessment Of Practical Large Scale Energy Storage Applications

A.A. Bistrika, E. Naswali, H.-Y. Han, C. Alexander, D. Halamay, D. Naviaux, T. Brekken, A. von Jouanne, and A. Yokochi, OSU, alex.yokochi@orst.edu, 541-737-9357

As the world's power needs grow, the demand for power from renewable resources, such as wind or solar is increasing. An issue with renewable resources is that the power output is dependent on environmental factors, such as wind speeds and cloud cover. This often causes the actual power produces exceeding or falling short of forecast levels, which will strain the stability of the grid and require increased spinning reserve and cycling of thermal and hydro power plants. Therefore, the development of practical Large Scale Energy Storage systems is critical to enable higher penetration of renewable into the grid. This BEST supported project focuses on the longevity and performance of zinc bromide flow cell batteries, selected due to previously reported long cycle-life and high efficiencies. This poster will report on recent results on measured electrode damage due to bromine redox reactions at the graphite electrodes employed in the system and energy storage sys
tem integration to the grid.

Low Environmental Impact Methods to Prevent Biofouling of Marine Surfaces

Matthew Delaney, Malachi Bunn , and Alex Yokochi, Oregon State University, alex.yokochi@orst.edu, 541-737-9357

Colonization of marine organisms on submerged surfaces is problematic for marine equipment, including wave energy converters. The conventional method to prevent biofouling is to coat exposed surfaces with biocide-entrained paints. Release of biocides concentrated in wave farms, ports, and other high traffic areas may have adverse environmental impacts. One option for mitigating these negative effects is to limit the release of biocide to the minimum effective rate. Experiments will determine the biocide release rate from paints and the critical concentration requirement to control growth. This data will be used to design a paint which will control fouling without excess release. One promising alternative technology is electrochemical surface passivation. This method has the benefit that no biocides are released, mitigating environmental impact and possibly extending service life. Experiments have been conducted to compare antifouling performance of copper biocide paints and painted graphite electrodes. Both anodic and cathodic electrode conditions protected the surface from biofouling equivalently to copper based paint for 3 weeks. Antifouling properties of the electrode depend on surface voltage. A model was developed to predict this surface voltage and lab-scale testing has been conducted in order to validate the model. Results show agreement between the model and experimental data.

Essential Oil Recovery from an Entrained Air-Steam Mixture via Microwave Extraction

Jonathan Leback and David Hackleman, Oregon State University, lebsackj@onid.orst.edu

With the potential to extract more oil and be slightly more cost effective than steam distillation, microwave technology has promise to overtake conventional methods of extracting peppermint oil from chopped mint. The microwave pilot plant uses a continuous process in which mint is loaded in through a belt that is open the atmosphere on the ends. It has been well documented that the difficulty of condensing steam in the presence of air is greatly increased. For this reason the current shell and tube heat exchangers are not effective enough. Instead a direct contact spray scrubber can be used as an effective method to condense the mixture.

Oregon Lab Researches Nanoscience as Key to Breakthroughs in Solar, Biofuels Technology

Nathan Corser & Bill Byers , CH2MHill, Nathan.Corser@ch2m.com

This poster will describe a groundbreaking Oregon project in which CH2M HILL's IDC Architects transformed a Hewlett-Packard warehouse in Corvallis into an advanced solar power nanotechnology research institute shared by the Microproducts Breakthrough Institute and the Oregon Nanoscience and Microtechnologies Institute (ONAMI). ONAMI is a collaboration of Oregon State University and nanoscience and microtechnology R&D institutions and industry to cultivate research and commercialization of nanotechnologies. Limited funds for the upgrade required a resourceful sustainable design approach featuring warm colors, wood and collaborative spaces. The facility has been a success – its lab spaces have leased out much faster than expected. The poster will review some of the facility's sustainable features, as well as a sampling of ONAMI's research

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projects to advance renewable energy technologies, which include thin film depositions to increase the efficiency of solar media, incorporation of quantum dots in photovoltaic cells to enhance photovoltaic device efficiency, transparent electronics that can be printed on glass and plastics, tiny microreactors for super-fast, portable biodiesel production, lightweight cooling units for use by soldiers and haz-mat workers in high-heat conditions, automobile air conditioning systems that utilize waste engine heat, and blood filters for low-energy portable kidney dialysis machines.

SUSTAINABLE BUILT ENVIRONMENT

Biology and the Built Environment: A Hospital Study

Steven W. Kembel, Evan Jones, Jeff Kline, Dale Northcutt, Jason Stenson, Ann M. Womack, Brendan J.M. Bohannan, and Jessica Green
University of Oregon, Eugene, OR 97403 (Contact G.Z. Brown, gzbrown@uoregon.edu, 541.346.5647

Buildings are complex ecosystems that house trillions of diverse microorganisms interacting with each other, with humans, and with their environment. The Biology and the Built Environment (BioBE) Center, of the University of Oregon, which includes Oregon BEST faculty members, is the architecture-biology interface advancing our understanding of the built environment "microbiome".

In a study conducted at Providence Milwaukee Hospital in Portland Oregon, we compared the bacterial composition of outdoor air to that of naturally and mechanically ventilated rooms. We found that airborne bacterial communities significantly differ between indoor and outdoor environments, and that indoor environments contain many taxa that are absent or rare outdoors, including human-associated bacteria. We observed that the abundance of potentially-pathogenic bacteria was higher indoors than outdoors, and higher in indoor environments with lower airflow rates and lower relative humidity.

Building attributes, including the source of ventilation air, airflow rates, relative humidity, and temperature, impact the diversity of indoor bacterial communities. These attributes are strongly influenced by architectural design, suggesting that it may be possible to manage indoor microbial communities to promote human health and well-being through sustainable building strategies such as natural ventilation, zoning, and daylighting.

Seismic Performance Assessment of Structurally Insulated Panels

Peter Dusicka and Michael Noddings
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Structurally insulated panels (SIP) panels are made from expanded polystyrene sandwiched between oriented strand boards. This composite material is used to prefabricate structural walls for houses that when completed have a higher insulation than conventional wood frame construction. While prescriptive design allows for construction of family housing using this material, uncertainty in structural behavior under combined gravity load and earthquake motion has lead to the need for experimental evaluation. Real time earthquake simulations are being conducted to assess the structural behavior of full-scale SIP walls. Preliminary results will be presented.

Green Classroom Toolbox ™ : A Cool Schools Primer

Ihab Elzeyadi
School of Architecture and Allied Arts, University of Oregon, Eugene, OR 97403, ihab@uoregon.edu, 541-346-3670

This poster will report on an on-going project that targets the problem of excessive energy consumption in existing schools by developing evidence-based design guidelines for retrofitting educational spaces.

The guidelines are developed to:
- Increase the productivity, comfort, and health of students in classrooms
- Facilitate integrated design and cooperation between building professionals
- Reduce environmental impacts and move us towards carbon neutral schools
- Have a potential to be a model for future replication and dissemination.

The developed guidelines produce a searchable data base that will provide tools for architects, engineers, retrofit professional, and school districts officials. It will generate the 30 best classroom retrofit practices based on typological and climatic inputs, sorted by energy impacts, academic performance, and health impacts evidence.

Boosting Residential Retrofit Rates using an Energy Labeling Infrastructure

David Heslam* and Tom Breunig , Earth Advantage Institute, dheslam@earthadvantage.org , 503-968-7160

The recent availability of stimulus (ARRA) dollars has allowed many U.S. cities to deploy residential energy audit retrofit programs, but the rate of "conversion" -- from audited home to implementation of energy upgrades – has historically been low due to insufficient education of the homeowner, inadequate messaging, and cost barriers.

This poster will discuss significant ongoing results of large energy labeling pilots involving a total of 6,000 homes in Seattle, and Bellingham, Washington, that are designed to increase residential retrofit rates. The programs were designed to offer an expandable infrastructure enabling municipalities to engage homeowners using a centralized or web-based information delivery system, with energy labeling as the focal point. In this way homeowners take advantage of "one-stop shopping" and easy-to-understand "miles-per-gallon" reference points, specific data on their own home audit, comparisons of contractors' upgrade bids, and proposed financing information.

The Bellingham program is currently showing a post-audit retrofit rate of 60%. Seattle program data is forthcoming as retrofitting ramps up this year.

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SUSTAINABLE BUILT ENVIRONMENT

Collaboration Advances Sustainable Building Materials Development
Tony Mustachio, CH2MHill, Tony.Mustachio@ch2m.com, 503-872-4426

This poster will describe a successful collaborative effort to advance the development of sustainable building projects through the methodical refinement and testing of new sustainable building material concepts in real world conditions. CH2M HILL's IDC Architects was asked to help Bayer optimize the efficiency of its 50-year-old, 12-building campus in Pittsburgh, Pennsylvania. In the course of that work, Bayer asked IDC Architects for innovative ideas related to sustainable building materials. IDC Architects helped Bayer refine an insulated rainscreen cladding product that additionally insulates by creating a pressure-neutral cavity inside the wall; and a new urethane-based window mullion system which has lower thermal transmission than aluminum and uses less embodied energy to produce. As a result IDC Architects was asked to join the EcoCommercial Building (ECB) Network of Bayer MaterialScience LLC, which advocates a holistic, collaborative approach to sustainable building design and construction. The program's members function independently to advance sustainable building strategies which may or may not involve Bayer MaterialScience products. Network member organizations provide products and/or services aligned with seven building solution areas (Insulation; Daylighting; Illumination; Indoor Environmental Quality; Sustainable Energy; Intelligent Building; and Heating, Ventilation and Air Conditioning) that help to increase sustainability and reduce energy costs.

A Model for Rejuvenating Aging Buildings Through "Sustainable Upgrade"
Kevin Duell & Kelly Gillard, CH2MHill, Kevin.Duell@ch2m.com, 503-872-4426

This poster will provide an overview of PSU's Science Building 2, the flagship project for PSU's new Science Research and Teaching Center designed by CH2M HILL's IDC Architects. It's also a model for sustainably upgrading existing buildings instead of incurring the higher financial and environmental costs of razing and rebuilding outdated structures. At roughly 250,000 square feet, SB2 will house the biology, chemistry, environmental science, and physics departments' research and teaching labs, offices, and student commons. The upgrade includes dramatically improved environmental performance, including upgraded air exhaust systems that consume half the energy of those in the original 40-year-old building. Other sustainability features include occupancy sensors to turn down lights and air systems in unoccupied spaces, reuse of laboratory casework versus sending it to a landfill, specification of recycled content and local sourcing for new construction materials, and a reflective white roof. Science Building 2 anticipates LEED® Gold Certification and compliance with strict state-mandated energy conservation requirements. Under state funding requirements, the building is also subject to the State Energy-Efficient Design (SEED) program, requiring the building to achieve a "minimum energy efficiency of 20% above the state energy code." The SEED program is among the most progressive in the U.S.

Real World Case Study for a Self-Sufficient Renewable Energy Commercial Park
Nathan Corser & Jeff Cross, CH2MHill, Nathan.Corser@ch2m.com, 503-872-4426

This poster will describe a new vision for a renewable energy-based business park combining a range of renewable power resources including geothermal, solar, wind, and energy storage on a single site. This project, dubbed Star Peak Energy Center, is receiving considerable attention as the first commercial development of its kind relying completely on site-generated renewable energy. Oregon technologists from CH2M HILL's IDC Architects performed master planning, energy analysis and economic analysis to develop this concept for a 10,000-acre site 110 miles north of Reno. The first development planned for the site is a latest-generation data center powered by geothermal power produced on the site. This approach will deliver on-site power at a lower cost than could be purchased from the local utility. Other targeted Star Peak participants are manufacturers of photovoltaic solar panels, algal biofuel production, general agriculture, and universities and/or national research laboratories with ongoing renewable energy programs. The concept uses waste heat from one process to support other processes on the site, making it a true example of sustainable energy development with a net export of renewable energy. The poster will focus on the exciting potential of this pioneering, prototypical project to be widely replicated in the future.

Development of Microbial Fuel Cell System for Onsite Wastewater Treatment in Sustainable Buildings
Sun-Kee Han, Yanzhen Fan, and Hong Liu, liuh@engr.orst.edu, 541-737-6309
Sustainability has become a core issue of wastewater treatment. Decentralized wastewater treatment systems are less resource intensive and more ecologically sustainable. Incorporation of an efficient on-site wastewater treatment/reuse system into a green building remains one of the great challenges for sustainable building design and operation. Here we present an innovative microbial fuel cell wastewater treatment system for on-site grey/black wastewater treatment and energy generation. The newly devised air-cathode microbial fuel cells (MFCs) with double cloth electrode assemblies produced a power density over 1.5KW/m3, which is the highest reported power density so far for MFCs. Comparisons were made with the state-of-the-art on-site wastewater treatment technologies such as constructed wetlands, recirculating biofilters and membrane bioreactors in terms of their energy efficiency, treatment efficiency, and conduction and operational costs. Our analysis demonstrates that MFC system has the potential to increase the sustainability of onsite wastewater treatment.

Determination of Optimal Operational Parameters for VTC Processing of Western Hemlock
Hongling Liu, Frederick A. Kamke; and Josef Weissensteiner , Green Building Materials Laboratory, Oregon State University , ai.tianxin@yahoo.com.cn, 541-602-9083

The viscoelastic thermal compression (VTC) process is a method for the production of wood products with enhanced mechanical properties due to increased density. The VTC process involves mechanical compression perpendicular to the grain under conditions of elevated and dynamic temperature and moisture content. VTC dramatically improves strength, stiffness and hardness and provides a means to utilize timber species that would not otherwise be suitable for building construction.

The objective of this project is to determine the range of conditions suitable for producing a laminated composite from VTC wood veneer and to characterize the material properties of the lamina and manufactured composite. VTC processing causes partial thermal degradation of wood and release of volatile organic compounds. Consequently, this research will assess chemical transformations using Fourier transform infrared spectrometry (FTIR) and as chromatography–mass spectrometry (GC-MS) analysis. These results will be compared with conventional wood processing technology. The material to be used is rotary-peeled western hemlock veneer, which currently has limited use in structural building products.

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SUSTAINABLE BUILT ENVIRONMENT

Expected Results:
For the range of experimental parameters tested, it is expected that an operational window of conditions will be found that reveals no significant difference of the measured properties. Analyzing chemical changes occurring in wood will offer some evidence about compression mechanism and help to optimize operational parameters.

Development of Dynamic Thermal Performance Metrics for Green Roof Systems

Seth Moody, Todd Rosenstiel, Carl Wamser, and David J. Sailor, Portland State University, seths.moody@gmail.com, 503-367-5792

Thermal mass enhanced R value (MER) associated with the addition of a green roof can reduce a building's heating and cooling loads. In order to obtain credit for green roofs in building energy load calculations the materials and parameters for green roof performance, design optimization and thermal mass evaluation must be fully understood. We have developed and are refining a green roof module for the "Energy Plus" building energy simulation software. The module has been validated using limited data from several field studies and in the lab but requires additional field data validation and further refinement. The Green Roof Integrated Photovoltaic (GRIPV) project, located on the Portland State University campus has been gathering plant canopy, soil temperature, soil moisture, composite drainage, evapotranspiration, PV output and complete localized weather data since January of 2011. The goals of this study are to further validate/tune the Energyplus green roof module, and to develop standardized metrics for assessing the time- varying thermal benefits of green roof systems that can be applied across building types and climate zones. This poster will summarize our research in this area with an emphasis on the development of standardized thermal performance metrics.

Integrating Phase Change Materials in Passive House Construction for Improved Thermal Comfort

K. Campbell, S. Rodriguez, S. Gross, C. Parocco , and D. Sailor, Portland State University, sailor@cecs.pdx.edu, 503-725-4265
This poster presents an overview of an ongoing project that seeks to understand the potential for improving thermal comfort in homes built to the passive house standard by incorporating phase change materials (PCM). A key characteristic of PCM for building applications is the ability to store heat in the form of latent heat associated with the melting of the PCM (usually a wax-like material) at room temperature. The PCM, which is generally encased either in micro or macro encapsulation packets, charges (solidifies) during the cooler evening hours, and discharges (melts) during the warm daytime hours. This process reduces the number of hours outside of thermal comfort for buildings without mechanical air conditioning and reduces energy use for buildings with air conditioning. The specific project discussed here revolves around an actual passive house duplex being constructed in NE Portland. We have used whole building simulation to optimize the phase change transition temperature, quantity of material, and placement location within the building. PCM is installed in one side of the duplex with the other side used as a control. The duplex will be extensively monitored to quantify thermal comfort, sub-metered energy use, and other parameters. Modeling and measurement results will be presented.

Green Building Material: Cross Laminated Timber (CLT)

Benjamin Sundberg, Mélanie Noyel, Thomas Pisaneschi, Vaclav Sebera and Lech Muszynski, Oregon State University, Lech.Muszynski@oregonstate.edu, 541 737-9479

Cross laminated timber (CLT) is a relatively new structural product utilizing low-grade timber (including species traditionally not considered for structural applications) arranged in cross laminated panels used as prefabricated wall and floor elements in residential and commercial structures. It has been developed in Europe and is already gaining momentum in Europe and Asia. The high integrity of this product allows for raising multistory wood structures passing the stringent code requirements for seismic zones in Italy and Japan. CLT creates a potential avenue for utilization of plantation grown hybrid poplar in high-performance structural products. However, the acceptance of CLT in North America requires development of domestic performance standards for this product. These are still a work in progress. One important issue in the development of such standards is correlating tests performed on small and medium scale specimens to full-scale products. In this presentation a comparison of torsional and bending characteristics determined on small, and medium -sized CLT panel samples using conventional and optical measuring techniques with FEM simulation of the test will be discussed.

A Control Architecture for Urban Microgrids

John Teeter and Wilfred Pinfold, People Power Company , john.teeter@peoplepowerco.com, 208 875 2269

A control architecture for the management of an electric infrastructure is described. A loosely coupled, message based control paradigm is to be applied. Cooperating computational agents enable contextually sensitive control algorithms to be applied dynamically within a distributed control context. Market information modeling is also to be supported and integrated in to the control system. Loosely coupled, message based computational systems have been successful in many application spaces. They are suitable for applications where information completeness is not available and where actions must be taken to control the "visible state" of the system as seen from the agents' perspective. This is especially true in the area of micro-robotics and fast-trading market applications. We believe that agent based control architectures in the energy domain will likewise prove very effective. The project will undertake to model the operation of an urban core microgrid. This effort will follow planned developments within Portland Oregon. Production resources (Hydro, Wind, and Solar), High Voltage Direct Current (HVDC), and High Performance High Density (HPHD) Data Centers that are being designed within the Portland core will be modeled as part of this project.

LED lights: field demonstrations at the University of Oregon Jordan Schnitzer Museum of Art and 14 other public sites

Mira Vowles and Craig Ciranny, Bonneville Power Association, mkvowles@bpa.gov, 503-230-4796

Light emitting diode (LED) lights are a new and rapidly evolving technology for the built environment with some inherent advantages over fluorescent and incandescent lights. Specifically, LEDs can deliver directed, bright light, while using less energy and emitting virtually no heat, infrared or ultraviolet rays. LEDs promise up to 100,000 hours of light, 10 times the life of compact fluorescent lamps and 66 times the life of incandescent light bulbs. To confirm product performance, heat tolerance, product life, installation barriers, product satisfaction and to demonstrate the technology, BPA conducted field demonstrations of LED track and down lights in fifteen public areas across the Pacific Northwest. One of these applications was in the Gordon Gilkey Gallery at University of Oregon, Jordan Schnitzer Museum of Art, in Eugene, Oregon. Museums are especially good applications for LED lights because the artwork is protected from excess heat, infrared rays and ultraviolet rays. This application was selected by the Pacific Northwest National Laboratory to be part of the U.S. DOE Solid-State Lighting Technology Demonstration GATEWAY Program. Collaborators in this project include Bonneville Power Administration, University of Oregon, Pacific Northwest National Laboratory and Eugene Water and Electric Board.

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OREGON BEST COMMERCIALIZATION GRANT AWARDEES

Development of a Fermentation Compatible Xylose Isomerase Enzyme

Curtis Lajoie , and Christine Kelly, Oregon State University, Chris Beatty, Trillium FiberFuels, Inc. lajoie@engr.orst.edu, 541-231-0306

Trillium FiberFuels, Inc. and researchers at Oregon State University have teamed to develop a novel enzyme biocatalyst (yeast xylose isomerase; XI) that will enable conventional yeast strains to convert multiple sugar types (xylose and glucose) from lignocellulosic materials to ethanol, as well as achieving the long term goal of a single stage fermentation to increase the efficiency of the biological production of fuels from agricultural and forestry residuals. Conventional glucose fermenting yeast, such as Saccharomyces cerevisiae (baker's yeast), cannot ferment xylose, but these strains can ferment xylulose to ethanol. The XI converts xylose to xyulose.
The new xylose isomerase, unlike commercially available XI enzymes, has low pH and temperature optima that make it ideally suited for use in conjunction with yeast fermentations. High cell density yeast fermentations and genetic engineering techniques are being employed to increase production of this XI. The economics of extracellullar xylose isomerization will be evaluated in a single stage saccharification, isomerization and fermentation process for ethanol production from wheat straw.
Success of this project will increase the fuel yield from biomass by 30% in a single conversion process, thereby expanding the range of lignocellulosic feedstocks for which Trillium's biofuel production process is cost competitive.

Development, Testing, and Pilot Scale Evaluation of a new Retrofit Window Insulation Product – The Indow Window

David Sailor, Portland State University, and Sam Pardue, Indow Windows, sailor@cecs.pdx.edu, 503-725-4265

This poster will describe a recently funded Oregon BEST Commercialization Grant project which seeks to quantify the value of the Indow Window retrofit window insulation product to consumers, utilities, and governments. The project involves both a laboratory testing component and a pilot program. The laboratory measurements are investigating thermal and acoustical benefits of multiple variations of the product using facilities in PSU's Green Building Research Laboratory. The pilot program being designed will deploy the Indow product in 3 to 5 residences. Each installation will be accompanied by a year-long measurement campaign which will include assessment of infiltration (blower door tests) before/after product installation, and measurements of indoor thermal performance, energy use, and outdoor weather conditions. These data will be used to tune and validate whole-house building energy simulation models. After suitable validation, these models will be applied in various simulated climates to estimate product performance across a range of climates.

Commercialization of VTC Technology

Ed Landis, Corvallis Tool Company, and Fred Kamke, Oregon State University, Fred.Kamke@oregonstate.edu

Patented technology that is assigned to OSU has potential to tap significant markets for high value wood products. There is demand for wood veneer that has better mechanical properties than available products. The goal of this project is to demonstrate the commercial proof-of-concept of VTC technology which leads to out-licensing of the intellectual property. Viscoelastic thermal compression is a technique of wood densification by means of mechanical compression perpendicular to grain in the presence elevated temperature and steam pressure. The unique dynamic conditions employed are well adapted to thin materials and laminated composite manufacture. The objectives of this project are: 1) develop engineering design plans for three commercial-scale VTC installations, 2) estimate the capital cost of equipment and processing cost of VTC technology, 3) develop a set of operating parameters for a commercial-scale VTC device, and 4) manufacture a set of prototype composite products using VTC wood. The project was performed in partnership with the Corvallis Tool Company of Philomath, Oregon. Funding for the project was provided by OSU Venture Fund and Oregon BEST.
The three equipment designs have been completed. The capital cost of equipment and operating capacity for each system has been estimated. Operating cost is yet to be determined. A variety of prototype VTC materials were manufactured using an existing laboratory-scale VTC system. A set of operating parameters has been developed. The process is technically feasible on a commercial scale. Economic feasibility depends on market conditions. OSU and Corvallis Tool Company are prepared to discuss commercial applications with potential manufacturers of VTC wood.

Oregon Institute of Technology - Green Lite Motors Commercialization Grant

James Long & Hugh Currin, Oregon Institute of Technology, and Tim Miller, Green Lite Motors, james.long@oit.edu

Green Lite Motors -Driven by Need: Commuters in large cities are stuck, spending more time in traffic and more money on gas. They're increasingly concerned about the environmental impact of their driving, and often have trouble parking downtown. Green Lite Motors' innovative vehicle will deliver freedom for commuters. GLM customers will be free to go in style and comfort, wrapped in the safety cell of a race car. They will also get 100 miles per gallon as they use the express lane to breeze past traffic, cruising at freeway speeds with a range of 250 miles, and parking with ease, even in motorcycle spots.

Project Overview: The commercialization project completes the last critical element in creating a fully functional prototype, positioning Green Lite Motors to obtain investment capital for commercialization. This crucial project enables the electric motor and gas engines to work in combination off a single throttle.

Goals:
- Minimum mechanical system modification
- Cost control by use of off-the-shelf components where possible
- Limit of digital system complexity
- Minimize software system complexity

RESEARCH & PRODUCT DEVELOPMENT DISPLAYS/ POSTER PRESENTATIONS

OREGON BEST SIGNATURE RESEARCH FACILITIES

The **GREEN BUILDING MATERIALS LABORATORY (GBML)** at Oregon State University includes research activities that span chemical, biological and environmental engineering; civil and construction engineering; and wood science and engineering. Equipment and expertise at this Oregon BEST signature research facility helps researchers from industry and academia characterize, develop, and test high performance sustainable materials for a wide variety of applications, including buildings and transportation infrastructure.
On the web: http://gbml.oregonstate.edu

The **GREEN BUILDING RESEARCH LABORATORY (GBRL)** at Portland State University houses extensive facilities for both fundamental research and applied measurements in support of Oregon's flourishing sustainable built environment sector. Industry partners can tap a range of equipment and expertise that includes infrared instruments, indoor environmental quality measurement and datalogging, computational resources for building energy and urban climate modeling, energy performance measurements and logging for equipment and buildings, and fundamental thermal property characterization of building materials.
On the web: http://greenbuilding.pdx.edu/Facilities.php

The **OREGON PROCESS INNOVATION CENTER (OPIC) FOR SUSTAINABLE SOLAR CELL MANUFACTURING** helps solar energy companies improve existing process technologies and enable next-generation solar cell concepts. Researchers affiliated with the lab collaborate with private industry to develop new capabilities and processes that dramatically reduce the costs and environmental impacts of solar cell manufacturing. The Corvallis-based lab is a resource to solve large-scale industry manufacturing problems and an educational training ground for future solar energy engineers and scientists. On the web: http://opic.oregonstate.edu

Funded by Oregon BEST and other local and federal agencies, the **SuNRISE PHOTOVOLTAIC LABORATORY** and the Solar Radiation Monitoring Laboratory on UO campus are part of the Support Network for Research Innovation in Solar Energy (SuNRISE) collaboration that is being established across the Oregon University System. These combined facilities offer a comprehensive set of indoor and outdoor testing capabilities that are essential for solar energy product research and development. Currently available services cover the needs for electrical/optical characterization of materials, overall efficiency and spectral response measurement for solar cells, and accurate assessment of solar resources. Since the establishment of the UO SuNRISE labs, more than a dozen local companies and OUS research groups have already benefited from the tools and services offered by these open-access facilities. This poster will showcase the capabilities of these labs and highlight several examples of how the SuNRISE labs help bring solar energy technologies and products closer to the market.
On the web: http://camcor.uoregon.edu/sunrise

The only facility of its kind in the U.S., the Façade Integrated Technologies Testing Facility, part of the **HIGH PERFORMANCE ENVIRONMENT (HiPE) LABORATORY**, occupies a three-story building on the University of Oregon campus. Eighteen modules on the north and south façades can test a wide range of façade technologies and track how building occupants interact with them. Technologies include: solar control and daylighting (light-guiding glazing, holographic optical elements, optoelectronic glazing, etc.), natural ventilation (breathable walls, active insulation, and operable envelope vents), and energy micro generation (façade-integrated photovoltaics, solar capillary tubes, solar awning tunnels, etc.). On the web: http://hipe.uoregon.edu/

With locations in both Portland and Eugene, the **ENERGY STUDIES IN BUILDINGS LABORATORY (ESBL)** is focused on understanding how buildings and related transportation determine energy and resource use. The lab's goals are to develop strategies for maximum energy efficiency in new materials, components, assemblies, and whole buildings. Architects, designers, builders, developers, and governmental agencies use the ESBL to improve buildings and communities. On the web: http://aaa.uoregon.edu/esbl

The **iSTAR (infraStructure Testing and Applied Research) Laboratory** features equipment, including a large platform that reproduces the seismic shaking of real earthquakes that enables the evaluation and testing of structural performance, architectural function, and operational performance of green building technologies at full or large scales. The laboratory's capability is of enormous value to public agencies and engineering firms designing structures for the earthquake-prone regions. Faculty and students conduct projects that focus on the effects of extreme loads on our infrastructure and on utilization of innovative materials. On the web: http://www.star.cee.pdx.edu

best
Oregon Built Environment & Sustainable Technologies Center

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ABOUT OREGON BEST

AN ECONOMIC ENGINE FOR OREGON

Established by the Oregon Legislature in 2007, the Oregon Built Environment & Sustainable Technologies Center (Oregon BEST) is an economic development catalyst—connecting our state's entrepreneurs and businesses with Oregon BEST's statewide, shared-user network of university research expertise and lab facilities aimed at growing Oregon's innovation sectors of renewable energy and the sustainable built environment.

INVESTING STRATEGICALLY IN INNOVATION

Oregon BEST invests strategically in programs that transform white lab coat research into green collar jobs by helping grow university research revenue, driving commercialization of new technologies, and ensuring Oregon's green economy thrives. In our first three years, we helped our 200+ Member Faculty at four universities (OIT, OSU, PSU and UO) transform $5 million of initial investment from Oregon BEST into more than $45 million in research revenue for Oregon.

Our Member Faculty and our seven shared-user signature research facilities are helping dozens of companies develop, test, and deploy new products (which creates jobs). Our programs achieve these remarkable results in three ways:

BUILD: Building our state's research assets through networking and investments in labs and research

CONVENE: Increasing interactions through events and working groups that forge greater ties and result in "Informed Innovation"

ACCELERATE: Supporting the business and technology development of companies taking university technologies, and their own, to market

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Oregon BEST's **SUSTAINABLE BUILT ENVIRONMENT RESEARCH CONSORTIUM** is hosting its Industry Advisory Board meeting on September 13th, in conjunction with Oregon BEST FEST '11. If you would like to learn more about membership in the Consortium, a prerequisite to attending the next IAB meeting in the Spring, please contact Johanna Brickman at jo.brickman@oregonbest.org.

OREGON BEST WOULD LIKE TO THANK ITS GENEROUS SPONSORS FOR TODAY'S EVENT:

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