



# ENERGY EFFICIENCY CENTER



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kWh

# OSU Energy Efficiency Center



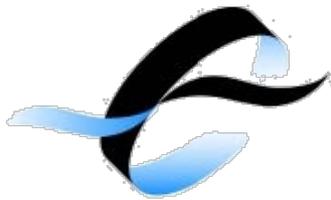
## 2010 Center Overview

- USDA REAP Agricultural Grant 2009-2011
- USDA REDA Renewable Grant 2010-2012
- Energy Efficiency Reference
- Integrated Building Design Research

# EEC Partners

U.S. DEPARTMENT OF  
**ENERGY**

 SunGrant  
INITIATIVE



OREGON  
DEPARTMENT OF  
ENERGY

 **PACIFIC POWER**

EnergyTrust  
of Oregon

  
NORTHWEST FOOD PROCESSORS ASSOCIATION

**USDA**  




OREGON<sup>™</sup>  
ASSOCIATION OF  
NURSERIES

Cascade Pacific   
Resource Conservation + Development

 Dairy  
Farmers  
OF OREGON

**Oregon State**  
UNIVERSITY

# Sun Grant Initiative

- Revitalization of Rural Communities
- Network of Land-Grant Universities
- Enabled Diversion from Industrial Assessments



# USDA REAP Agricultural Grant 2009-2011

- Rural Energy for America Program (REAP)
- Perform 90 Rural or Small Business Assessments
- Diversify Types of Energy Audits Performed
- Unique Geographic Location in Corvallis, Oregon



# USDA REDA Agricultural Grant 2010-2012

- Renewable Energy Development Assistance (REDA)
- Perform 20 Rural or Small Business Energy Assessments
- 8 Renewable Rural Site Assessments
  - Photovoltaic Array
  - Anaerobic Digester
  - Solar Thermal



# Renewable Recommendations



Source: [www.nrel.gov](http://www.nrel.gov)



Source: <http://lincoln.ne.gov>



Source: <http://feww.wordpress.com/>

# Energy Efficiency Reference (EERef)

The screenshot shows the home page of the Oregon State University Energy Efficiency Reference (EERef) website. At the top, the OSU logo and 'Energy Efficiency Center' are displayed. A navigation menu on the left includes 'Home', 'About Us', 'Contact Us', 'Disclaimer', 'Community Section', and 'Energy Efficiency Re...'. The main content area features a large banner with the text 'CONTACT US' and a sub-headline 'Contact the Oregon State University Energy Efficiency Center.' Below the banner, a paragraph explains that the EERef is a service provided by the OSU EEC to help users identify and quantify opportunities to improve efficiency in Industrial, Agricultural, Commercial, Institutional, and Residential sectors. Two sections follow: 'Energy Efficiency Reference' which mentions moderated content, opportunity templates, and assessment checklists; and 'Community Section' which describes a platform for collaborating groups and individuals to add content on the fly, mentioning DOE Industrial Assessment Centers and other energy institutions. At the bottom, logos for USDA Rural Development, SunGrant Initiative, and the U.S. Department of Energy are shown.

- Developed in 2009
- Archive Recommendations
- Community Tool

## Funding Provided by:

- U.S. Dept. of Energy
- Sun Grant Initiative
- EEC Partners

Source: <http://eeref.engr.oregonstate.edu/>

## Energy Efficiency Reference (EERef)

- Opportunity Templates
- Assessment Checklist
- Common Technologies and Energy Systems



## Community Section

- Participant Pages
- Community Commons



# EERef Opportunity Template

The screenshot shows an Excel spreadsheet with the following sections:

- Data Collected:**
  - Dimensional Data:** Total Area of Roof (TA) = 10,000 ft<sup>2</sup> (N. 1)
  - Incremental Energy Data:** Annual Energy Consumption = 100,000 kWh (N. 2); Incremental Energy Cost (EC) = \$0.07500 \$/kWh (N. 2); Incremental Demand Cost (DC) = \$5.00 \$/kW-mo (N. 2)
- Assumptions:**
  - Efficiencies:** Percent of Area to be used (PA) = 75% (N. 3); Inverter Efficiency (η<sub>i</sub>) = 90% (Rf. 1)
  - System Specifications:** Production Capacity (PC) = 1.15 kWh/W-yr (Rf. 1); Solar Panel Rating (SP) = 12 W/ft<sup>2</sup> (Rf. 2)
- Photovoltaic Analysis:**
  - Available Area (A) = 7,500 ft<sup>2</sup> (Eq. 1)
  - Usable Energy (UE) = 12.4 kWh/ft<sup>2</sup>-yr (Eq. 2)
  - Solar Panel Output (PO) = 10.6 kW (Eq. 3)
- Savings Summary:**
  - Demand Savings (DS) = 10.6 kW-mo
  - Energy Savings (ES) = 93,150 kWh (Eq. 4)
- Implementation Costs Summary:**
  - Material Costs:** Inverter Cost (NC) = \$721 \$/kW (Rf. 3); Panel and Mounting Cost (PC) = \$4,821 \$/kW (Rf. 3)
  - Labor Costs:** Number of panels per kW (N) = 5.25 panels/kW (Rf. 2)
- Equations:**
  - Eq. 1: Available Area (A) =  $(PA \times TA)$
  - Eq. 2: Usable Energy (UE) =  $(PC \times SP \times \eta_i)$
  - Eq. 3: Solar Panel Output (PO) =  $UE \times A \times \left(\frac{1 \text{ year}}{8,760 \text{ hrs}}\right)$
  - Eq. 4: Energy Savings (ES) =  $(A \times UE)$
  - Eq. 5: Labor Costs (L<sub>c</sub>) =  $(N \times T \times LR)$
  - Eq. 6: Cost Savings (CS) =  $(EC \times ES) + (DC \times DS \times 12 \text{ mo})$
  - Eq. 7: Implementation Costs (IC) =  $(NC + PC + L_c) \times PO$
- References:**
  - Rf. 1) <http://www.energytrust.org>
  - Rf. 2) <http://www.aesrenew.com>
  - Rf. 3) <http://www.solarbuzz.com>
- Notes:**
  - N. 1) Surface area was estimated using Google Earth.

Source: <http://eeref.engr.oregonstate.edu/>



# Integrated Building Design



## Oregon Sustainability Center

- City of Portland, OR
- Portland Sustainability Institute
- Oregon University System
- Portland Development Commission
- Oregon Environmental Council
- Earth Advantage Institute
- Oregon Best

Source: <http://oregonsustainabilitycenter.org>

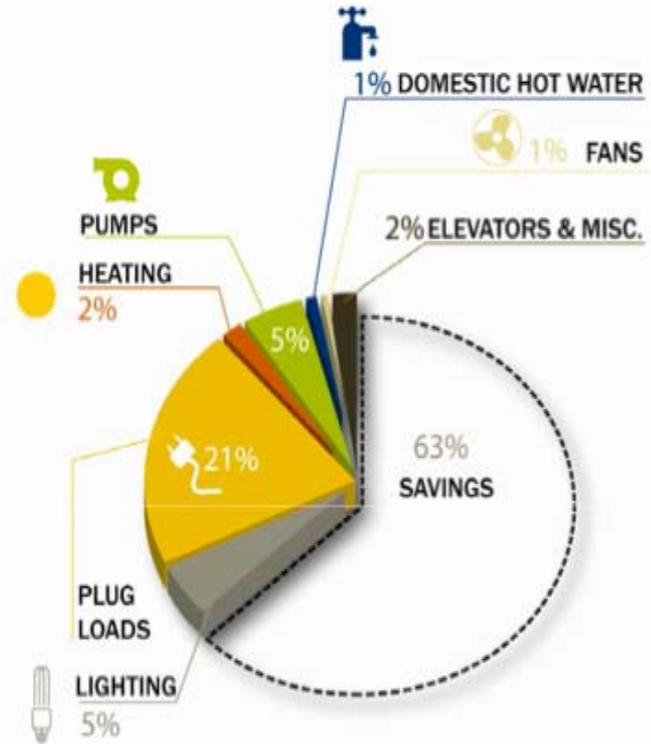
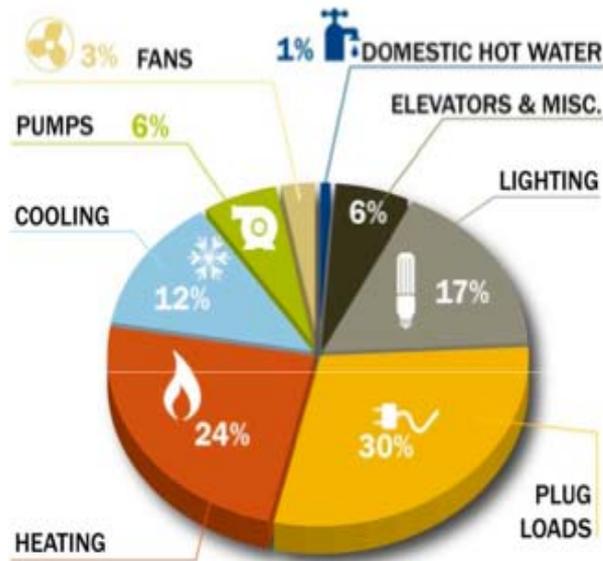
# Net Zero Energy / Green Building Challenge



- Water / Sewer System
- Active Solar
- Passive Solar
- Geothermal Heating / Cooling
- Behavior Modification

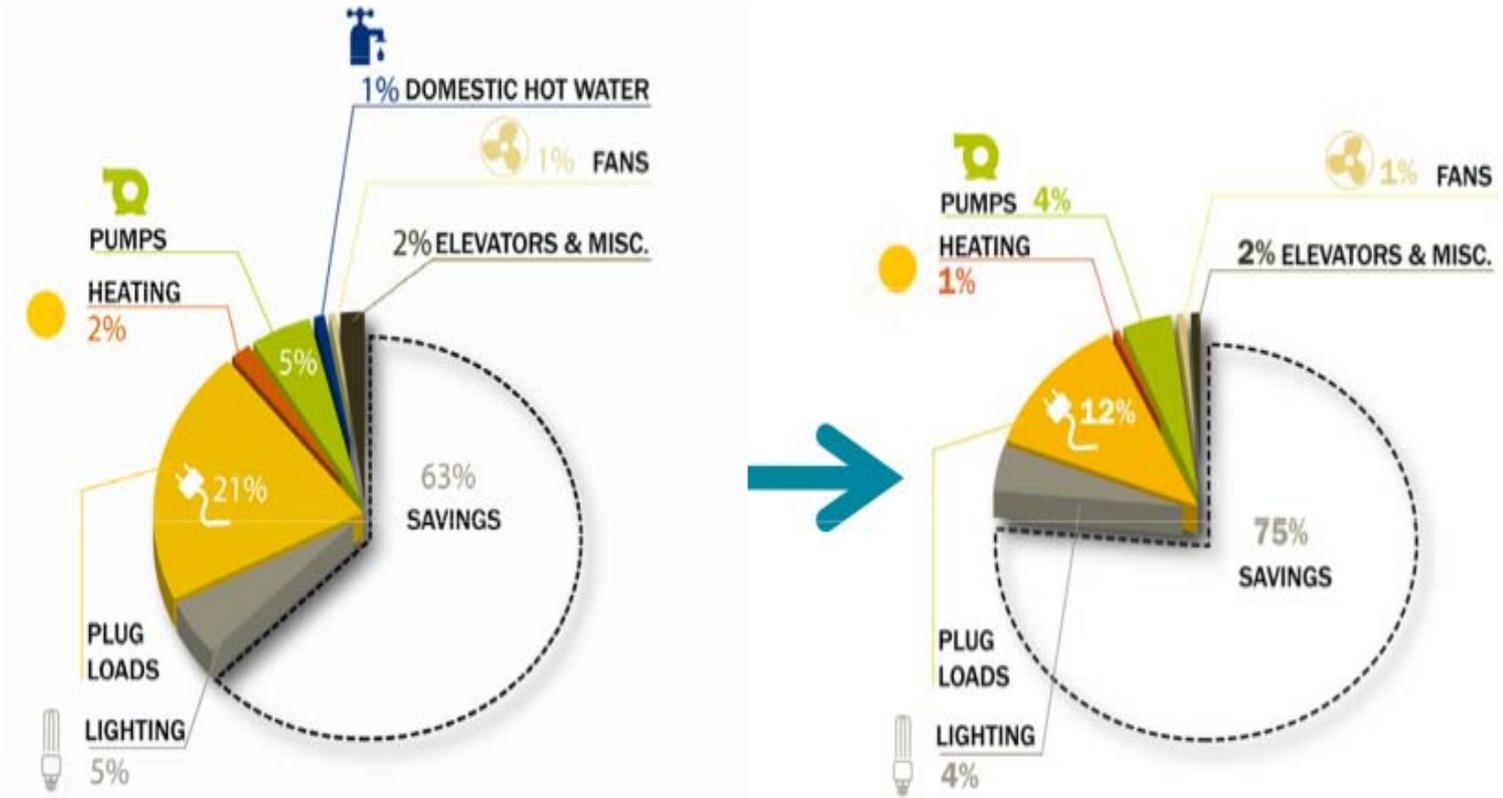
Source: <http://oregonsustainabilitycenter.org>

# OSC Projected Energy Savings From Design Only



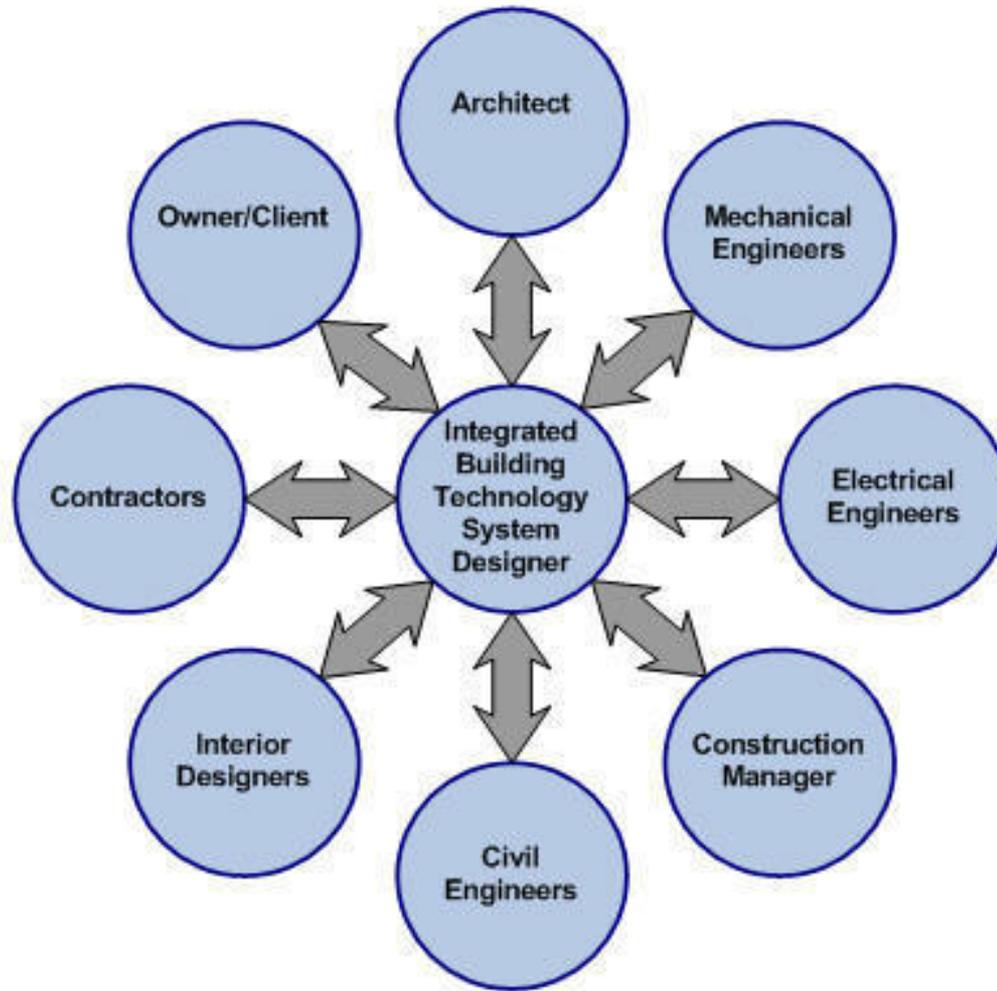
Source: <http://oregonsustainabilitycenter.org>

# OSC Energy Savings with Behavior Modification



Source: <http://oregonsustainabilitycenter.org>

# Integrated Building Design Process



Source: <http://www.automatedbuildings.com>

# Application to the EEC

- New Technologies for Energy Assessments
- Retrofit Existing Building Envelope
- Behavior Modification Recommendation
- Energy Assessment of Completed Building



# Questions?



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**<http://eec.engr.oregonstate.edu/>**