Portland State University and Portland General Electric
Smart House Design Competition

Enter the PSU-PGE Smart House Design Competition for a chance to win the $5,000 top prize!
Deadline to register: February 15, 2016
Final submittal due: May 1, 2016

Smart House Design Competition Background
For the entire history of the modern grid, electricity, provided by natural monopolies, has been regulated on the principle of “obligation to serve.” This means electricity providers have built a generation portfolio big enough to serve every electric device that is powered from the grid. Makers of electricity-consuming devices assume an infinite supply of power available from the grid at all times and design devices that serve the needs of the consumer. A world that relies on renewable power generated by the whims of Mother Nature, stands this paradigm on its head. Now, the reverse is needed: electric devices must consume when renewable generation is available.

As wind and solar generation supply an increasing percentage of energy to the grid, there will be periods of over-generation. After backing down most conventional power plants, the power generated from renewable, zero-marginal-cost devices will exceed the demand of all electric loads. A report by Energy + Environmental Economics estimates that under a range of 50% RPS (Renewable Portfolio Standards) scenarios, the over-generation of renewable energy in California would amount to 3.4 to 8.9% of all energy produced. It becomes possible to back down our high-cost fossil fuel power plants in Northwest and buy power at depressed prices from the over-generation in California.

By reducing oil and gas consumption, the RPS standards could spread across the nation and potentially go higher than 50%. Rising RPS give rise to two large-scale changes to our energy consumption:

- When we consume electricity will be modified according to the times of renewable generation production, and
- Renewable energy will be stored, either electrically or thermally, for use at a later time.

On the other hand, the rise of the Internet-of-Things will open up new opportunities to optimize and conserve the resources required to support a modern household. In a report produced from Icontrol Networks it is estimated that by 2022 a typical family home could contain more than 500 smart devices. This projection marks a potential revolution in behavior and consumption through thorough and thoughtful design.

These large-scale changes in technology and behavior form the basis for the Smart House completion. Though a sustainable Smart House solution may touch on many aspects, this competition focuses on energy.
Smart House Design Competition Problem Statement

Portland State University (PSU) and Portland General Electric (PGE) are sponsoring a student competition to design the home of the future. The Smart House Design Competition is an opportunity for PSU students to showcase their creativity, design talents and multidisciplinary team skills to design a single family house that will take advantage of the latest smart grid and energy efficiency technologies. The Smart House of the future will be well designed, readily incorporate smart grid elements and include an interface that makes saving energy easy while improving the overall quality of life for the residents of the home.

Winning teams will receive $5,000 for first place and $1,000 for second.

The purpose of the design competition is to highlight existing and cutting edge technologies and to help determine if PSU and PGE should construct a demonstration house to provide real-life testing of smart grid and energy efficiency technologies. Construction funds for the PSU-PGE Smart House will come from a variety of sources, including the possibility of corporate sponsorships.

Design Objectives

The objective of the design competition is to maximize the consumption of electricity generated from renewable sources (e.g. wind, solar, etc.). Consideration should be given to all important component systems of the house and their control, electricity load intensity (regardless of current fuel used), transportation vehicles and their interaction with the house, occupant comfort and the way occupants use energy. The design should address the specific barriers and significant development tasks to be faced by the implementation of the design.

We want solutions to focus on the following:

- Architectural/building design considerations
- Information, communication, and control considerations
- Machine-human interface considerations
- Federal, state, or local policies that could accelerate the solutions
- Immediate applicability and longevity of a solution (a house that can be built within two years, with the flexibility to incorporate new technologies for at least the next 30 years)

Design Parameters

All design submittals should assume the following characteristic/needs of the home. It is a 2,200 sq. ft. single-family house. The house is to provide the following minimum functions:

- Four (4) bedrooms
- Three (3) bathrooms
- Kitchen (range, oven, refrigerator, dishwasher, microwave)
- Living room
- Dining room
- Laundry room (washer and dryer)
- Two-car garage with room for one SUV and one sedan

The house should comfortably accommodate four occupants: two adults, a teenager and a ten-year old, and it is connected to the electric grid.

**Other Considerations**
Design concepts should have broad application and applicability beyond new homes, single-family homes, homes located in Northwest, operations that require advanced education, etc.

**Competition Rules**

**Team Eligibility**
There is no limit to the size of the design team, but all team members must be enrolled in a PSU degree program at the time of design submission. Multidisciplinary teams across colleges and schools are encouraged to tackle the design problems from technology to human comfort. Teams are allowed to seek guidance from faculty and professional contacts but all work must be produced by members of the team. Both undergraduate and graduate students are welcome to participate.

**Competition Entry**
Teams must register by February 15, 2016. Registration information must include the names of the team members, primary team contact and team advisors. Only submissions by registered teams will be judged.

**Submittal Requirements**
The final submittal is a design report that must not exceed 20 total pages including cover. There is no required breakdown of pages, but the submittal must include a rendering of the home and the floorplans for each room. The submittal should respond to the problem statement, design parameters, and the judging criteria stated below. Creativity is encouraged and reports will be judged on their readability, overall organization and graphic quality.

The final report must be submitted to smarthouse@pdx.edu in PDF format by 11:59pm on May 1, 2016.

**Interviews**
Design reports will be judged and graded and the top three teams will be invited to present to the judges panel to determine the final grand prize winner and runner-up. Interview format, criteria, time and location will be announced May 2, 2016.
**Competition Schedule**
- Competition announced and competition opened – January 13, 2016
- Competition info session – January 28, 2016 at 4:00pm in EB 103
- Registration deadline – February 15, 2016
- Last date to submit questions – March 11, 2016
- Submittal due – May 1, 2016
- Judging – May 2 to May 13, 2016
- Interview format, criteria and times announced – May 2, 2016
- Finalists announced – May 13, 2016
- Interviews – May 17, 2016
- Winners announced – May 18, 2016

**Judging Criteria**
The design reports will be judged based on the following criteria:

- *Innovation.* The judges will be looking for innovation in design, integration of smart grid technologies and the human interface with the technology in the house. Judges will be looking for innovative use of materials, integration of new technologies and ease of use that encourages the residents to save energy. (50 points available)

- *Technical merit.* The judges will score proposals on their appropriate use of technology, the feasibility of the design and the accurate description of project design features. (35 points)

- *Multidisciplinary solution.* Judges will be looking for a strong integration of all important factors of design from aesthetics to technology to human comfort and behavior. (35 points)

- *Value proposition.* Judges will evaluate the concept on whether the house is readily buildable and whether it promotes the art and science of homebuilding. PSU and PGE are considering actual construction of a Smart House. The judges will be scoring the entries on their ability to help PSU and PGE on this goal. Judges also will be scoring on the ability of the designs for broader applications. (20 points)

- *Overall report quality.* Entries will be scored on their overall quality, including organization, design, layout, report, and use of photos, renderings and sketches and design details. (20 points)
Awards

- Grand Prize / Frist Place: $5,000
- Honorable Mention / Second Place: $1,000

Competition Review Committee

The Competition Review Committee will include industry professionals who represent homebuilding, interconnected smart technologies, energy, and related fields. The Competition Review Committee will also include representatives from PSU and PGE. PSU and PGE will extend an invitation to prominent, private sector individuals to donate their time to serving on the Review Committee. Each Review Committee member will review submitted proposals and participate in the interview process to determine Grand Prize and Honorable Mention. Members of the Competition Review Committee are responsible for any expenses to travel to Portland, though some participation may be conducted remotely.

The Competition Review Committee will be announced by May 2, 2016.

Intellectual Property

Any IP related to the proposals in the competition will remain the property of the students. By entering this competition, you grant Portland State University a non-exclusive, non-commercial, research-use license to any intellectual property either created during the course of the competition or relied upon to practice your final submission.

Competition Organization Committee:

Charlie Allcock
Director, Business Development, Portland General Electric

Conrad Eustis
Director of Retail Technology Strategy, Portland General Electric

Jason Franklin
Director of Campus Planning and Design, Portland State University

Elizabeth Paul
Director, Retail Strategy & Development, Portland General Electric

Julie Rutherford
Communications Director, Maseeh College of Engineering and Computer Science, Portland State University

Renjeng Su
Dean of the Maseeh College of Engineering and Computer Science, Portland State University