

Honda smart home offers vision for zero carbon living

March 26 2014, by Andy Fell



Energy consumption and generation throughout the house can be monitored with an app. Credit: American Honda Motor Co.

Honda and the University of California, Davis, today marked the opening of Honda Smart Home US, showcasing technologies that enable zero net energy living and transportation. The home in UC Davis West Village is capable of producing more energy on-site from renewable sources than it consumes annually, including enough energy to power a Honda Fit EV for daily commuting.

A Honda-developed [home energy](#) management system and an energy efficient design will allow the occupants to use less than half of the

energy of a similarly sized new home in the Davis area for heating, cooling and lighting. The home is also three times more water-efficient than a typical U.S. home. Watch videos about Honda Smart Home US.

Honda Smart Home, construction of which began in April 2013, will serve as a residence for a member of the UC Davis community, whose selection will soon be announced. The fully-furnished home comes equipped with a Honda Fit EV battery electric vehicle for daily transportation.

In addition to showcasing Honda's vision for sustainable, zero-carbon living and personal mobility, the home will function as a living laboratory where the company, along with researchers from UC Davis and Pacific Gas and Electric Co. (PG&E), will evaluate new technologies and business opportunities at the intersection of housing, transportation, energy and the environment.

Honda's environmental efforts extend beyond personal mobility to address two of the primary sources of carbon dioxide emissions: cars and homes. Together, energy used to power homes and light duty vehicles contributes to approximately 44 percent of greenhouse gas emissions in the United States. Technology that enables distributed renewable energy generation to supply power to homes and cars seamlessly is one of the key potential pathways to address climate change.

Honda Smart Home fits right in at UC Davis West Village, the largest planned zero net energy housing development in the United States. Opened in 2011, West Village is home to the university's internationally recognized research centers focused on energy efficiency, sustainability and transportation.

Honda home energy management system

Honda Smart Home implements Honda's home energy management system, or HEMS, a proprietary hardware and software system that monitors, controls and optimizes electrical generation and consumption throughout the home's microgrid.

A 10kWh battery energy storage system in the garage, using the same lithium-ion cells that are used in the Honda Fit EV, allows stored solar energy to be used at night, when household demand typically peaks and electric vehicles are usually charged. Honda's HEMS leverages the battery to balance, shift and buffer loads to minimize the home's impact to the electric grid. The system also enables Honda to evaluate the second life, or reuse, of EV batteries in grid applications, home-to-grid connectivity and other concepts.

Honda's HEMS is also capable of improving grid reliability by automatically responding to demand response signals and providing other grid services. If the electricity grid is overloaded, for example, Honda Smart Home is capable of shedding its load and even supplying power back to the grid. This type of smart grid connectivity will enable the mass deployment of electric vehicles and renewable energy without sacrificing grid reliability.

Sustainable features

Honda Smart Home brings together innovative technology and the latest green building concepts:

Solar photovoltaics—A 9.5kW solar photovoltaic, or PV, system mounted on the roof will generate more energy than the home and Fit EV consume on an annual basis, due in large part to the efficient design of the home. All of the energy for space heating, space cooling, ventilation, lighting, hot water, appliances and consumer loads, in

addition to the transportation energy for the Honda Fit EV, is supplied by the solar panels on the home.

Electric vehicle charging—The Honda Fit EV included with the home has been modified to accept DC power directly from the home's solar panels or stationary battery, eliminating up to half of the energy that is typically lost to heat during DC-to-AC and AC-to-DC power conversion. When the solar panels are generating electricity at full capacity, the vehicle can fully recharge in approximately two hours directly from sunlight.

Geothermal radiant heating and cooling—In homes and cars, heating and air conditioning systems consume significant amounts of energy. In the ground beneath the Honda Smart Home's back yard, eight 20-foot-deep boreholes allow a geothermal heat pump to harness the ground's relatively stable thermal sink to heat and cool the home's floors and ceiling throughout the year. Researchers from UC Davis will evaluate the performance of the system to determine its adaptability to mainstream use.

Pozzolan infused and post-tensioned concrete—Concrete accounts for approximately 5 percent of global, man-made CO₂ emissions. This large CO₂ footprint is a result of producing cement—the "glue" of concrete—by heating limestone to more than 1,000 degrees Celsius. This heating requires the burning of fossil fuels, while the chemical reaction itself also releases CO₂. A naturally-occurring substance called pozzolan was infused into the Honda Smart Home's concrete to replace half of the cement typically needed. A technique called post-tensioning, which uses steel cables to compress the concrete slab, was used to reduce the amount of concrete and steel needed. Watch videos on pozzolan and post-tensioning.

Advanced lighting—The LED lighting used throughout the home is not

only five times more energy efficient than conventional lighting, is also designed to support the health and wellness of the home's occupants. Honda worked with researchers from UC Davis' California Lighting Technology Center to explore new circadian color control logic.

Mimicking the natural shifts in daylight that occur from morning to night, the circadian-friendly lighting design allows occupants to select lighting scenes that complement occupants' circadian rhythms and support nighttime vision.

The amber hallway night lights, for example, provide enough light to navigate through the home in darkness without depleting a photopigment in the human eye called rhodopsin that helps people see in low-light conditions. This allows occupants to move about safely and return to sleep quickly and easily.

Exposure to bright, blue-rich light during the day helps put body and mind in an alert and energetic state, but at night, blue light can disrupt circadian sleep cycles. Therefore, Honda Smart Home minimizes the use of blue light at night.

Passive design—Honda Smart Home is designed to be extremely energy efficient by taking into account local weather conditions, sun direction and the home's outer shell. Known as "passive design," these techniques reduce the energy needed for heating and cooling while maintaining comfortable living conditions.

Honda Smart Home's south-facing windows are optimized for heating and cooling, while the north-facing windows are positioned to maximize natural light and ventilation. This will keep the home naturally cool in the summer and warm in the winter. Double stud walls, cool roofing material and a fully insulated concrete slab all contribute to the home's energy efficiency.

Sustainable materials and waste management—Sustainable materials were used throughout the construction process. Rather than cover the concrete foundation with wood, diamond pads were used to create a smooth, polished finish. For the roof, metal was selected, which is more recyclable than asphalt. All lumber used in the construction process was sustainably harvested from forests certified by the Forest Stewardship Council, while advanced framing techniques were used to reduce the amount of material needed. The Honda Smart Home will seek a number of "green" certifications, including LEED from the U.S. Green Building Council, National Green Building Standard from the National Association of Home Builders and Energy Star from the U.S. Environmental Protection Agency.

Finally, 96 percent of the construction waste associated with the project, including drywall, brick, plastics and lumber, was recycled.

Surpassing California's 2020 zero net energy goal

Honda Smart Home US was designed to address specific challenges associated with the transportation and energy sectors in the United States.

California's Energy Efficiency Strategic Plan, for example, sets a goal for all new homes to be zero net energy beginning in 2020. Through a combination of advanced technology integration, energy efficiency measures and sustainable design techniques, Honda Smart Home surpasses that goal by producing enough energy to power the home and an electric vehicle on a daily basis.

Sharing data and technical details

Hundreds of channels of energy data generated by sensors throughout

the house will be shared with PG&E and UC Davis researchers. In addition, Honda's Environmental Business Development Office, in conjunction with Honda research and development, will use the home as a living laboratory to test new technologies and evaluate new environmental business opportunities.

Regular updates on the home are available [online](#). Contribute to the conversation on Facebook and Twitter using the hashtag #HondaSmartHome.

By the numbers: Emissions and water consumption

Honda Smart Home is expected to generate a surplus of 2.6 megawatt-hours of electricity over the course of a year, while a comparable home will consume approximately 13.3 megawatt-hours. This results in a net offset of nearly 13,100 pounds of CO₂ per year, even when taking into account California's relatively clean electricity. The excess energy anticipates potential future increases in energy needs, such as the addition of more occupants or electric vehicles to the home, and an increased daily commute.

The savings are even more dramatic when you consider Honda Smart Home produces its own transportation fuel. CO₂ savings rise to more than 23,500 pounds per year versus a comparable home and vehicle.

Honda Smart Home is three times more water-efficient than a typical U.S. household. In a typical home, the toilet alone can use 27 percent of household water consumption. Dual-flush toilets with WaterSense certification, along with low-flow faucets in the sinks and showers and a high-efficiency washing machine and dishwasher all contribute to water savings. A technique called xeriscaping was used in the garden, where 30 percent of a typical home's water is consumed. Plants that thrive naturally in arid climates were selected, while filtered gray water

recycled from the home is the only source of water other than rain.

Provided by UC Davis

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