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Honda Smart Home US Offers Vision for Zero Carbon Living and Mobility

- *Super-efficient “living laboratory” seeks to address two major sources of U.S. CO2 emissions: cars and homes*
- *Project achieves more than 11 tons of CO2 reduction per year compared to a conventional home and vehicle*
- *Honda home energy management system (HEMS) maximizes the home’s energy efficiency while communicating with the electric utility to improve grid stability*
- *Home surpasses California’s 2020 target for zero net energy residential construction*
- *Member of University of California, Davis community will live in home, drive Honda Fit EV (electric vehicle)*

Honda today marked the opening of Honda Smart Home US, showcasing technologies that enable zero net energy living and transportation. The home, located on the West Village campus of the University of California, Davis, 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 home’s occupant 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. [See videos](#) about Honda Smart Home US.

Honda Smart Home US, 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 the resident’s 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 (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 CO2 emissions: cars and homes. Together, energy used to power homes and light duty vehicles contributes to approximately 44% of U.S. greenhouse gas emissions in the United States¹. 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.

UC Davis’s West Village, where the Honda Smart Homes is located, is the largest planned zero net energy housing development in the U.S. 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 US implements Honda’s home energy management system (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 will also enable Honda to evaluate the second life, or re-use, of EV batteries in grid applications, home-to-grid (H2G) 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 US brings together innovative technology and the latest green building concepts:

Solar Photovoltaics (PV)

A 9.5kW solar photovoltaic (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.

DC-to-DC 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 & Cooling

In homes and cars, heating and air conditioning systems consume significant amounts of energy. In the ground beneath Honda Smart Home's backyard, 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% of global, man-made CO₂ emissionsⁱⁱ. This large CO₂ footprint is a result of producing cement – the concrete's "glue" – by heating limestone to more than one thousand 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 also 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; it is also designed to support the health and wellness of the home's occupants. Honda worked with researchers from the California Lighting Technology Center at UC Davis 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 humans 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.

The 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 & 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 (FSC), while advanced framing techniques were used to reduce the amount of material needed. Honda Smart Home will seek a number of “green” certifications, including US Green Building Council’s LEED, National Association of Home Builders’ National Green Building Standard and U.S. EPA’s Energy Star. Finally, 96% of the construction waste associated with the project, including drywall, brick, plastics and lumber, was recycled.

Surpassing California’s 2020 Zero Net Energy Goal

The 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.ⁱⁱⁱ 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 R&D, will use the home as a living laboratory to test new technologies and evaluate new environmental business opportunities.

Regular updates on the home can be found at www.hondasmarthome.com. 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^{iv}. 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^v.

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^{vi}. 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% of a typical home’s water is consumed. Plants that thrive naturally in arid climates were selected, while filtered greywater recycled from the home is the only source of water other than rain.

Executive Quotes

“With the Honda Smart Home, we’ve developed technologies and design solutions to address two primary sources of greenhouse gas emissions – homes and cars,” said Steve Center, vice president of the Environmental Business Development Office of American Honda Motor Co., Inc. “Ultimately, our goal is to contribute to the public dialogue about addressing CO₂ emissions.”

“In West Village, UC Davis made a commitment to build zero net energy housing and gave our research center the goal of creating the first university hub to focus on energy and transportation research,” said Dan Sperling, Ph.D., director of the Institute of Transportation Studies at the University of California, Davis. “Honda Smart Home is a dynamic environment that will help the university meet its research objectives and is a perfect example of the industry partnerships we strive to build.”

About sustainability at UC Davis

UC Davis has long served as a proving ground for innovations in environmental sustainability. Sierra Magazine named UC Davis the nation’s #1 Cool School in its 2012 ranking of the country’s greenest colleges. In 2011, UC Davis West Village opened its doors and is on track to become the nation’s largest planned zero net energy community. Four UC Davis building complexes are certified LEED Platinum, the highest ranking awarded by the U.S. Green Building Council. Aggressive recycling, composting and reuse efforts prevent more than 63 percent of campus waste from entering landfills annually. Through its Climate

Action Plan, the campus has reduced greenhouse gas emissions below year 2000 levels and expects to reach year 1990 levels by 2020. The campus also boasts more than 42 miles of bike paths and more than 20,000 bike racks, earning it a gold award from the League of American Bicyclists.

About Honda Environmental Leadership

Honda is a leader in the development of leading-edge technologies to improve fuel efficiency and reduce CO2 emissions. Honda has led the Union of Concerned Scientists (UCS) rankings of overall vehicle environmental performance since 2000, and a Honda vehicle has topped the list of America's greenest vehicles from the American Council for an Energy-Efficient Economy (ACEEE) for eleven out of the past thirteen years. The company leads all automakers with thirteen LEED-certified "Green Buildings" in North America. Ten of its 14 North American manufacturing facilities are zero-waste to landfill.

In 2006, Honda became the first automaker to announce voluntary CO2 emissions reduction targets for its global fleet of automobile, power sports and power equipment products and its global network of manufacturing plants. Today, the company is striving for even greater reductions in CO2 emissions that contribute to global climate change, while also working to minimize waste, water use and the total environmental footprint of its operations worldwide.

Honda established operations in America in 1959, and now employs more than 26,000 associates in its U.S. sales, R & D and manufacturing operations with a capital investment of more than \$12.5 billion. Over 95% of Honda vehicles sold in the U.S. are produced in North America, using globally and locally sourced parts.

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ⁱ Internal calculation based on data from US EPA:

<http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>

ⁱⁱ <http://blogs.ei.columbia.edu/2012/05/09/emissions-from-the-cement-industry/>

ⁱⁱⁱ http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/res_zne_action+plan.htm

^{iv} http://www.epa.gov/cleanenergy/documents/eGRID/eGRID_9th_edition_V1-0_year_2010_Summary_Tables.pdf

^v Assumes 12,000 miles per year. Comparative vehicle is 2013 Fit Sport with automatic transmission

^{vi} <http://www.epa.gov/WaterSense/pubs/indoor.html>