



PNC

SMART



**BUILD A BETTER HOME  
BUILD A BETTER FUTURE**

**Exhibit Resource Guide**  
June through September 2011

Cleveland Museum of  
NATURAL HISTORY



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Cleveland Museum of  
NATURAL HISTORY 

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## WELCOME!

The term *Natural History* often evokes a sense of the past, but this summer The Cleveland Museum of Natural History is proud to present the future. *PNC SmartHome Cleveland* is the future of green building technology, both here and across the nation. Its premise begins with the idea that we can design for more energy-efficient and healthy living; that by building smartly we can make better use of our natural resources and take better care of ourselves and our families. Its promise is a home that is beautiful, functional and inspirational.

*PNC SmartHome Cleveland* is first an exhibit—a tangible example of the latest advances in green construction techniques and materials. Northeast Ohio can be proud of the innovative ideas and products created here. The lighting, paint and bathroom fixtures . . . even the art on the walls highlight the talent and ingenuity of local companies and artists. *SmartHome* is also the ultimate green exhibit—100 percent repurposed into a family home. At its final location on the edge of the vibrant University Circle community, it is an investment and a vote of confidence in a Cleveland neighborhood.

Most amazing is that *PNC SmartHome Cleveland* has become a true community project. The Museum has more than 100 partners who have helped design, build, finance and furnish this remarkable house and garden. The enthusiasm and energy of

our partners, combined with their expertise and ideas, have been truly inspiring, and attest to the leadership of Northeast Ohio in creating a sustainable future for our region and our country.

I would like to thank David Beach, the Museum's director of sustainability and its GreenCityBlueLake Institute, and Bill Lynerd, chief development officer, who have taken this house from an idea to a reality; The Cleveland Foundation for its crucial early support; PNC Bank for its generous sponsorship; and all of our partners, who have contributed so much. A special thank you goes to our architect, Chuck Miller of Doty & Miller Architects, who has gone above and beyond in designing, building and overseeing every aspect of the project.

*PNC SmartHome Cleveland* began as an audacious dream—a home designed to meet the world's most rigorous standard of energy performance, serve as an inspirational and informative exhibit, and ultimately house a family—with only a two-month window for construction. We now offer this dream to you and hope that you enjoy your tour of the future.

Evalyn Gates, Ph.D.  
Executive Director and CEO



## HOMES WITHOUT FURNACES

### THE PROMISE OF PASSIVE DESIGN FOR EFFICIENCY, HEALTH AND COMFORT

In the future, it will probably be unusual to experience a house with a gas-fired furnace or boiler. It will be strange to hear the noise of a blower motor and feel a blast of hot air or to hear the clanking of steam pipes. It will seem uncivilized to live in a house with drafts, cold spots, and room temperatures that fluctuate wildly as the furnace cycles on and off. And it will seem ridiculous to pay a lot of money for heating bills.

This future is happening today at PNC SmartHome Cleveland. SmartHome is the first house in Northeast Ohio designed to meet the Passive House standard, the most rigorous residential energy performance

standard in the world. Thousands of passive houses have been built in Europe, and now innovative architects and builders are bringing the design intelligence to the United States.

PNC SmartHome Cleveland is expected to consume 90 percent less heating and cooling energy than a conventional house (and about 70 percent less primary energy for all uses).

It accomplishes this by following some basic principles.

## DESIGN PRINCIPLES

### Heat-retaining building shape —

SmartHome has a simple, rectangular shape to minimize the ratio of surface area to volume. (A cube would be even better. A sphere has the lowest ratio.)

**Super insulation —** The walls are more than a foot thick and are packed with foam and cellulose to achieve an insulation value of about R-50. In comparison, Ohio's building code requires a minimum side wall insulation level of just R-13.

**High-performance windows —** The triple-pane windows achieve an awesome R-11 insulation value in the center of the glass, and they close like a bank vault to stop cold drafts.

**Air-tight construction —** All the holes and seams in the building envelope (the outer perimeter of the living space) have been carefully sealed. As a result, it's expected that the "draftiness" of SmartHome will be less than 0.6 air changes per hour when measured by a pressurized blower door test. In comparison, a typical new house might have 3-6 air changes per hour, and a drafty old house might be as high as 20. In addition, the continuous air barrier in SmartHome is positioned in the middle of the wall where it is less likely to be perforated accidentally in the future.

**Thermal bridge-free construction —** It's amazing how much heat can be conducted through a piece of wood, such as a 2x4 stud in a wall. The walls in SmartHome are designed to eliminate such thermal bridging with the strategic placement of insulation.

When you put all these design principles together, you get a house that is comfortable and quiet, has low energy costs, and is simple to operate. It's also durable because there won't be condensation or other moisture problems.

**Heat-recovery ventilation —** An airtight house can develop indoor air quality problems if adequate ventilation is not provided. But when you vent stale air from a house, you also lose heat. So SmartHome's ventilation system transfers the heat of the outgoing air to the incoming fresh air. The energy is transferred at 84 percent efficiency. As a result, the house has healthy fresh air with little energy penalty.

**Efficient supplementary heating —** SmartHome is designed to maintain temperature like a thermos. The heating demand will be so low that the home needs no conventional furnace. Instead, the house can make it through the cold Cleveland winter with a small, ductless, air-source heat pump, which requires minimal energy. (The heat pump also provides supplementary cooling in the summer.)

**Optimal solar orientation and shading for passive solar gain —** SmartHome was designed for a south-facing lot on Wade Park Avenue near University Circle. The large windows on the south side allow sunlight to enter and warm the house during the colder months of the year. The windows are shaded so that during the summer, when the sun is higher in the sky, sunlight is blocked.

**Energy-efficient appliances and lighting —** It makes no sense to build an extremely energy-efficient house and then fill it with energy-hogging appliances and lighting. So SmartHome features Energy Star appliances and extremely efficient LED lighting.



# THE BUILDING OF PNC SMARTHOME CLEVELAND

**JULY 2010** — The Cleveland Museum of Natural History begins exploring how to design and build an energy-efficient house to complement an exhibit on climate change coming in 2011.

**OCTOBER 2010** — Museum staff members and local Passive House consultant begin evaluating vacant lots in Cleveland neighborhoods for a site with good solar orientation and market potential. A lot is identified on Wade Park Avenue, just a few blocks from the Museum.

**NOVEMBER 2010** — The design team begins to plan a house for the Wade Park Avenue site that can meet the rigorous Passive House standard for energy performance.

**NOVEMBER 2010 – JANUARY 2011** — Museum staff and the design team hold many meetings with City of Cleveland staff and neighborhood residents to listen to concerns, modify plans, and finally win support for a house design that will complement the historic Wade Park neighborhood.

**MARCH 2011** — Structural walls are fabricated off-site. The site next to the Museum is prepared and a temporary foundation is built.

**APRIL-MAY 2011** — PNC SmartHome Cleveland is constructed next to the Museum as a fully furnished model home exhibit.



**JUNE-SEPTEMBER 2011** — PNC SmartHome Cleveland is open for guided tours.

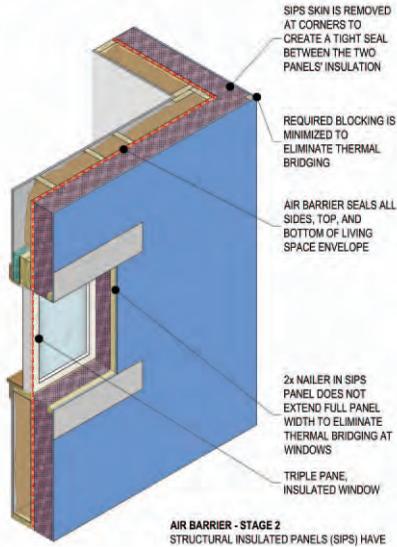
**OCTOBER 2011** — PNC SmartHome Cleveland will be moved intact from the Museum to the Wade Park Avenue site, where it will be installed on a permanent foundation and sold.



## SCIENCE ON DISPLAY

PNC SmartHome Cleveland brings leading building technology to Northeast Ohio:

- Passive House methodology
- Panelized wood frame construction
- Structural insulated panels
- Advanced air barrier sealing techniques



- Thermal bridging reduction
- High-performance windows
- High-performance energy-recovery ventilation and air-source heat pump
- Insulated concrete form foundation walls
- Efficient structured plumbing system and water-conserving fixtures
- LED lighting system
- Landscaping for stormwater management featuring native plants

The SmartHome project is being extensively documented, and instructional workshops are being held for local building professionals and the public. The hope is that the lessons of SmartHome will help to raise the bar of residential construction in Northeast Ohio.

## SAVING GREEN

With more insulation, better windows, and more careful design and construction, a passive house currently costs more to build than a conventional house. Estimates put the cost premium at 10 percent to 20 percent.

However, housing affordability is not just a matter of initial construction costs. It's also about operating and maintenance costs. A passive house can save money in the long run because of dramatically reduced energy costs. Indeed, a passive house can be a hedge against future spikes in energy prices. And the durability of a passive house can reduce maintenance costs. That's why Habitat for Humanity chapters in the U.S. are starting to build passive houses. When the focus is on long-term affordability and sustainability, it makes sense to invest a little more upfront.

In any case, the cost premium should be reduced as more passive houses go into production, more energy-efficient products become available in the U.S., and the building industry becomes more familiar with the concepts. In Northeast Ohio, the example of PNC SmartHome Cleveland is already stimulating builders to think about how to put passive house principles into cost-effective, large-scale production.



## A HEALTHY HOUSE

In addition to being extremely energy efficient, PNC SmartHome Cleveland is designed to be a healthy house. Here are some of the ways that the house will protect the health of its occupants:

### VENTILATION AND MOISTURE CONTROL —

PNC SmartHome Cleveland is built to be extremely air tight to prevent heat loss, so it must have a system of controlled ventilation to provide fresh air and prevent moisture build-up. (Some of the passive solar houses of the '70s had problems because they failed to address this.) SmartHome's energy-recovery ventilation system and air-source heat pump will provide a continuous flow of fresh, filtered air at the proper humidity. In addition, the walls are designed so moisture cannot accumulate and create mold.



ENERGY-RECOVERY VENTILATION

**NO COMBUSTION SOURCES —** Combustion creates carbon monoxide and other air pollutants, which is why gas furnaces and appliances need to be vented to the outside. But that venting wastes a lot of energy. Why blow warm air out of your house in the winter? So PNC SmartHome Cleveland will have no combustion sources—no furnace, no fireplace, no gas stove, no gas hot water heater, no gas clothes dryer.

### LOW-VOC PAINTS AND MATERIALS —



Sherwin-Williams is donating very low-VOC ProMar 200 paints for the interior of SmartHome. Volatile organic compounds off-gas from drying paint and can be hazardous, so they should be reduced as much as possible. Other materials in the home were also chosen with this in mind.

**HARD-SURFACE FLOORS —** Carpeting can be a trap for dirt, dust, allergens, mites, mold, and other things that can affect your health. PNC SmartHome Cleveland will have hardwood and tile floors that are easier to keep clean, along with carpet tiles and rugs that can be washed.

**DETACHED GARAGE —** Garages can be sources of dangerous fumes and hazardous chemicals, so it's better that they not be attached to houses. SmartHome will have a detached garage at its permanent location on Wade Park Avenue.

**QUIET —** With its thick, well-insulated walls, high-performance windows, and no noisy forced-air furnace, SmartHome should be a quiet refuge from all the noise pollution in the rest of our urban environment.





## BUILDING FOR THE FUTURE

According to the U.S. Energy Information Administration, buildings consume nearly half of the energy produced in the U.S. and are responsible for nearly half of the nation's carbon dioxide emissions that are contributing to accelerated global warming. A carbon emissions inventory conducted by the GreenCityBlueLake Institute revealed similar proportions for the building sector of Northeast Ohio ([www.gcbl.org/energy/NEOCarbonFootprintProject\\_2005](http://www.gcbl.org/energy/NEOCarbonFootprintProject_2005)).

But buildings can also be the source of the greatest energy savings and carbon reductions. As passive houses demonstrate, it's possible to go beyond incremental improvements and achieve dramatic breakthroughs in performance. Indeed, passive house designers talk about "Factor of 10" improvements because of the 90 percent less heating energy used in passive houses. Such breakthroughs are necessary if developed nations are to reduce greenhouse gas emissions to the level recommended by scientists to avert the worst consequences of climate change.

Thus, passive houses represent a hope for a more sustainable future. With smart design and construction, they reduce energy demand to a very low level. They do this passively, so the building occupants don't have to think much about it. Great performance is just built into the house.

Then, when energy demand is so low, it becomes increasingly practical to add enough on-site renewable power sources, such as solar panels, to make the house net-zero energy — meaning that the house produces as much energy as it needs over the course of a year.

That is the ultimate hope. Homes that produce as much clean energy as they need without burdening the rest of the planet — while providing high-quality shelter for all.



## WHAT MAKES A PASSIVE HOUSE?

The Passive House certification process is conducted by the Passive House Institute U.S. ([www.passivehouse.us](http://www.passivehouse.us)). To meet the standard, a building must pass three tests:

- Energy use for both heating and cooling must be less than 15 kWh/m<sup>2</sup>/year (4,755 Btu/ft<sup>2</sup>/year).
- Total primary energy use must be less than 120 kWh/m<sup>2</sup>/year (38,000 Btu/ft<sup>2</sup>/year) for all energy needs (including lighting, water heating, and appliances).
- Air leakage must be less than 0.6 air changes per hour at 50 pascals of pressure difference between the interior and exterior (0.6 ACH<sub>50</sub>). This is measured by a blower door test.

The Passive House standard is different from the better known LEED rating system of the U.S. Green Building Council ([www.usgbc.org](http://www.usgbc.org)) because it focuses entirely on energy performance. The LEED system addresses a broad range of issues related to the environmental impact of buildings, including the location of the building site, life-cycle impact of materials, energy use, water use, indoor air quality, and landscaping. While PNC SmartHome Cleveland is not seeking LEED certification, it was designed with the LEED criteria in mind and would rank highly.

Another green building standard is the Green Communities Criteria, which was developed by Enterprise Community Partners, a national funder of urban neighborhood redevelopment ([www.greencommunitiesonline.org](http://www.greencommunitiesonline.org)). PNC SmartHome Cleveland is expected to meet this standard as part of the process of meeting the City of Cleveland's requirements for residential tax abatement on new home construction.



Heat-recovery ventilation



Exterior wall super insulation

# THE DESIGN TEAM

PNC SmartHome Cleveland could not have been developed without a talented design/build team of professionals from Northeast Ohio. The team included:

**Chuck Miller, Doty & Miller Architects** ([www.dotyandmiller.com](http://www.dotyandmiller.com)) — Chuck was the principal designer of SmartHome and pulled all the pieces together. Doty & Miller has been a green building leader in Northeast Ohio. The firm’s LEED Gold offices are in a restored, historic post office building in Bedford, OH.

**Jeff Walters, Panzica Construction** ([www.panzica.com](http://www.panzica.com)) — While providing overall construction oversight, Jeff helped to mobilize the extensive network of subcontractors who work with Panzica on green buildings throughout the region.

**Chris Kontur, CPK Construction** ([www.cpkus.com](http://www.cpkus.com)) — Along with his brothers, Mark and John, Chris helped to ensure that SmartHome’s passive design elements and

wall system could actually be built — and completed to meet a nearly impossible deadline.

**Mark Hoberecht, HarvestBuild Associates** ([www.harvestbuild.com](http://www.harvestbuild.com)) — Mark was the project’s Passive House consultant, and he made sure that the house was designed to meet the Passive House standard for energy performance.

**Ed Shank, Comfort Systems USA** ([www.comfortsystemsusaohio.com](http://www.comfortsystemsusaohio.com)) — Ed brought the world’s most efficient heating/cooling and energy-recovery ventilation systems to the house.

**Mike McAndrews, Knight & Stolar Landscape Architecture** (<http://kslarch.com>) — Mike designed the landscaping and storm water management features at the exhibit site.



## THE ARCHITECT’S DESIGN GOALS

“A house in the 21<sup>st</sup> century should be durable (made to last 300 years or more), flexible (easily adaptable to changing lifestyles), affordable (responsive to overall cost of ownership), and beautiful.”

*Chuck Miller, Doty & Miller Architects*

## EXHIBIT TOUR

PNC SmartHome Cleveland is a showcase of environmentally friendly designs and products. Here are some of the noteworthy features on display. For more information, see [www.cmnh.org/site/SmartHomeCleveland.aspx](http://www.cmnh.org/site/SmartHomeCleveland.aspx).

### Throughout PNC SmartHome Cleveland

**PRE-FABRICATED WOOD STUD WALLS** | CPK Construction, [www.cpkus.com](http://www.cpkus.com) | Structural walls produced off-site to reduce construction waste and speed construction, assembled and sealed on site to create an extremely airtight building envelope.

**STRUCTURAL INSULATED PANELS** | SureTight Insulated Panels, [www.suretight.com](http://www.suretight.com) | Prefabricated panels with expanded polystyrene (EPS) rigid foam core sandwiched between two structural skins of oriented strandboard (OSB). Manufactured in western Pennsylvania.

**AIR-BARRIER SEALING** | Self-adhering water vapor permeable sheet (VPS) membrane and Perm-A-Barrier wall flashing tape | Grace Construction Products, [www.na.graceconstruction.com](http://www.na.graceconstruction.com).

**SEALING AROUND WINDOW FRAMES** | Illmod Trio sealing tape | Tremco Illbruck, [www.tremco-illbruck.com](http://www.tremco-illbruck.com).

**SEALANTS** | Mono 555 one-part acrylic sealant and Tremsil 200 silicone sealant | Tremco Sealants, [www.tremcosealants.com](http://www.tremcosealants.com).

**PRE-ENGINEERED WOOD TRUSSES** | Stark Truss Company, [www.starktruss.com](http://www.starktruss.com) | Wood-conserving floor and roof trusses, spanning the entire width of the house to allow for flexible positioning of interior walls. Manufactured in Northeast Ohio.

**INSULATION INSIDE STRUCTURAL WALLS** | Dense-packed cellulose insulation from Advanced Fiber Technology, [www.advancedfiber.com](http://www.advancedfiber.com) | Polyurethane spray foam insulation from Fomo Products, [www.fomo.com](http://www.fomo.com) | Installation by Insulation Systems, [www.insulationsystems.net](http://www.insulationsystems.net).

**WINDOWS AND EXTERIOR DOORS** | Energate 1202 wood-aluminum clad casement and fixed, [www.energate.com](http://www.energate.com) | Imported by H Windows, [www.passivehwindow.com](http://www.passivehwindow.com) | Energy-efficient, triple-pane windows and doors with high-performance glass for solar heat gain and frames that minimize thermal bridging. The windows achieve an amazing insulation value of R-11 at the center of the glass.

**HEATING/COOLING** | Mr. Slim Hyper Heat ductless mini-split air-source heat pumps | Mitsubishi, [www.mehvac.com](http://www.mehvac.com) | Installed by Comfort Systems USA, [www.comfortsystemsusaohio.com](http://www.comfortsystemsusaohio.com) | Super-efficient heat pump with variable-speed compressor, variable heating and cooling output, environmentally friendly refrigerant, superior air filtration, wireless remote control, and quiet operation. Provides heat down to -13 degrees Fahrenheit.





## HOME EXTERIOR

**ROOF** | Landmark Solaria fiberglass-asphalt roof, | CertainTeed, [www.certainteed.com](http://www.certainteed.com) | Shingles with solar-reflective granules for a cooler roof.

**SIDING** | Fiber-reinforced cementitious panels and siding | James Hardie Building Products, [www.jameshardie.com](http://www.jameshardie.com) | Durable siding not made of petroleum-based chemicals.

**EXTERIOR PAINT** | SuperPaint acrylic latex | Sherwin-Williams, [www.sherwin-williams.com](http://www.sherwin-williams.com) | Durable, low-VOC exterior coating.

**VENTILATION** | ComfoAir 350 EX L Luxe energy-recovery ventilation (ERV) unit | Zehnder, [www.zehnderamerica.com](http://www.zehnderamerica.com) | Installed by Comfort Systems USA, [www.comfortsystemsusaohio.com](http://www.comfortsystemsusaohio.com) | Exhausts stale air and brings in fresh air while capturing approximately 84 percent of the heat, controlling humidity, and filtering the air.

**LIGHTING** | Energy-efficient LED bulbs and fixtures | GE Lighting, [www.gelighting.com](http://www.gelighting.com) | Edge Lighting, [www.edgelighting.com](http://www.edgelighting.com).

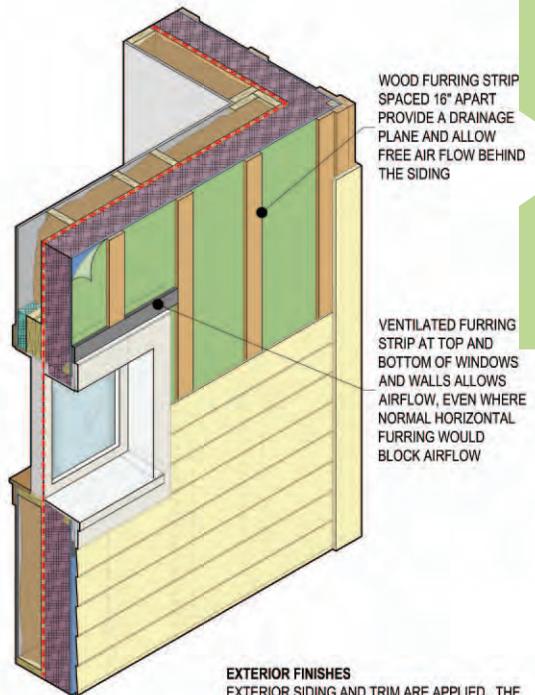
**OAK HARDWOOD FLOORING** | Reclaimed from house deconstructed in Cleveland Heights | Greater Cleveland Habitat for Humanity ReStore, [www.gchfh.org](http://www.gchfh.org).

**INTERIOR DOORS** | Emerald Safe 'N Sound solid core paint-grade doors | Masonite, [www.masonite.com](http://www.masonite.com) | B&B Wood Products, [www.bbwood.com](http://www.bbwood.com) | Made from wheat straw, a rapidly renewable resource, with pre-consumer recycled content and low formaldehyde emissions.

**DOOR HARDWARE** | Schlage Latitude lever handles | Cleveland Vicon, [www.clevelandvicon.com](http://www.clevelandvicon.com) | Lever-style door handle for easy use by people of all abilities.

**INTERIOR PAINT** | ProMar 200 acrylic latex | Sherwin-Williams, [www.sherwin-williams.com](http://www.sherwin-williams.com) | Low-VOC paint for healthy indoor air quality.

**CABLE CONNECTIONS** | In-wall wiring for cable TV and data | Time Warner Cable, [www.timewarnercable.com/neowpa/](http://www.timewarnercable.com/neowpa/).



**EXTERIOR FINISHES**  
EXTERIOR SIDING AND TRIM ARE APPLIED. THE DESIGN OF THE EXTERIOR MATCHES THE ARCHITECTURAL CHARACTER AND STYLE OF THE OF THE ADJACENT HOMES



## FIRST FLOOR

**TIMBER FRAME DECORATIVE ARCH FROM RECLAIMED WOOD** | DY Timberframing, [www.dytimberframing.com](http://www.dytimberframing.com).

**STONE FLOOR** | Natural slate | Virginia Tile, [www.virginiatile.com](http://www.virginiatile.com).

**WINDOW TREATMENTS** | Energy-conserving Hunter Douglas Duette blinds Timan Custom Window Treatments, [www.timanwindowtreatments.com](http://www.timanwindowtreatments.com).

**LIVING ROOM TABLES** | Tables made of wood reclaimed from deconstructed Cleveland houses | A Piece of Cleveland, [www.apieceofcleveland.com](http://www.apieceofcleveland.com) | APOC is a leader in the creative repurposing of materials mined from the many buildings being demolished in Cleveland.

**LIVING ROOM CABINET** | Walnut and hickory cabinet, locally made by Freddy Hill Designs, <http://bombfactoryfurniture.com>.

**DINING ROOM TABLE** | Freddy Hill Designs table with bamboo top and reclaimed steel base | <http://bombfactoryfurniture.com>.

**KITCHEN ISLAND** | Scoop chairs made from reclaimed material by Steelcase loaned from Ohio Desk, [www.ohiodesk.com](http://www.ohiodesk.com).

**KITCHEN CABINETS** | KraftMaid cabinets discounted by Home Depot, [www.homedepot.com](http://www.homedepot.com) | Produced locally in Middlefield, OH, with wood-conserving manufacturing processes.

**ENERGY STAR APPLIANCES** | GE Profile refrigerator and dishwasher | Home Depot, [www.homedepot.com](http://www.homedepot.com) | Thanks to improvements in insulation and compressors, today's refrigerators use much less energy than older models. Energy Star qualified refrigerators are 20 percent more energy efficient than the minimum federal standard, which can cut energy bills by around \$165 over the lifetime of the refrigerator.

**COOKTOP** | GE Profile electric induction cooktop | Home Depot, [www.homedepot.com](http://www.homedepot.com) | Induction technology heats only the pan and its contents and offers energy efficiency by reducing wasted heat when compared to radiant and gas cooktops. Since there is not a traditional thermal heating element,

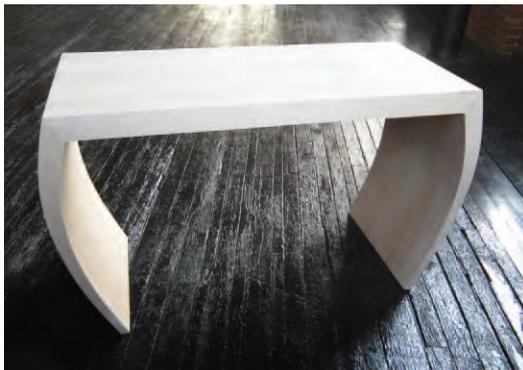




the induction cooktop stays cooler than conventional radiant cooktops. Passive houses are tightly sealed, so they cannot have gas cooktops that require venting of combustion gases to the outside.

**COUNTERTOP** | IceStone, [www.icestone.biz](http://www.icestone.biz) | Installed by Stoneworks, [www.stoneworksltd.com](http://www.stoneworksltd.com) | Durable surface made of 100 percent recycled glass in a cement matrix. VOC-free. Only durable surface in the world to receive Cradle to Cradle Gold certification for life-cycle sustainability.

**KITCHEN FAUCET** | Lancaster Eco-Performance faucet in stainless steel | Moen, [www.moen.com](http://www.moen.com) | Users can easily switch between water-conserving, low-flow stream or spray at 1.5 gallons per minute or a full flow option at 2.2 gallons per minute for tasks that require a set amount of water, such as filling a pot.



## SECOND FLOOR

**OFFICE** | Steelcase Think Chair loaned by Ohio Desk, [www.ohiodesk.com](http://www.ohiodesk.com) | The first chair to receive Cradle to Cradle certification for life-cycle sustainability. It is made of 41 percent recycled materials and is 99 percent recyclable by weight. | Freddy Hill Designs fluorescent lamp with reclaimed wood base and touch light control. | Freddy Hill Designs Marin desk made from locally sourced woods. | <http://bombfactoryfurniture.com>.

**LOUNGE CHAIR** | Herman Miller Eames Lounge Chair loaned by APG Office Furnishings, [www.APGOF.com](http://www.APGOF.com) | Constructed in a LEED Silver manufacturing facility, this chair and ottoman are 35 percent recyclable and made of 29 percent recycled materials. The wood of the base is sustainably harvested.

**CHILD'S ROOM** | MAX Bench from Freddy Hill, [www.bombfactoryfurniture.com](http://www.bombfactoryfurniture.com) | Locally designed and produced out of reclaimed wood. Freddy Hill Designs bench at foot of bed made from reclaimed pine wood. | Freddy Hill Designs with Jason Radcliffe, The Mouse Desk and Chair made from reclaimed steel.

**TOILETS** | Toto Aquia dual-flush toilets | Toto USA, [www.totousa.com](http://www.totousa.com) | It's estimated that toilet flushing accounts for more than 25 percent of home water use — which means that a lot of purified, potable water is used just to flush away waste. Newer low-flush toilets (1.6 gallons per flush) conserve water and have been engineered to flush more effectively. Dual-flush toilets allow further savings by offering the choice of a 0.9-gallon flush when less water is needed.

**FAUCETS** | Eva high-arc bathroom faucets in brushed nickel | Moen, [www.moen.com](http://www.moen.com) | Meet EPA's WaterSense standard for water efficiency and performance. Moen received the WaterSense Manufacturer Partner of the Year award for 2010.

**SHOWERHEAD IN MASTER BATH** | Level One Eco-Performance shower head | Moen, [www.moen.com](http://www.moen.com) | Designed to use up to 30 percent less water, yet maximize the power of water to provide a thorough rinse. Meets EPA WaterSense criteria.

**TOWEL RACK** | Heated towel bar radiator | Zehnder, [www.zehnderamerica.com](http://www.zehnderamerica.com) | Efficient heating for warm, dry towels – and supplementary heat for the whole house. SmartHome requires so little heating to maintain temperature that a heated towel rack can be a major heat source.

**MASTER BEDROOM CHAIRS** | Two Joel Chairs from Coalesse loaned from Ohio Desk, [www.ohiodesk.com](http://www.ohiodesk.com). | These chairs have a natural wool fabric on them that is recyclable material. The chair itself is made of 14 percent recycled materials, and 80 percent of the chair's materials are recyclable at the end of its life cycle.





# FEATURES EXPECTED TO BE ADDED AT WADE PARK AVENUE LOCATION

## A Neighborhood Asset

Following the close of the PNC SmartHome Cleveland exhibit, SmartHome will be moved to a nearby lot on Wade Park Avenue and become available for purchase as a residential home for a Cleveland family. Sales information is available through Realtor Ernie Cahoon with Howard Hanna. For more details, call (216) 440-1210.

**INSULATED FOUNDATION** | Insulated concrete forms | Logix Platinum Wall | [www.logixicf.com](http://www.logixicf.com) | Installed by Wallrus Wall Systems | [www.wallruswallsystems.com](http://www.wallruswallsystems.com).

**GARAGE ROOF** | POWERply T24 membrane roof | Tremco | [www.tremcoroofing.com](http://www.tremcoroofing.com) | Reflective membrane roof on which a solar panel array can be installed.



wade park avenue perspective

## ECO-MINDED ARTWORK

PNC SmartHome Cleveland features the work of some of Northeast Ohio's top artists working with environmental themes, materials and processes. These works include imagery, thoughts and ideas that address climate change and our impact on the planet. All of the artists live and work in this community, contributing to the cultural and economic fabric of this region. The installation was curated by Christy Gray of the Red Dot Project ([www.reddotproject.org](http://www.reddotproject.org)), a nonprofit organization that connects artists in Northeast Ohio with business opportunities.



### PARTICIPATING ARTISTS INCLUDE:

Judy Brandon  
Johnny Coleman  
Susie Frazier  
Rosalyn Gaier  
Fred Gearhart  
Bradley Hart  
Michel Ina  
Tricia Lazuka  
Charlotte Lees  
Liz Maugans  
Nicole McGee  
Nancy Richards-Davis  
Chris Zielski

Before SmartHome is moved to its permanent location in a nearby neighborhood, art featured in the home will be available for purchase during a SmartSale on October 9, 2011.

## SUSTAINABLE LANDSCAPING

With the support of the Northeast Ohio Regional Sewer District, the landscape design for PNC SmartHome Cleveland demonstrates sustainable site practices in stormwater management and use of low-maintenance, native plants. A demonstration solar array is also on display. The landscaping was installed by F. Buddie Contracting, Cirino & Son Landscaping, Corsi Landscape, and Royal Landscape. Klyn Nurseries supplied plants, and Vizmeg Landscape supplied sod.

Stormwater runoff has become the region's biggest water quality challenge. During heavy rains, storm water runs off impervious surfaces, such as parking lots and rooftops, and causes flooding and stream erosion. The water picks up pollutants along the way and carries them to Lake Erie.

Everyone has a stake in reducing stormwater pollution. For tips on what you can do around the house, see [www.neorsd.org/rainworkingforyou.php](http://www.neorsd.org/rainworkingforyou.php). By installing approved stormwater management techniques, homeowners can earn credits to reduce future storm water fees.



### What to See

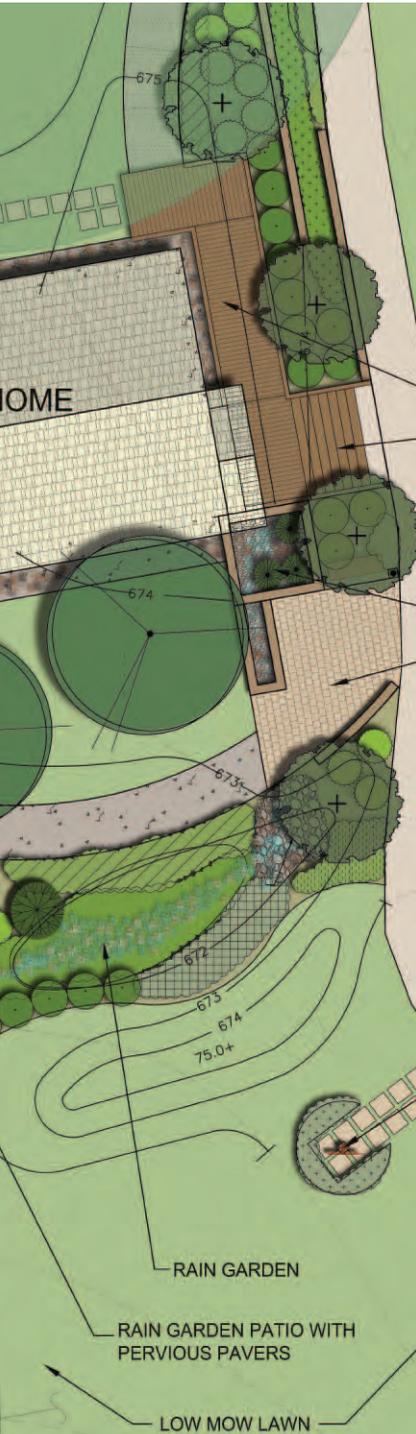
**ENTRY RAMP SURFACE MADE OF PERVIOUS CONCRETE** | Porous concrete is made of a courser mix of aggregate which creates voids allowing water to drain through, thus reducing stormwater runoff and increasing groundwater recharge. The gentle slope of the ramp is ADA-compliant.

**PLAZA PAVEMENT** | Eco-Priora permeable unit pavers | Unilock, [www.unilock.com](http://www.unilock.com) | Pavers have wide joints to allow water to infiltrate into the ground. A stone base under the pavers increases the amount of water that can be retained.

**WATER FEATURE** | The plaza at the front of the house features a rain chain and two-tiered structure, serving as a precipitation-fed water feature. Roof runoff flows from the gutter along a rain chain into a two-tiered basin that carries water under the pervious paver plaza to the rain garden. Sights and sounds of water in motion provide seasonal interest. Collection basins are filled with decorative aggregate materials and water-tolerant plants, such as species found in bogs or along pond edges.

**RAIN GARDEN** | Rain gardens are landscape features that collect and slow the rapid flow of stormwater runoff from hard surfaces, such as pavements and buildings. They allow for percolation of runoff to recharge groundwater and lessen





stress on storm sewers. They can also filter contaminants from storm water. The PNC SmartHome Cleveland rain garden collects runoff from the roof, patio areas, and much of the garden path on the south side of the exhibit site. Water and drought-tolerant native plants fill the rain garden basin.

**CISTERN** | 500-gallon, above-ground tank made of high-density polyethylene | Rain Brothers, [www.rainbrothers.com](http://www.rainbrothers.com) | Cisterns and smaller rain barrels prevent water pollution by preventing storm water from running off the site. Tank is sized to store all the water from one side of the PNC SmartHome Cleveland roof during a one-inch rain event. The water can be used to water the landscape.

**EXTERIOR LIGHT** | LED light post | Holophane Lighting, [www.holophane.com](http://www.holophane.com) | Efficient LED lighting, with full cutoff, downward fixture to reduce light pollution at night.

**SOLAR PANEL ARRAY** | Pole-mounted array by Dovetail Solar and Wind, [www.dovetailsolar.com](http://www.dovetailsolar.com) | Photovoltaic panels convert sunlight to electricity without the carbon emissions and other pollutants created when burning coal or other fossil fuels. An array about four times larger than this display could make SmartHome a net-zero energy house on an annual basis.

**SOLAR PANEL TRACKING** | emPower Plant manual tracking system | Sunflower Solutions, [www.thesunflowersolutions.com](http://www.thesunflowersolutions.com). | The world's first manually adjusted solar power tracking system, aimed at schools, hospitals, farms, water pumps, small businesses, and homes in the developing regions of the world. It allows solar arrays to produce up to 40 percent more power than stationary arrays without using complicated and costly technology. Developed by Sunflower Solutions, a Cleveland start-up company.

**TREES AND GARDEN PLANTS** | Plants selected for PNC SmartHome Cleveland are predominantly native to Northeast Ohio and the Great Lakes region — and are generally more adaptable to local climate and soil conditions and need less maintenance once they become established. They include several species of trees, shrubs, perennials and grasses that are arranged to play useful roles beyond enhancing the appearance of the house and its site. For example, deciduous oak and river birch trees on the south side of the house are located to provide shade from summer sun once they begin to mature. Ornamental serviceberries, elderberries and choke cherries grow fruits that attract birds. The Rain Garden includes plants that can tolerate both wet and drought condition. Flowers and seeds of several species attract butterflies and birds. A display of sand barren landscape plants provides an example of the type of vegetation that was indigenous to Wade Oval's sandy soils before the area was settled.

## ECO-TIPS FOR YOUR OWN HOME

You don't have to buy a new passive house to reduce your energy bills. Here are 8 smart ways to save energy now:

### Change light bulbs

Compact fluorescent light bulbs (CFLs) use up to 75 percent less energy than traditional incandescent bulbs and can last 10 times as long. Newer LED bulbs use even less energy. And, of course, turn out the lights when you leave a room!

### Weatherize

Caulking and insulating to reduce air leaks can reduce heating and cooling demands dramatically. Get a home energy audit to discover the most cost-effective options.

### Save water

Pumping and heating water require large amounts of energy. Install low-flow faucets and showerheads, turn the water off while you shave or brush your teeth, and wash clothes in cold water.

### Buy efficient appliances

Replacing older appliances with Energy Star models can significantly reduce your electricity bill and your carbon footprint. Start with the refrigerator, which uses the most electricity in an average home.

### Stop energy "vampires"

As much as 5 percent to 8 percent of home electricity is consumed by appliances and electronic devices in passive or standby mode. Use powerstrips to turn devices off.

### Eat lower on the food chain

To reduce the environmental impact of your diet, eat more whole grains, fruits and vegetables, while eating less meat and processed foods. Try to eat local foods in season.

### Reduce, reuse, recycle

Buy only what you really need, and recycle whatever you can. Take reusable cloth bags to the store, and choose products that don't have excessive packaging. Compost kitchen waste.

### Calculate your carbon footprint

To get a better grasp of your environmental impact, calculate the greenhouse gas emissions from your energy consumption at [www.clevelandcarbonfund.org](http://www.clevelandcarbonfund.org).



## ECO-RESOURCES FOR DESIGN AND SUSTAINABLE LIVING

The GreenCityBlueLake Institute is the sustainability center of The Cleveland Museum of Natural History. It is a nationally recognized center of thought and practice about urban sustainability that promotes the design of ecological cities that are good for people and nature. Its staff has expertise in the fields of green building, city and regional planning, transportation, watershed planning, energy, carbon footprint analysis and planning to mitigate climate change.



The website of the GreenCityBlueLake Institute ([www.gcbl.org](http://www.gcbl.org)) is the most comprehensive source of information about sustainability in Northeast Ohio. Here are links to more information and resources that can help you turn your home into a SmartHome — and discover other ways to reduce your environmental impact:

**GREEN BUILDING:** [www.gcbl.org/building/green-building](http://www.gcbl.org/building/green-building)

**ENERGY CONSERVATION AND EFFICIENCY:**  
[www.gcbl.org/energy/conservation-and-efficiency](http://www.gcbl.org/energy/conservation-and-efficiency)

**HOME WEATHERIZATION AND ENERGY AUDITS:**  
[www.gcbl.org/energy/conservation/efficiency/  
weatherization-and-insulation](http://www.gcbl.org/energy/conservation/efficiency/weatherization-and-insulation)

**RENEWABLE ENERGY:** [www.gcbl.org/energy/renewables](http://www.gcbl.org/energy/renewables)

**LOCAL FOOD:** [www.gcbl.org/food/local-markets](http://www.gcbl.org/food/local-markets)

**LANDSCAPING AND STORMWATER MANAGEMENT:**  
[www.gcbl.org/water/healthy-yard-clean-water](http://www.gcbl.org/water/healthy-yard-clean-water)

**LANDSCAPING WITH NATIVE PLANTS:** [www.gcbl.org/land/landscaping](http://www.gcbl.org/land/landscaping)

**TRANSPORTATION ALTERNATIVES:**  
[www.gcbl.org/transportation](http://www.gcbl.org/transportation)

**REDUCING CARBON EMISSIONS:** [www.gcbl.org/energy/regional-agenda/climate-change](http://www.gcbl.org/energy/regional-agenda/climate-change)

## **GLOSSARY**

**ACH (air changes per hour)** — A measure of how drafty a house is, typically measured by a blower-door test that creates negative or positive pressure in the house to accentuate where air is leaking in.

**Building envelope** — The structure that separates the interior and exterior of a building. In a passive house, the building envelope is designed carefully to limit air leaks and to control moisture.

**Carbon footprint** — Amount of greenhouse gases, such as carbon dioxide, emitted by a person (or group) as a result of all activities in a given period of time.

**Energy-recovery ventilation (ERV)** — A ventilation system that transfers heat from exhaust air to incoming fresh air to save energy.

**Energy Star** — A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy promoting energy-efficient products and building practices

**Greenhouse gases** — Gases in the Earth's atmosphere, such as carbon dioxide and methane, that trap heat.

**HERS (Home Energy Rating System) rating** — A scoring system established by the Residential Energy Services Network (RESNET) to compare the energy performance of homes. A HERS Reference Home (based on the 2006 International Energy Conservation Code) scores 100, while a net-zero energy home scores 0. Each 1-point decrease in the HERS Index corresponds to a 1 percent reduction in energy consumption. Homes that meet the Passive House standard typically score about 15-20.

**LED (light-emitting diode)** — A semiconductor diode that efficiently converts electric power to light. Small LEDs have been used in electronic devices for many years, and more recently they have been adapted to replace light bulbs in buildings, as they are more efficient than compact fluorescent (CFL) bulbs.

**Net-zero energy house** — A house that requires no energy from outside sources on an annual basis. Such a house will have some sort of renewable energy source, such as solar panels, but it does not have to be “off the grid.” It can consume energy at times and produce energy at times, as long as the net for the year is zero.

**Passive house** — A house that has been certified by the U.S. Passive House Institute as meeting the Passive House Building Energy Standard.

**R-value** — A measure of thermal resistance used to indicate how well an insulation material impedes the flow of heat. The higher the value, the more effective the insulation.

**Rain garden** — A garden designed to intercept the flow of rainwater runoff so the water can soak into the ground instead of flowing directly into storm sewers, streams or lakes.

**Solar panel** — A module of solar cells that converts the energy of sunlight to electricity. Also called a photovoltaic (PV) panel.

**Storm water** — The water that runs off of impervious surfaces (roads, parking lots, rooftops, hard-packed lawns) during rain events. In addition to causing flooding, storm water typically flows into streams and lakes without treatment, causing water pollution.

**Structural insulated panel (SIP)** — An energy-efficient construction material typically made of large sheets of rigid foam insulation sandwiched between plywood or oriented-strand board. SIPs can be strong enough to form the structural walls of buildings.

**Sustainability** — A process of decision-making that takes future generations into account and integrates considerations of economic progress, social equity and environmental quality.

**Thermal bridge** — Where noninsulating materials, such as metal or wood, conduct heat through the entire thickness of a wall. Buildings can be made more energy efficient by breaking thermal bridges with a layer of insulation.

**Urban heat island effect** — The tendency of urban areas to be hotter than surrounding areas because of less vegetation and more hot surfaces, such as roads and rooftops.

**VOCs (volatile organic compounds)** — Hydrocarbon compounds that evaporate readily and are often found in paints, adhesives and petroleum products. Many are toxic.



## SPECIAL THANKS TO OUR DESIGN TEAM:



## THANK YOU TO ALL OUR PARTNERS:

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**(AS OF MAY 13, 2011)**

**Thank You!**

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TO INSPIRE, THROUGH  
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A PASSION FOR NATURE,  
THE PROTECTION OF  
NATURAL DIVERSITY,  
THE FOSTERING OF HEALTH,  
AND LEADERSHIP TO A  
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