

**BUILDING AMERICA CONSORTIA
AND
NATIONAL LABORATORY
STATUS REPORT**

February 2010

IBACOS®
| Home Quality + Performance |

MONTHLY STATUS REPORT, February 2010

Cooperative Agreement DE-FC26-08NT 02231

Prepared by IBACOS

I. CURRENT PROGRESS AT EACH GATE LEVEL

Task 2

Gate 1A – *Expected Whole House Energy Savings and Cost Targets*

- IBACOS completed a detailed modeling study on how different wall and window assemblies affect comfort conditions and energy usage. IBACOS conducted detailed TRNSYS modeling on the lab house designs located in Pittsburgh, PA, Atlanta, GA, and Phoenix, AZ. A total of 15 high performance wall systems (including a base wall) and five high performance window systems (including a base window) were modeled to research the comfort and energy impacts of various wall and window configurations in the Cold, Mixed-Humid and Hot-Dry climate zones. These research results were incorporated into a paper for the Buildings XI Conference and submitted for peer review to the conference organizers and the National Renewable Energy Laboratory (NREL).
- IBACOS conducted a parametric study of high performance wall system house designs. Figure 1 below displays the whole house annual average Thermal Comfort Performance Index (TCPI) values determined for each of the designs. In this study, only the wall system characteristics changed, and all other house system components remained unchanged; windows were modeled with values at $U=0.25$ and $SHGC=0.27$. Across all of the climates zones IBACOS studied, three wall types exhibited the best comfort conditions—a 2x8 staggered study wall with 2” of exterior insulating sheathing (the wall used to be for the Cold-Pittsburgh lab house), a 2x6 stud wall with 3” of exterior insulating sheathing and a layer of spray polyurethane foam insulation (with blown fiberglass insulation in the wall cavities), and a 2x6 stud wall with 4” of exterior insulating sheathing. In addition, an analysis of the modeling results determined that building high performance walls in a Cold climate location will increase comfort significantly more than in the other climate zones.

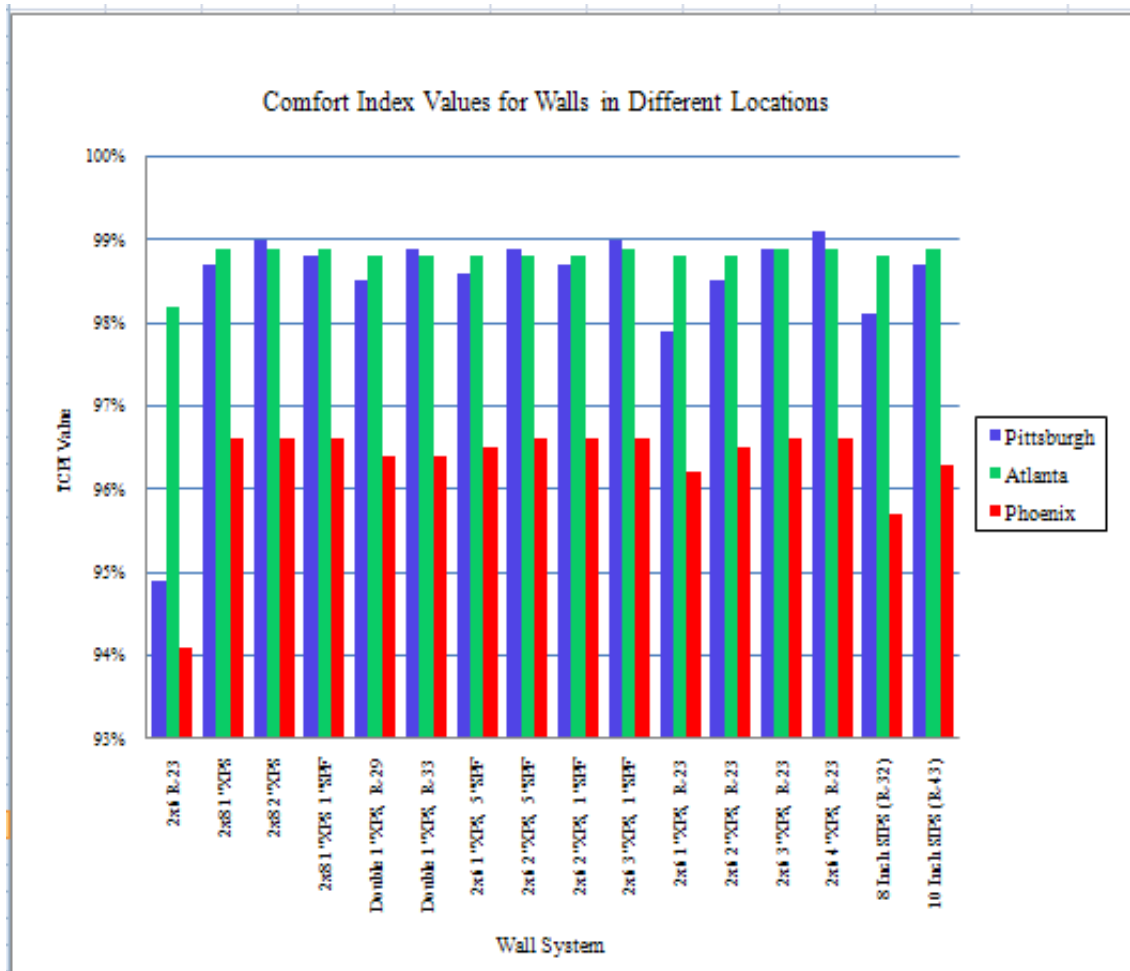


Figure 1: Whole house annual average TCPI values for each high performance wall system house design that IBACOS studied

- With regard to wall system energy usage in the Pittsburgh, PA models, IBACOS observed a good correlation between the comfort index values and annual heating and cooling energy use. Wall systems with low space conditioning energy usage had high TCPI values. In Atlanta, GA, this correlation was not as evident. Many of the wall systems IBACOS studied would be suitable for Atlanta house designs, because they have a high comfort index value and low heating and cooling energy usage. In Phoenix, AZ, a good correlation exists between high TCPI values and low space conditioning energy usage for the leading wall systems.
- Parametric modeling of window systems was based on a 2x8 staggered stud wall with 2" of exterior insulating sheathing (the wall to be used in the Cold-Pittsburgh lab house). TRNSYS modeling indicated that windows with triple glazing, a U-value of 0.19 or less, and a SHGC of 0.22 or less provided the best comfort situations in all three climate zones. However, even

with these windows, discomfort from overheating occurred in south-facing bedrooms in the Hot-Dry climate zone, reinforcing the value of exterior and permanent shading devices. Using high solar heat gain windows in the Cold climate zone resulted in overheating and discomfort during the shoulder seasons. Figure 2 shows the whole house annual average TCPI values for the high performance window system house designs for all study locations. The U-value and SHGC for each window system is noted.

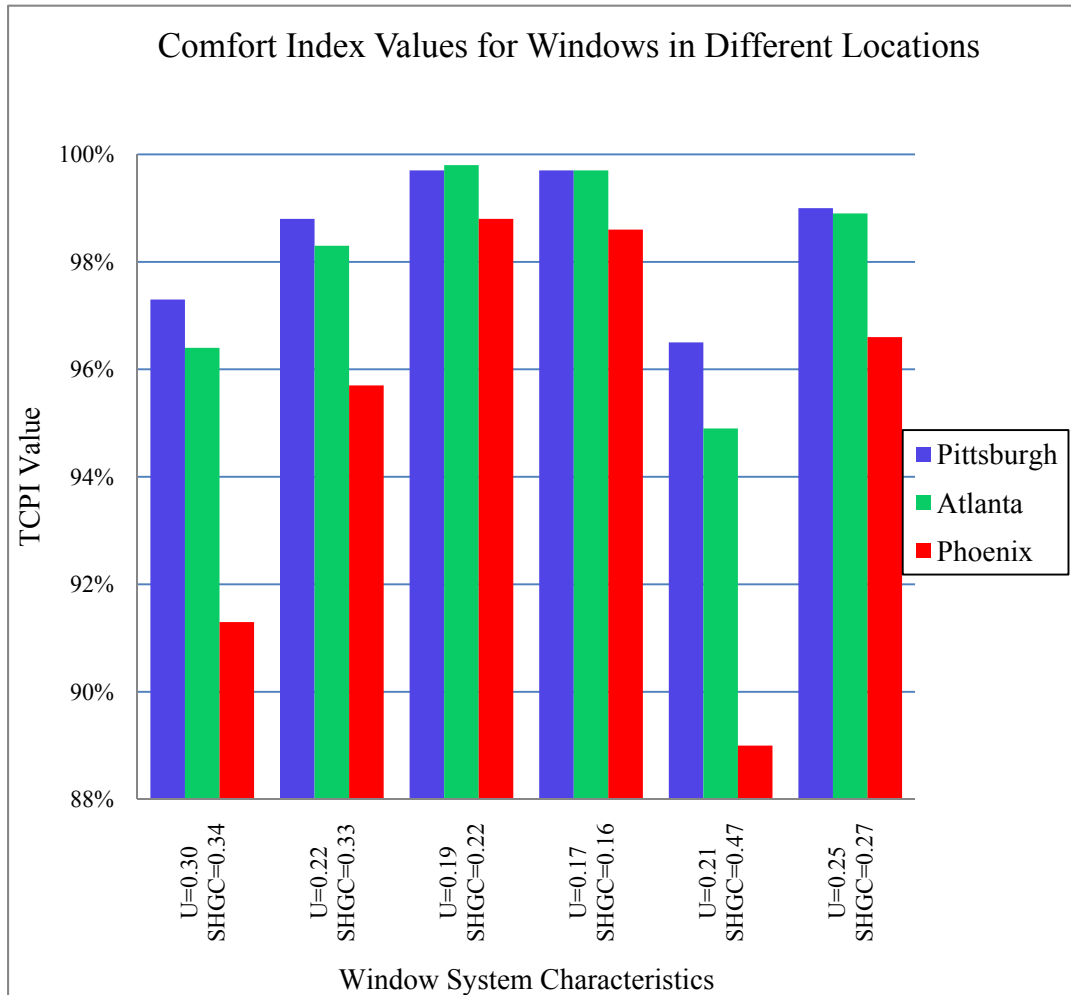


Figure 2: Whole house annual average TCPI values for each high performance window system house design that IBACOS studied

- IBACOS continued integrating technical details and results from the December mock-up activities into the final construction documentation for the Cold-Pittsburgh Lab House.
- IBACOS documented the key findings from its mock-up work related to the use of Dow

STYROFOAM™ Brand WALLMATE™ Insulation as exterior insulation on above-grade walls. IBACOS evaluated 2” thick, 2’x8’ WALLMATE Insulation as an above-grade exterior wall insulating sheathing product.

- IBACOS evaluated the constructability and durability of a 4” thick Exterior Insulation and Finish System (EIFS) over a 2x6 stud frame with continuous 7/16” OSB structural sheathing. The EIFS system incorporated a fluid-applied drainage plane material and drainage channels formed using the base coat adhesive material behind the foam. IBACOS also assessed the flashing details for one window installed in the wall assembly.

Gate 1B – Systems Evaluations and Specifications

- The field test at The New American Home® 2009 in Las Vegas, NV continued to take measurements related to the gas engine-fired mini-split heat pump system and the gas-fired tankless water heater.
- The field test at The New American Home 2008 in Orlando, FL continued to take measurements related to the thermal and moisture performance of the aerated concrete block wall. IBACOS expects to conclude this test in the near future.

Task 3

Gate 2 – Prototype House Evaluations

- **Ecological Construction Laboratory – Champaign, IL, 50%, Cold.** Monitoring and data collection continued in February.
- **Harvard Communities – Denver, CO, 50%, Cold.** Data acquisition is underway and will continue for the rest of 2010. New homeowners that now occupy the house have given their consent to permit ongoing monitoring. Now that the house is occupied, IBACOS can evaluate the performance of the domestic water heating (DHW) system.
- **Imagine Homes – San Antonio, TX, 50%, Hot-Humid.** Advanced framing layouts are substantially complete. In March, drawings will be developed for key framing details and drainage plane integration using exterior extruded polystyrene (XPS) foam sheathing. Work continued on the final details for the solar system configuration (tank size and number of collectors) using TRNSYS and TRNSED modeling. The builder worked on securing financing, and construction is projected to start in early April.
- **Insight Homes – Sussex County, DE, 50%, Mixed-Humid.** IBACOS provided Insight Homes with the energy use analysis for several building specification packages that the builder requested to evaluate for achieving the 50% level of source energy use savings. The specification package options included the use of balanced ventilation, a ground source heat pump with an integral desuperheater, continuous exterior foam sheathing on above-grade walls, and enhanced attic insulation. Work will continue during March to assess costs associated with the specific design packages and determine the construction schedule for the prototype house.

- **K. Hovnanian Homes – Ontario, CA, 50% Hot-Dry.** IBACOS finalized a 50% solution specification package for the prototype house in February. The house is now scheduled to start construction between May 15th and June 15th, 2010.
- **Meritage Homes – Phoenix/Tucson, AZ, 50% Hot-Dry.** The builder is still planning to use insulating concrete forms (ICF) construction technology in its Phoenix high performance package and advanced framing for its Tucson package. Pricing on these strategies was still underway in February.
- **Pine Mountain Builders – Pine Mountain, GA, 50%, Mixed-Humid.** Monitoring continued on the two completed 50% prototype houses. The discussions centered on applications of exterior foam sheathing, advanced framing, improved insulation strategies, and reduced infiltration strategies, with the goal of developing more cost-effective design strategies that still meet the 50% source energy savings milestone.
- **Wathen-Castanos – Fresno, CA, 50%, Hot-Dry.** During the first week of February, IBACOS visited the builder’s Work Improvement Groups to get an update on their progress and provide further coaching on using the quality management tools to achieve their objectives. The builder has rolled out its second generation Hybrid Home (≈47% savings WRT BA Benchmark), and in February, a 50% solution specification package was selected for the prototype house that the builder will market as its Concept Home. Construction is scheduled to begin in March and completed in June 2010.

Task 4

Gate 3 – *Initial Community-Scale Evaluations*

- **Imagine Homes – San Antonio, TX, 40%, Hot-Humid.** The builder met all G3 “Must Meet” and “Should Meet” criteria. More than 10 houses are complete.
- **Pine Mountain Builders – Pine Mountain, GA, 40%, Mixed-Humid.** The builder met all G3 “Must Meet” and “Should Meet” criteria. More than 10 houses are complete.
- **Tindall Homes – Mansfield, NJ, 40%, Mixed-Humid.** The builder met all G3 “Must Meet” and “Should Meet” criteria. More than 10 houses are complete.
- **Insight Homes – Sussex County, DE, 40%, Mixed-Humid.** IBACOS continues to work with Insight Homes on various “Should Meet” Stage Gate criteria for communities, as well as other criteria related to prototype houses. Since Insight Homes was building 40% houses as its standard specification when it partnered with IBACOS in 2007, a prototype house project at the 40% level of energy savings was not completed with the builder. During discussions with NREL in January, it was decided to include Insight Homes as one of the 40% Mixed-Humid communities for the 2010 Mixed-Humid Project Management Milestone (PMM) Report. IBACOS has focused on compiling the work completed with the builder to include it in the report.

II. SUMMARY OF TECHNICAL HIGHLIGHTS

Task 1 – Building America System Research Management and Technical Support

- IBACOS coordinated with Building America Teams and NREL on draft documentation for the five projects that will be featured in the 2010 Mixed-Humid PMM Report. The communities are:
 - Insight Homes, Sussex County, DE
 - Pine Mountain Builders, Pine Mountain, GA
 - Struever Bros. Eccles & Rouse, Baltimore, MD
 - Tindall Homes, Mansfield, NJ
 - Urbane Homes, Louisville, KY

Task 2

Stage 1 – Integrated Solutions for Specific Climate Regions and System Performance Evaluations

- One of the key findings from IBACOS' mock-up work related to the use of Dow STYROFOAM™ Brand WALLMATE™ Insulation as exterior insulation on above-grade walls was that while foam sheathing is becoming increasingly common in the market, the use of foam with integrated recessed furring strips in exterior wall applications is still a fairly uncommon practice. Therefore, the tools needed to make additional channels/grooves in the foam (e.g. hot knife and foam knife) are not typically found on a construction site. However, these tools are not significant additions to a trade partner's arsenal, since a hot knife costs approximately \$200 to \$800, depending on the accessories. IBACOS also determined that the furring strips can be fastened with 12d 3-1/4" collated framing nails at 16" o.c. from top to bottom; however, before recommending this schedule to the general industry, the manufacturer will need to perform additional structural evaluations in order to determine if this nailing schedule meets all wind and shear load requirements. If these loads can be met via nails instead of screws, it is possible to produce substantial production efficiencies. IBACOS built upon existing research from Building Science Corporation (BSC) regarding the fastening of furring strips and will coordinate future work in this area with BSC.
- IBACOS evaluated the constructability and durability of a 4" thick EIFS over a 2x6 stud frame with continuous 7/16" OSB structural sheathing. Major conclusions are that EIFS is an easy way to increase wall insulation values without affecting the framing details or interior dimensions and layout. However, troweled-on adhesive must be applied properly to maintain the drainage channels behind the foam. There is a risk that installers will apply the adhesive incorrectly, inhibiting free drainage and trapping water behind the foam. Discussions with the manufacturer revealed that there are alternative options to providing drainage behind the foam that require less vigilance on the part of the installer.
- Planning continued with Verve Living Systems and Progress Lighting to complete the IBACOS Lighting Demonstration Area, which will highlight a range of high performance lighting solutions for targeted residential applications.

Task 3

Stage 2 – *Prototype Houses*

- **Meritage Homes.** The builder continued to explore the use of an innovative R-30 ICF wall system called HercuWall™ for the first floor construction with advanced framing for the second floor construction in the Phoenix, AZ market. Meritage Homes also continued to conduct pricing in February.
- **K Hovnanian Homes.** IBACOS and K. Hovnanian have settled on a 50% solution for the prototype house in Lake Elsinore, CA (Hot-Dry climate zone). The significant changes the builder will use include a 2x4 R-13 wall system with R-4 continuous expanded polystyrene (EPS) insulating sheathing under a one-coat stucco system, 90% fluorescent lighting, a tankless water heater, and all ENERGY STAR® appliances. In addition, the builder will also be upgrading the gas furnace from 80% to 92% AFUE and the air conditioning from a 13 SEER to a 14 SEER system.
- **Wathen-Castanos.** IBACOS and Wathen-Castanos have settled on a 50% solution for the prototype house. The significant changes the builder will use include a 2x4 wall system with JM Spider® blown fiberglass and an increase in the attic insulation to R-49. Buried attic ducts will also be considered. In addition, the builder is upgrading the furnace from 92% to 94% AFUE and the air conditioning from a 16 SEER to an 18 SEER. The builder will also be upgrading to a 98 EF Navien tankless water heating system.
- **Imagine Homes.** A solar thermal system has been selected for water heating (Roth HelioStar® 252 collectors with Bradford-White EcoStor™ SC). The builder expects to construct its prototype house during the second three months of 2010. The primary technical solutions under investigation for this Hot-Humid house include 2x6 advanced framing and solar thermal water heating.
- **The New American Home 2010.** Construction activities recommenced at the house with an emphasis on interior finishing work. All HVAC equipment is expected to be installed in March. The house is scheduled to be complete by May 1, 2010 in time to participate in a local parade of homes event.
- **The New American Home 2011.** Construction on the house started this month with pouring the footings and preparing the under-slab services. IBACOS provided technical assistance to the builder in its discussions with photovoltaic system providers.
- IBACOS continued to actively collect monitoring data from ten houses.

Task 4

Stage 3 – *Initial Community-Scale Evaluations*

- **Insight Homes.** Construction above the 40% level of energy savings continued on the backlog of houses the builder accrued through the end of 2009. IBACOS worked on developing roof water management details for Insight Homes, including proper valley

flashing, roofing underlayment, roof rake-to-vertical wall intersections, and roof penetrations. The details are being drawn up and will be sent to the builder for review during March. Currently, Insight Homes uses exhaust fans that coordinate operation to run intermittently throughout the day as needed to achieve a predetermined exhaust rate; however, this strategy does not provide a fresh air supply to the house. Preliminary modeling to evaluate the impact of a balanced ventilation strategy (ERV) in combination with the addition of 1" exterior rigid foam sheathing resulted in a whole house source energy use savings of approximately 50.2%, which is a 2% improvement over Insight Homes' standard building practice (48.2%). Further discussions with Insight Homes need to take place to determine the cost, constructability, and homeowner maintenance issues associated with implementing these design options.

Task 5

Stage 4 – Project Closeout, Final Evaluations of BA Communities

No 2010 activity planned.

Task 6 - Other Research Activities

IBACOS is waiting for approval of its BP3 Project Management Plan (PMP) before starting new work in the proposed area of "Solution Sets for Whole House Retrofits."

III. PROJECT MANAGEMENT ISSUES

IBACOS has not been contacted regarding the finalization of its BP3 PMP. IBACOS has recently proposed revisions to the scope of BP3 projects in the areas of quality management and retrofit. These efforts are currently on hold pending feedback and authorization from the Contract Officer that work can begin, or direction on the modification of work efforts based on the DOE's needs. Without timely feedback on the plan that was submitted in December 2009, the projects will not make the planned progress stated in the PMP.

The Building America Team Meetings for 2010 are listed on the Building Technologies Program Calendar, but no location is provided for the July and October meetings. While these meetings are typically held in Washington D.C. at DOE Headquarters, there has been discussion about hosting the meetings at a different location. Typically, these meetings are planned well in advance so that teams can make the appropriate travel arrangements. Without more detailed information, IBACOS is unable to make arrangements and is concerned about being able to adequately plan for these future Building America Team Meetings.

IV. INPUT ON UPCOMING EVENTS FOR EERE'S 30-60-90 DAY REPORT

Event Date: March 25, 2010; 10:00 – 10:45am
 Event: **Net Zero Energy Lab Home Groundbreaking**
 Location: Pittsburgh, PA; Cobblestone Community
 Description: Media and community event to launch the Cold climate lab home being built by IBACOS and S&A Homes in Pittsburgh as part of our advanced systems research. The event will consist of a few brief presentations, a Q&A session, and a photo opportunity. A follow-up ribbon cutting event will be held in the fall and will include a tour of the finished house.
 Participants: builders, select industry suppliers, local and regional elected officials, the media, and the public
 Action: DOE representatives are invited to attend.
 Program Contact: Elizabeth Scott, 412-325-1514

CONFERENCE PRESENTATIONS

The following is a list of conference presentations and peer-reviewed papers IBACOS is delivering in 2010.

Event	Presentation or Paper	Presenter
International Builders' Show (January 19-22)	X-Ray of The New American Home	Brad Oberg
<i>Builder Online</i> Presidential Online Seminar Series (April 8)	How to Use Energy Efficiency as a Competitive Advantage	Brad Oberg Michael Dickens John Friesenhahn (Imagine Homes) Mike Nimon (Wathen-Castanos Hybrid Homes Inc.)
Building Enclosure Science and Technology (BEST2) Conference (April 12-14)	Sustainable Lighting Products, Practices, and Principles	Brad Oberg
	Selecting the Ideal Windows for a High Performance Home in a Cold Climate	John Broniek
	Evaluating R-40 Above-Grade Walls for a Production Built Zero Energy House	John Broniek
	Best Practices® and Quality	Brad Oberg

	Issues in Residential Stucco Application	
	The Inherent Risk of Going Green	Graham Davis
Affordable Comfort Institute Conference (April 19-23)	Understanding Heating and Cooling Loads	Brad Oberg
	Building America Technology Updates	Brad Oberg
	Lighting, Appliances, and Misc. Electric Loads	Brad Oberg
	Duct Design and Register Selection	Brad Oberg
ACEEE Summer Study on Energy Efficiency (August 15-20)	Thermal Enclosure Design Challenges for a Cold Climate Zero Energy House	John Broniek
EEBA Excellence in Building Conference (October 12-14)	Sessions to be determined	Speakers to be determined
Buildings XI Conference (December 5-9)	Detailed Modeling Study on How Different Assemblies Affect Comfort Conditions in Zero Energy House Designs	John Broniek