

Envelope – Air – Quality

Mark S Taylor

University of Illinois at Urbana Champaign



Envelope – Air – Quality

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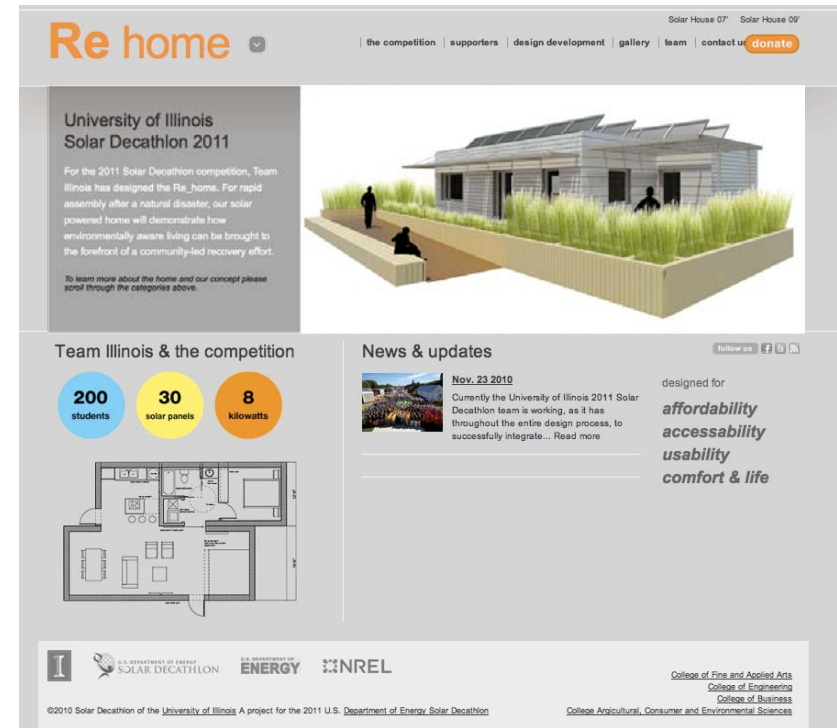
University of Illinois at Urbana Champaign



2009



2011



2009

GABLE HOME - A synthesis of vernacular architecture and new technology.

THE UNIVERSITY OF ILLINOIS SOLAR DECATHLON

Solar Decathlon | Gable Home | Media Page | Our Supporters | Team Contacts | Blog

[Learn About the Gable Home!](#)



NEWS AND UPDATES

17 Oct 09:
1st place in three competitions,
2nd in three more, 2nd overall!
CONGRATS!!

16 Oct 09:
Illinois Earns 2nd Place

11 Oct 09:
Illinois fan club growing

11 Oct 09:
Tours are open, competition in progress - Illinois in first!

GALLERY



Visit our [photo gallery](#) to see pictures of our project.

Also visit our [video gallery](#) to see animations and construction videos.

LINKS

U.S. Department of Energy Solar Decathlon

[Subscribe to our blog!](#)

University of Illinois:
College of Fine and Applied Arts
College of Engineering
College Agriculture, Consumer and Environmental Sciences

Team members: For more updates, log into the [Solar Decathlon Wiki](#).

CONTACT US

Current address:
At the I Hotel
1900 South 1st Street
Champaign, IL 61820

You may email us at:
solardecathlon@uius.edu.

The Gable Home will be available for public viewing by mid-January, 2010. Please contact us to [schedule a tour](#).

If you have a specific request or question, perhaps you can find the right person on our [contacts](#) page.

2011

Re home

Solar House 07 | Solar House 09

| the competition | supporters | design development | gallery | team | contact us | [donate](#)

University of Illinois Solar Decathlon 2011

For the 2011 Solar Decathlon competition, Team Illinois has designed the Re_home. For rapid assembly after a natural disaster, our solar powered home will demonstrate how environmentally aware living can be brought to the forefront of a community-led recovery effort.

To learn more about the home and our concept please scroll through the categories above.



Team Illinois & the competition

200 students | 30 solar panels | 8 kilowatts

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Nov. 23 2010
Currently the University of Illinois 2011 Solar Decathlon team is working, as it has throughout the entire design process, to successfully integrate... Read more

designed for

affordability
accessability
usability
comfort & life



Logos: U.S. DEPARTMENT OF ENERGY, SOLAR DECATHLON, ENERGY, NREL, College of Fine and Applied Arts, College of Engineering, College of Business, College Agriculture, Consumer and Environmental Sciences.

©2010 Solar Decathlon of the University of Illinois A project for the 2011 U.S. Department of Energy Solar Decathlon

Specific Demands with Reference to the Treated Floor Area				
Treated Floor Area:	45.3	m ²		
Applied:	Monthly Method	PH Certificate:		Fulfilled?
Specific Space Heat Demand:	14	kWh/(m ² a)	15 kWh/(m ² a)	Yes
Pressurization Test Result:	0.6	h ⁻¹	0.6 h ⁻¹	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	57	kWh/(m ² a)	120 kWh/(m ² a)	Yes
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Specific Primary Energy Demand Energy Conservation by Solar Electricity:	492	kWh/(m ² a)		
Heating Load:	25	W/m ²		
Frequency of Overheating:	%	over 25 °C		
Specific Useful Cooling Energy Demand:	5	kWh/(m ² a)	15 kWh/(m ² a)	Yes
Cooling Load:	21	W/m ²		

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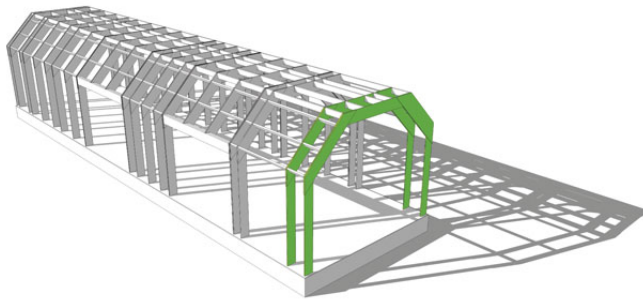


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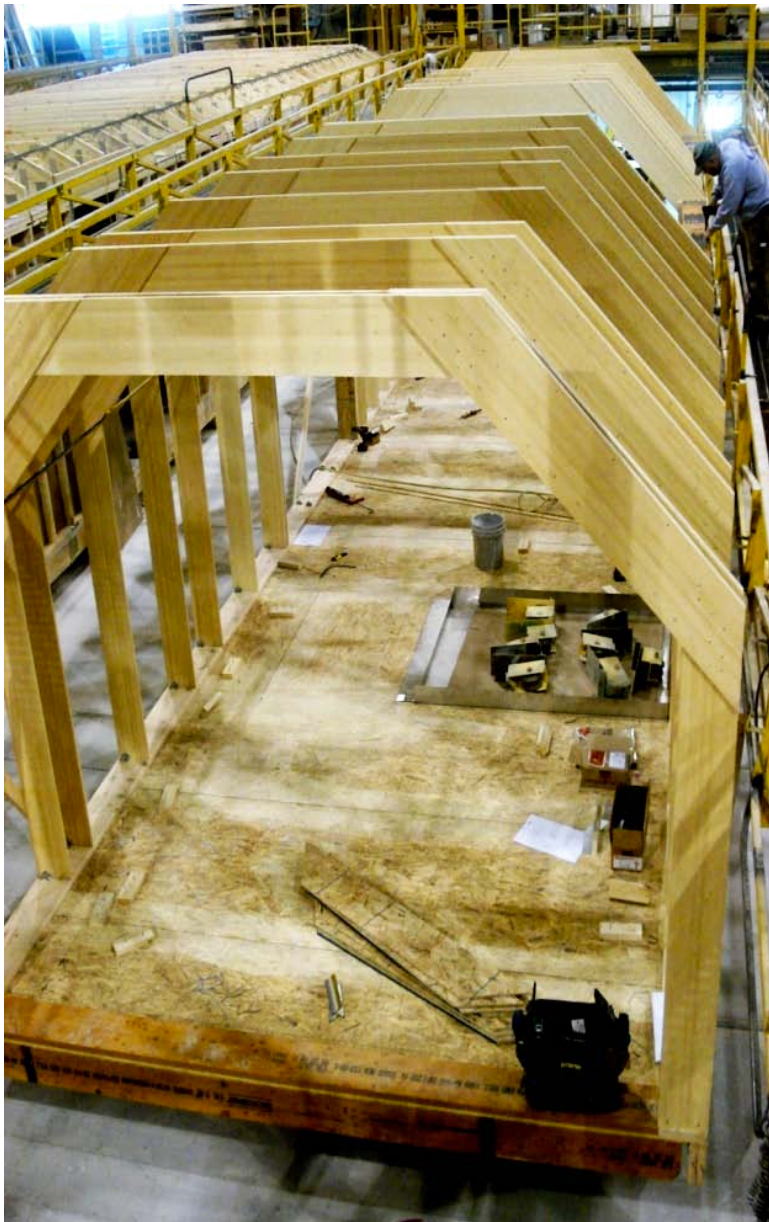
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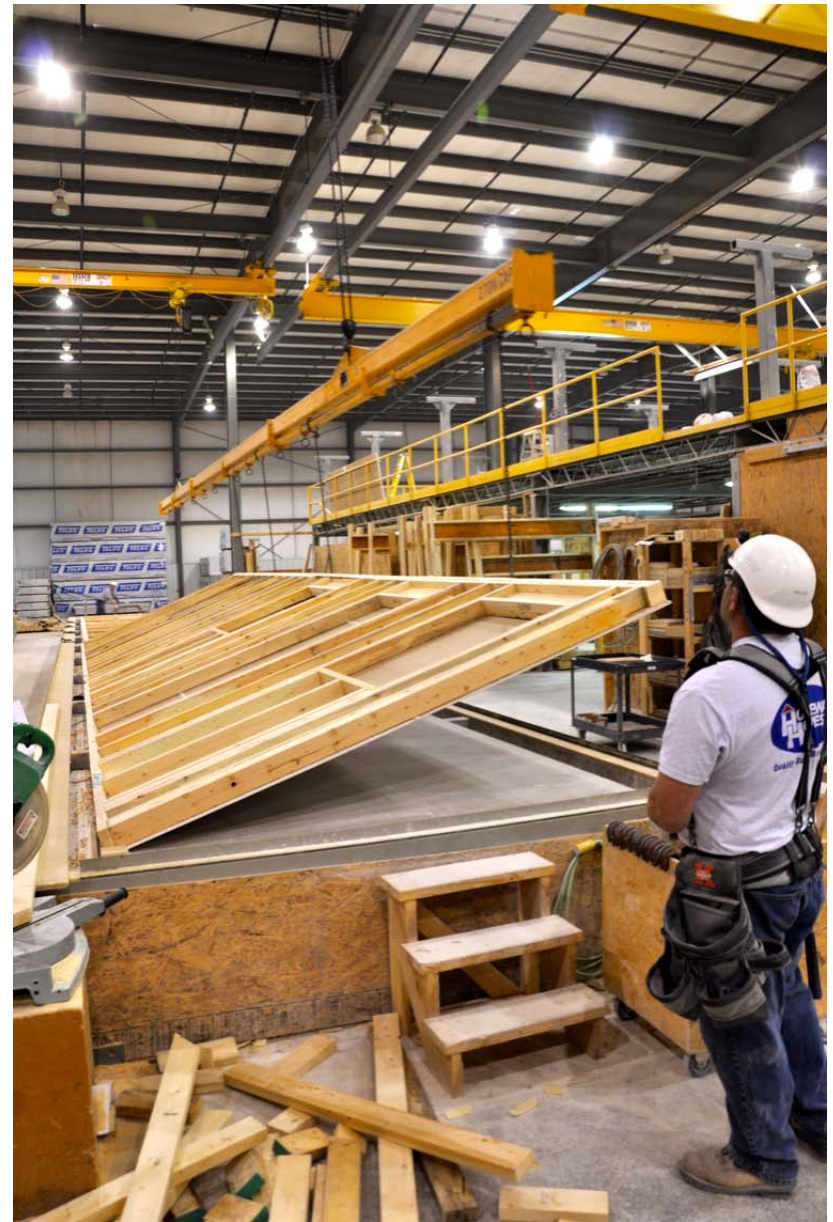
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2011



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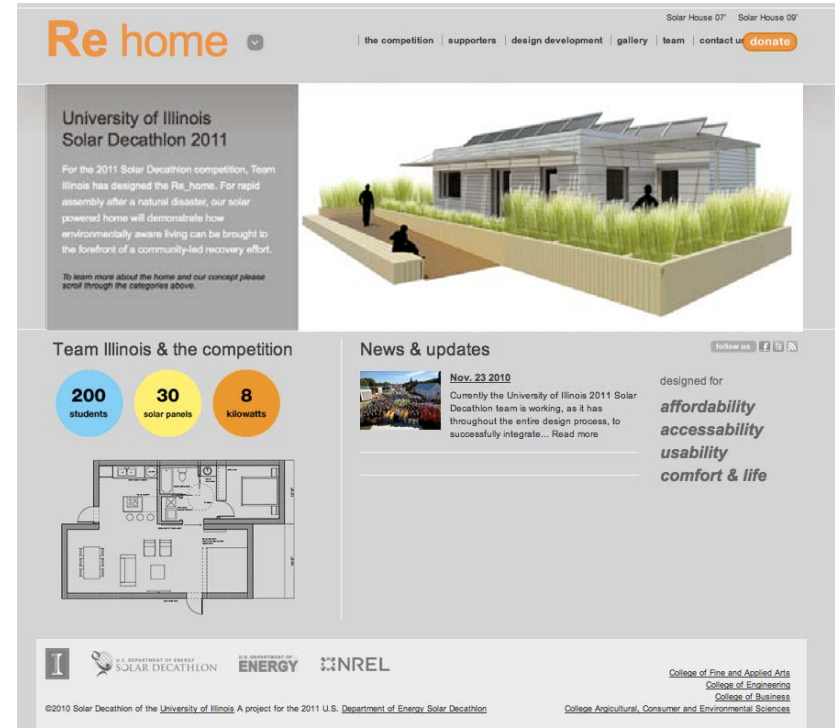


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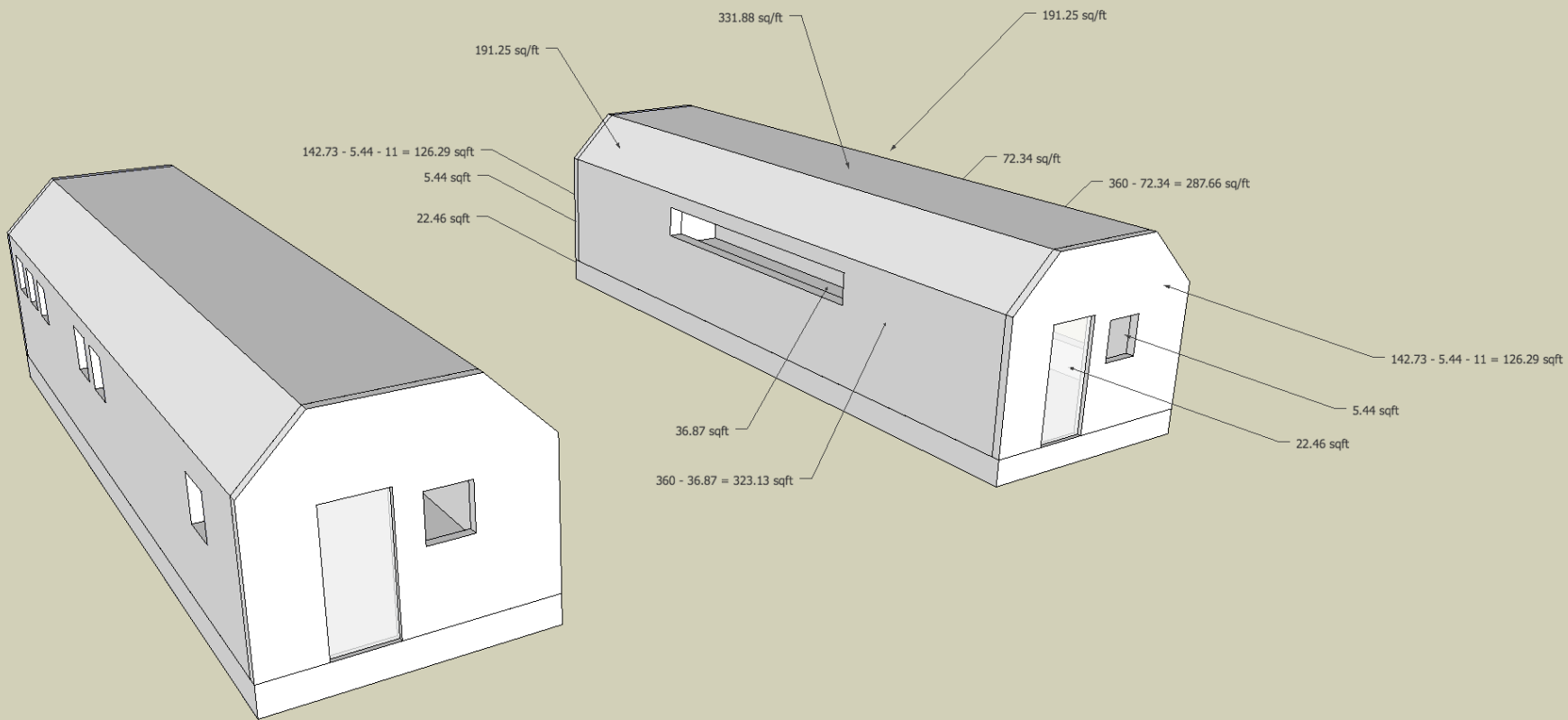


Interior Square Footage: 524 sq/ft
(PHP 506 sq/ft – Treated Floor Area)

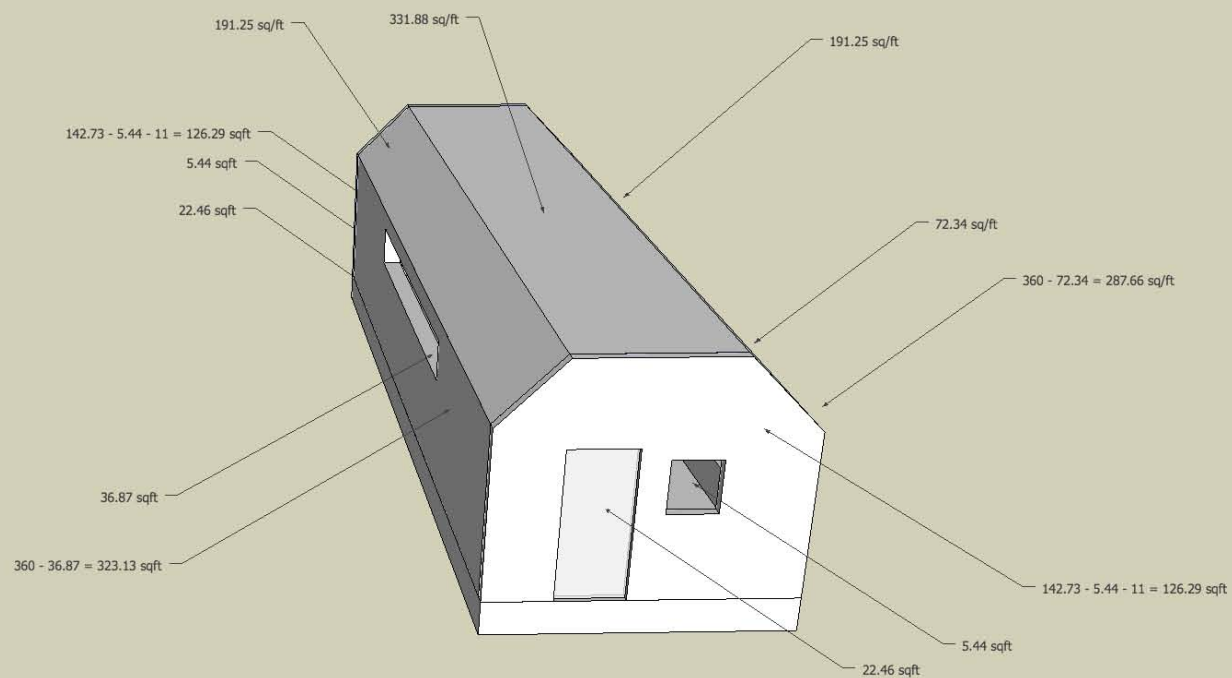
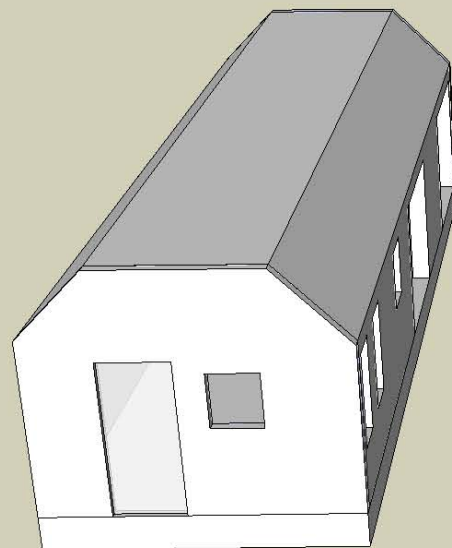
2011



Interior Square Footage: 816 sq/ft
(Realtor approx. 1,000 sq/ft)



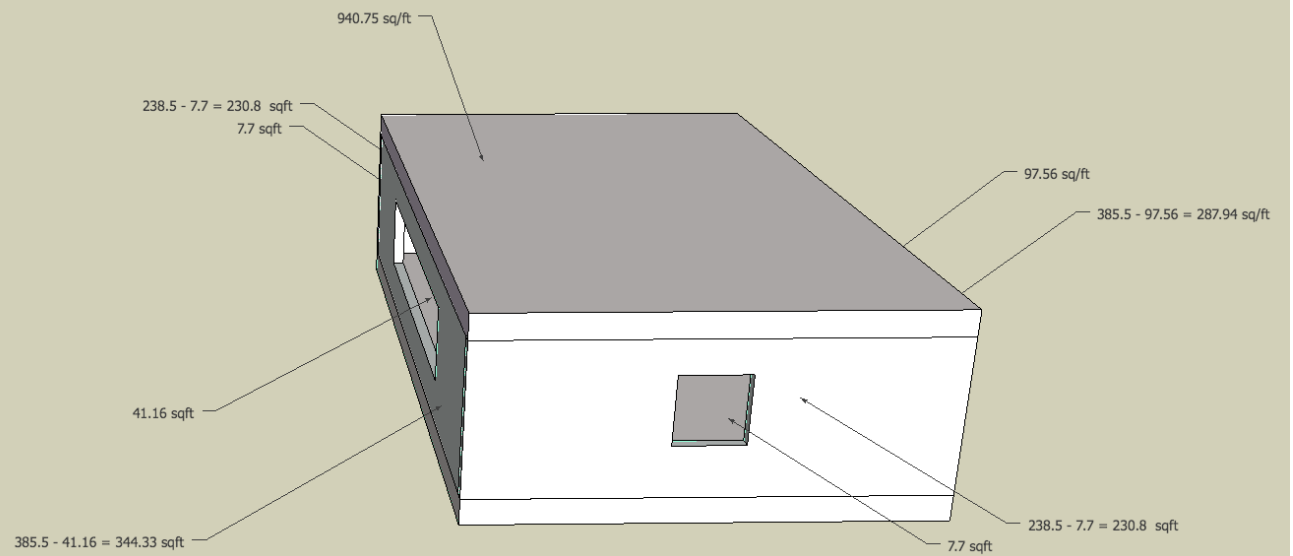
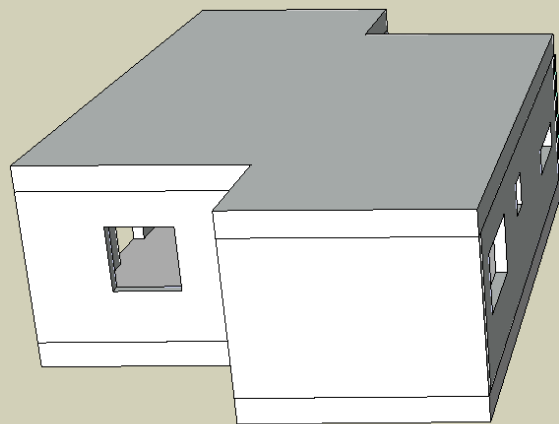
2009



2009

Opaque Walls : 1,578 sq/ft
 Fenestration : 142 sq/ft
 Total: 1,720 sq/ft

Interior Floor Area: 524 sq/ft
 Floor to Wall & Roof Ratio: 1 - 3.3



Opaque Walls : 2,034 sq/ft
Fenestration : 154 sq/ft
Total: 2,189 sq/ft

Interior Floor Area: 816 sq/ft
Floor to Wall & Roof Ratio: 1 - 2.7

2011

2009

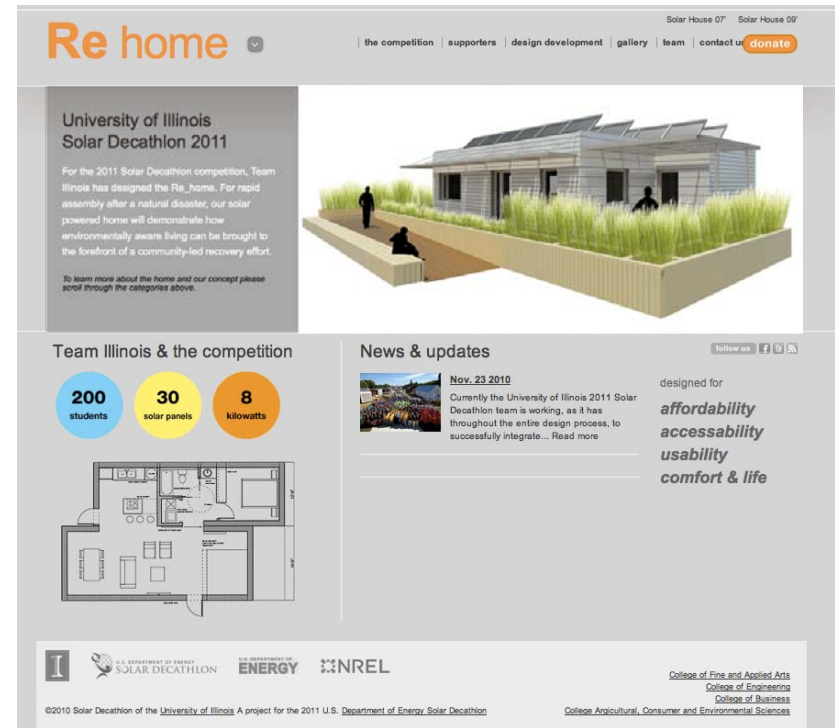


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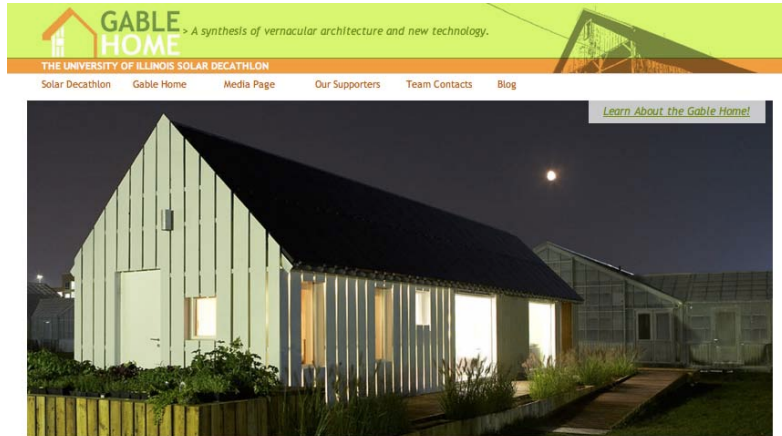


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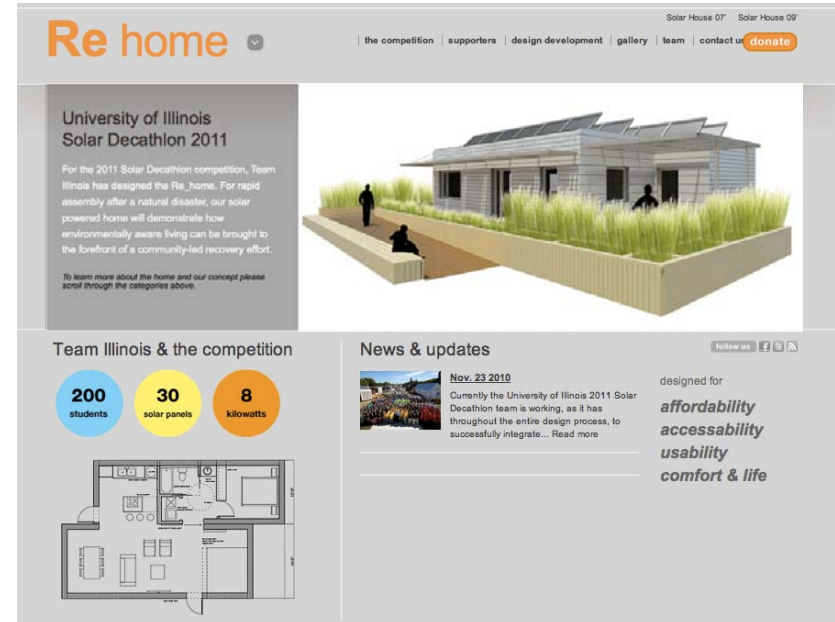
2009



Team	Cost Category	Cost Range
Arizona	\$\$\$	\$450,000–\$650,000
Cornell	\$\$\$	\$450,000–\$650,000
Illinois	\$\$	\$250,000–\$450,000
Rice	\$	up to \$250,000
Team Alberta	\$\$\$	\$450,000–\$650,000
Team Boston	\$\$\$	\$450,000–\$650,000
Team California	\$\$\$	\$450,000–\$650,000
Team Germany	\$\$\$\$	\$650,000–\$850,000

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2011



Place	Team	Estimated Cost	Score
1	Parsons NS Stevens	\$229,890.26	100.000
1	Team Belgium	\$249,568.09	100.000
2	Purdue	\$257,853.70	99.215
3	SCI-Arc/Caltech	\$262,495.11	98.750
4	Team Massachusetts	\$267,913.06	98.209
5	Middlebury College	\$282,570.07	96.743
6	Ohio State	\$285,982.23	96.402
7	Canada	\$286,051.31	96.395
8	Illinois	\$291,812.68	95.819

Interior Square Footage: 816 sq/ft
(Realtor approx. 1,000 sq/ft)

2009

APPROXIMATE COSTS	
<i>Building Shell</i> \$86,000	<i>Appliances</i> \$ 6,600
<i>Windows and Doors</i> \$24,700	<i>HVAC</i> \$12,800
<i>Foundation</i> \$5,800	<i>Furniture and Accessories</i> \$7,000
<i>Roof</i> \$20,000	<i>Kitchen / Living Room Cabinetry</i> \$55,000
<i>PV System</i> \$85,400	<i>Plumbing</i> \$7,400
<i>Flooring and Trim</i> \$1,800	<i>Landscaping</i> \$2,500
<i>Paint and Oil (inside and out)</i> \$3,000	<i>Transportation</i> \$38,000
<i>Appliances</i> \$ 6,600	<i>Accommodations</i> \$10,350

Interior Square Footage: 524 sq/ft
 (\$307,900 / 524)
 \$588 per sq/ft

Illinois	\$\$	\$250,000–\$450,000
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Interior Square Footage: 524 sq/ft
 (PHP 506 sq/ft – Treated Floor Area)

2011

Re home | the competition | supporters | design development | gallery | team | contact us | donate

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comfort & life



Interior Square Footage: 816 sq/ft
 \$358 per sq/ft

8	Illinois	\$291,812.68	95.819
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From 03/08/2015 to 03/13/2015

Load Data

Export Data to CSV

Gable Home

Re_home



Reset Zoom

eGauge GableHome

3/8/2015 12:01am - 3/13/2015 12:00am

View | LAN Access | Tools | Settings | Help

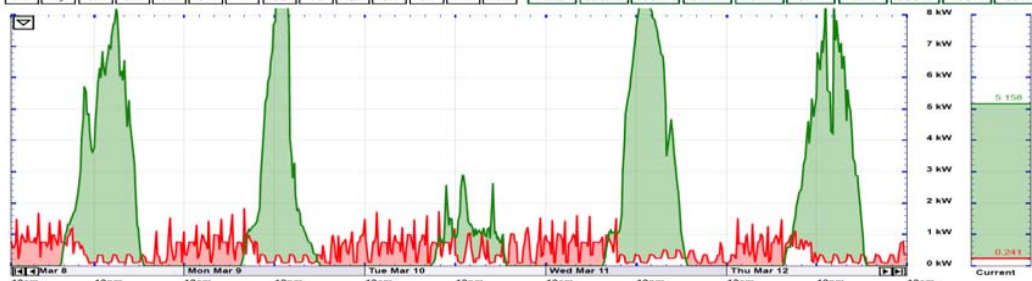
Summary for time-period shown in graph

Energy Used 58.4 kWh (approx. \$5.84 used)
Energy Generated 189 kWh (approx. \$18.85 saved)
Net 130 kWh sold (approx. \$13.01 earned)

Summary over last 30 days

Energy Used 394 kWh (approx. \$39.36 used)
Energy Generated 1.07 MWh (approx. \$107.24 saved)
Net 679 kWh sold (approx. \$67.87 earned)

All 1y 6M 3M 1M 3w 1w 3d 1d 12h 6h 3h 1h 10m Auto 500kW 100kW 50kW 10kW 5kW 1kW 500W 100W 50W



Power used Energy from grid Power generated Energy to grid
CERV gen Auto Solar gen Auto Wall Sockets BR KT ER gen Auto Lights LR KT HL WL gen Auto
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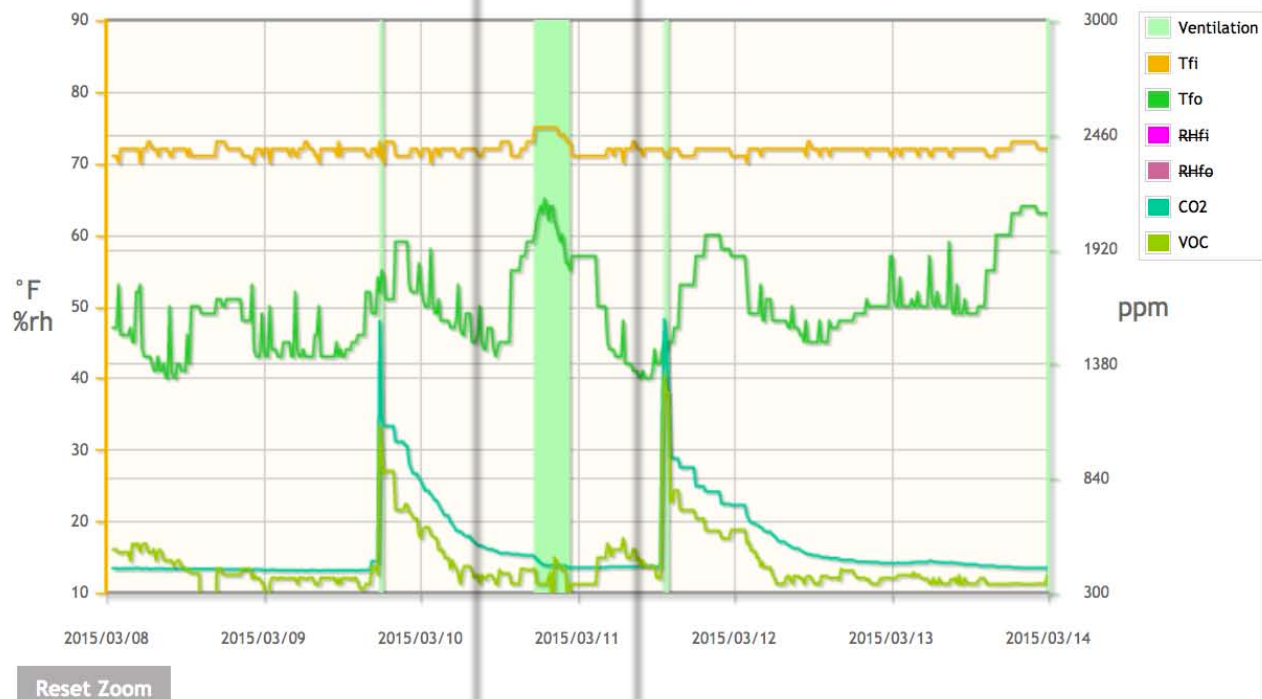
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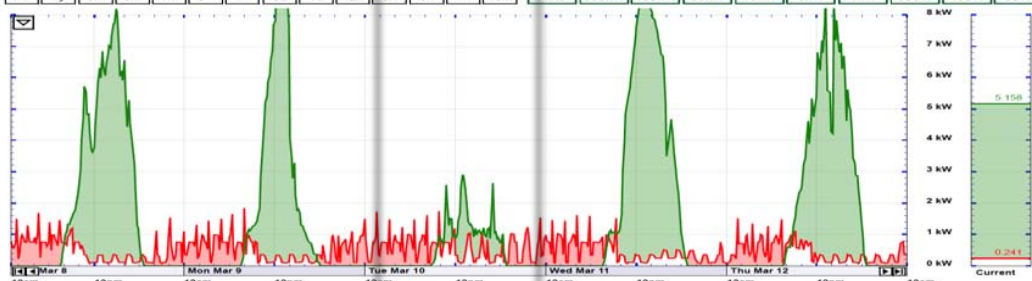
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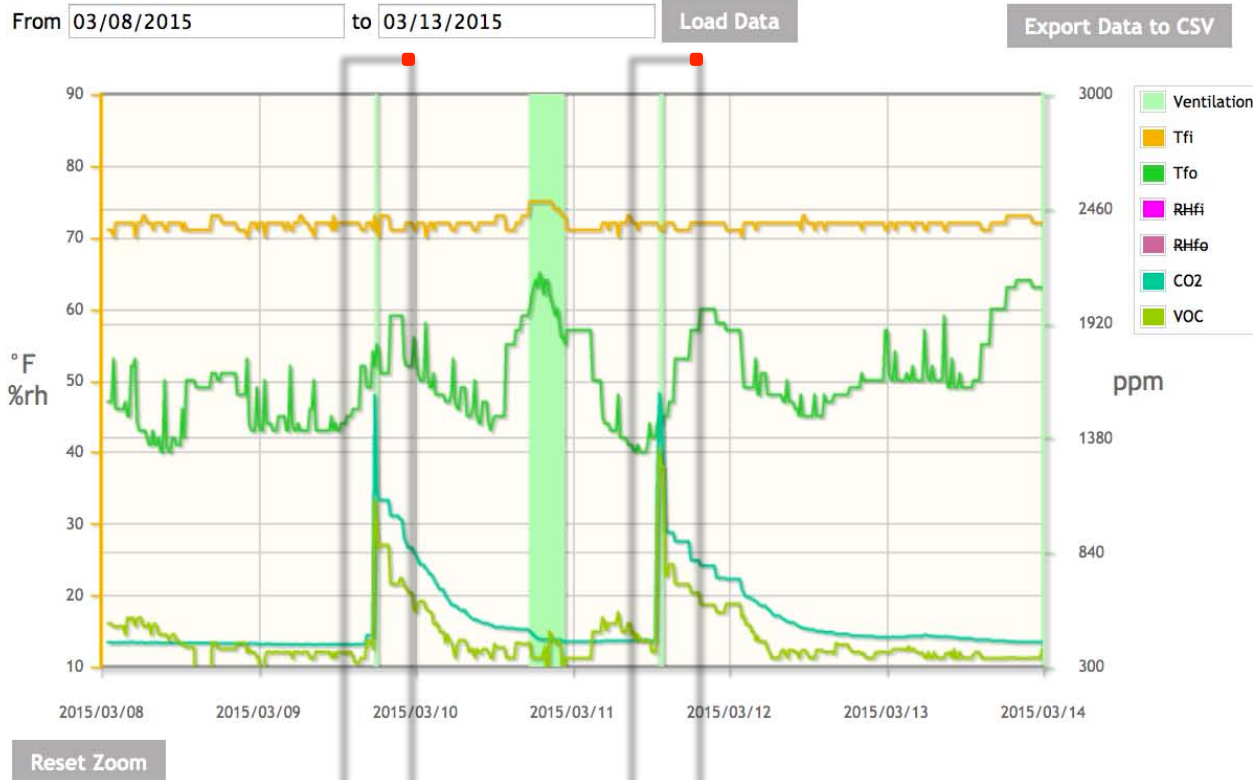
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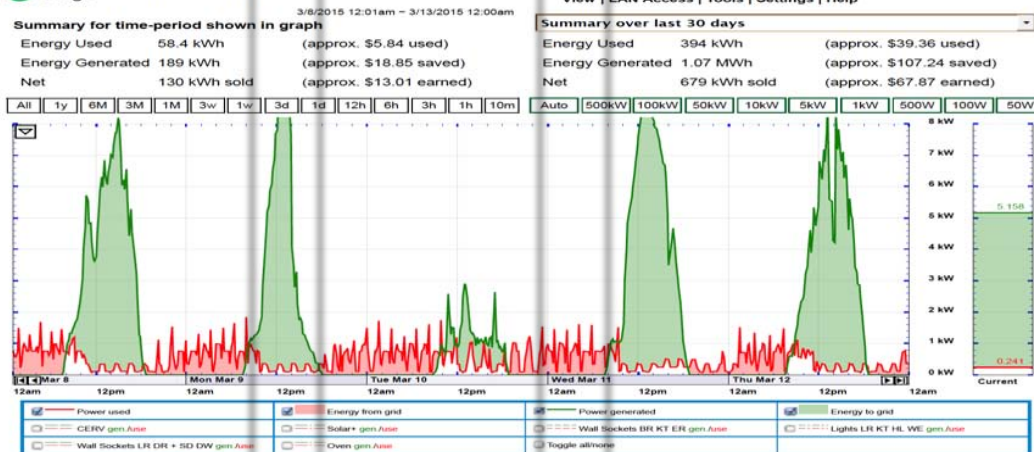
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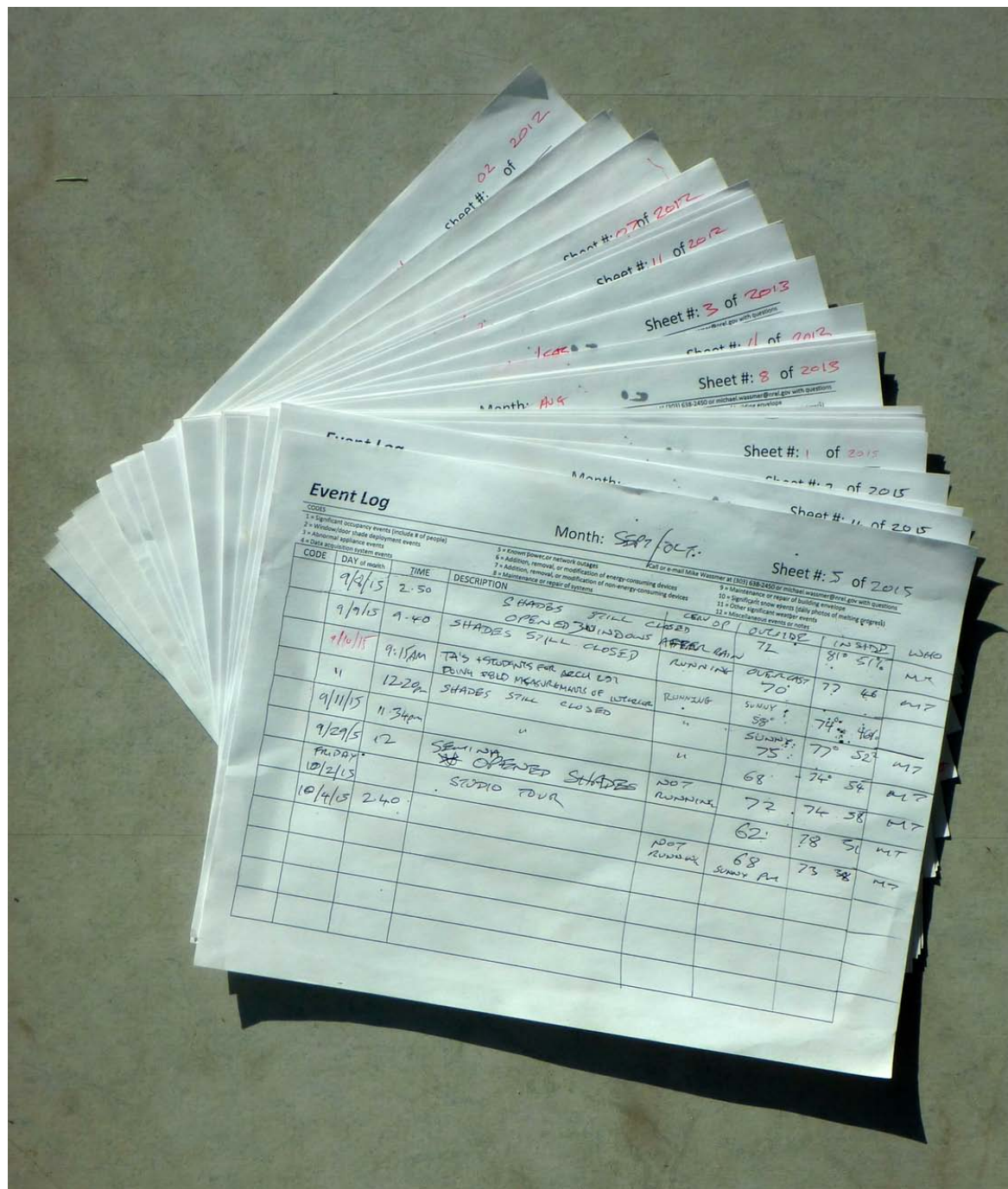


Gable Home

Re_home

Gauge GableHome







Event Log

Month:

2 Sheet #: 2 of 2015

CODES

- 1 = Significant occupancy events (include # of people)
- 2 = Window/door shade deployment events
- 3 = Abnormal appliance events
- 4 = Data acquisition system events

- 5 = Known power or network outages
- 6 = Addition, removal, or modification of energy-consuming devices
- 7 = Addition, removal, or modification of non-energy-consuming devices
- 8 = Maintenance or repair of systems

Call or e-mail Mike Wassmer at (303) 638-2450 or michael.wassmer@nrel.gov with questions

- 9 = Maintenance or repair of building envelope
- 10 = Significant snow events (daily photos of melting progress)
- 11 = Other significant weather events
- 12 = Miscellaneous events or notes

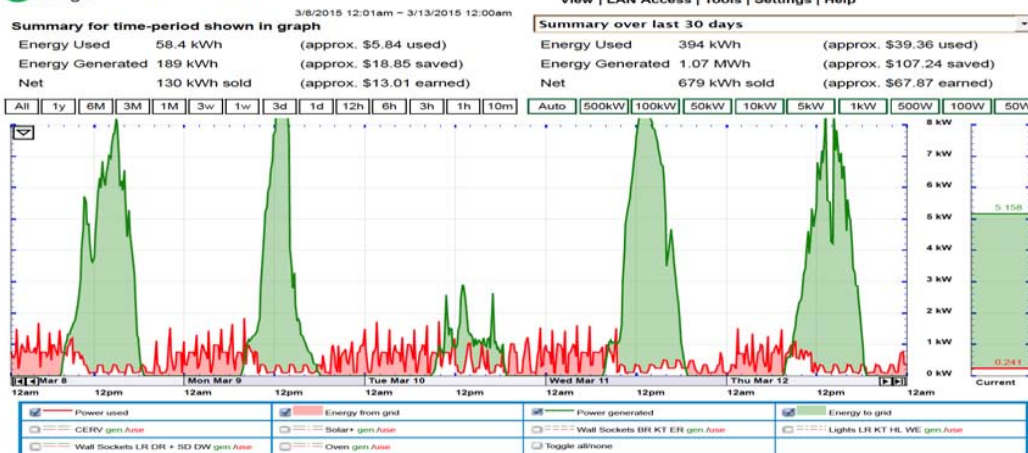
CODE	DAY of month	TIME	DESCRIPTION	CERV OP	OUTSIDE	INSIDE
	2/6/15	11:50AM	CLEANED PART OF FLOOR		35°	68° 21%
	2/9/15	9:30AM	OVER	RUNNING	30 OVERCAST	68° 25
	2/10/15	10:30	CLEANED FLOOR	RUNNING	30 SUNNY	68° 24
	2/11/15	10AM		RUNNING	38 OVERCAST	68° 24
	2/12/15	9:30AM	TURNED FAN HEAT ON/ADJUSTED @ 44° THERMOSTAT	RUNNING	18 SUNNY	64° 22
	2/18/15	9:23	FAN HEATER NOT ON S. ADJUSTED THERMOSTAT UP	STANBY	12 SUN/CLOUD	62 19
	2/19/15	9:39		RUNNING	3 SUNNY	64 13
	2/21/15 WED	9:30 12:30	MEETING DOE SHADES GOT MOVED FAN HEATER GOT UNPLUGGED !!	"	38 SUNNY	69 20%
	FRIDAY 2/23/15	9:47	COULD NOT MOVE SHADES BACK! / SWITCH FAN BACK ON	RUNNING	12 SUNNY	60 16%
	3/2/15	10AM		RUNNING	28 SUNNY	66 20
1	3/10/15	2:00PM	Illinois Solar Decathlon tour hosting Vibrona High School		46 CLOUDY	

Gable Home

Re_home



GableHome





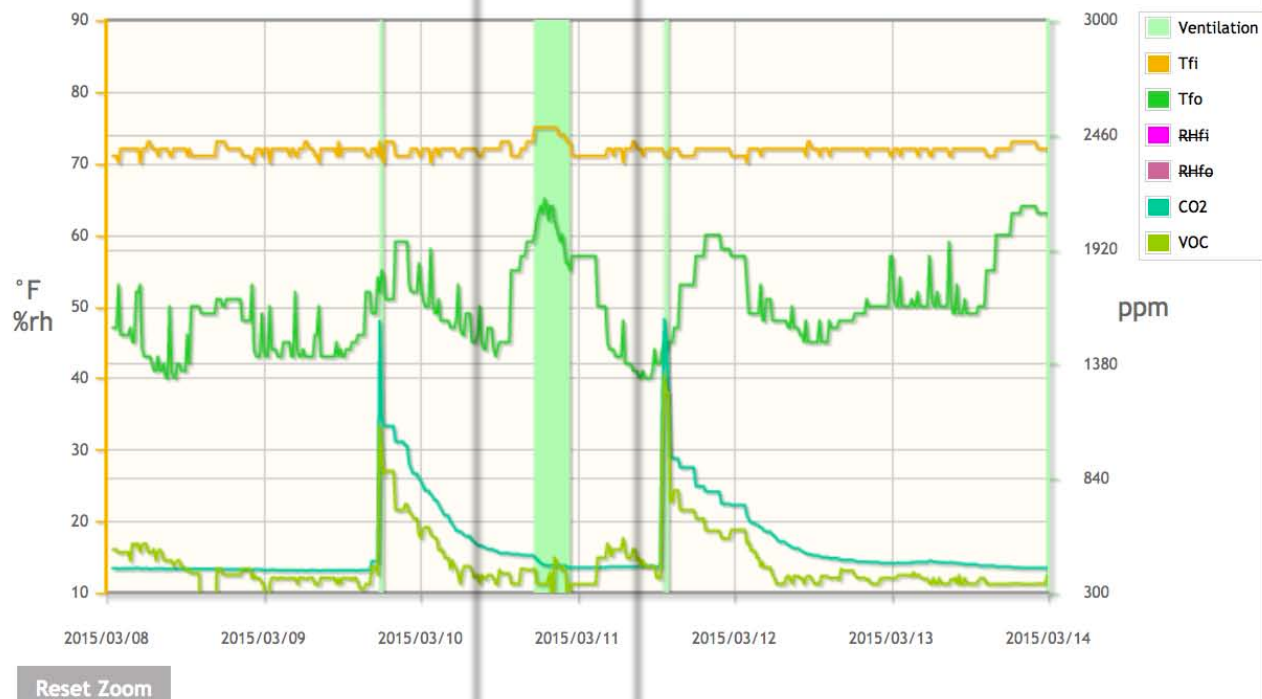
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Re_home



Gauge GableHome

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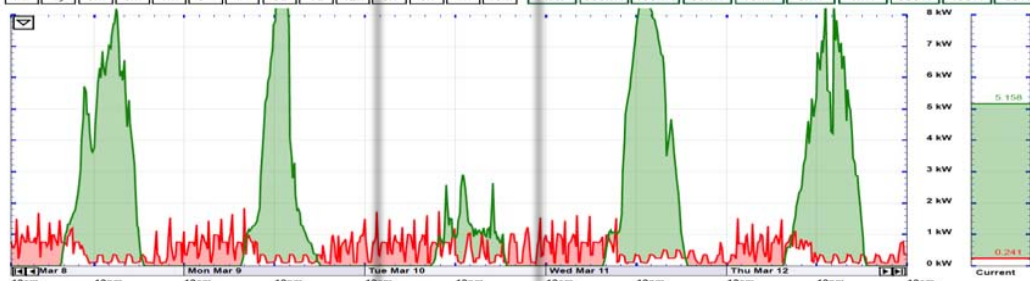
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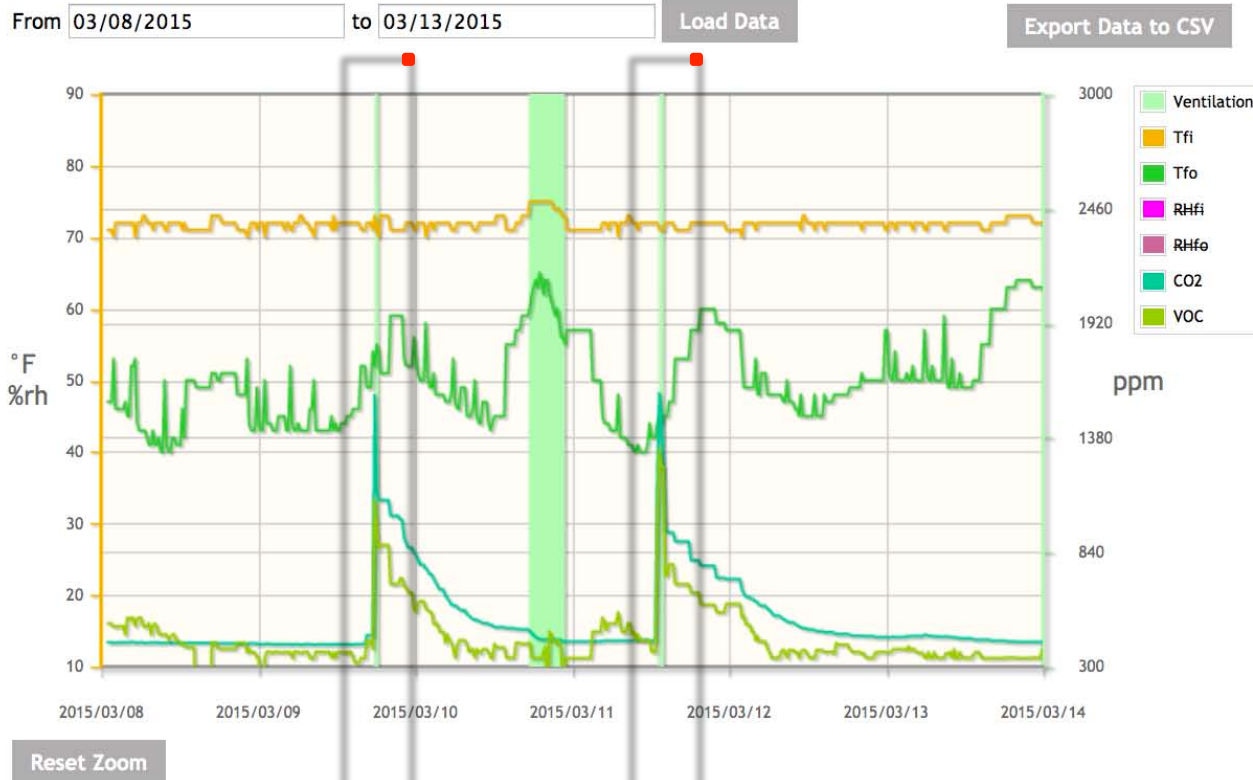
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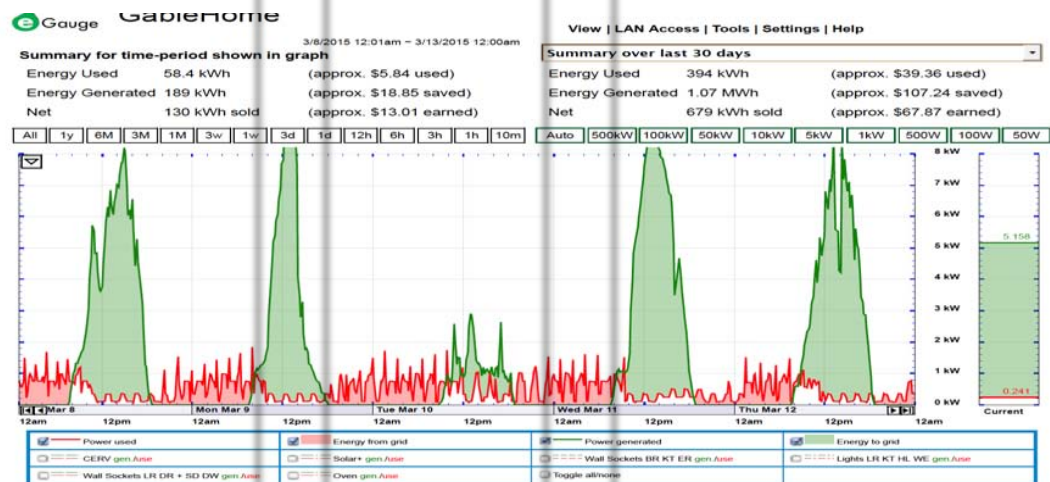
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- Energy from grid
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- Solar + gen. Auto
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Gable Home

Re_home





From 03/08/2015

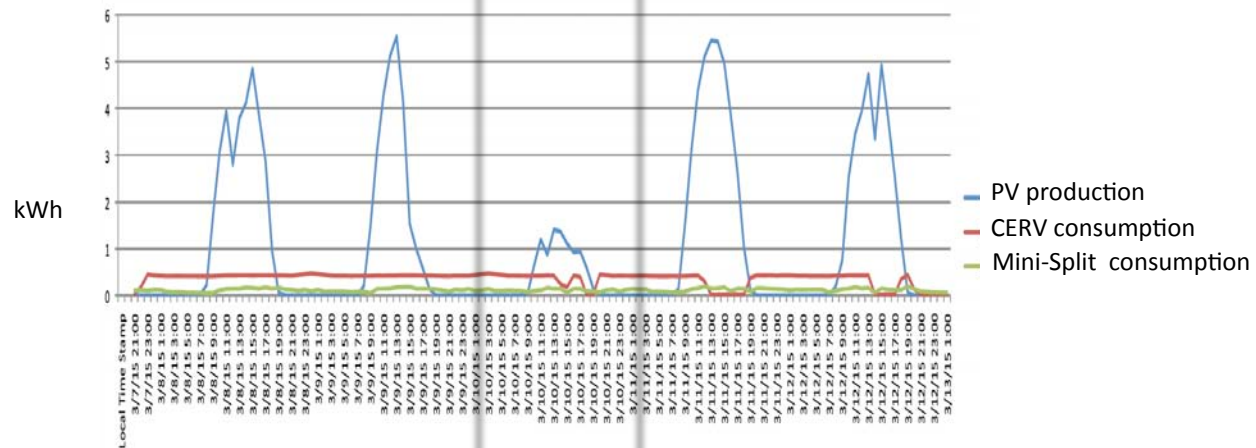
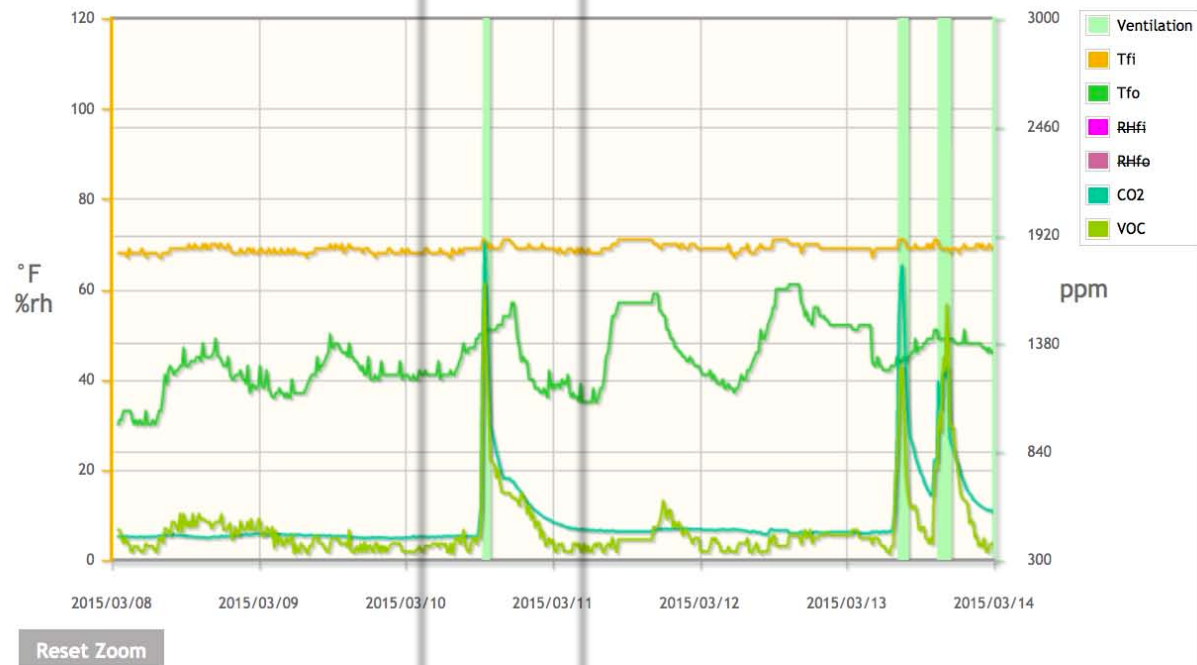
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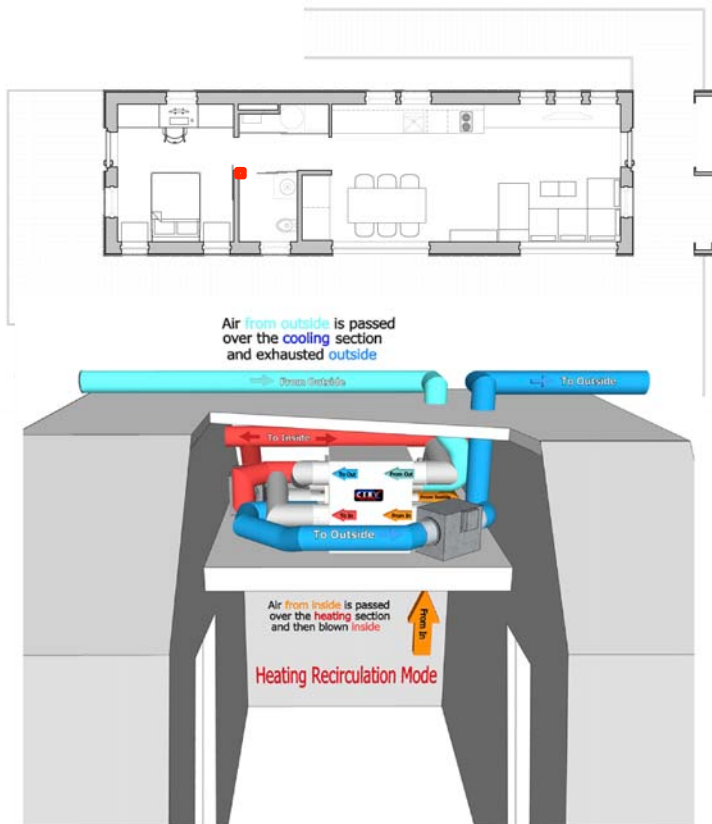
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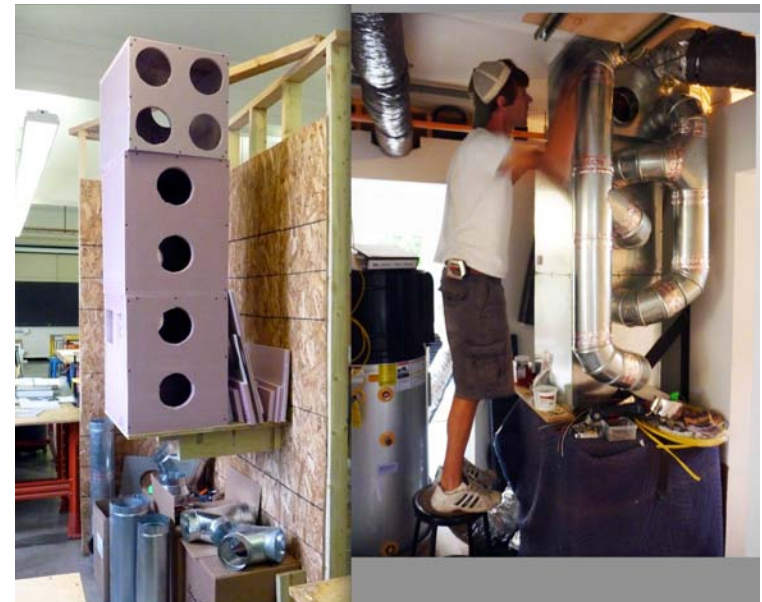
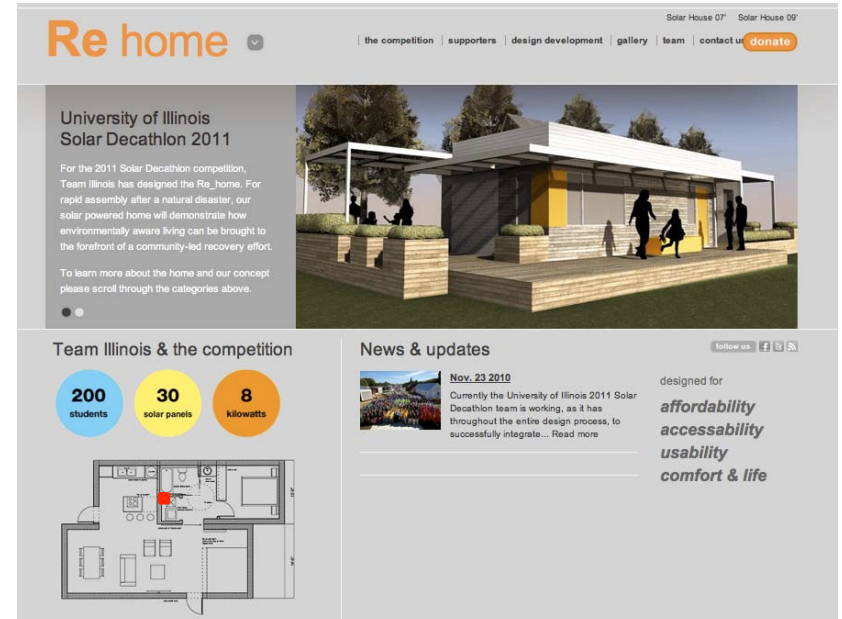
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2009



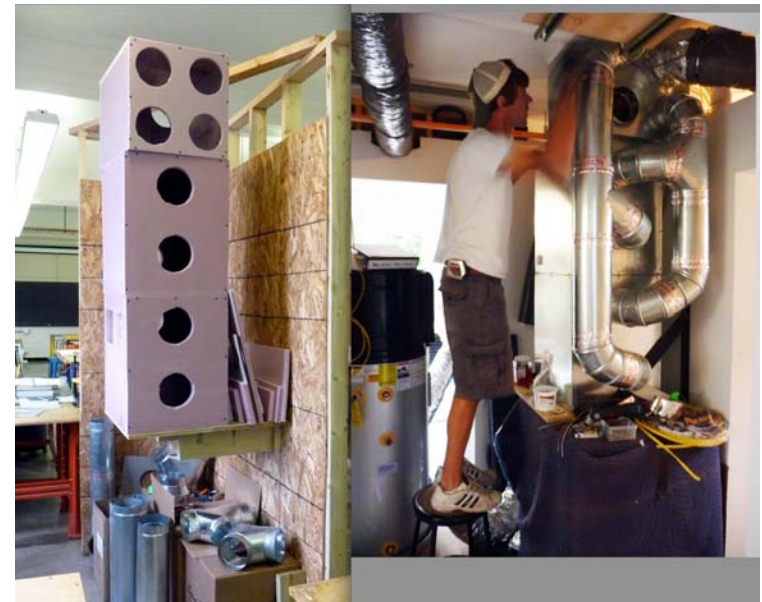
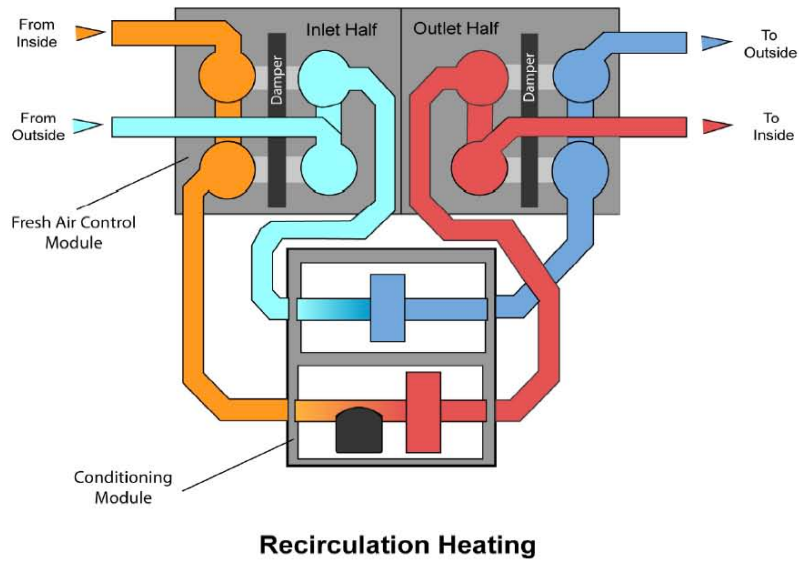
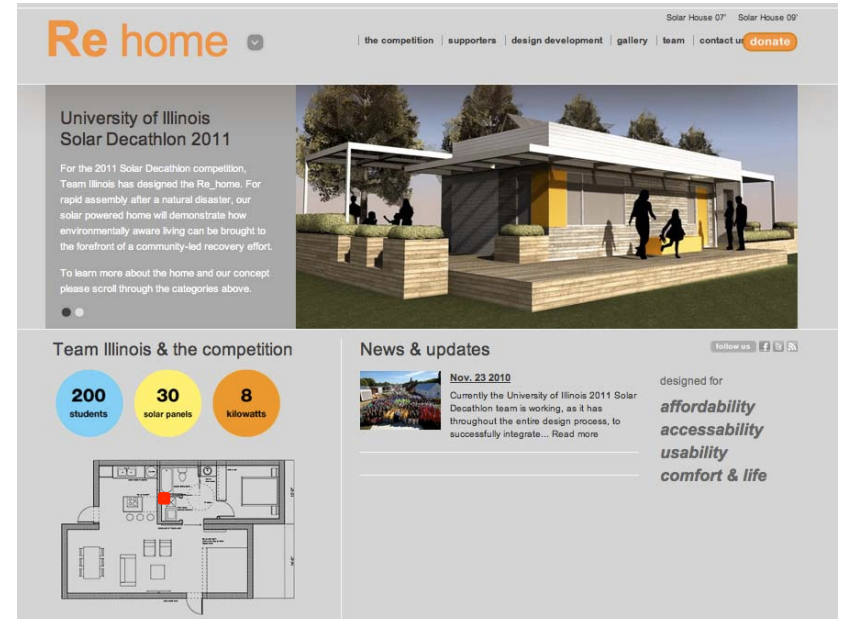
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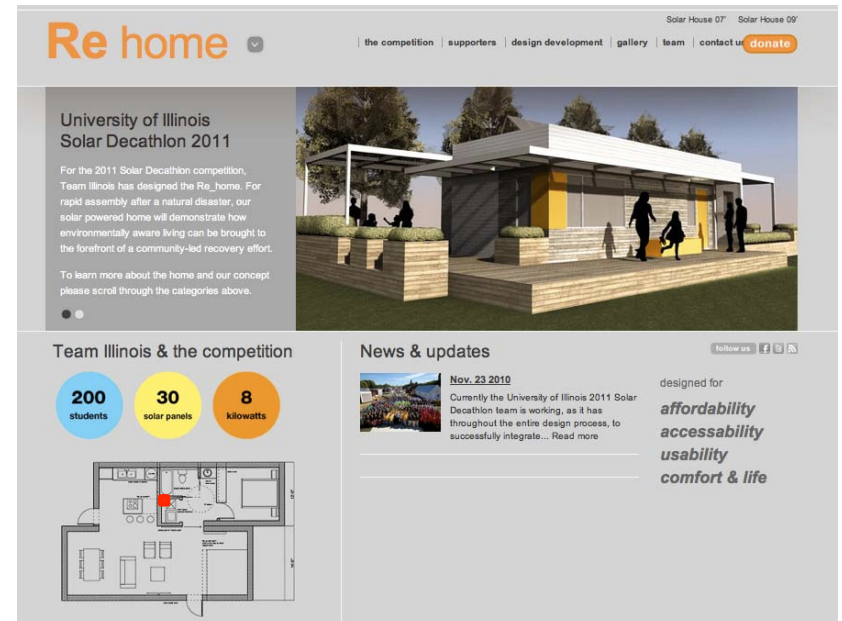
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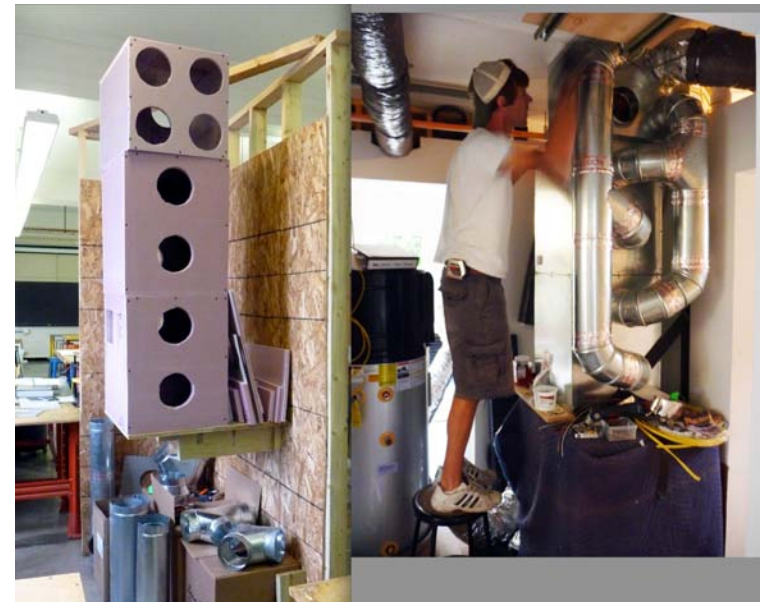
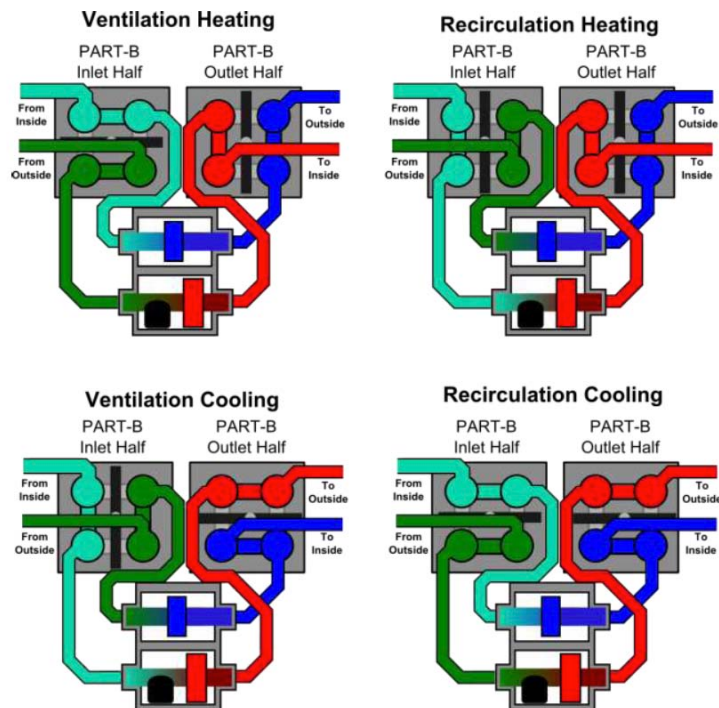
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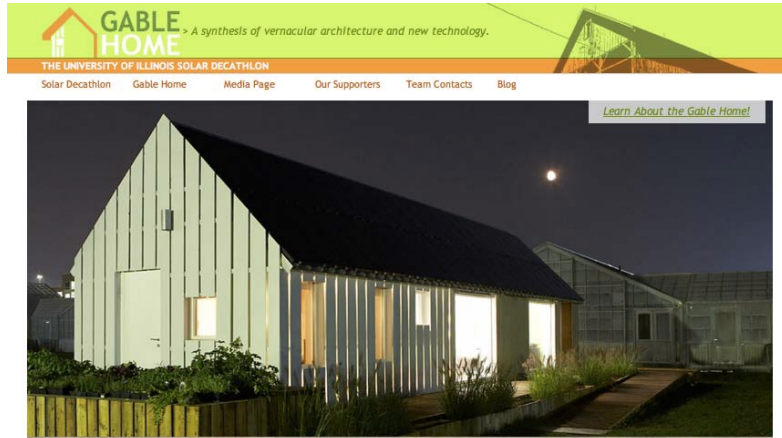
2011



OPERATION MODES



2009



2011



CONDITIONING ENERGY RECOVERY VENTILATOR

FEATURES

On demand ventilation capabilities

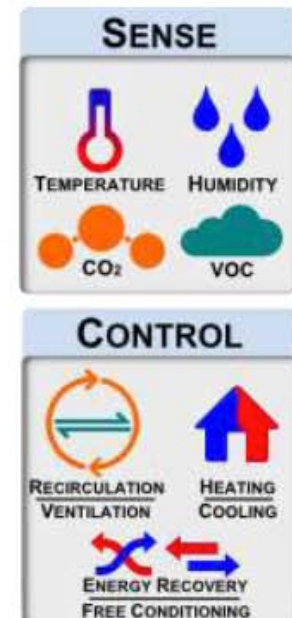
Unique control system monitors:

- Inside & Outside Temperature
- Inside & Outside Relative Humidity
- VOCs & CO2

Integrated heat pump for energy recovery

- Low power consumption (600W)
- 1200W (~3800 Btu/hr) Cooling Capacity
- 1600W (~5500 Btu/hr) Heating Capacity

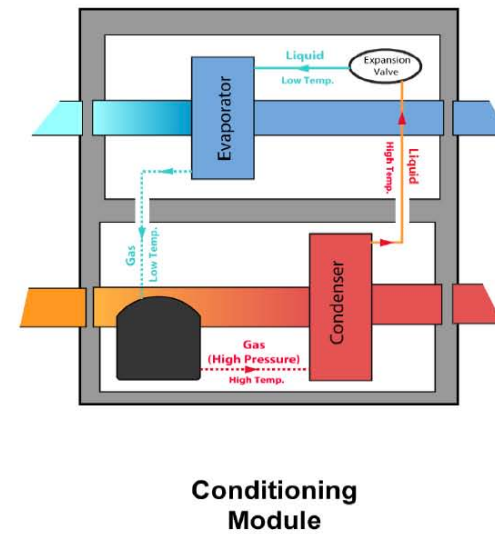
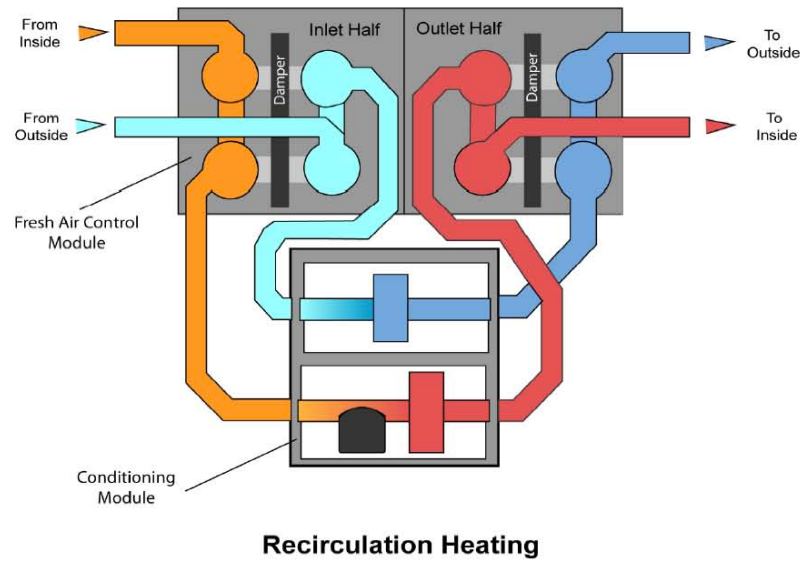
**Only requires ducting and electrical;
no refrigeration lines to run!**



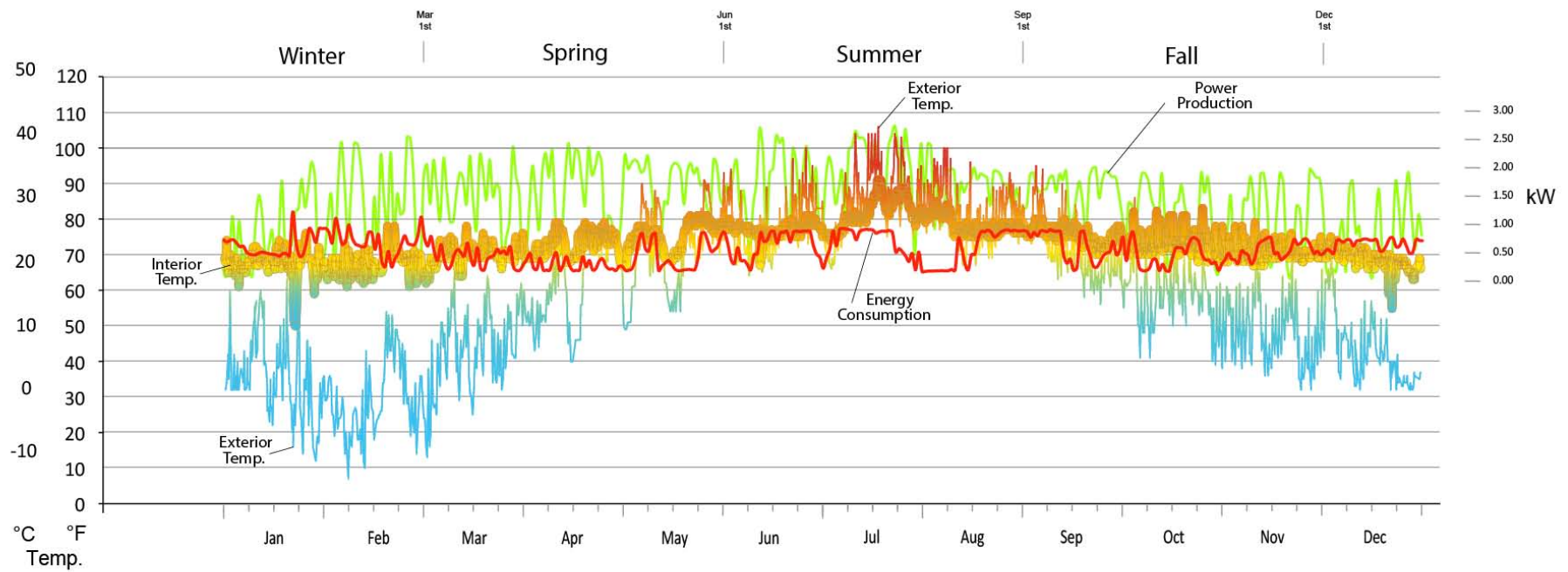
2009



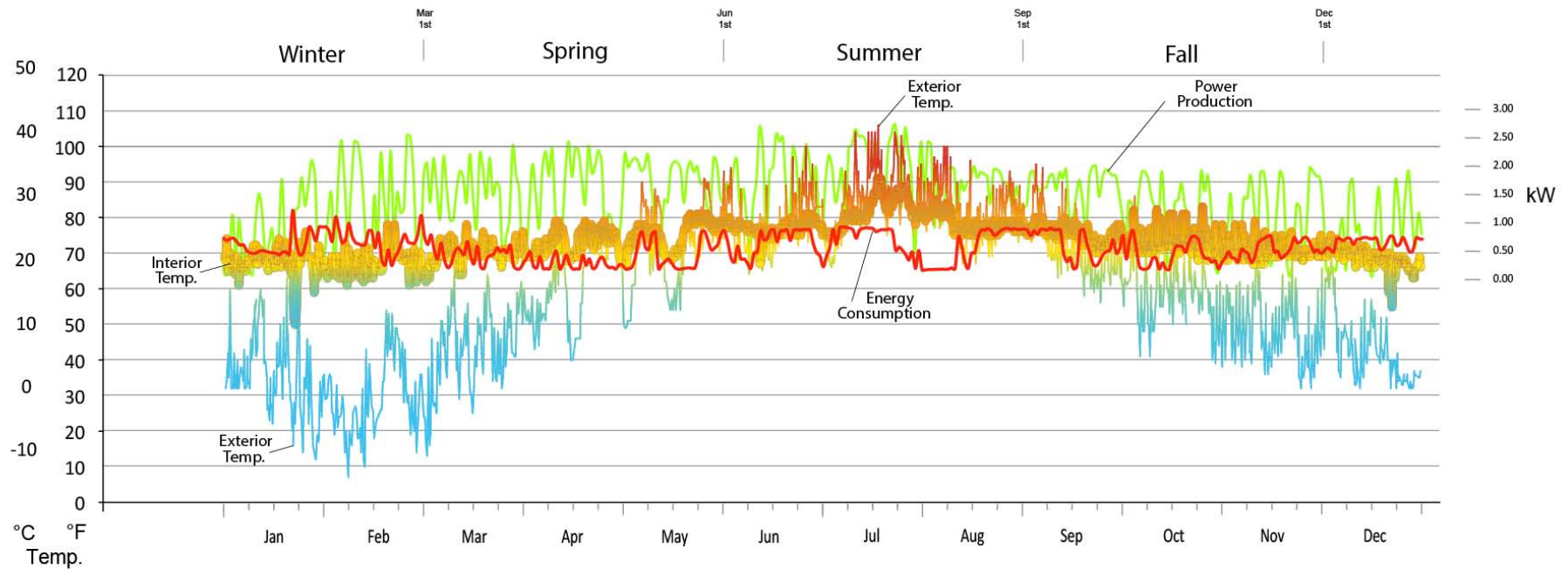
2011



Plot from Gable Home (2009 House)

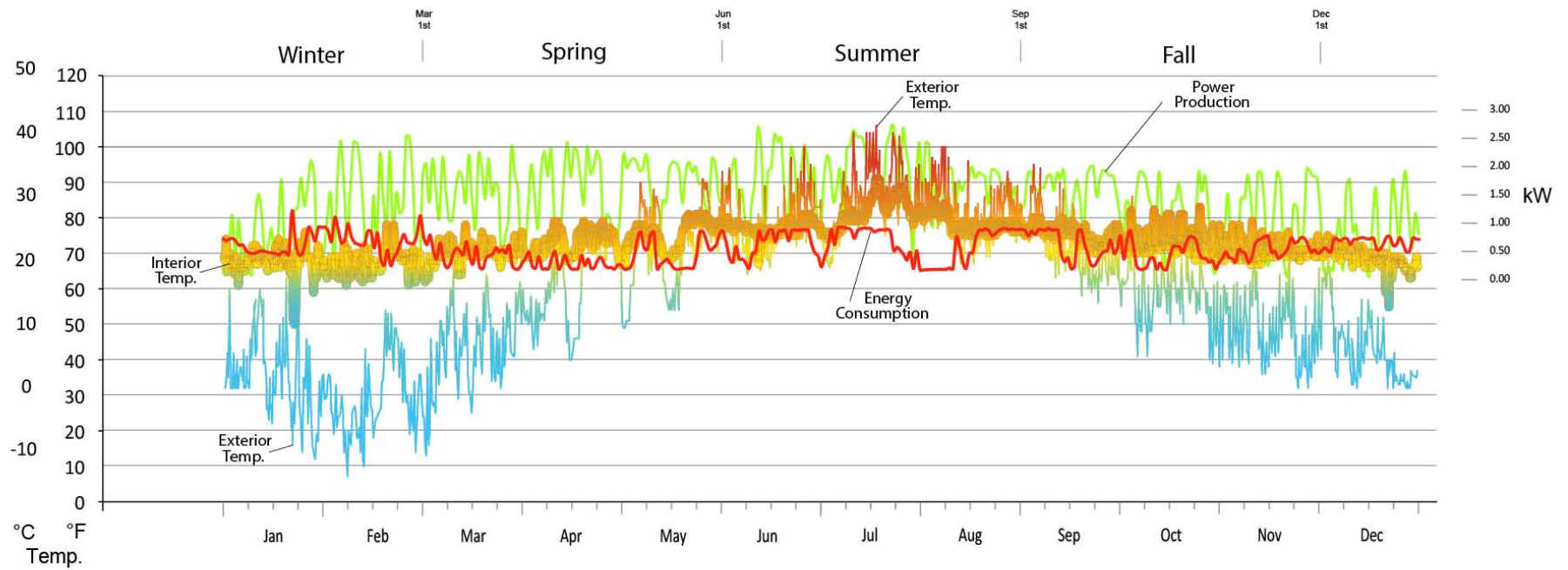


Net Electricity Used [kWh]													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2014	-77	-498	-712	-917	-925	-52 ¹	-	-	-	-	-	-	-3182
2013	-251	-521	-837	-1088	-1003	-912	-922	-886	-713	-529	-414	-109	-8183
2012	-400	-481	-1002	-866	-918	-790	-646	-691	-694	-692	-549	-93	-7824
2011	-	-	-	-	-	-	-	-	-0 ²	0	-314	-371	-685



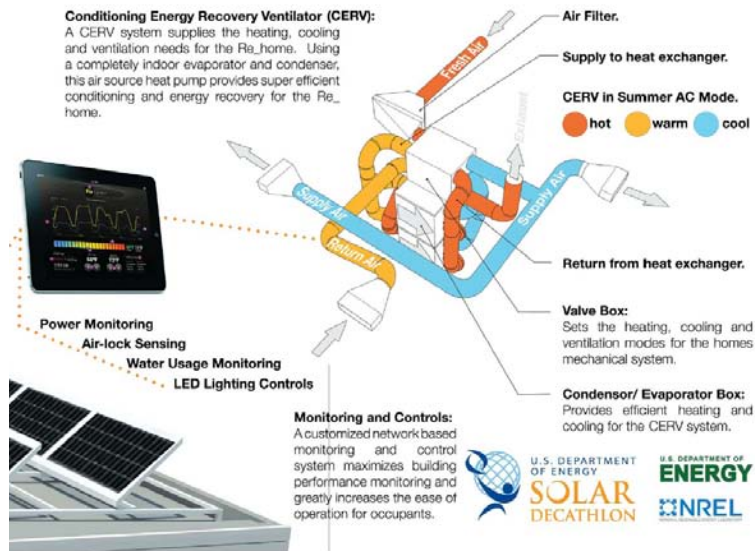
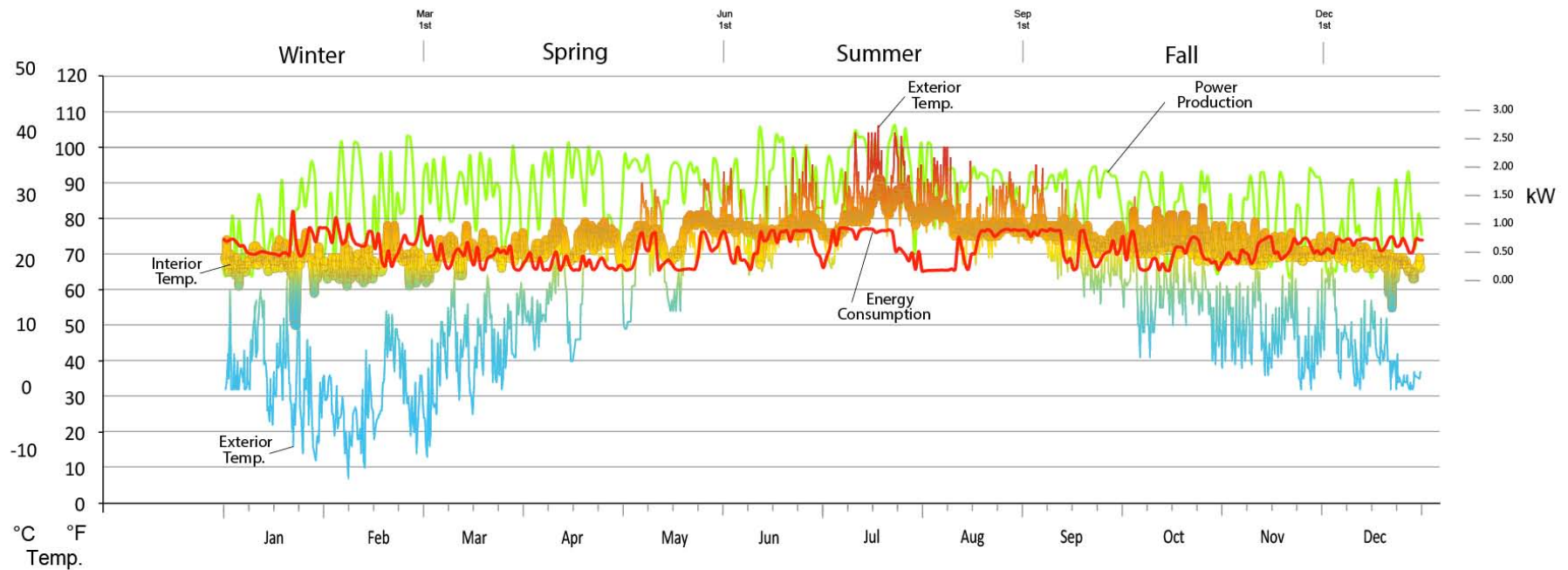
Total Electricity Used [kWh]													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2014	545	454	371	205	313	47 ¹	-	-	-	-	-	-	1936
2013	615	495	434	295	430	496	521	398	458	325	389	486	5341
2012	411	204	176	247	401	462	583	519	369	221	348	465	4406
2011	-	-	-	-	-	-	-	-	0 ²	0	89	220	132

Plot from Gable Home (2009 House)



Initial install at Re_home (2011 House)

Plot from Gable Home (2009 House)

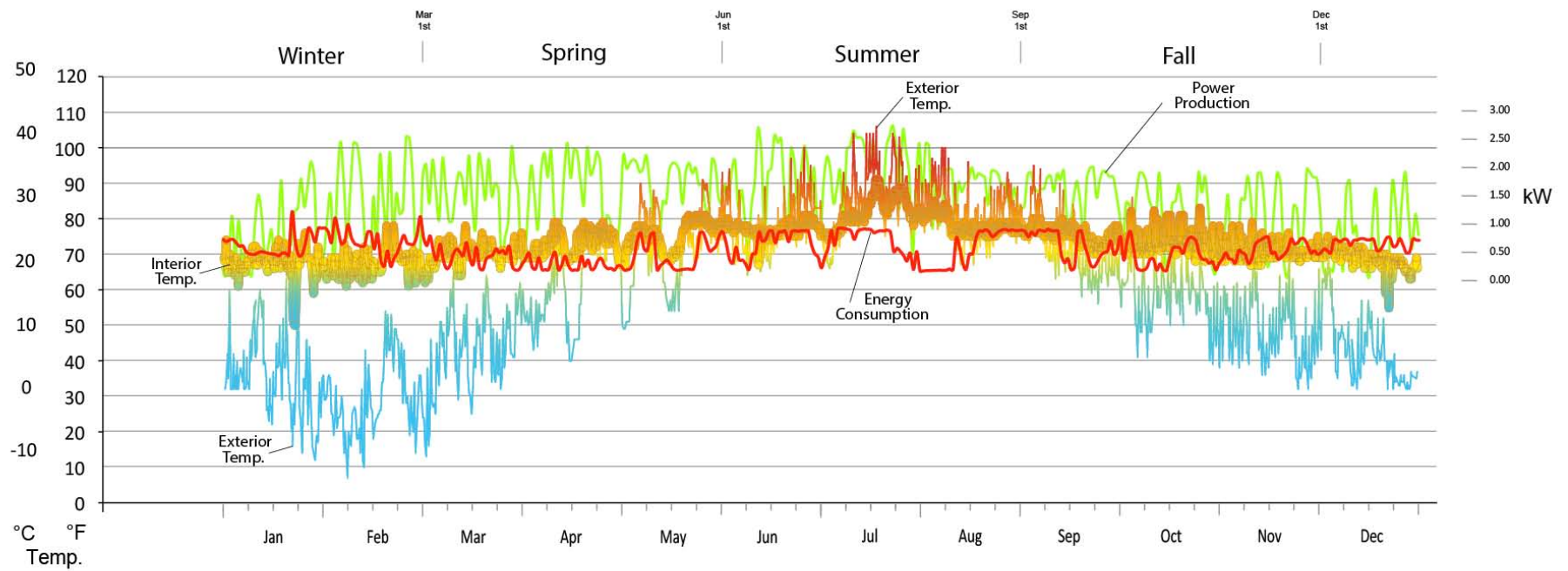


Initial install at Re_home (2011 House)

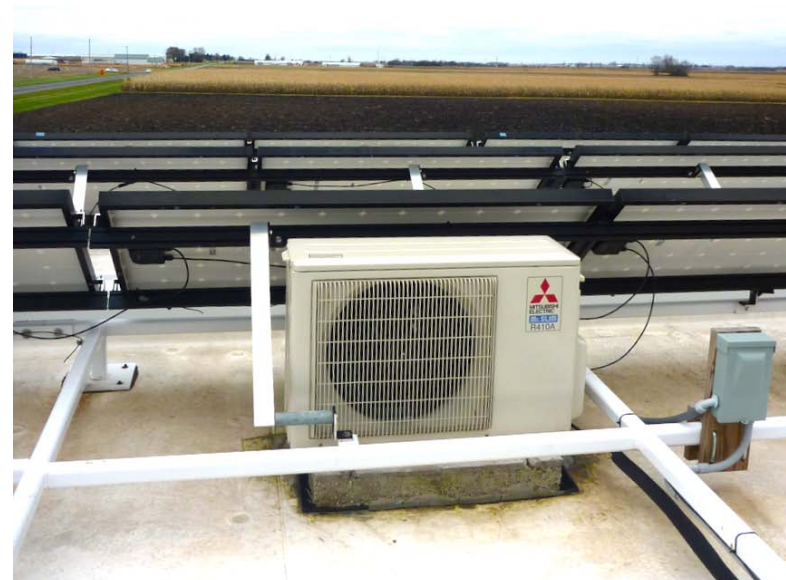


Mini Split addition at Re_home (2011 House)

Plot from Gable Home (2009 House)

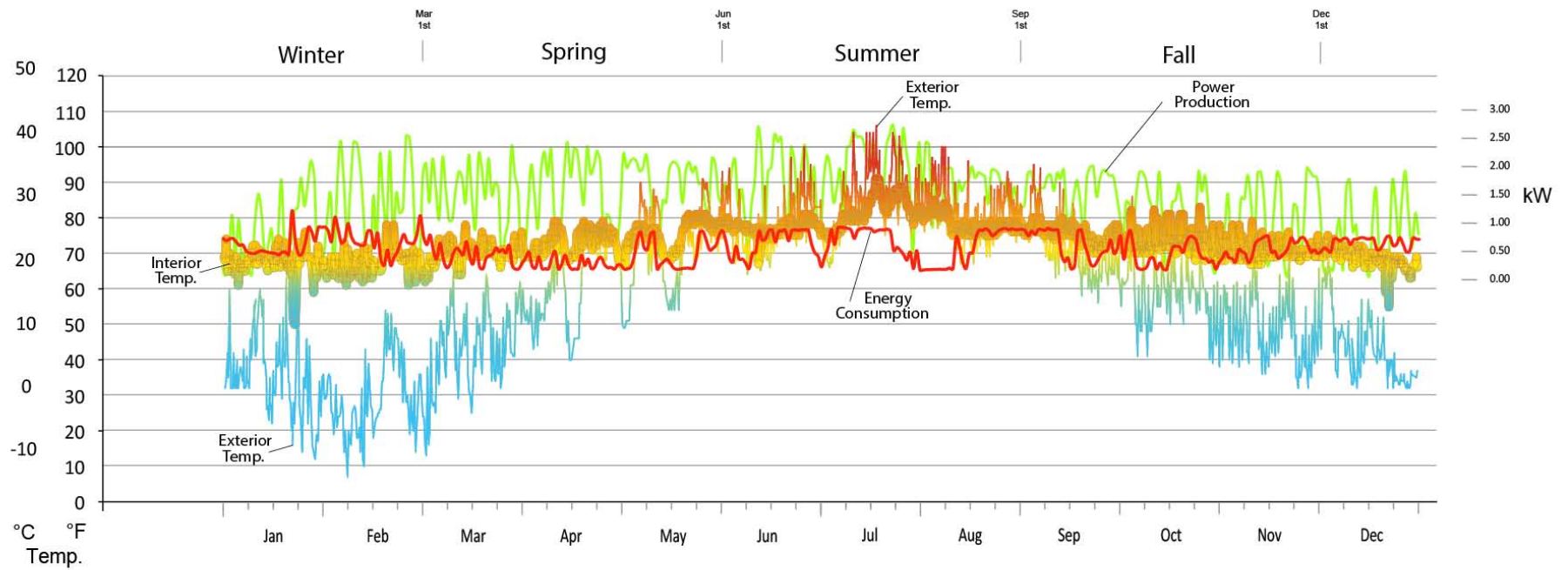


Location of Mini Split interior unit at Re_home (2011 House)



Mini Split addition at Re_home (2011 House)

Plot from Gable Home (2009 House)



Location of Mini Split interior unit at Re_home (2011 House)



Mini Split addition at Re_home (2011 House)

Envelope – Air – Quality

Mark S Taylor
University of Illinois at Urbana Champaign



<Solar Decathlon 2009 Home

Teams

Arizona
Cornell
Illinois
Iowa State
Kentucky
Minnesota
Ohio State
Penn State
Puerto Rico
Rice
Team Alberta
Team Boston
Team California
Team Germany
Team Missouri
Team Ontario/BC
Team Spain
Univ. of Louisiana
Virginia Tech
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Solar Decathlon 2009

University of Illinois at Urbana-Champaign

Team Web site: <http://2009.solardecathlon.illinois.edu>

Old is New Again

After the 2007 Solar Decathlon competition, the Illinois team set out to prove that the best new energy technologies could still look like a real home. Its Gable Home produces up to four times the energy it needs, yet looks like a traditional home. It has 100-year-old barn wood and high-efficiency solar panels on the outside and features a familiar gable roof profile. Inside, the newest structural bamboo and optimized windows, insulation, and appliances mean it can be heated with a single hair dryer.

The Team

More than 200 people worked—from performing energy calculations to checking out products to helping out on work days—on Gable Home. “I enjoyed the collaboration and just talking to people on campus that we don’t see otherwise,” says architecture student Joe Simon.

The team set out to prove that there is “no schism” between new technologies and traditional ways of building houses. “Our whole process has been a back and forth to find relationships between vernacular or traditional styles of housing and new technologies,” says Simon.

The team really wants Gable Home’s innovations to reach consumers. It is working with a builder of modular homes to make this more than a one-of-a-kind project.

The House

The gable roof line is common in Midwestern agricultural areas. The barn wood siding, barn door-like sliding shade structure, and decking made of reclaimed wood from a grain elevator echo traditional home features.

Rather than having a single flat roof facing south for maximum installation of solar panels, the gable design presents half of the roof to the south. “We hope this proves that solar panels are efficient enough to get the electricity you need,” says student Camden Greenlee.

The Technology

Gable Home expects to be certified by the U.S. Passive House Institute in Urbana, Illinois, as using 90% less energy than typical construction. Its technologies include:

- Nearly 12 in. (30.5 cm) of high-performance insulation incorporated into the walls, roof, and floor
- Laminated bamboo for structural elements that is stronger than wood and more rapidly renewable
- A high-efficiency, small air volume heating, ventilation, and air conditioning system custom-designed for the small needs of the house
- A special hot water system heat exchanger that contributes to heating, ventilation, and air conditioning
- Efficient light-emitting diode lighting that further reduces electricity demand
- Solar panels that generate up to 9.1 kW of direct current power, which is converted to alternating current for use in the house.

House Highlights

- Reclaimed barn wood and familiar gable roof profile
- High-efficiency solar panels that produce up to four times what the house needs
- Laminated bamboo structure that minimizes thermal bridges
- Low energy-consuming stove, dishwasher, and refrigerator as well as touchless faucets

Printable Version



The Illinois team outside its temporary construction and testing site following a day of work on footings, decking, and siding for its Solar Decathlon Gable Home.



Gable Home incorporates architectural features common in the Midwest.

Construction Costs

\$\$\$\$\$

\$250,000-\$450,000

[Learn more about the construction cost estimate](#)

Download
Construction Drawings ([Zip 4.1 MB](#))
Project Manual ([Zip 9.1 MB](#))

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U.S. DEPARTMENT OF ENERGY
NATIONAL MALL, WEST POTOMAC PARK, WASHINGTON, D.C.
SEPT. 23–OCT. 2, 2011



About
Competition
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The U.S. Department of Energy Solar Decathlon challenges collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive. The winner of the competition is the team that best blends affordability, consumer appeal, and design excellence with optimal energy production and maximum efficiency.



The University of Illinois at Urbana-Champaign returns to the U.S. Department of Energy Solar Decathlon with *Re_home*.

Learn how the team plans to bring sustainable solutions to families in need after natural disasters.

More >

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- ☐ ENERGYSTAR®-labeled appliances
- ☐ High-efficiency lightbulbs
- ☐ Programmable thermostat
- ☐ Energy-efficient HVAC system
- ☐ Energy-efficient water heater
- ☐ More than one of these
- ☐ None

[Vote >](#) [View Results >](#)





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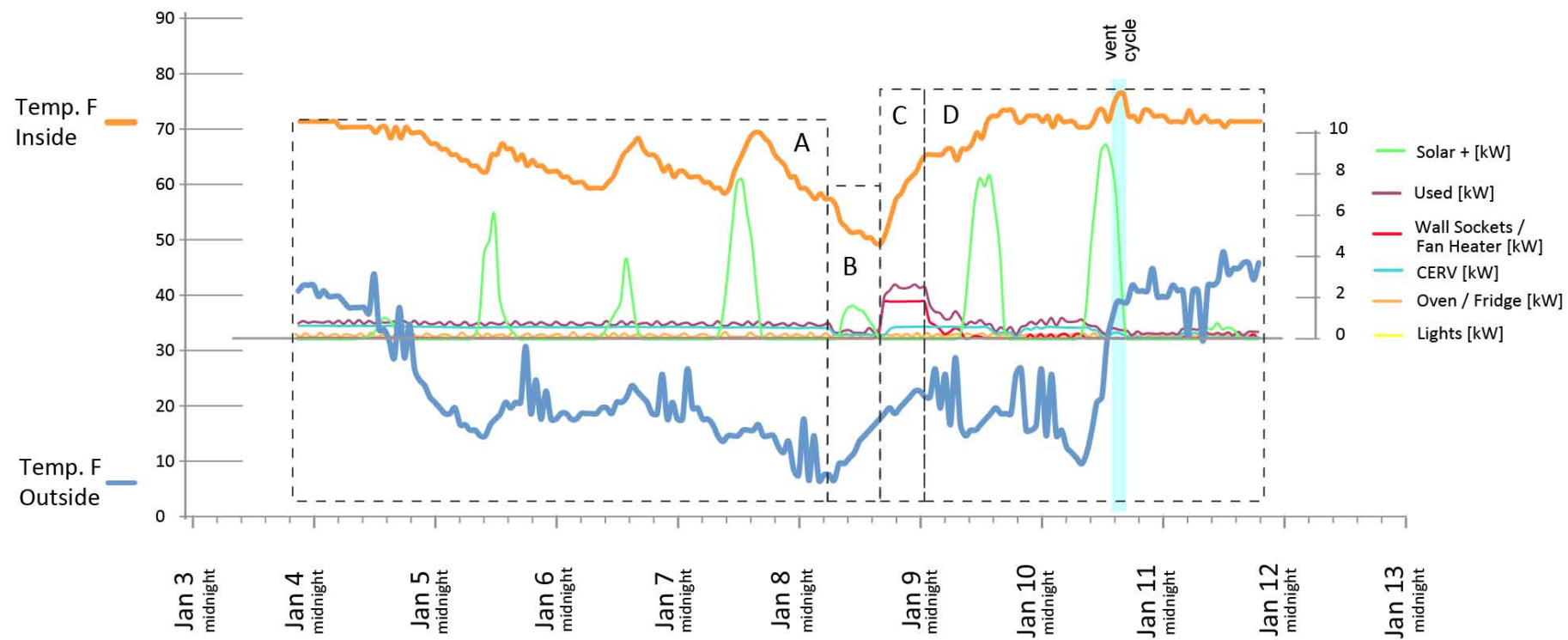
Photo by Mike Hines



photo by Dept. of Energy







Envelope – Air – Quality

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University of Illinois at Urbana Champaign

