



U.S. DEPARTMENT OF ENERGY  
**SOLAR DECATHLON**

2011

# A Home in the Cloud

## How Modern Homes are Becoming Energy EcoSystems

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# A Home in the Cloud

- What is the Cloud?
  - Data
  - Home
  - Life
- The Home of the Future is the Home of Today
  - Room by Room Design
  - Platform Integration
  - Simplicity

*First, some numbers....*



**The Residential market accounts for 34% of annual US electrical usage, with the average yearly utility bill of approximately \$1500 per household.**



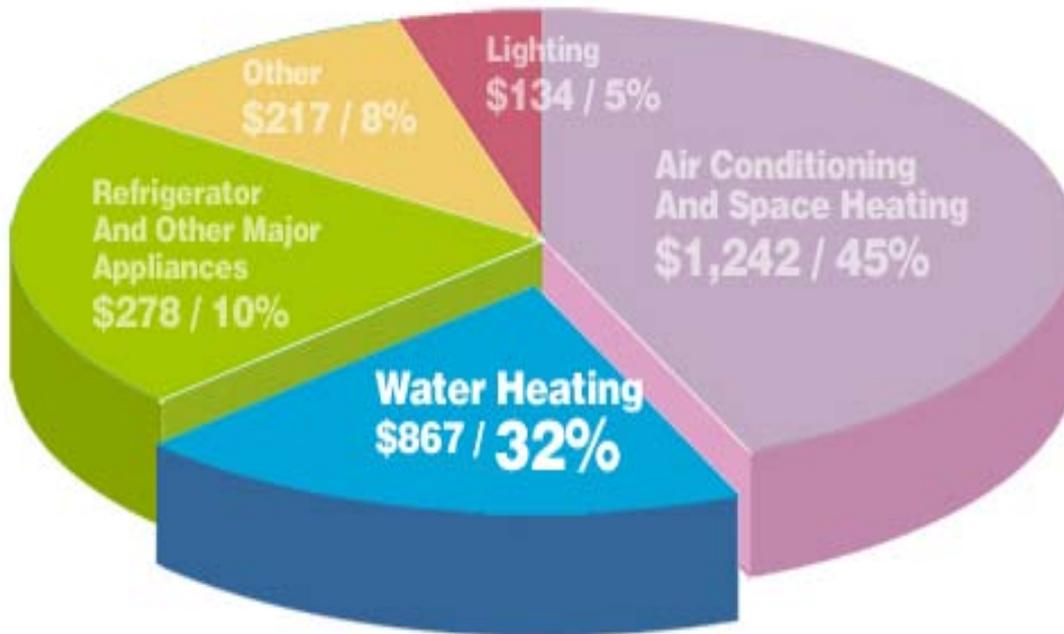
Census Division and State	Residential 9-Nov	Commercial <sup>1</sup> 9-Nov
<b>New England</b>	<b>16.97</b>	<b>14.54</b>
Connecticut	20.57	16.11
Maine	15.29	12.3
Massachusetts	15.89	14.44
New Hampshire	16.25	13.9
Rhode Island	15.11	13.59
Vermont	14.93	12.94
<b>Middle Atlantic</b>	<b>14.47</b>	<b>12.69</b>
New Jersey	15.63	13.07
New York	16.99	14.49
Pennsylvania	11.59	9.43
<b>East North Central</b>	<b>10.78</b>	<b>8.84</b>
Illinois	11.1	8.06
Indiana	9.15	7.9
Michigan	11.58	9.76
Ohio	10.61	9.54
Wisconsin	11.55	9.24

Census Division and State	Residential 9-Nov	Commercial <sup>1</sup> 9-Nov
<b>West North Central</b>	<b>8.57</b>	<b>6.93</b>
Iowa	9.13	6.74
Kansas	9.56	7.79
Minnesota	9.57	7.57
Missouri	7.6	6.08
Nebraska	8.02	6.99
North Dakota	7.56	6.86
South Dakota	8.49	7.07
<b>South Atlantic</b>	<b>11.31</b>	<b>9.64</b>
Delaware	14.57	11.84
District of Columbia	12.66	13.18
Florida	12.43	10.81
Georgia	9.59	8.79
Maryland	14.23	11.48
North Carolina	10.16	8.01
South Carolina	10.64	9.03
Virginia	10.51	8
West Virginia	8.38	7.49

Census Division	Residential	Commercial <sup>1</sup>
<b>East South Central</b>	<b>9.21</b>	<b>8.8</b>
Alabama	10.08	9.61
Kentucky	8.03	7.15
Mississippi	10.3	9.5
Tennessee	8.87	8.93
<b>West South Central</b>	<b>10.83</b>	<b>8.72</b>
Arkansas	9.28	7.42
Louisiana	7.52	7.28
Oklahoma	8.25	6.66
Texas	12.37	9.54
<b>Mountain</b>	<b>9.78</b>	<b>8.45</b>
Arizona	9.86	8.88
Colorado	10.4	8.85
Idaho	7.83	6.7
Montana	8.8	7.93
Nevada	13.72	10.64
New Mexico	9.6	8.26
Utah	8	6.48
Wyoming	8.53	7.36
<b>Pacific Contiguous</b>	<b>11.88</b>	<b>10.88</b>
California	14.6	12.24
Oregon	8.82	7.74
Washington	7.81	7.28

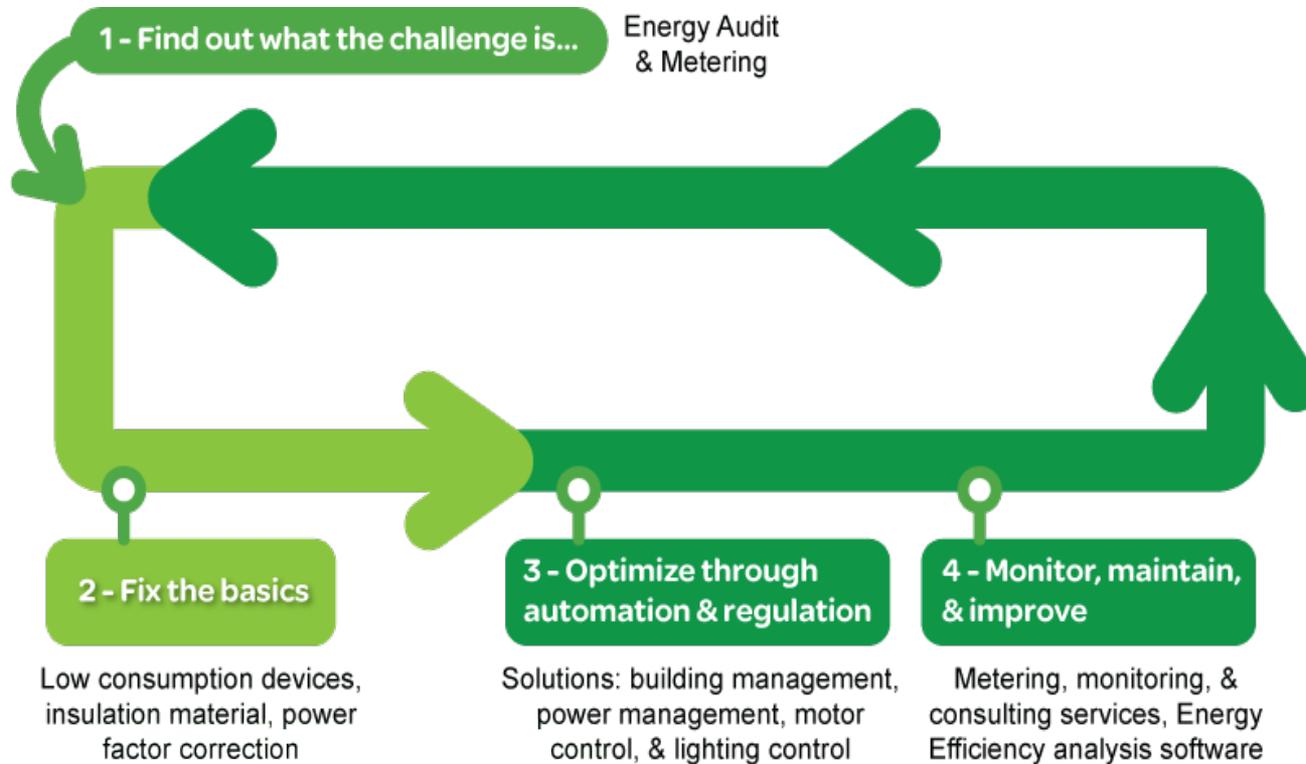


The average yearly energy cost for a  
2000 square foot home





## Lifecycle Solutions for Energy Efficiency

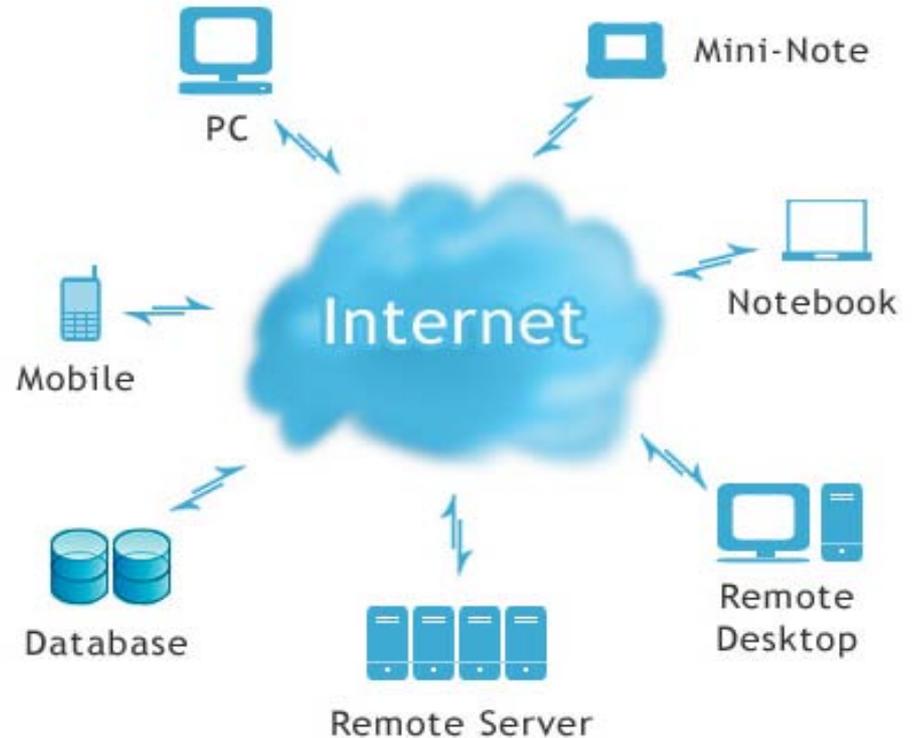


**Active energy efficiency is the fastest way to save energy and CO<sup>2</sup>**



# What is the Cloud ?

**Cloud computing** is the delivery of computing as a service rather than a product, whereby shared resources, software and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet).







# The Cloud in a Home Allows You to...

- Control lights
- Control A/V equipment
- Access security
- Manage HVAC
- Monitor usage in real time
- Access your home from anywhere in the world



## The Home of the Future is the Home of Today

- How many remote controls do you have in your house?
- The average American household has seven (7) remote controls
- The Frykholm's have twelve (12)
  - 3 TV remotes
  - 3 Cable/DVR remotes
  - 4 DVD/Stereo Remotes
  - 2 random remotes that no one knows what they are for



## The Home of the Future is the Home of Today

- How many wireless portals do you have in your house?
- The average American home has four wireless portals in it
- The Frykholm's have 12 wireless portals
  - 3 laptop computers
  - 4 smart phones
  - 2 DVR access points
  - 3 gaming devices
    - Wii
    - 2 Nintendo DS



## The Home of the Future is the Home of Today

- 91% of the American population has at least one mobile device
  - Americans traded 922 billion text messages—5 billion per day—for the second half of 2010, and over 1.7 trillion for the whole year
  - Americans traded 102.8 billion photos, videos, and audio clips moving from one mobile phone to another in 2010.



**The question is.....**

**has all this technology made our  
homes easier to live in or harder?**



## Easier or Harder?

- My response would be it has made our homes harder to live in and also less efficient, even with more sophisticated equipment

The good news is, the Cloud can change all of that



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# A Home in the Clouds

Room by Room



## A Home in the Clouds

### Room by Room – The Living Area

- Your living room is where you spend much of your free time while at home, either entertaining or relaxing. You've found setting and recalling appropriate lighting scenes to suit different occasions very easy. Your system has enabled you to centralize all of your audio and video components in a remote location so that the interior of the room is uncluttered. You have instant control of it via the single touch screen that's so intuitive to use it has replaced the handful of remote controls you had gathered over the years.





## A Home in the Clouds

### Room by Room – The Kitchen

- You regularly use your kitchen for eating and socializing as well as cooking, so you've made it both practical and inviting. The lighting scenes you've created offer diverse yet effective lighting; you enjoy direct overhead light while preparing food but softer lighting while eating. The data port connects a wall mounted flat screen that you use to watch TV. With the computer, waterproof keyboard and wireless mouse tucked away when not in use, you've all the convenience without the clutter. You now enjoy using the Internet as a resource to look up recipes on-line, order your groceries and listen to the radio.





## A Home in the Clouds

### Room by Room – The Dining Room

- Both lighting and music are so important to create the right mood for an enjoyable dinner. Having set up a central audio system to store all your CDs, and with speakers discretely installed in the ceiling or walls, you access the play lists you compiled earlier for the occasion. The lighting scenes you've set up are equally impressive and create a really relaxing atmosphere.





## A Home in the Clouds

### Room by Room – The Bedroom

- From your bedside you access everything on your home system. You enjoy full access to your entire entertainment collection. You access the audio system and instantly retrieve any genre or specific track to listen to via speakers that are discretely installed in walls or ceilings. You often finish watching the DVD in bed that you started viewing in the living room. You've also created some appropriate pre-set mood lighting scenes. During the night, the temperature is controlled for maximum comfort; you've set thermostats to monitor and adjust the heating depending on the time of day.



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## A Home in the Clouds

### Room by Room – The Bathroom

- Once considered as a purely functional room, your bathroom has become a haven for relaxation. With good lighting and music, you now enjoy a truly soothing atmosphere. Within your whole home audio system, your entire music collection, located on a server elsewhere, is there to be enjoyed through water resistant speakers mounted in the ceiling. Via your waterproof handset, everything, including lighting, is fully controllable whilst you are soaking in the bath. You even have a fully waterproof television to keep up with the soaps!





## A Home in the Clouds

### Room by Room – The Patio

- You are making more use of your outdoor spaces during the summer since you enhanced them with sophisticated entertainment and lighting to create an open-air reception/games/dining room. Fully weather resistant speakers have proved much more effective than ‘turning up the volume’ indoors, and connecting garden lights to your system has made creating lighting scenes easy.



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## A Home in the Clouds

### Room by Room – Security

- For enhanced security, you've connected cameras so that they can be monitored from any television or computer in your home, as well as on any mobile device in the world. The same touch screen interface also acts as a door/gate entry system, allowing you to interact with and admit visitors. On leaving your home, you inform the system and it plays back your usual lighting habits to give the impression of occupancy while deactivating any audio/video sources that you may have left on, as well as any electrical devices not in use. This also controls the thermostat and resets your HVAC to a pre-set level.



*The nuts and bolts of a home  
cloud system...*

**It's not as hard as you think.**



A simple **integrated solution** to manage the home energy eco-system and an opportunity to turn a functional home into a **smart and exciting** place

Load Management

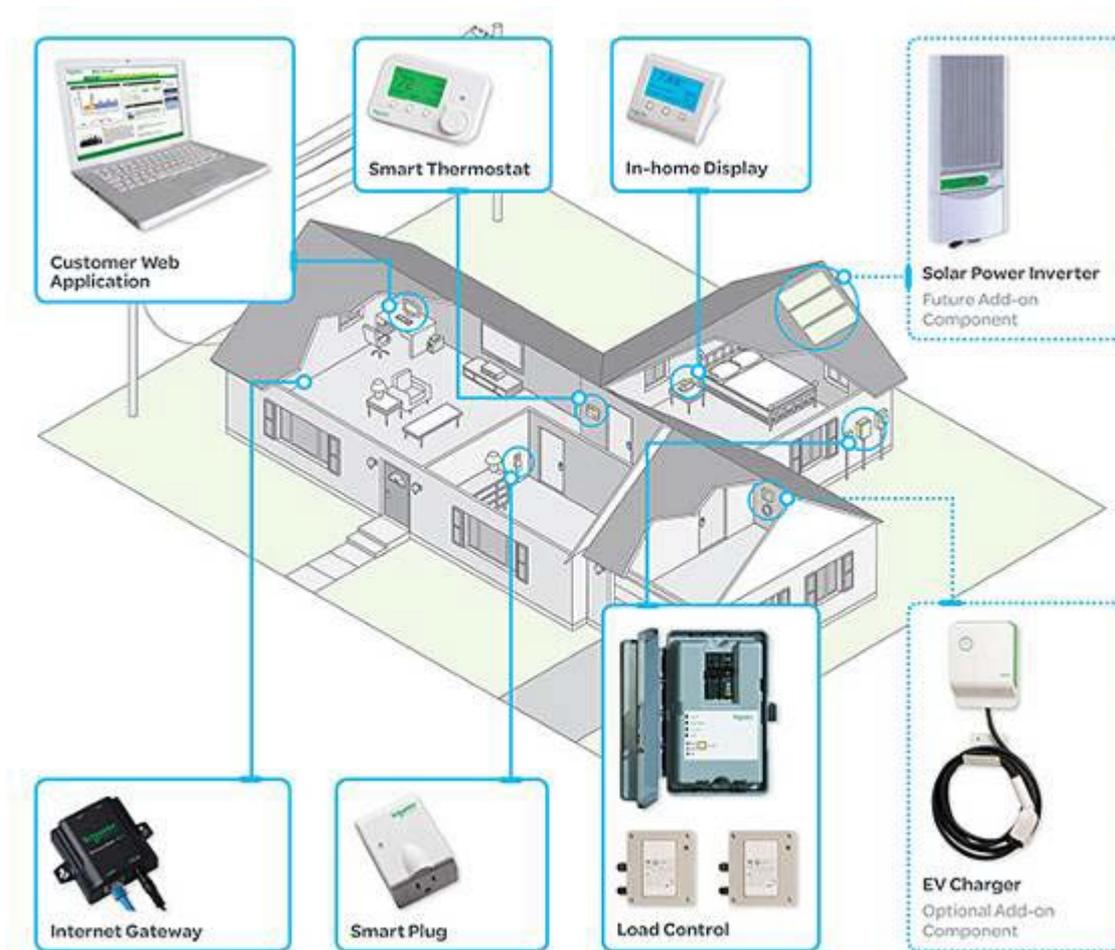
HVAC Management

Demand Response

Electricity Monitoring

Remote Access

Smart Grid Software

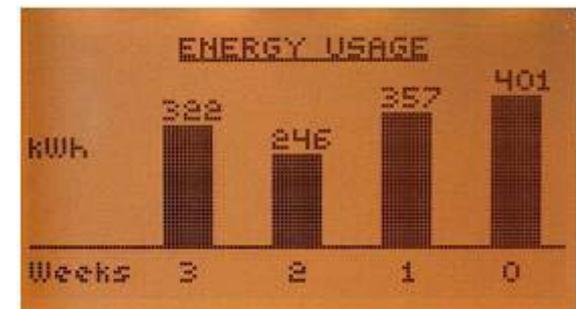
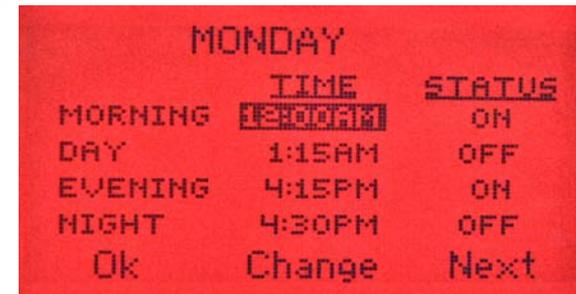


## In Home Display

- Displays details of energy consumption on a daily, weekly, monthly, and yearly basis
- Information gathered from simple metering devices located within the smart energy system
- Displays clock and weather information, plus homeowner can control remote devices with event opt-out capability offering increased homeowner functionality

*display color will change based on the energy cost*

Rate	Color
Critical (most expensive)	Red
High	Orange
Medium	Blue
Low (least expensive)	Green
Demand Response	Blue



Energy Usage Display



## Smart Thermostat

- Programmable Communicating Thermostat that can be remotely controlled by the IHD
- Functions as an In Home Display with color pricing notification



*display color will change based on the energy cost*

Rate	Color
Critical (most expensive)	Red
High	Orange
Medium	Blue
Low (least expensive)	Green
Demand Response	Blue



**ENERGY SETBACKS**

Low Level Setback → Low: 0 °F at 0.07 /kWh → Low Setback

Medium Level Setback → Medium: 0 °F at 0.10 /kWh → Medium Setback

High Level Setback → High: 2 °F at 0.15 /kWh → High Setback

Critical Level → Critical: 6 °F at 0.33 /kWh → Critical Setback

Cancel Ok Next

**Energy Setbacks**

**ENERGY CYCLE**

Low Level Cycle → Low: 0 % at 0.07 /kWh → Low Cycle Price

Medium Level → Medium: 75 % at 0.10 /kWh → Medium Cycle

High Level Cycle → High: 80 % at 0.15 /kWh → High Cycle Price

Critical Level → Critical: 85 % at 0.33 /kWh → Critical Cycle

Cancel Ok Next

Energy Cycle Settings



Green: Low (least-expensive)



Blue: Medium



Orange: High



Red: Warning, extremely high (most-expensive)

*Homeowner automated HVAC control based upon pricing signals.*



## *Additional Components*

- **Load Control Devices**
  - With or without energy reporting
  - May have simple timer functions
  - Inter Device Communication (IDC)
  - Opt out capability
- **Electric Vehicle Charging Stations**
  - May incorporate timer functions, or remote control
  - May support demand response, and variable electricity rates
  - Inter Device Communication (IDC)
  - Opt out capability
- **Solar Panel Integration**



# Conclusion

- The Cloud equals **Simplicity** in a Home
  - More technology with less confusion
  - More options from different platforms
  - More flexibility as technology changes



## Conclusion

- The Cloud equals **Efficiency** in a Home
  - Real time monitoring
  - Demand response usage
  - Usage control
  - Money savings
  - CO2 Savings



## Conclusion

- The Cloud equals the **Future** of the Home
  - Solar
  - Electric Vehicles
  - Smart Grid
  - Interactivity



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***Thank You***