High-Tech Consumer Products for Energy-Efficient Homes of 2010 & Beyond

Chris Schairbaum, Texas Instruments
Outline

• Relating consumer products to Solar
• Appliance power and connectivity
• Illumination & comfort
• Smart electrons & water molecules
• Questions & Answers
Step 1 for a Solar Home

Squeeze the Energy Bill…
What’s my Load?

Load = Power.

How many Watts (or kilowatt-hours) is my house pulling from the grid?
Dissecting the Energy Bill

Energy consumption of a typical household, 2009

- 38% Space heating/cooling
- 13% Water heating
- 11% Lighting
- 5% Clothes washer/dryer
- 7% Refrigeration/freezer
- 3% Cooking
- 1% Dishwashers
- 5% Television
- 2% Personal computers
- 15% Other uses

Source: enviornmentalleader.com 2009
How to Squeeze the Energy Bill…

**Mechanically**
- Smartly designed & insulated shell and HVAC

**Electrically**
- Efficient heating, cooling & lighting
- Efficient appliances & electronics

**Behaviorally (or Electronically Controlled)**
- Only use energy when it is needed (or cheap)
- Minimize the # of household gadgets
Example:
Typical American home with 1,000 kWh / month electricity consumption
How much can smart technology in consumer products lessen my load?
Electronics & Appliances Collide

Load at the Meter
Smarter Heating & Cooling

From:
• Manual temp settings
• Single speed blowers
• Single zone setup
• Low power factor (-e %)
• Manual on/off

To:
• Programmed temp settings
• Variable speed blowers
• Multi zone setup
• High power factor (+e %)
• Demand response & mgmt

> 40% monthly savings on energy usage.
Smarter Lighting

From:
• Manual on/dim/off
• 5% energy to light (incand.)
• 85% energy to light (CFL)
• Low power factor (-e %)
• Single color temperature

To:
• Condition-based on/dim/off
• 95% energy to light (LED)
• High power factor (+e %)
• Variable color temperature

> 40% monthly savings on energy usage.
Lighting Control

• Turn off / dim lights when daylight is present
• Occupancy sensors to turn on lights only when people are present
• New systems are wireless and use energy harvesting to provide the power
  – Efficient ultra low power chips
  – Energy scavenging / harvesting (light, vibration, thermal)
Smarter Laundry

From:
- Too much hot water
- Over-dried clothes
- Single speed motors
- Low power factor (-e %)
- Manual on/off

To:
- Just enough water…
- Perfectly-dried clothes
- Variable speed motors
- High power factor (+e %)
- Demand response & mgmt

> 50% monthly savings on laundry energy and water usage.
Big Appliances / Motors

- Residential motors, used in fans, pumps, and appliances, are often only about 60% efficient.
- Many new brushless permanent magnet motors (also called electronically commutated motors) are 80% efficient.
- Changing to efficient motors greatly reduces power use.
- Variable frequency drives (VFD’s) can further reduce fan/pump energy via the cube law.
- VFD’s allow for lighter motor components because they reduce abrupt starting forces.
Smarter Power Supplies

From:

• Always on supplies
• 70+% efficiency
• Single product supplies
• Transformer-based
• Fan-based supplies

To:

• No-load detect supplies
• 90+% efficiency
• Universal product supplies
• Transformerless-based
• No-Fan-based supplies

Up to 15% monthly savings on consumer electronics energy usage.
Solar Power Supplies

- Removes landscape lighting from the grid
- Unplugs the older 24-hour vampire power supplies

Up to 75% monthly savings on gadget electricity usage.

* Veranda Solar
In Home Displays

• Shows the real time cost of energy
• Displays how much energy is spent, when, and where
• Compares your home’s performance with others in the neighborhood

5-15% monthly savings on total household energy usage.
How much can we squeeze the bill?

20-40% Annually
Residential Solar Power

- PV panels
- Inverter
- Load
- Grid

Charge Controller (optional)

Batteries or storage (optional)
Micro-Inverters / Micro-Converters

Each panel can output its maximum power

Up to 25% more power output over traditional solar installations.
Inverter

Distributed Generation

In Home Display

Smart Meter

Smart Grid – energy and information flow

Grid

Smart meter communicates via wired and/or wireless protocol

Smarter Homes Taking Shape

Smart Garage
Questions?
Thank You