

U.S. DEPARTMENT OF ENERGY



SOLAR DECATHLON 2009

U.S. DEPARTMENT OF
ENERGY



National Renewable
Energy Laboratory
Innovation for Our Energy Future



APPLIED
MATERIALS.

bp



Your life. Plugged in.™



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



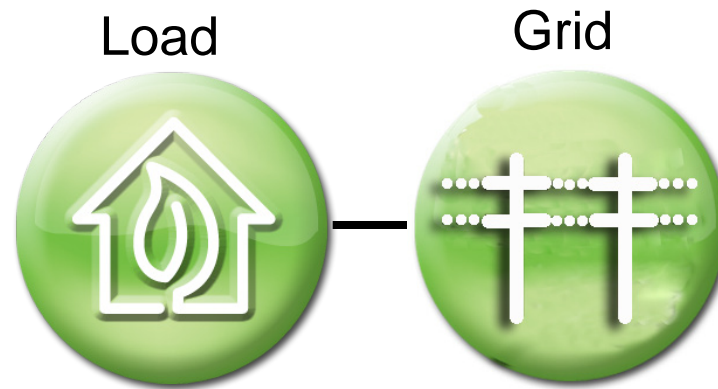
Step 1 for a Solar Home



Squeeze the Energy Bill...



What's my Load?



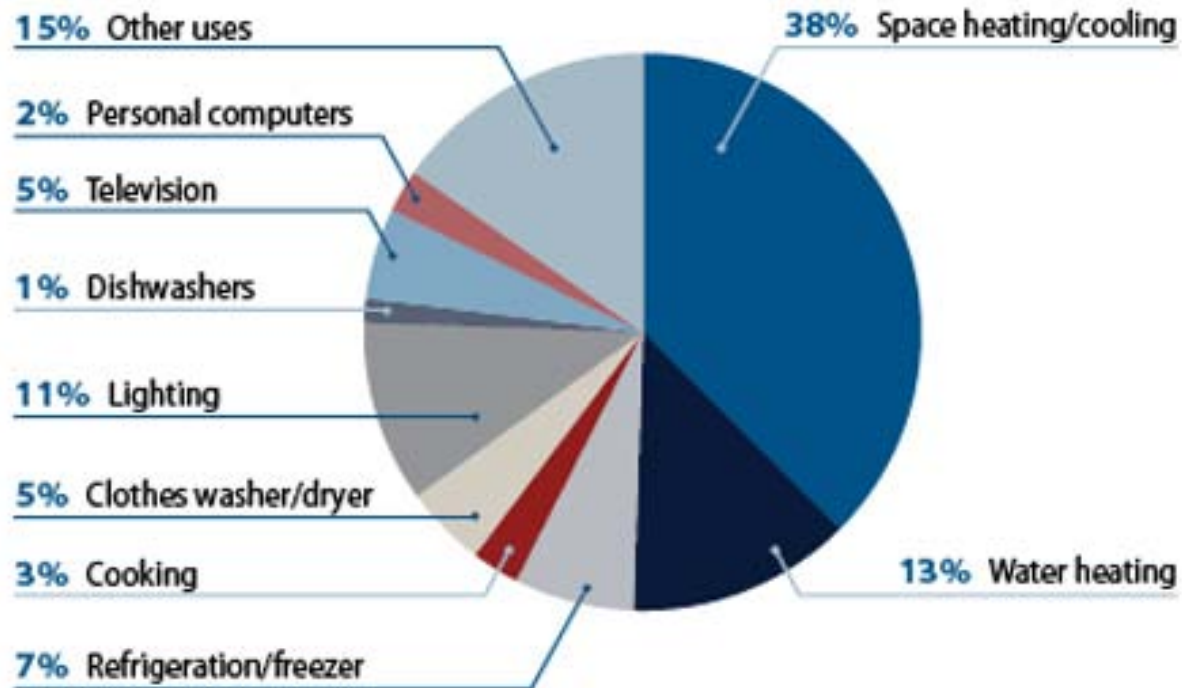
Load = Power.

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



Dissecting the Energy Bill

Energy consumption of a typical household, 2009



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

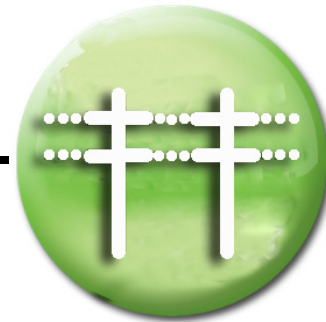


Lessening My Load!

Load at
the Meter

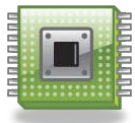


Grid



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



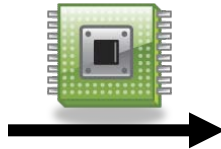


Smarter Heating & Cooling

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.

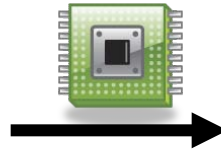


Smarter Lighting

From:



To:



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

- 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)



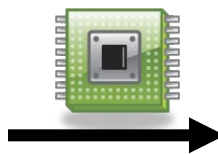


Smarter Laundry

From:



To:



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

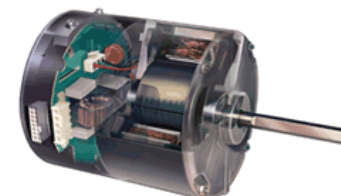
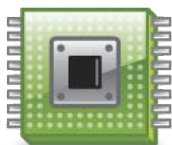
- Just enough water...
- Perfectly-dried clothes
- Variable speed motors
- High power factor (+e %)
- Demand response & mgmt

> 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



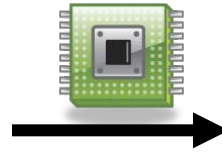


Smarter Power Supplies

From:



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



To:



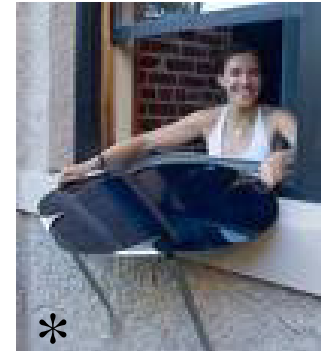
- No-load detect supplies
- 90+% efficiency
- Universal product supplies
- Transformerless-based
- No-Fan-based supplies



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

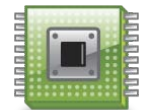


Google PowerMeter

- 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

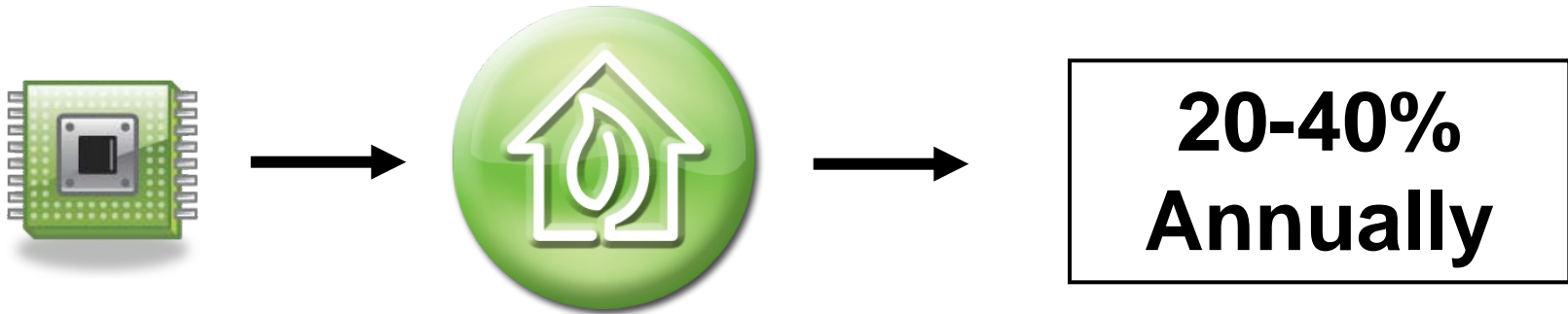


5-15% monthly savings on total household energy usage.



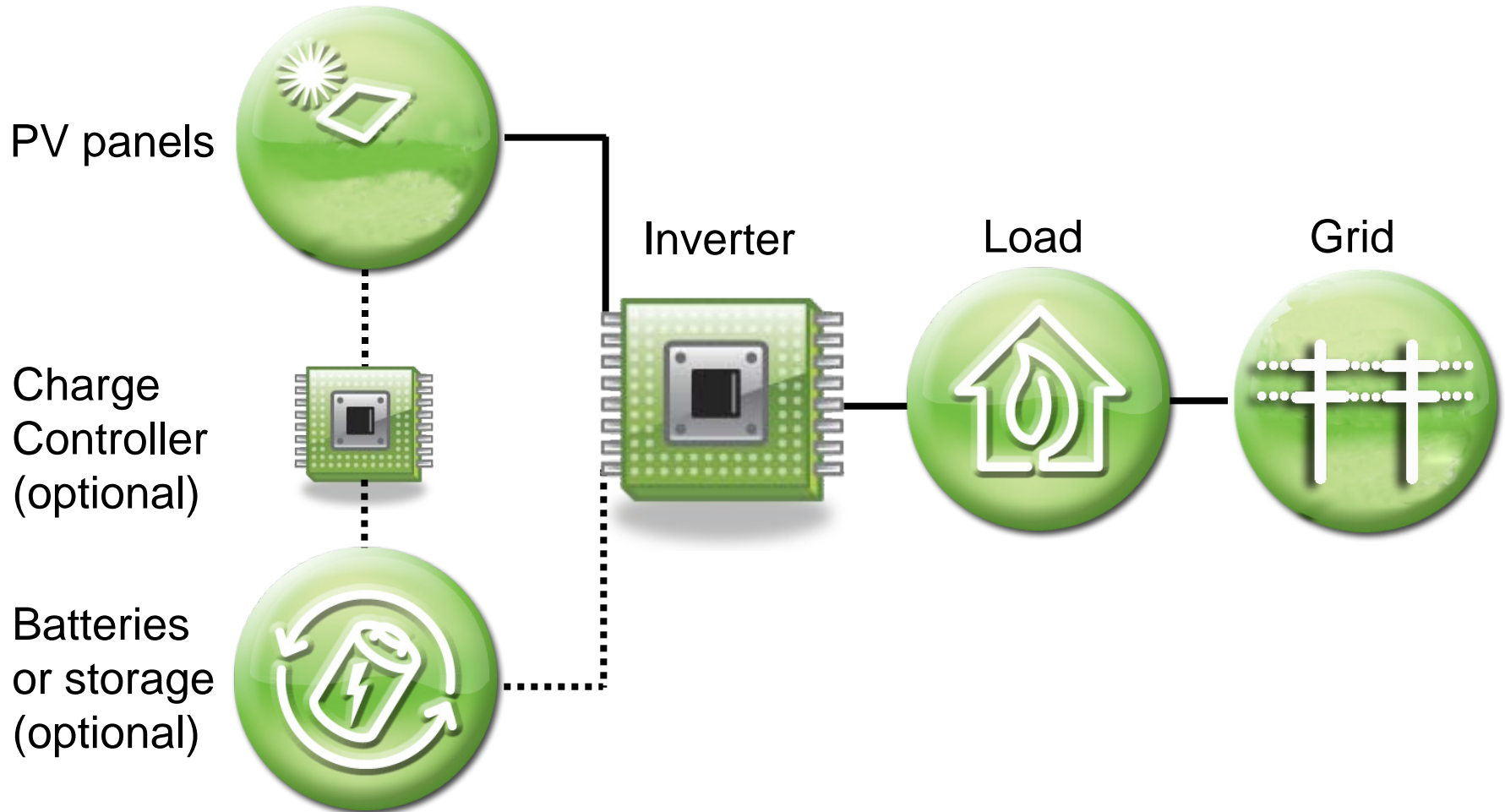


How much can we squeeze the bill?





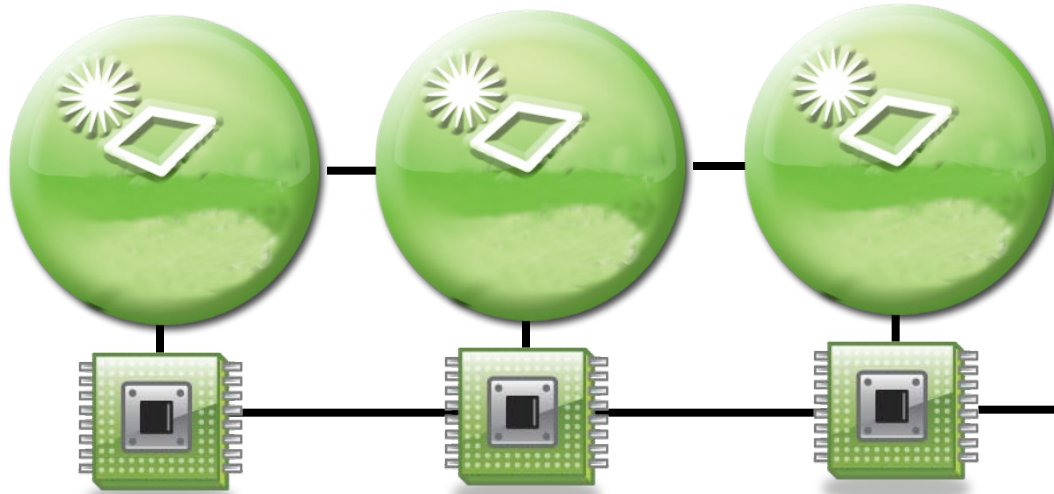
Residential Solar Power





Micro-Inverters / Micro-Converters

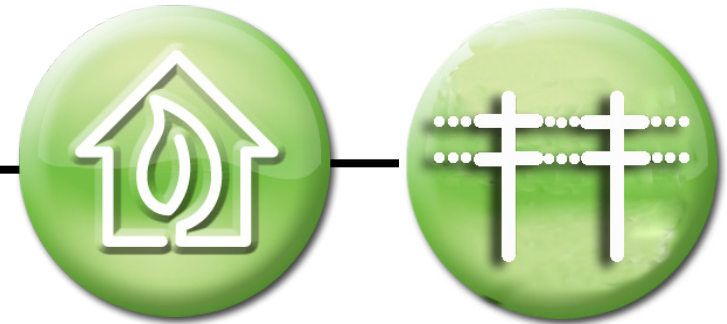
PV panels



Micro-Inverter or
Micro-Converter
One attached to
each PV panel

Load

Grid



Each panel can output its maximum power



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



Smarter Homes Taking Shape



Distributed Generation

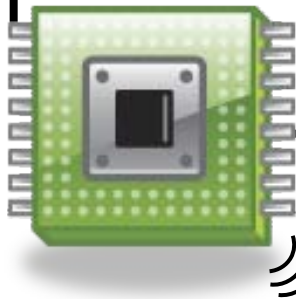
Smart Grid – energy and information flow

Inverter

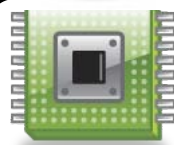
In Home Display

Smart Meter

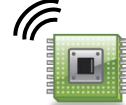
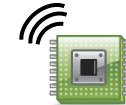
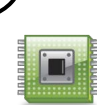
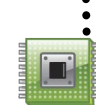
Grid



Smart meter communicates via wired and/or wireless protocol



Smart Garage





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Questions?



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Thank You