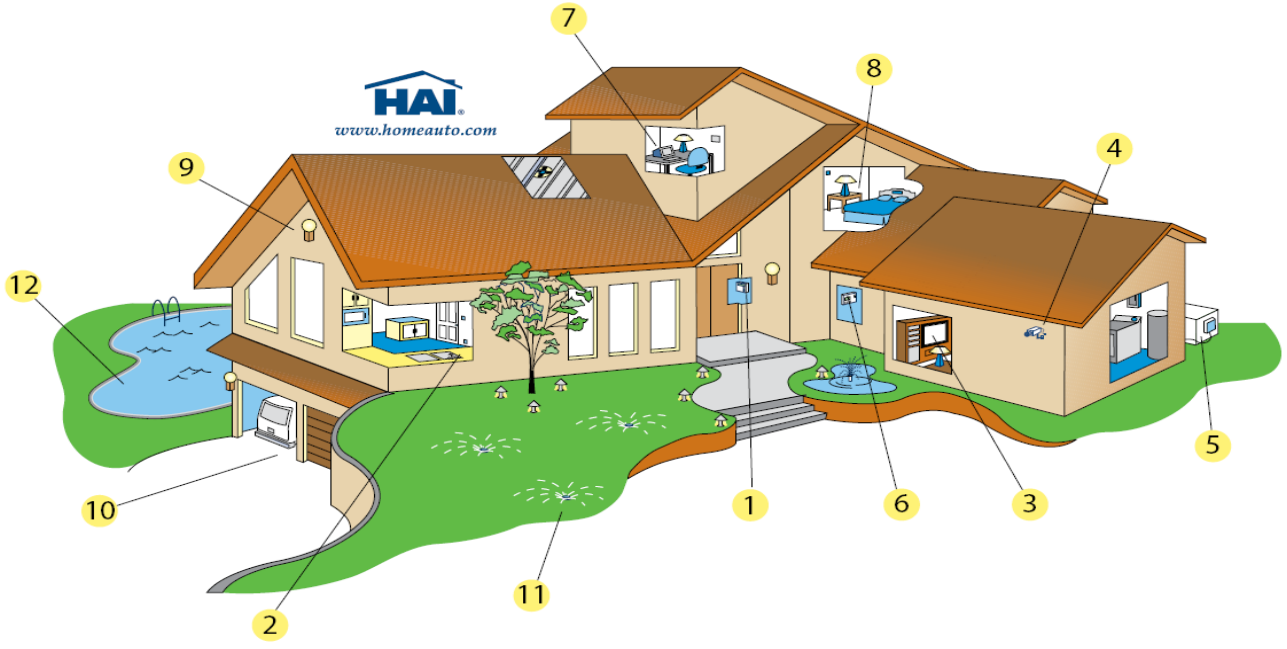


Automated Home / Energy Management

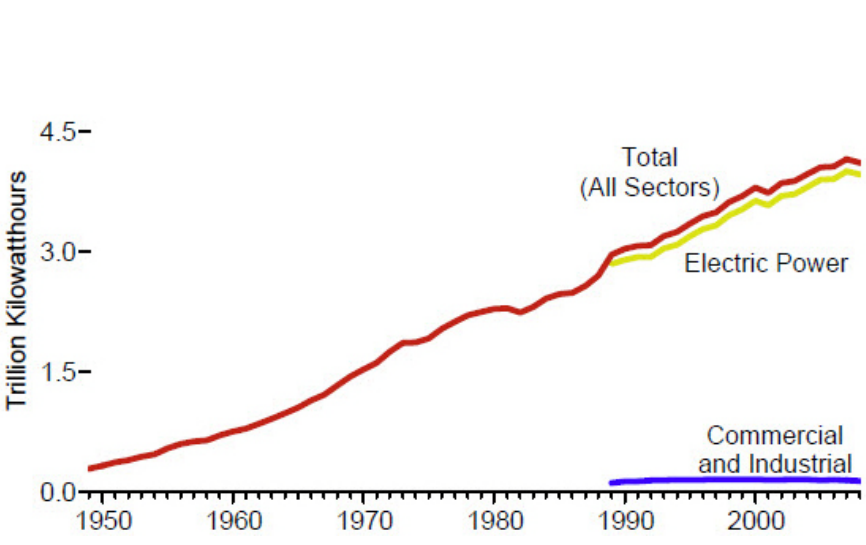
Jay McLellan, HAI (Home Automation, Inc.)

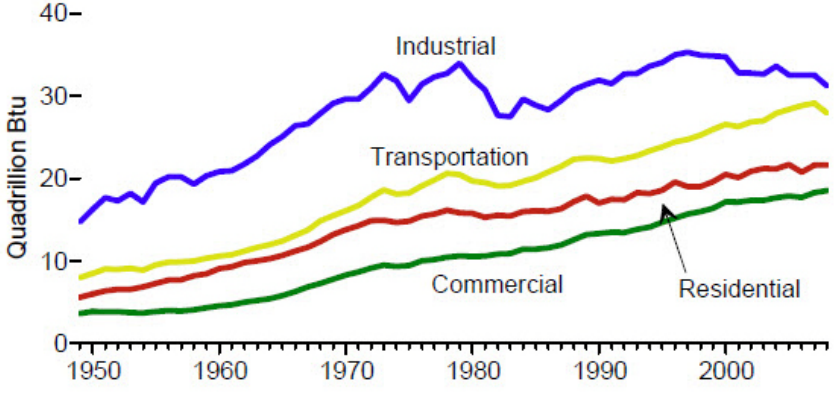
Energy Timeline

- Earth: 4.5 billion years (4.5 B)
- Man: 2 million years (4.502 B)
- Clearcutting, paving & burning everything in sight: 100 years (4.5020001 B)
- = unsustainable

US Electricity Generation

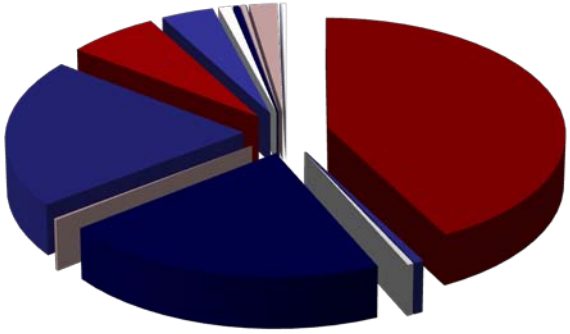
- **Need for power increasing** – air conditioning vs. climate change
- **Consumer Electronics** – very efficient, but more of them
- **Electric Vehicles** - Moving 10% of transportation energy to electric grid = 1 trillion kWh more…





Fuel for Electricity

- May ‘09
  - Coal (42%)
  - Natural Gas (21%)
  - Nuclear (21%)
  - Hydroelectric (7%)
  - Other Renewables (4%)
  - Wind (2%)
- Future
  - Negawatts (conservation & demand response)
  - Nuclear
  - Concentrating Solar



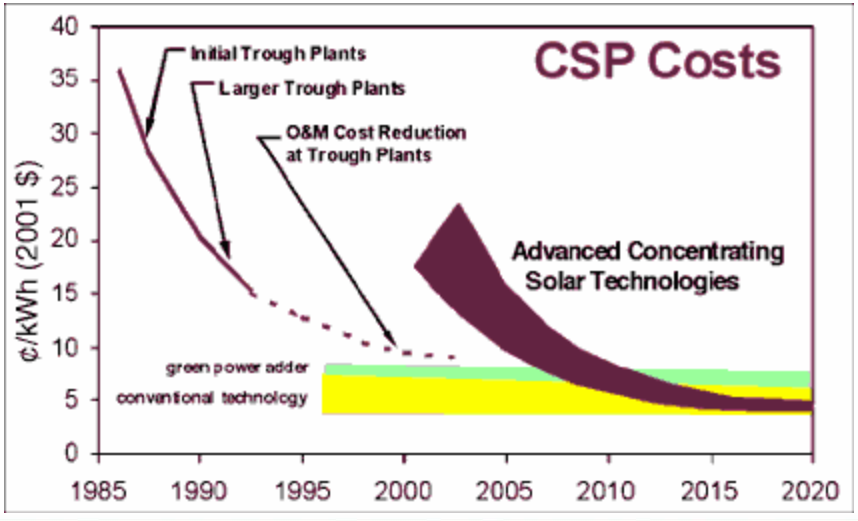
Solar

PV Still expensive, but gaining popularity - 2 KW systems about $20,000 installed

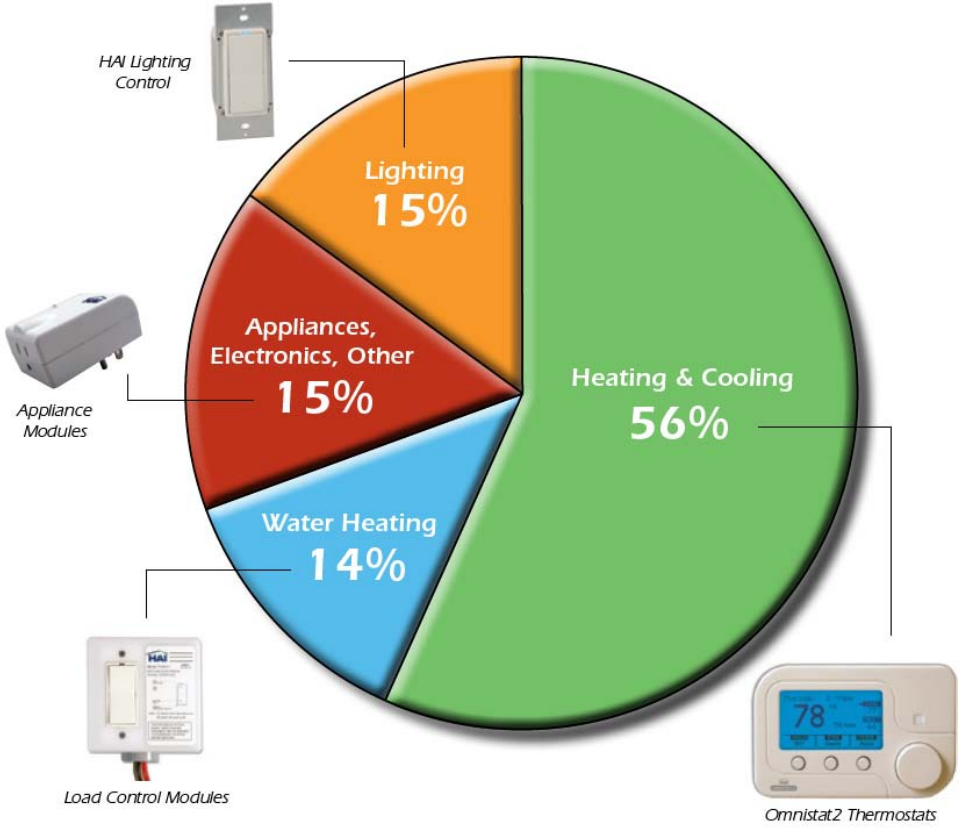
Concentrating Solar: Utility scale

Utility and tax incentives available, example: $4 / watt (Florida) from $8,000 to $20,000 available for residences

California: 3 GW solar o*ver the next 10 years* - over $3 billion statewide.



Major Energy Users in Homes



Home Automation and Smart Grid

- **An automated home brings together security, fire, lighting, temperature control, audio, video, pool, spa, drapery control, sprinklers, and anything else that you want so that these systems can talk to each other and work together**

- An automated home can include some or all of these components – minimum of 3 + remote
- Practical systems focus on energy and security; high end systems on audio/video
- In an automated home these devices work together to make the home more energy efficient, comfortable, more convenient, and safer

Automating for Energy Efficiency

- Goals
- Conservation
  - Reduce runtimes
  - Manual on, auto off
- Demand Response
  - Utility driven, temporary
- Efficiency without affecting Comfort
  - Key: knowing what the occupant is doing
  - Indoor Air Quality – temperature, humidity, smells/hazards
- Remote Control
  - Connect to mobile devices

Equipment

TCP/IP

POTS

CELLULAR

- Controller
- Door and Motion sensors
- Switches
- Sensors
- Thermostat

Wired

- long term reliability
- powered by controller

Wireless

- retrofittable
- batteries or EPS

Conservation Apps

- Adjusting for home, asleep, away, vacation…
  - Mode switch by door, bedroom
  - Activity detection
- Reduce runtimes
  - “sweep” lighting, a/v equipment, set back hvac
- Intelligent control for IAQ
  - Humidity, VOC’s (smells)
  - Economizer (enthalpy) control
- Active control of shades & blinds
  - Seasons
  - Sunrise+, Sunset-
  - temperatures, insolation

Examples

No Activity Detection

- WHEN
  - Door opened
  - Motion detected
  - Switch operated
- AND IF
  - Weekdays 9 to 5
- Set TIMER to 45 minutes

- WHEN
  - Timer expires
- Say “turning off lights now”
- Turn off lights, set back hvac

Shutter control for heat gain

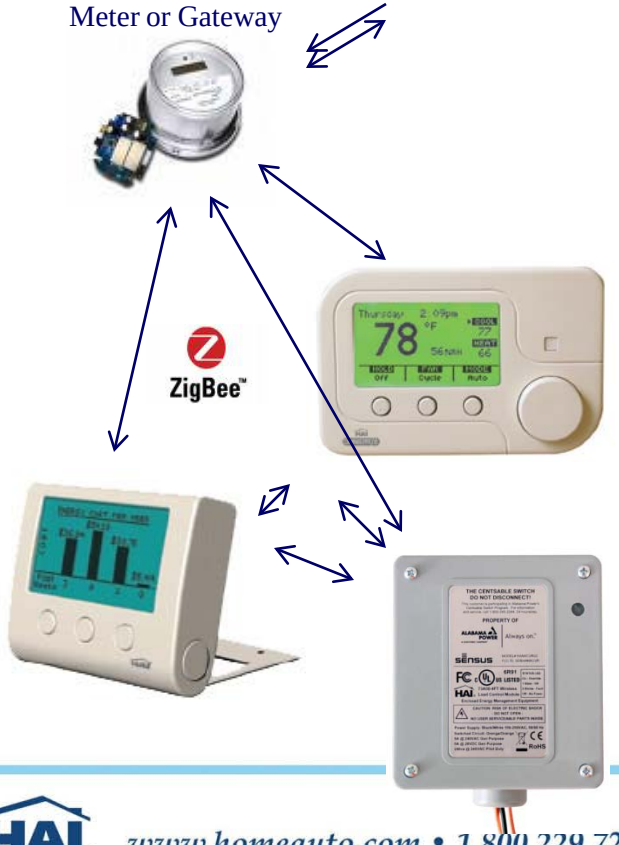
- WHEN:
  - Sunrise +90 minutes
- AND IF
  - Winter season
  - Indoor temp < 72
  - Indoor temp < outdoor temp
- Open shutters

Demand Response

- Utility communications & control
- Balance supply and demand

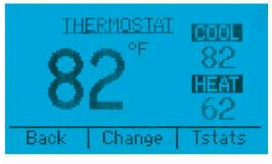
1. Time of Use Programs
   - Scheduled – simple tier system
2. Critical Response
   - Prevent a blackout
   - Renewables solar & wind
3. Real Time Pricing -
   - Adjust use based on cost

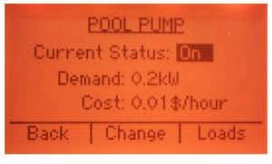
- Easiest Resi/Retro Targets: HVAC, pool pump, water heat.



HAI Smart Grid Solutions

Multi-Function display changes color to show energy cost at a glance.





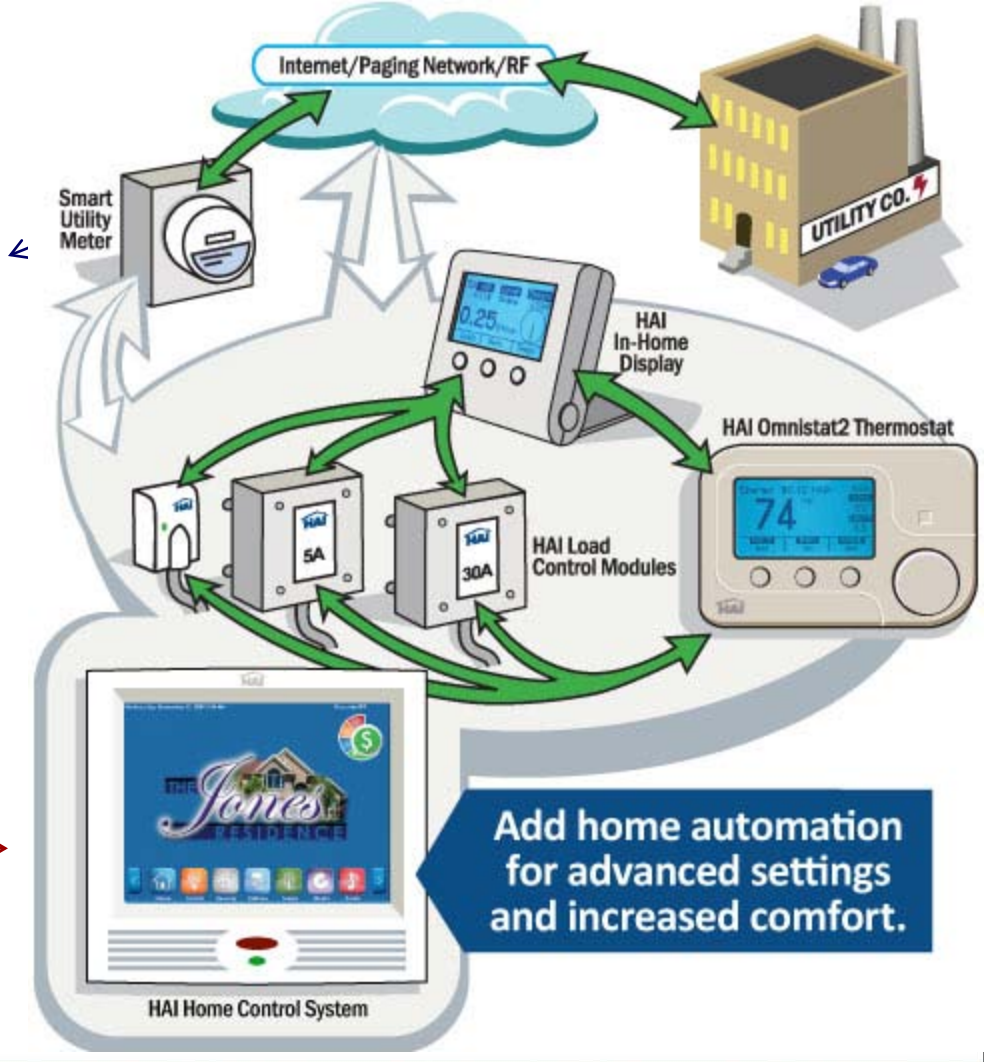
Smart Grid Communications

- Automatic Metering Infrastructure (AMI)
  - Meter to Utility – cash register
  - Usually proprietary to meter manufacturer, RF, PLC, Mesh, Cellular… eventually as IP
  - More data, better data (Google, Hohm, others)
- Gateway to the Home
  - Meter
  - Gateway to Internet, Cellular, GSM
- Home Area Network
  - ZigBee (RF) Smart Energy Profile
  - HomePlug (PLC), Sensus FlexNet
  - Bridges to others (HAI Omni, Lumina)
  - Lots of work on Security, Interoperability

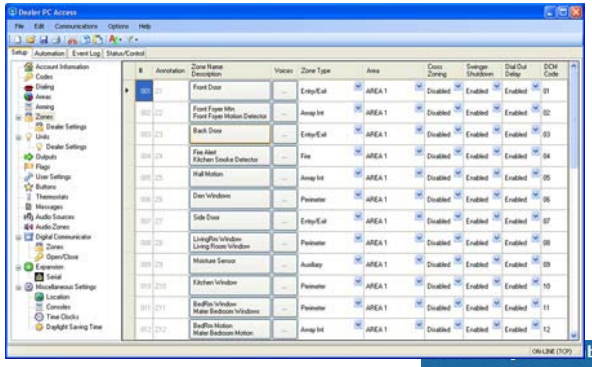
ZigBee™

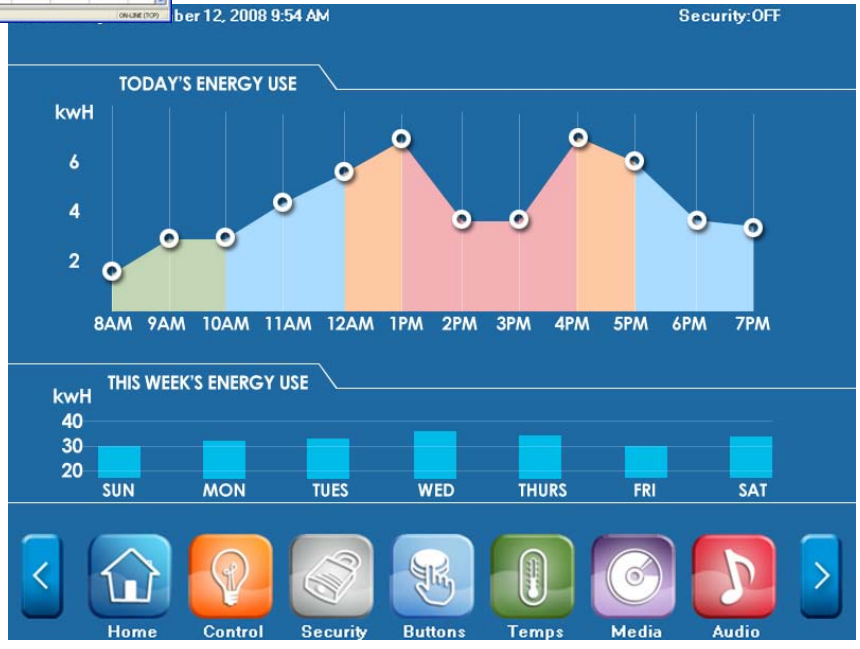
Whole Home Automation

- Security, lighting, HVAC, Remote Control
- Scheduling, Occupancy Sensing, Energy Management
- Gets utility info from IHD, PCT or Internet
- Integrate rest of the house
- Program locally or remotely



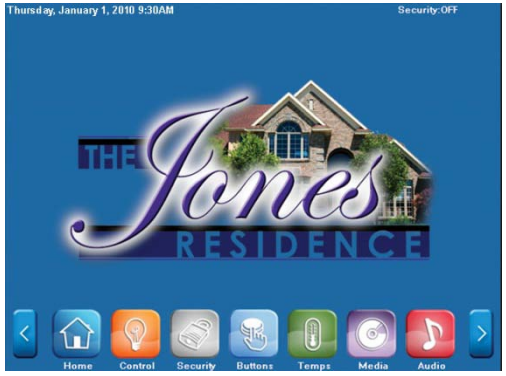
Mobiles & Touchscreens

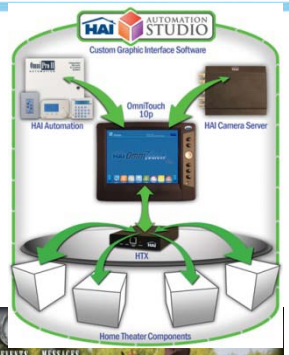




New Touchscreens

- Floor Plans & Themes
- Dealer Info
- Help Screens
- HTX
- Front Door Cam server
- Web Pages
  - Google PowerMeter
  - Microsoft Hohm
  - Utility Energy Pages
- Custom Pages





Energy Management – Here and Now

- Reduce runtimes whenever possible
- Turn off lights, set back HVAC when asleep, away, vacation
- Schedule energy consumption when energy is cheap and/or available
- Use Temperature sensors to control & monitor temperatures in attics, garages, greenhouses, basements, wine cellars or coolers.

Wall warts and other "parasites"

- Cell phone chargers, battery chargers, external power supplies
- "Charging Closet:" wall warts on a power strip in closet…
- Smart Power Strips – Trickle Star
  - PCs, Television accessories
- Consumer Electronics Association working with States, Federal gov't and manufacturers to get consistent national standards for:
  - Standby power maximums
  - Energy efficiency requirements
  - Power supplies, set top box, a/v equipment, chargers.

HAI System Energy Consumption

- Controllers
  - Omni LT: <2 watts
  - Lumina & Omni IIe: 3 watts
- Accessories
  - Sensors: < ½ watt
  - HLC Light switches: 1/8 watt
  - 5.7 touchscreen: 3.5 watts on, <2 standby
  - LCD console: 1/3 watt
  - Thermostats: < 1 watt
  - Door sensors: 0
  - Motion sensors: <1/8 watt
  - LCM's: ¼ watt (ZigBee)
- No batteries to pollute…

RC-3000 ADT

- RC-3000 ADT
- Advanced Diagnostic Thermostat system can detect:
  - refrigerant over charge, under charge
  - bad airflow on condenser, evaporator
  - other efficiency problems long before human detection
- Communicates to owner, utility, HVAC dealer
- Patented technology uses low cost sensors in hvac unit
- Research & Development by SWA and HAI, funding assistance from NIST
- Field testing now, mid 2010 deployment

Residential Cogeneration (Micro CHP)

Climate Energy “freewatt”

Residential Combined Heat & Power

1.2 kW electric

12 kBTU heat

Thanks for Attending!

We hope HAI can be a profitable part of your future!