Echo Solar:
Creating Low Energy Healthy Homes

Building America Spring Meeting
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Main sections

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Section 1

About Echo
What is Echo

Echo contains PV, but is not just generation

Echo is an integrated energy supply system designed to optimize operation of residential building systems

Echo increases solar energy capture density from 15% to 50%

  Echo is designed to overcome limited roof space available in most residential construction

Echo is designed to work with both existing and new homes

  It incorporates aesthetics with performance

Echo was developed from 2003-2007 with funding from DoE Solar Thermal Technologies Program, as part of the pathway to Zero Energy
Echo captures both electrical and thermal energy from the solar PV panel.
**Echo Captures The Energy A Basic Solar Electric System Wastes**

**Basic solar electric (PV):**
- 85% of the sun’s energy is wasted – absorbed as heat by the PV panels

**Echo solar system:**
- Fan draws air under panels
- Air is heated by panels
- Hot air used to heat the home and the water

*A simple, air-based approach*
Echo developed through DoE funding between 2005 - 2010

DOE Phase 1
Proof of Principle
2005

DOE Phase 2
R&D Facility
2006

DOE Phase 3
First Field System
2007

DOE Phase 3
Full Field Evaluation
2008

DOE Phase 4
Commercial Buildings
2009

DOE Phase 4
Solar Cooling Demonstration
2010
**Solar Array:**
- Out-of-the-box PV panels
Echo Solar System Schematic and Key Components

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- Out-of-the-box PV panels

Energy Transfer Module (ETM):
- Thermal energy transfer air to H2O
- Manages energy distribution
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Echo Controller:
- An intelligent control system
- Regulates echo solar system operation
Echo Solar System Schematic and Key Components

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Water Side Mechanicals (WSM):
• Solar storage tank and pump group
• Recovers and stores heat
More than 40 patents filed and 10 US patents awarded

Array Development (22 Patents)

- PVT Array Concept (2005)
- Thermal Module (2005)
- Electrical Grounding (2006)

Mechanical Systems & Controls (10 Patents)

- Home Controls Integration (2006)
- Consumer UI (2008)

Systems Level IP (10 Patents)

- PVT Array Control (2006)
- Thermally Driven Cooling (2006)
Section 3

How does Echo benefit homeowners
Echo Delivers 2X The Energy Of A Basic Solar System

Solar electric energy + solar thermal energy = more energy

Modeled performance from a 2115 watt STC DC array, offsetting electric water heating, Phoenix, 2500 square foot home, HERS rating 75
Echo Satisfies More of the Home’s Energy Needs

Modeled performance from a 2860 watt STC DC array, offsetting electric water heating, Phoenix, AZ, 2500 square foot home, HERS rating 75
## Home Energy Performance

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<th>Echo Solar System</th>
<th>Basic Solar</th>
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<td><strong>Electric Utility:</strong></td>
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<td>Home Cooling</td>
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<tr>
<td>Ventilation</td>
<td>—**</td>
<td>—</td>
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<tr>
<td><strong>Totals</strong></td>
<td>8,055 (+69%)</td>
<td>$768 (+69%)</td>
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Echo Complements The Curb Appeal Of Beautiful Homes

Sleek aesthetics create a system your homebuyer will be proud to show off.
Echo Includes State Of The Art Performance Monitoring
Echo’s provides remote control of home energy systems

Echo transforms a computer or mobile phone into a ‘home remote control’.

**Convenience and Comfort**
Control your home thermostat from anywhere in the world, simply and easily.

**Energy Savings**
Intelligent thermostat controls save energy while maintaining home comfort.
Section 3

Echo and Building Energy Use
Echo Satisfies More of the Home’s Energy Needs

**Tucson**
- 75%
- 25%

**San Francisco**
- 70%
- 30%

Efficient Home with Echo
Echo Delivers 2X Energy So Your Home Gets Better “Miles Per Gallon”

New Homes with Echo attains HERS scores of 25 - 40

HERS ratings may vary home to home
Section 4

Echo & Water Heating
Echo has options for both closed and open loop water heating

Echo transfer heat from air to water using an Energy Transfer Module and heat exchanger

No Water on the roof – reduced risk of freezing
  - Extends the range of climates where glycol is not required
  - Reduces system cost
  - Increases performance

Echo is certified to both OG-100 and OG-300 solar water heating standards

Solar Fraction for a 2.1 KW system ranges from 50% to 90% depending on climate
Section 5

Echo Heating and Cooling
Echo is controlled independent of HVAC system
Echo ties into ducting downstream of Air Handler to provide proper distribution
Indoor and outdoor temp sensors turn Echo on for heating and cooling
Echo Controller communicates with wireless thermostat
Echo operating mode is synchronized to thermostat operating mode
How do you save energy?

Building Passive Storage – slab and insulation

Psychometric Comfort Ranges – ASHRAE standard 55
   People are comfortable over a range of indoor conditions – 72 F is not the only comfort point

Enabling better user behavior – The Prius Effect
   What matters is the minimum and maximum temperatures
   Educate users on savings energy by adapting behavior w/ thermostats

What does Echo do
   Uses Building Passive storage to float home temperature
   Defer heating and cooling energy usage by charging the home with solar heating and night sky radiant cooling
ECHO Virtual Thermostat

Designed to exploit building passive storage and comfort range to maximize energy savings
ECHO Thermostat features

A classic “speedometer” look to provide an intuitive dial type control

Intuitive, easy to use calendar

Acts as a programmable thermostat, with a more user friendly design

Single point control, seamless control for all space conditioning systems

Remote control from anywhere in the world

Comfort band concept to reduce fossil fuel usage and optimize solar heating and night cooling

Eliminate any conflict between Echo and auxiliary system
How does it work with complex high efficiency HVAC systems

A 4 zone system with 4 wireless thermostats. Echo controller reads temp and mode on all thermostats – web UI for all T-stats. Echo connects downstream of AHU into multiple zones.

Zone Controller co-ordinates HVAC system operation between the zones – Echo does not connect to zone controller.
Section 6

Echo Smart Ventilation
What is unique about Echo Ventilation

Promotes a healthier indoor environment with ASHRAE 62.2 compliant ventilation

Echo can provide heated air to the space in winter and cool air in the summer

Intermittent Ventilation Strategy

ASHRAE 62.2 allows intermittent ventilation with higher air flow rates operating for a fraction of 12 and 24 hr cycles

Echo operates at 3 – 5 time base ventilation rates using variable speed fans at 0.2 W/CFM

Standard cooling and heating operation count to ventilation credit

Reduces energy use for ventilation by 40 – 80%, especially in dry climates
Energy Efficient Ventilation

Sum of fan energy and heating and cooling energy lower than alternate methodologies in western climates
Section 6

System Commissioning, Monitoring and Fleet Management
Complete system commissioning with remote verification

SmartComm ensures that the full system is operational and meets criteria for airflow, PV production, based on system design.

Commissioning data stored in central database and available to partners
Multiple Home Comfort parameters monitored

Echo monitors both energy generation and system temperatures related to HVAC and water heating.
Echo Fleet Control Center monitors system performance 24/7

Dealer and Internal Dashboards allow real time monitoring and historical performance evaluation of the fleet.

Individual systems can be compared to locational system averages.
Automated Diagnostics enables fault finding and rectification

Automated Diagnostics help detect faults as they happen real time
Technical Control center fixes most faults remotely
Echo provides ability to co-ordinate service calls with HVAC and plumbing trades