



## Emerging HVAC Technologies: The Long View

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Washington, DC

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### What is ACEEE?

- Nonprofit, dedicated to advancing energy-efficient policies, practices, and technologies, through:
  - Technical and policy analyses
  - Convening conferences
  - Advising policymakers and program managers
  - Educating businesses and consumers
- Founded in 1980



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### What are Emerging Technologies, to ACEEE?

- Emerging technology is:
  - Not yet commercialized, but cost-effective and market-ready
  - OR -
  - Commercialized, but less than 2% market-share
- Pulling ET's into the market is an important strategy for pursuing greater energy-efficiency
- ACEEE has tracked ET for over a decade
  - Publish regular reports on a selection of ETs



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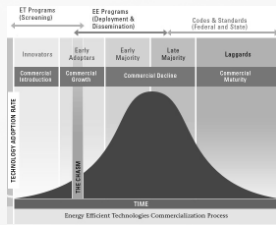
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## Why do we care about ET?

- Market image:  
Lab → first commercial product (ET) → Market Transformation → Codes and Standards.
- ACEEE involved since 1993  
(Reports published in 1993, 1998, 2004, 2006, 2009)



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## Emerging Technologies: Part of a Process



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## 2008 – 2009 HVAC ET Work\*

<<http://aceee.org/emertech/buildings.htm>>

- 15 Technologies, 4 – 8 pages on each  
Standard Presentation:
- Background & description
  - Data summary table
  - Current status
  - Economics: Savings and Cost-effectiveness
  - Market Barriers
  - Key Assumptions
  - Next Steps
  - Not Included: How to profit as a contractor.

\*Wilson Lin and Harvey Sachs

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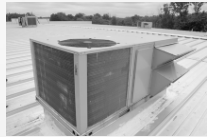
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### Advanced Rooftop Packaged Air Conditioners

- More efficient rooftop units with features such as improved fans and economizers, better controls, and advanced diagnostics

- Cost of Saved Energy: \$0.11/kWh
- Demand (kW) savings additional




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### Advanced “Gas-Pack” Rooftop Packaged Air Conditioners

- Packaged units with condensing gas furnace heating, well-insulated cabinet, and insulated low-bypass dampers.

- Cost of Saved Energy: \$7.18/MMBtu




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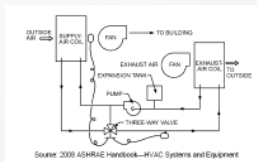
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### Commercial Energy Recovery Ventilation Systems

- Heat exchanger to capture heat of outgoing exhaust air in mechanically-ventilated commercial buildings.

- Cost of Saved Energy: \$0.06/kWh




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### Residential Hot-Dry Air Conditioners

- Conventional air conditioners provide deep cooling to ensure adequate dehumidification. In dry climates where this is not required, a climate-optimized unit can save 20% of air conditioner energy.

- Cost of Saved Energy: \$0.07/kWh



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### Smart Premium (Robust) Residential Air Conditioners

- Improvements in long-term field performance, by resolving common issues such as incorrect air flow, leaky ducts, oversizing, refrigerant leakage. Auto-diagnostics are another component.

- Cost of Saved Energy: \$0.13/kWh



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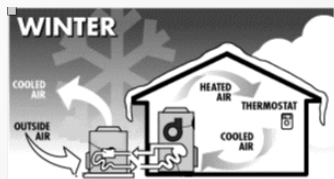
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### Advanced Northern Heat Pumps

- Heat pumps optimized to capture heat better in colder climates, minimizing back-up resistive heat.

- Cost of Saved Energy: \$0.07/kWh



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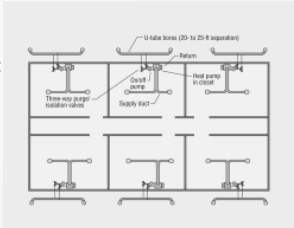
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## Commercial Ground-Source Heat Pumps: One-Pipe Loops

- The one-pipe loop systems have a lower first cost than conventional ground-source heat pump systems, and are easier to design, install, and commission.

- Cost of Saved Energy: \$0.07/kWh



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## Residential Ductwork Optimization

- For new buildings, optimizing ductwork can include:
  - Placing all ducts in conditioned spaces
  - Correctly sizing ducts
  - Using high-quality materials,
  - Properly sealed ducts, or self-sealing ducts
  - Reducing friction and turbulence

- Cost of Saved Energy: \$0.03/kWh



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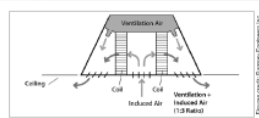
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## Active Chilled Beam Cooling with DOAS

- Commercial building HVAC systems that combine high efficiency and high amenity levels by using radiant-connective active chilled beams as the terminal units. These mix tempered ventilation air with recirculated room air.

- Cost of Saved Energy: Negative!



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### Advanced (Commercial AC) Modulating HVAC Compressor

- Instead of cycling on and off to meet part load conditions (inefficiently), modulating compressors vary their output to meet the load. This increases efficiency as well as humidity control.
- Cost of Saved Energy: \$0.01



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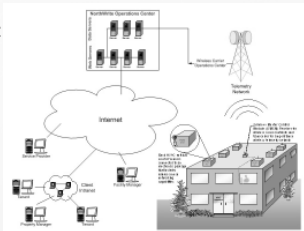
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### Automated Fault Detection and Diagnostics for Rooftop Units

- Smart units that detect when they are failing or when they are running below optimum efficiency.
- Cost of Saved Energy: Negative!



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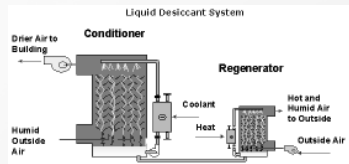
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### Liquid Desiccant Air Conditioner

- Controls humidity via a concentrated salt solution, thus avoiding the need to cool the air below the dew point.
- Cost of Saved Energy: Negative!



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## Residential Boiler Controls

- Integrated and stand-alone controls for residential boilers that estimate changes in heat demand under part-load conditions and control maximum boiler water temperature, firing time, and/or circulating pump cycling and speed in response.

- Cost of Saved Energy:  
\$4.86/MMBtu




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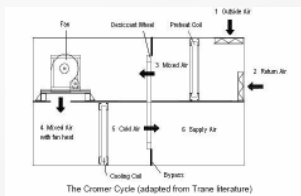
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## Dehumidification Enhancements for Air Conditioners in Hot-Humid Climates

- Cromer cycle systems (systems with a desiccant wheel and vapor compression air conditioner), match heating loads in humid areas, especially at part load conditions.

- Cost of Saved Energy:  
\$0/kWh




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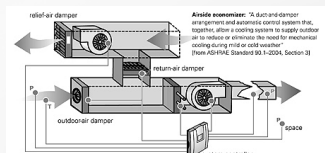
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## Air-Side Economizer Control Strategies

- Outdoor air is used to condition the indoor space when outdoor conditions are favorable. This supplements or replaces the heating or cooling equipment.

- Cost of Saved Energy:  
\$7.58/MMBtu




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### Conclusions?

- Change and Innovation are the new constants.
- Contractor profitability likely to require great people, great marketing, and understanding how to benefit first from the new opportunities.
- We have to love learning to ride the waves to the future.
- Caution: wave-riding can be hazardous (but there are no options)



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### For More Information:

The study (free downloads):  
<http://aceee.org/emertech/buildings.htm>

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