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The Association of Energy Engineers

Application of Advanced Energy Technologies

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AdvanTek

AdvanTek

- Strategic Project Management & Prioritization
- Specialists in Energy Efficiency Technology
    - Analysis
    - Engineering
    - Implementation
- Attention to Overall Building Performance
- A Small Business Vested in Your Success

MAIN POINTS of Presentation

- Advanced technologies provide savings in addition to savings from standard lighting and HVAC retrofits by 50% or more
- Proper application of advanced technology requires a thorough systems-based energy survey and rigorous engineering
- Longer payback periods require detailed economic analysis and innovative financing requirements to achieve economic viability

Strategic Energy Management

- *A well thought out plan includes*:
  - ✓ Explicit savings goals
  - ✓ Strategic project prioritization and focusing of resources
  - ✓ Attention to both *operations* and *technology*
  - ✓ Comprehensive energy and water surveys
  - ✓ Application of the best available advanced technologies
  - ✓ Financing options and review of rebates and incentives
  - ✓ Coordination with Green Lights® and ENERGY STAR®
  - ✓ Proactive Training and Preventative Maintenance Planning
  - ✓ Options for making the most of utility restructuring
  - ✓ Measurement & Verification of Savings

Equipment Based Approach: An ECM Checklist

ECM CHECKLIST

Building ______ Room________

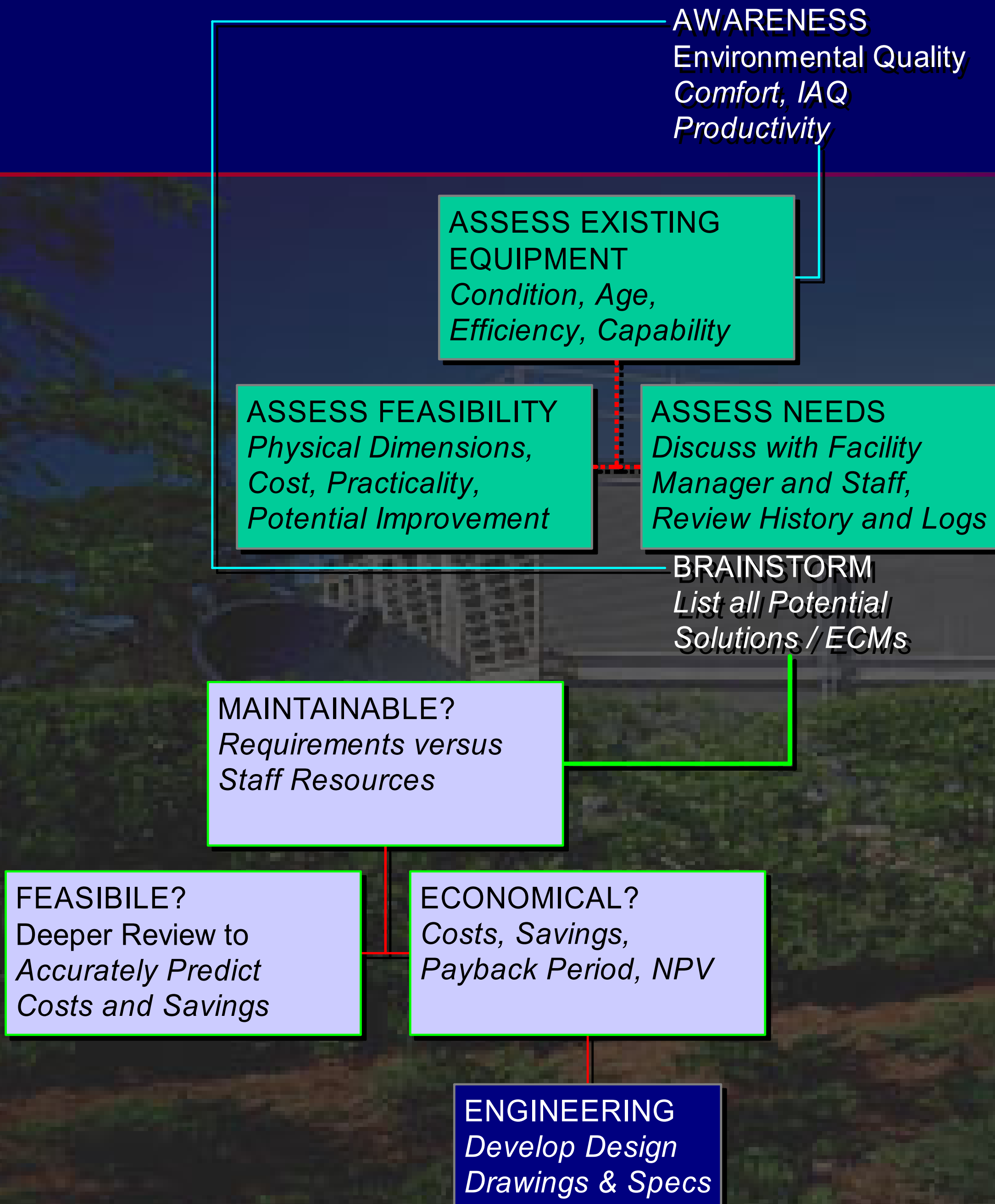
LIGHTING

- ❐ UPGRADE TO T8 LAMPS
- ❐ COMPACT FLORESCENTS
- ❐ CHANGE EXIT SIGNS TO LED
- ❐ INSTALL OCCUPANCY SENSORS
- ❐ PHOTOCELL OR TIMER

HVAC

- ❐ VARIABLE SPEED DRIVE
- ❐ CHILLER REPLACEMENT
- ❐ CONTROL SYSTEM UPGRADE
- ❐ REPLACE CONDENSING UNIT
- ❐ SETBACK THERMOSTAT

Systems Based Approach: An ECM Development Process



Advanced HVAC Technologies

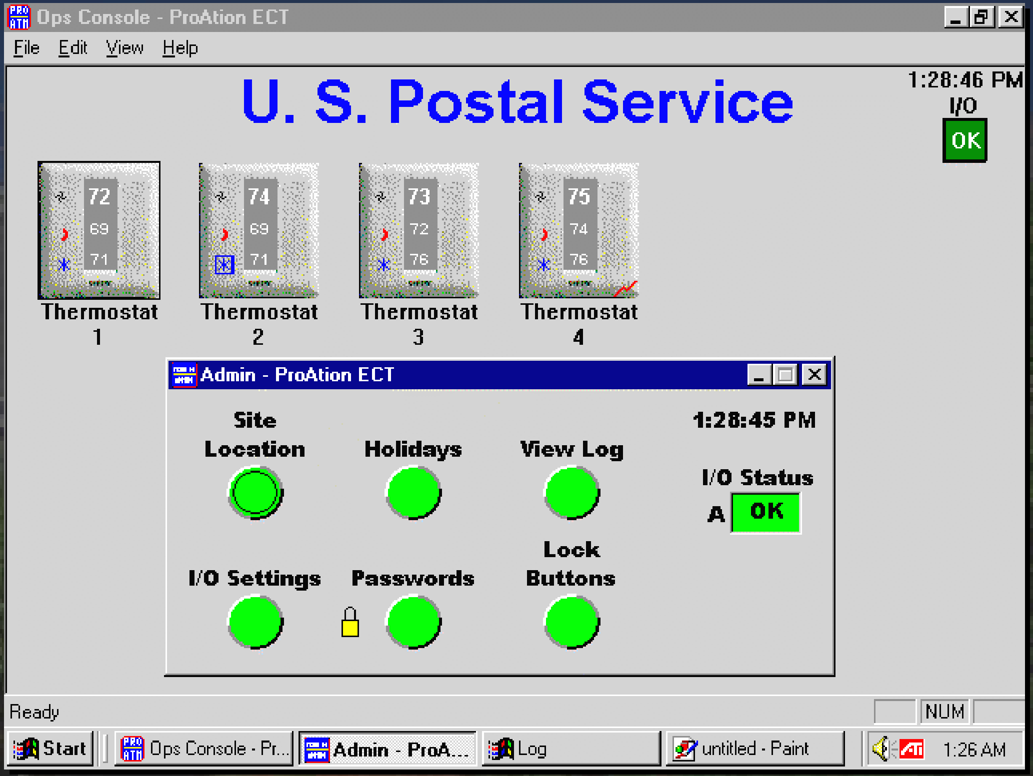
- Internet Communicating Thermostats
- Dual Source (Ground-plus-Air) HVAC
- Desiccant Fresh Air Pre-Conditioning
  - Micro-Turbine CHP ***(GLOBALCON Track 1)***
- Engineered Package Unit Modifications
- Solar Hot Water Heating
- Cold Air Distribution
- Heat Pipe Heat Recovery
- Demand Controlled Ventilation (DCV)
- Thermal Storage

Advanced Energy Technologies

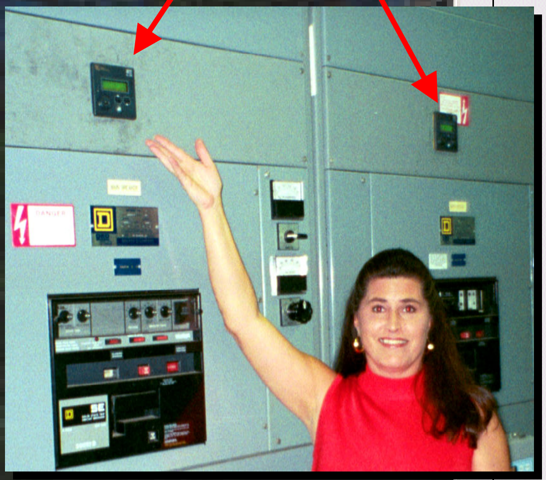
- LOAD SHIFTING
  - On-Site Co-generation
    - Micro-Turbine, Fuel Cells, Absorption Chiller
  - Web-enabled Power Meters ***(GLOBALCON Session 2B)***
  - BAS Load Shedding and Demand Limiting
- RENEWABLE ENERGY
  - Solar Ventilation-air and Space Heating
  - Solar Shower, Kitchen, and Lavatory Water Heating
  - PV electricity for remote sites and emergency power

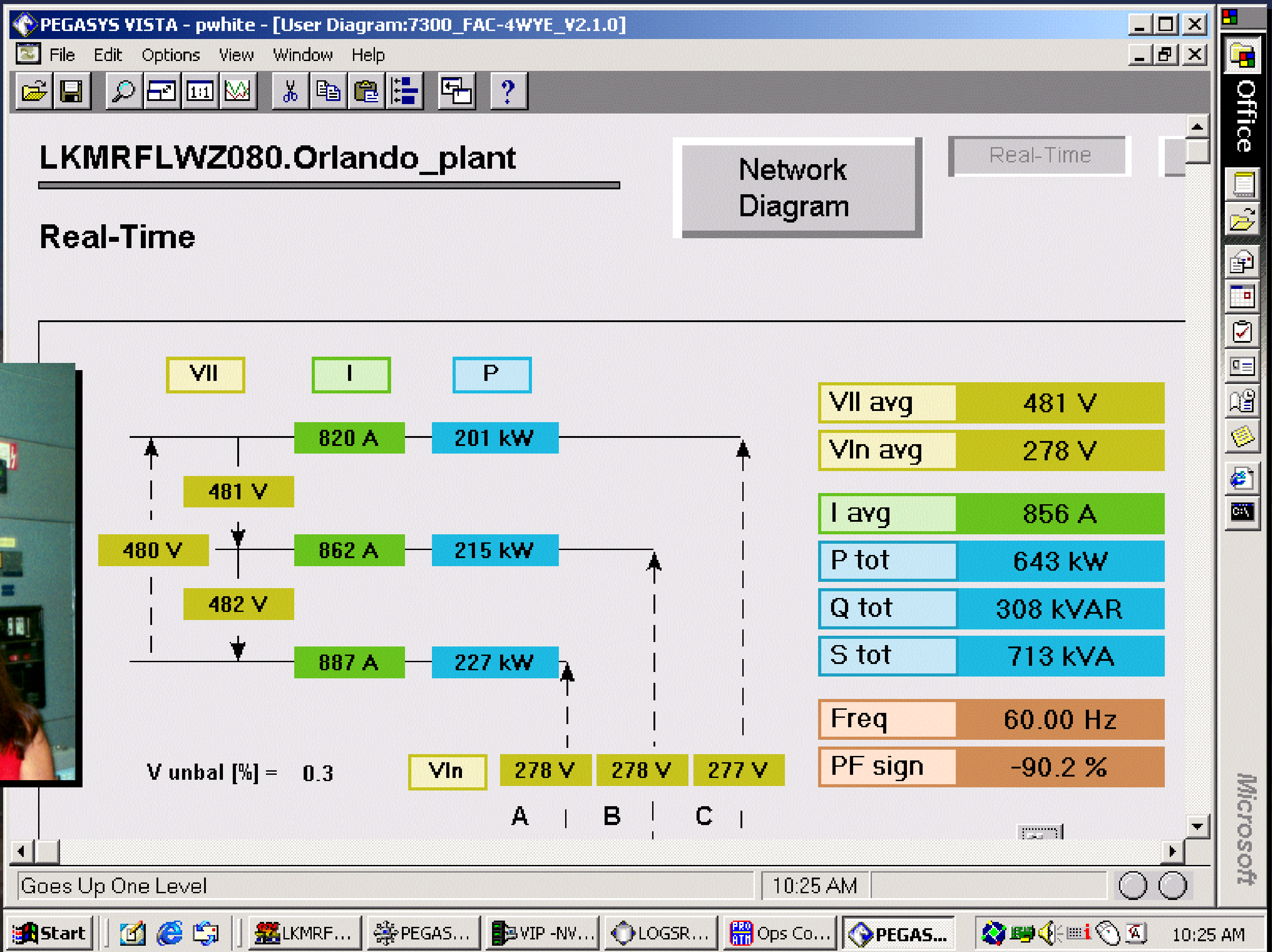
ECM Example:
Internet Communicating Thermostats

- Monitor and Control All Thermostat Functions
- Access from any PC
- Observe, Trend, and Limit Set Point Changes
- Auxiliary Control and Monitoring of Lighting
- Cost Effective BAS for Groups of Smaller Buildings



ECM Example:
Internet Communicating Power Monitors

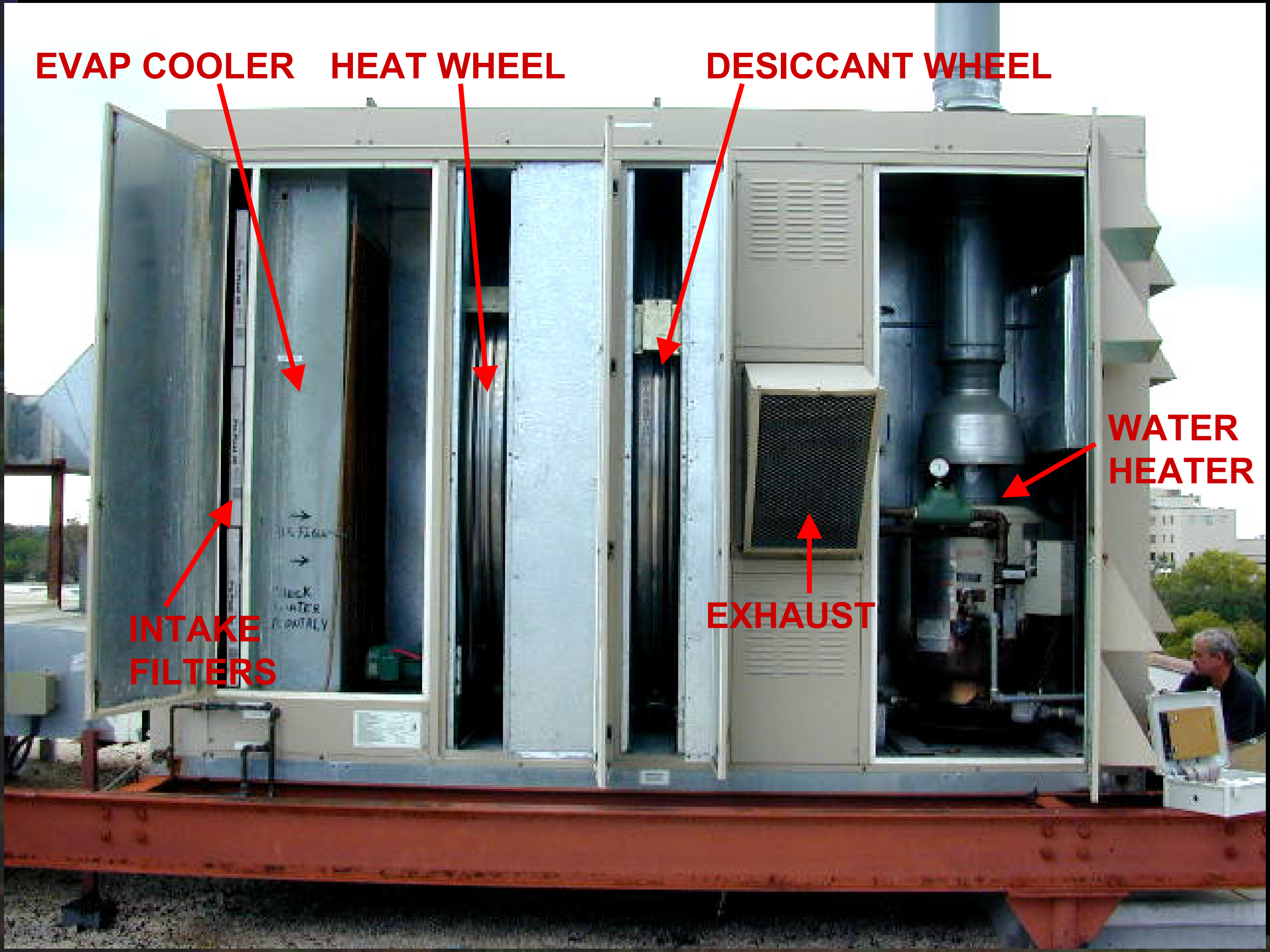




ECM Example:
Internet Communicating Power Monitors

- Demand Responsive Buildings
  - Real time building/account metering
  - Sliding window interval data recording
    - (15-minute interval)
  - Web Access TCP/IP Communications
  - Provides building operators ability to reduce HVAC, lighting, or process loads in response to price signals

ECM Example: Desiccant Ventilation Units



ECM Example: Desiccant Ventilation Units

- ***Energy Efficiency***
  - Manufacturer’s peak load rating: 0.73 COP
  - Measured peak load rating: 0.83 COP
  - Measured average: 0.53 COP
- ***Cooling Capacity***
  - 19% less dehumidification than rated
  - 155 MBH measured versus 248 MBH rated
- ***Heat Input***
  - 12% less than manufacturer’s rating

ECM Example: Micro-Turbine CHP

- **Microturbines - commercially available clean power**
  - Capstone 30 kW or 60kW
- **Waste heat is used to power desiccant unit**

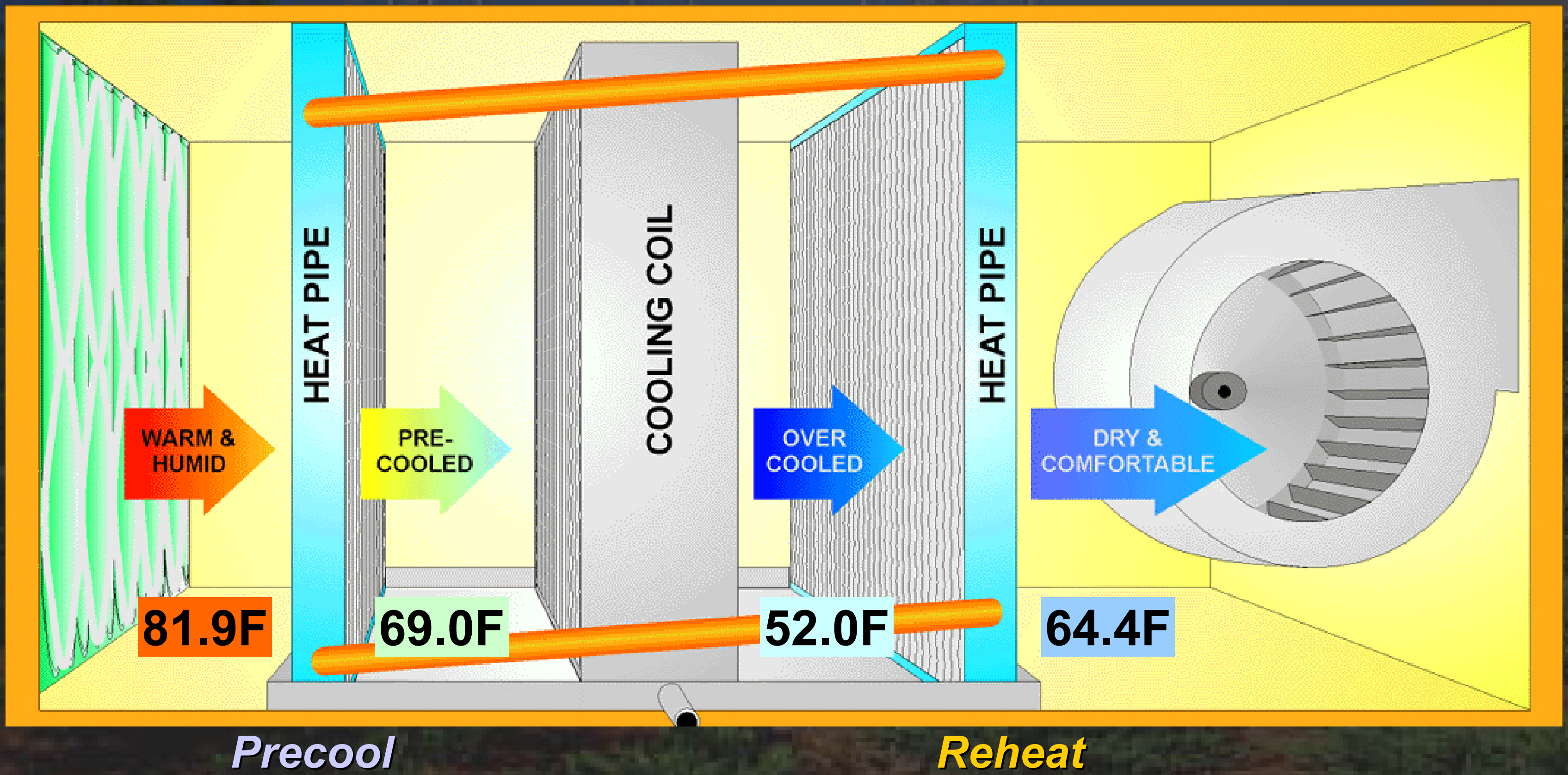
Application Example:
Patrick Air Force Base Dormitories

Four 30kW Microturbines
370 kW load shed
190 MBH Hot Water for Showers & Laundry
15,480 cfm Conditioned Outside Air

Annual Savings: $38,000
Installed Cost: $225,000
Simple Payback: 6 years

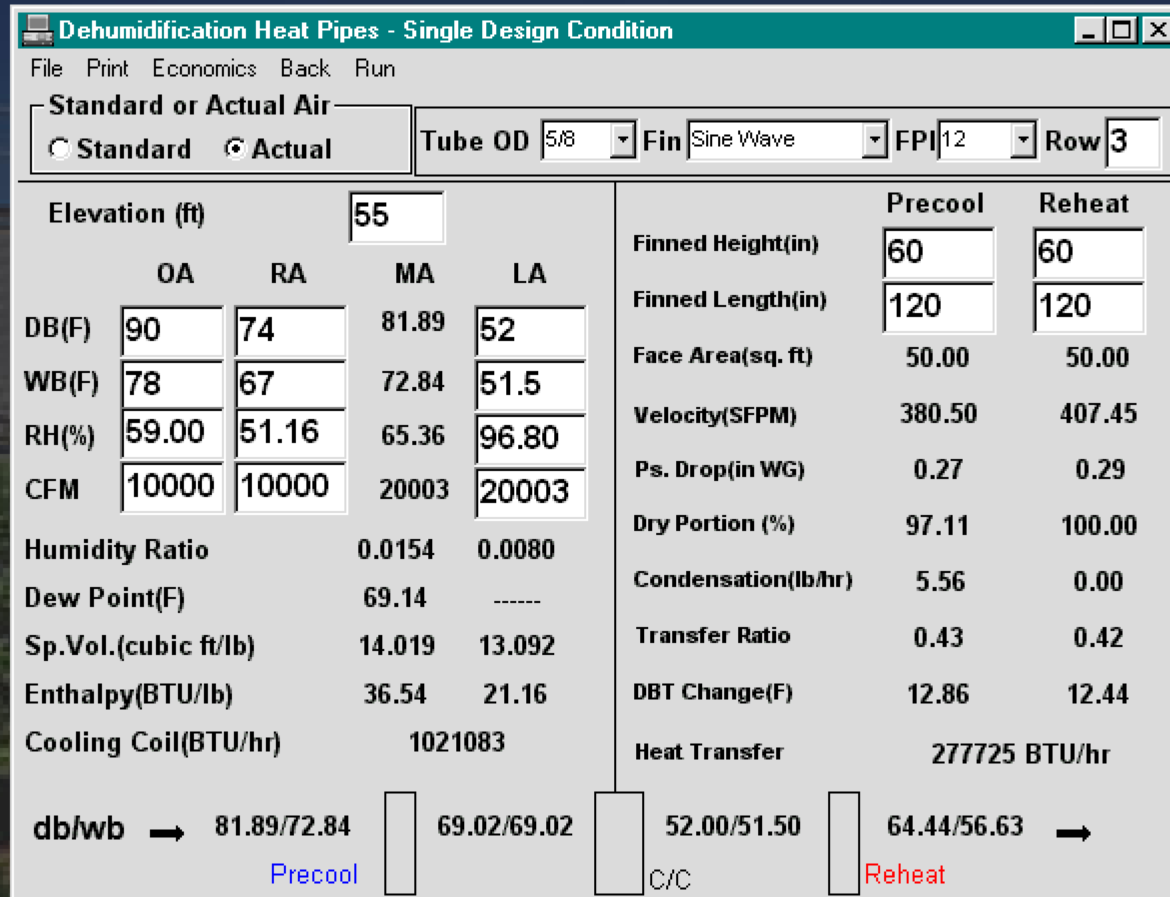
ECM Example: Dehumidifier Heat Pipe

- Doubles Latent Heat Capacity
- 60% More Energy Efficient than Electric Reheat



Rigorous Engineering & Savings Analysis

- Visual DOE2.1e
- Energy-10
- e-Quest
- System Analyzer
- Joint Frequency BIN
- Desi-Calc
- Proprietary Software

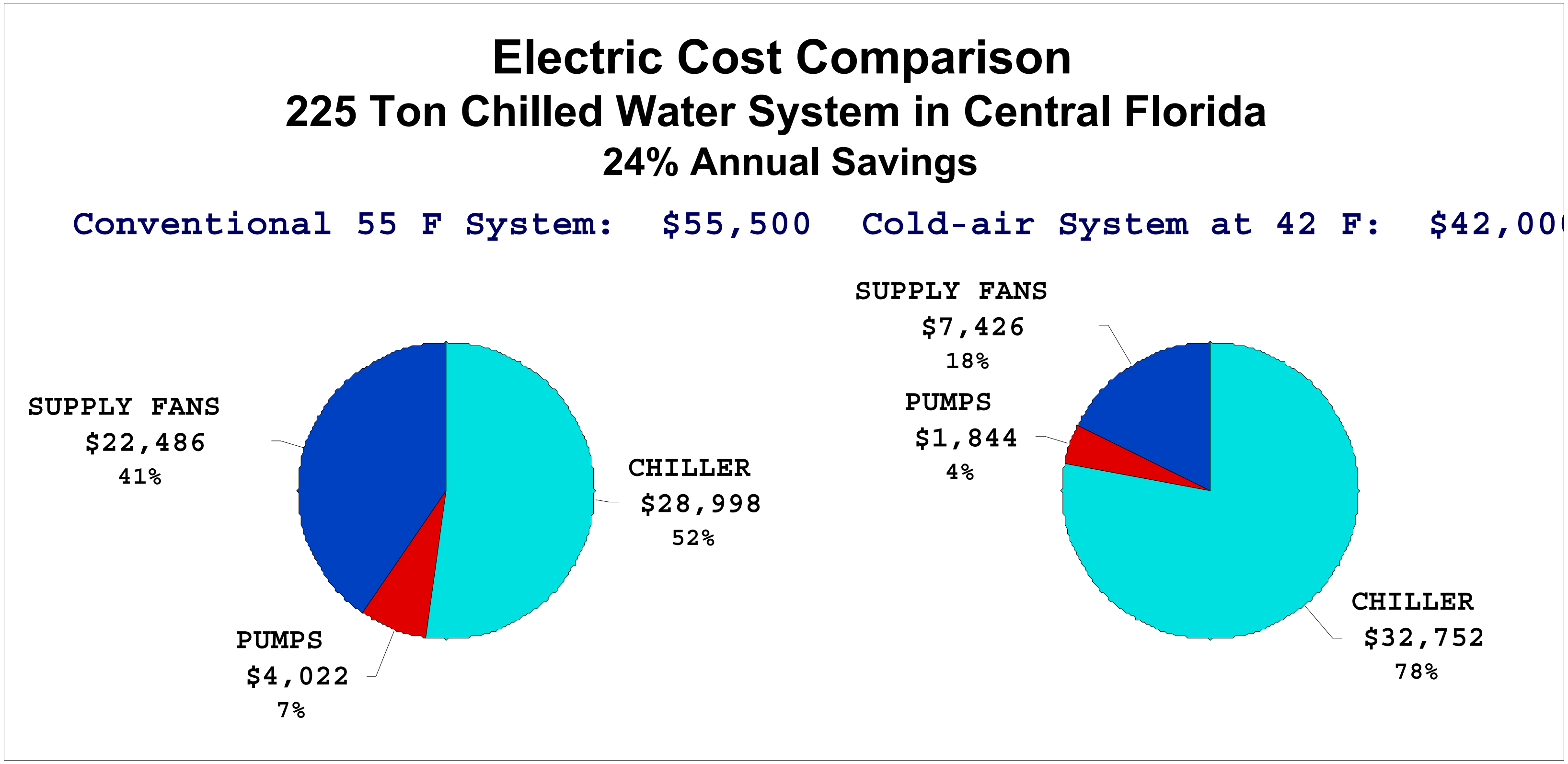


ECM Example: Cold Air Distribution

- More Energy Efficient
- More Dehumidification
- More Occupied Space
  - smaller mechanical rooms
  - less space above ceiling
  - smaller chases
- More Effective Ventilation
  - Higher fraction of fresh air
  - Better room mixing
- Smaller Fans
- Less Ductwork
- Less Piping
- Smaller Pumps
- Smaller Motors
- Less Energy Use
- Lower First Cost

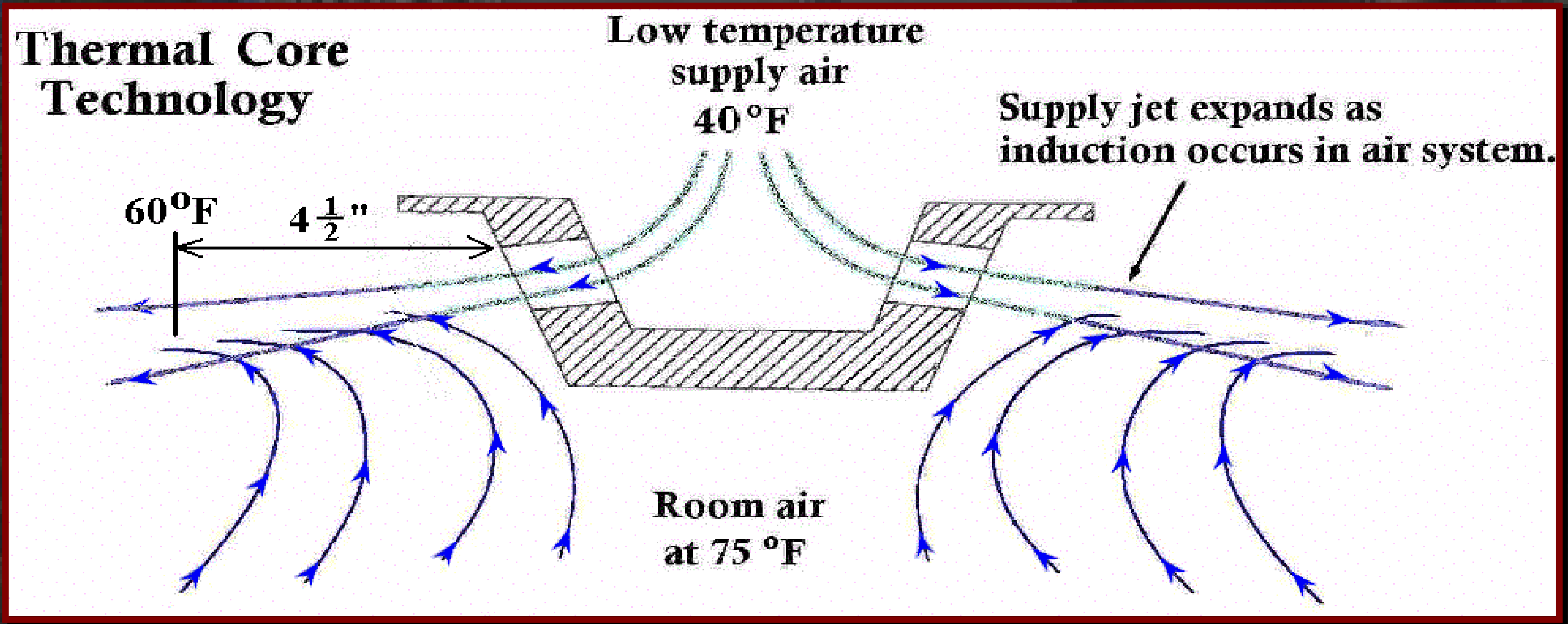
Cold-air electric savings

Compare the electric costs for a 225-ton chilled water system with 15,000 cfm of fresh air.

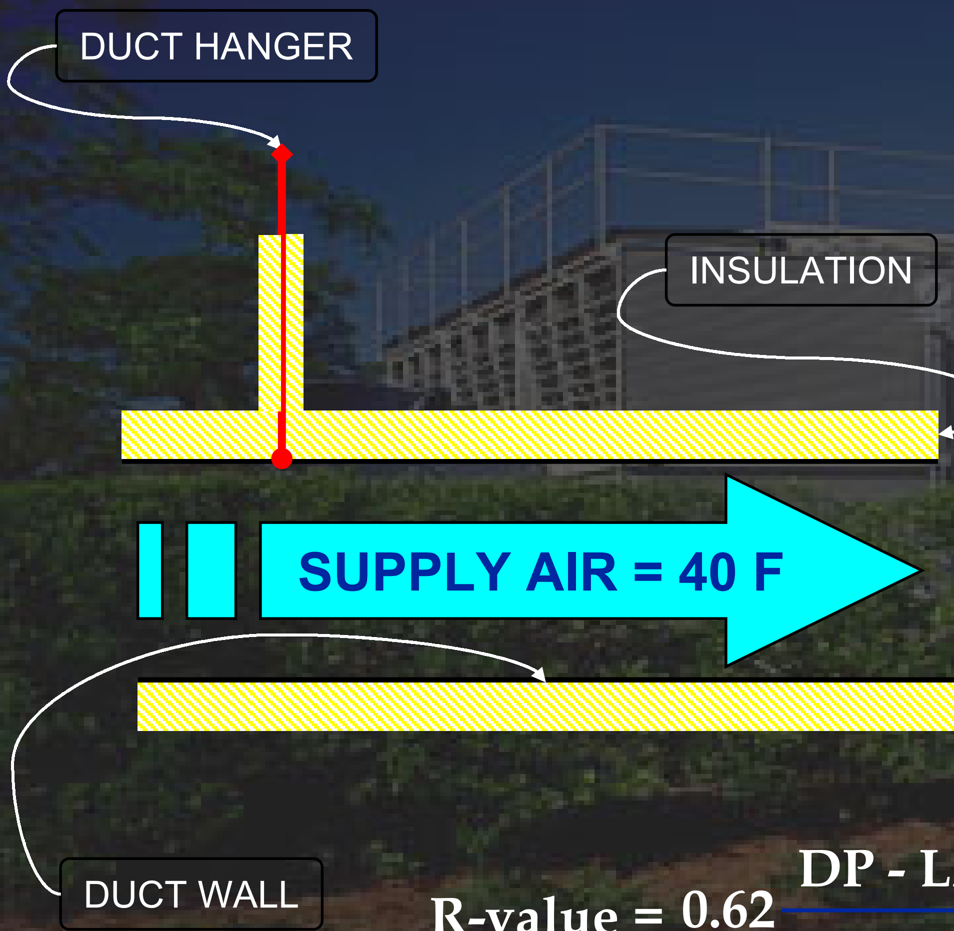


Cold Air Distribution

- Selection of supply diffusers is critical to prevent condensation on diffusers and ceiling, and to ensure adequate mixing with room air at lower cfms.
  - Proper sizing (throw & cfm), location, and insulation
  - Requires a high induction ratio (>2.0)



Insulation Thickness for Cold Air



$$\text{R-value} = 0.62\,\frac{\text{DP - LAT}}{\text{DB - DP}}$$

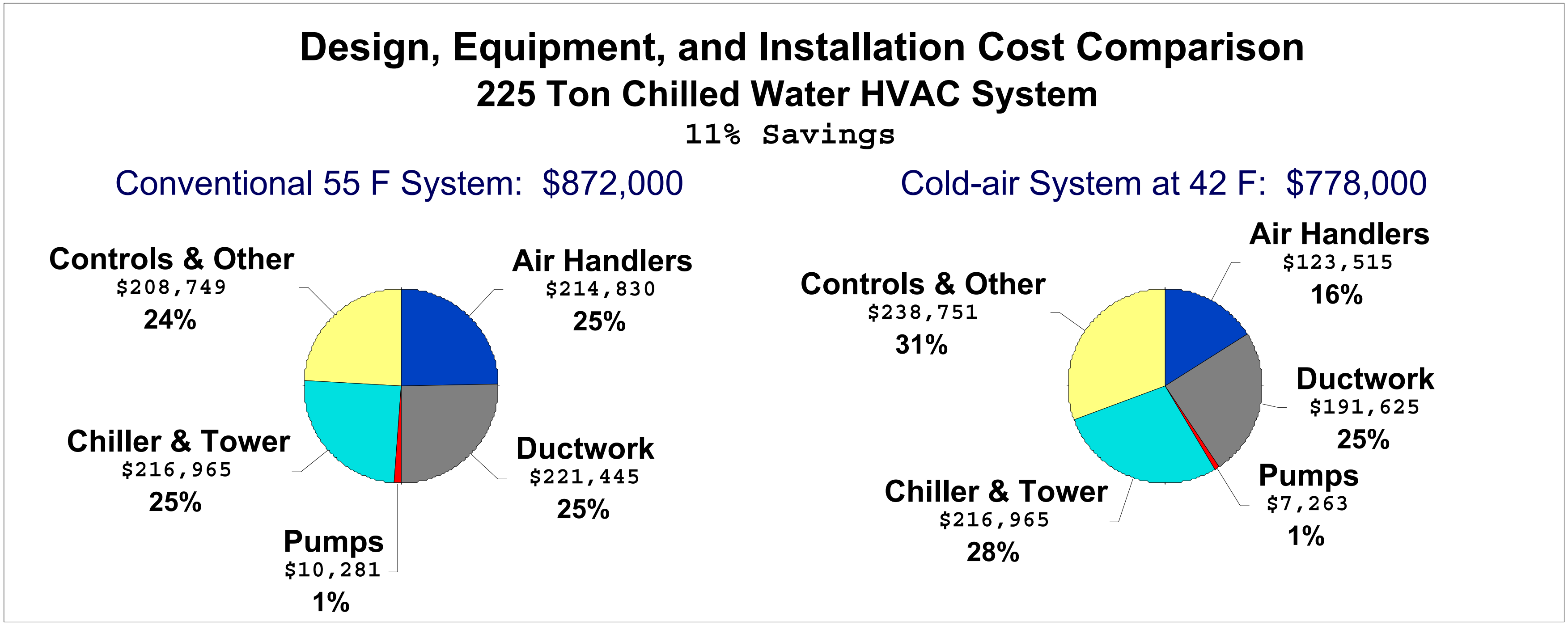
Cold-Air Duct Insulation

INSULATION THICKNESS FOR SUPPLY AIR 40 DEG F

	UNCOND	COND
DRY BULB	82	80
RH	90	80
DP	79	73
GR/LB	150	124
WET BULB	80	75
R-VALUE	7	3
INCHES	2.7	1.1

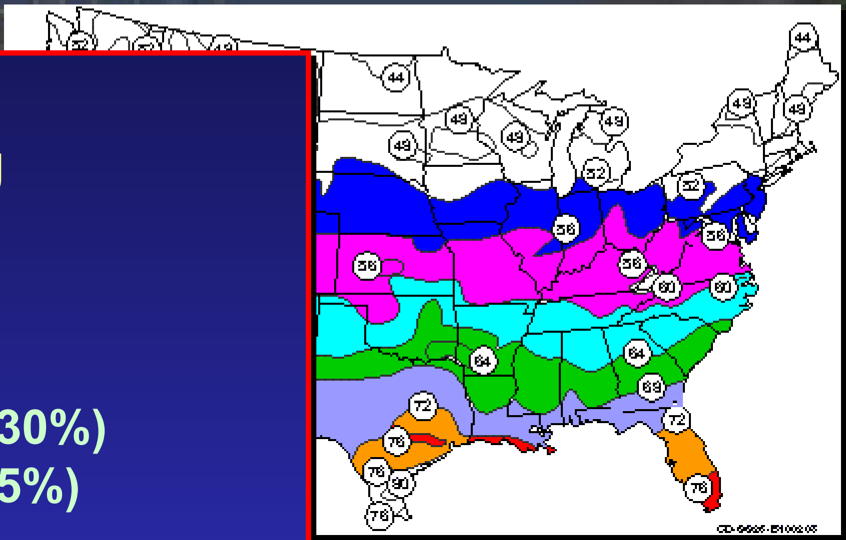
Cold-air equipment savings

Compare the design, equipment and installation costs for a 225-ton chilled water system with 15,000 cfm of fresh air. Life-cycle cost savings is about $5 per square foot.



ECM Example: Dual-Source Heat Pumps

- **Combines the energy efficiency of ground-source with the low first cost of air-source**
- **Uses ground-coupling to extend the delta-T available from ambient air**



Application Example:
MS Naval Training Classroom Building

24,730 square feet
Two 35-ton Roof Top Package Units

Electric Cost:

STANDARD AC:	$17,600
DUAL-SOURCE:	$12,400 (30%)
GEOTHERMAL:	$8,000 (55%)

Installed Cost / Payback

STANDARD AC:	$30,000
DUAL-SOURCE:	$49,000 / 3.6 years
GEOTHERMAL:	$125,000 / 9.9 years

Advanced Technology Applicability

ECM APPLICATION	Stand-alone Communicating HVAC and Lighting Controls	Integration of Building Automation/Control Systems	HVAC Conversions: CAV to VAV, Primary-Secondary to Variable Primary	On-site Electric Generation / Combined Heat & Power	AHU Condensate Reclaim	Bi-Level Task-Ambient Lighting	Solar Hot Water Heating	Ground-Source/Geothermal Cooling	Thermal Energy Storage	Thermal and Infiltration Envelope Improvements	Energy Recovery Units / Waste Heat Recovery	Reflective Roof Coating	Hybrid Gas/Electric Chiller Plant
Large Existing Buildings		X	X	X	X	X	X	X	X	X	X	X	X
Small Existing Buildings	X				X	X	X	X		X	X	X	
Labs and Special Use Facilities	X	X	X	X	X	X	X	X		X	X	X	X
New Construction	X	X	X	X	X	X	X	X	X	X	X	X	X

Economics is Key to Making The Project Work

… dollars available for advanced technology projects.

Project Component	*Amount*
Audit	$20,000
Design	20,000
Contractor Install	250,000
Overhead, Markups, and Profit (20%)	50,000
Finance Charges (10 years 5.35%)	85,000
Total Cost ($340,000 principal)	425,000 ($42,500 annual payments)
Savings over 10 years	450,000 ($45,000 per year savings)
Savings Left after 10 years	$25,000 **Retained Savings is 5.6%**

… project is barely worthwhile

Making The Project Work Economically

Start with the Retained Savings at the Top

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'Extra' money for advanced technology projects!

Making The Project Work Economically

Project Component	*Amount*
Retained Savings Goal = 10%	$50,000 ***Retained Savings is 10%***
Savings over 10 years	500,000 ($50,000 per year savings)
Total Budget ($360,000 principal)	450,000 ($45,000 annual payments)
Financing (10 years 5.35%)	80,000
Advanced Technology Energy Survey	40,000
Engineering Design	32,500
Equipment, Materials, & Labor	265,000 ***$40,000 Available***
Overhead, Markups, and Profit (10%)	22,500

Financing Advanced Projects

- Three Basic Types for Energy Projects
  - **Traditional Capital Payment**
    - » *pro:* Facility has total control of the project
    - » *con:* Need capital dollars
  - **Performance Contract**
    - » *pro:* ESCO Fully Finances Project
    - » *con:* ESCO controls project
  - **Hybrid Financing**
    - » Combines the best of Capital with Financing

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