

Energy Efficiency Measures

A list for the Energy Auditor

Energy in Buildings
Athens, Greece, 2015



Existing Buildings and new construction

- Enormous potential of energy savings
- Energy costs rises
- Financial initiatives
- Usually energy saving upgrades improves overall performance
- REFERENCES
 - KENAK
 - ASHRAE 90.1
 - ASHRAE “Procedures For Commercial Building Energy Audits”
 - International Measurement and Verification Protocol



Energy-Efficiency Measures Field of Application

- **Envelope**
- **Lighting**
- **HVAC Systems**
- **Water Heating**
- **Power Systems**
- **Miscellaneous**



Envelope

- **Reduce Heat Losses-Ceiling/roof**
 - Additional Ceiling/Roof Insulation
 - Use Light-Colored Roof Surfaces
- **Reduce Heat Losses-Walls/floors**
 - Additional Wall Insulation
 - Additional Floor/Slab Insulation
 - Use Light Colored Exterior Surfaces



Envelope

○ Reduce Heat Losses-Windows/Doors

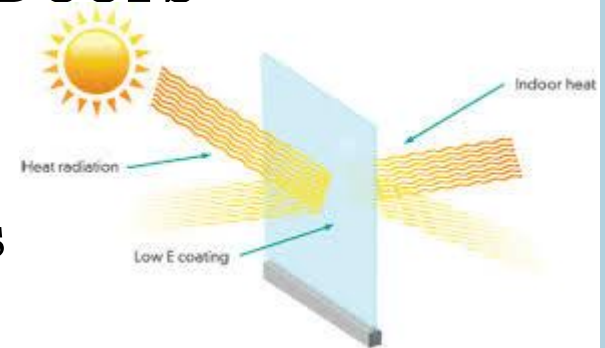
- Replace Fenestration
- Install Additional Glazing Layer
- Use Special Coatings - membranes

○ Reduce Heat Gain--Windows/Doors

- Install Exterior Shading
- Install Interior Shading
- Use Tinted or Reflective Coatings

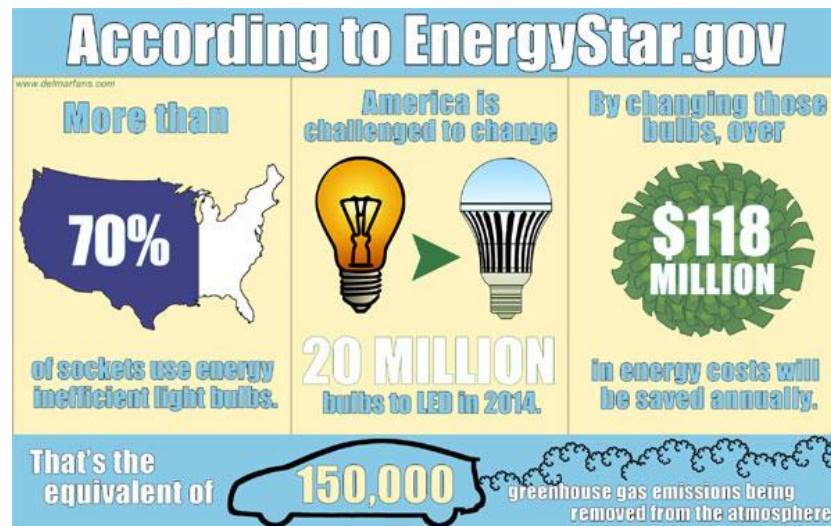
○ Reduce Infiltration

- Caulk and Weatherstrip Doors and Windows
- Install Air-Lock Vestibule System or Revolving Doors



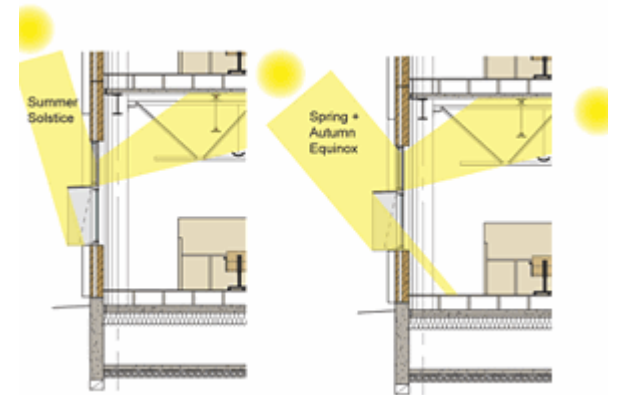
Lighting

- **Reduce Lighting Required**
 - Utilize Task Lighting
 - Lighting Controls (timing control, Occupancy sensors)
 - Use Light-Colored Interior Wall Finishes



Lighting

- **Install More Energy-Efficient Lighting System**
 - Use High-Efficiency Fixtures
 - LED
- **Use Daylighting**
 - Install Dimming Controls
 - Architectural Modifications



HVAC Systems

Air Distribution Systems

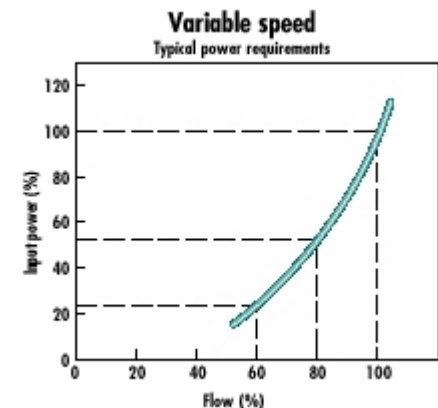
○ Reduce Energy Losses

- Increase duct insulation
- Install air-to-air heat recovery
- Runaround loop heat recovery



○ Reduce System Flow Rates

- Airflow and fan speed reduction
- VAV system to reduce fan energy use
- Variable speed drive motor for VAV



HVAC Systems

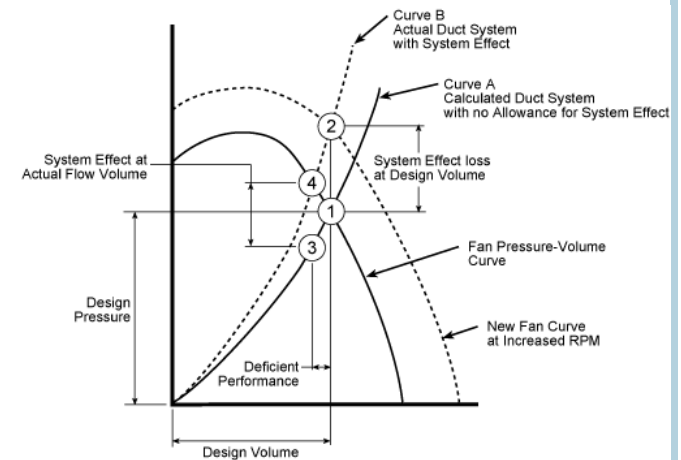
Air Distribution Systems

○ Reduce System Resistance

- Reduce System Resistance
- Improve design and balance of duct system
- System effect factor

○ Reduce Ventilation Loads

- Reduce ventilation rate to minimum (without compromising IAQ – CO₂ sensors)
- Install local ventilation and makeup air for hoods



HVAC Systems

Water Distribution

- **Reduce Energy Losses**
 - Increase pipe insulation
 - Design with low velocities
- **Reduce System Flow Rates**
 - Primary/secondary pumping with variable speed motors
 - Proper control valves
 - Proper variable pump set points



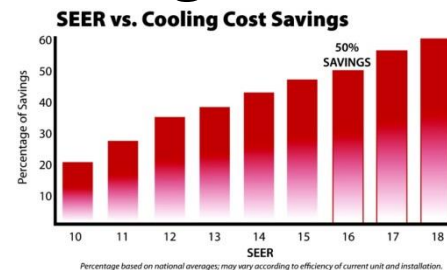
Cooling Plant

- **Select More Efficient Cooling System**
 - Use evaporative cooling (pads etc.)
 - Use cooling tower instead of air-cooled system (under design consideration)
 - Use heat recovery chiller
- **Improve Cooling Efficiency**
 - Optimize chiller efficiency with temperature controls
 - Use multiple chillers and optimization controls
 - Increase chilled water design temperature
 - Optimize cooling tower flow controls



Cooling Plant

- **Increase Condensing Efficiency**
 - Lower condenser water design temperature
 - Reset controls on water temperature
 - Tube-brush cleaning system
 - Chemical washing system
- **Improve Part-Load Performance**
 - Select chillers based on Integrated Part Load Value (IPLV)
 - SEER



Heating Plant

- **Improve Boiler or Furnace Efficiency**
 - Match boiler size to load
 - Install multiple boilers
 - Condensing hydronic boiler
 - Preheat combustion air or fuel supply
- **Install High-Efficiency Heat Pump**
 - Air-to-air heat pump
 - Ground-source heat pump
 - Water-source heat pump
 - Energy recovery chillers
 - Thermal Storage Systems



Control Systems

- Demand Limiting EMCS/DDC
- Optimize Start/Stop
- Duty Cycling Control System (Reduce unoccupied ventilation)
- Supply Temperature Setup/Setback Control System (Install programmable thermostats)
- Install Economizer Control System
- Chiller parallel operation and strategies
- Boiler Control Strategies



Water Heating

○ Reduce Water Heating Loads

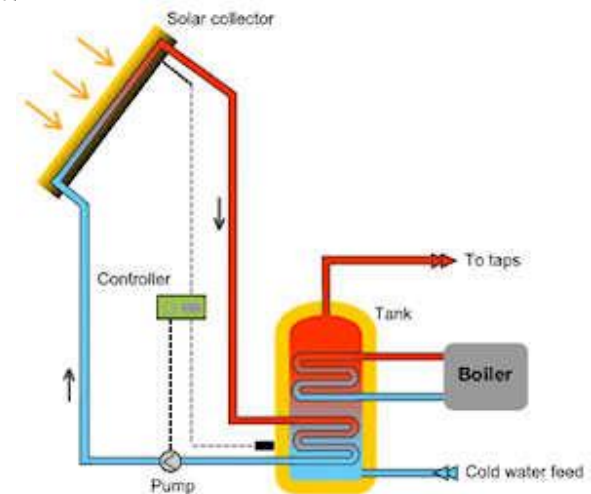
- Use Low Water Use Devices
- Use Local Heaters
- Timeclock Controls to Reduce Unoccupied Loads)

○ Reduce System Losses

- Increase Insulation on Hot Water Pipes and Boilers

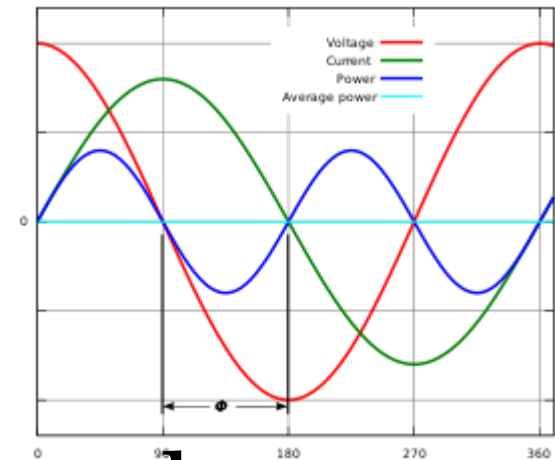
○ Install More Energy Efficient Water Heating System

- Solar-Assisted Water Heater
- Use Heat-Pump Water Heaters



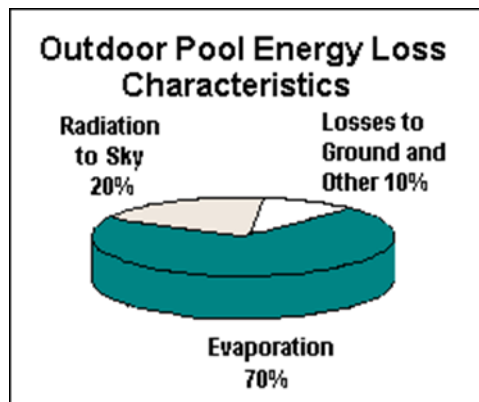
Power Systems

- **Reduce Power System Losses**
 - Correct Power Factors
 - Install Energy-Efficient Transformers
- **Install Energy-Efficient Motors**
 - High-Efficiency Motors
 - Multispeed. Motors
 - Variable-Speed Motors
 - Optimize Motor Sizing
- **Reduce Peak Power Demand**
 - Demand Limit Controls



Miscellaneous

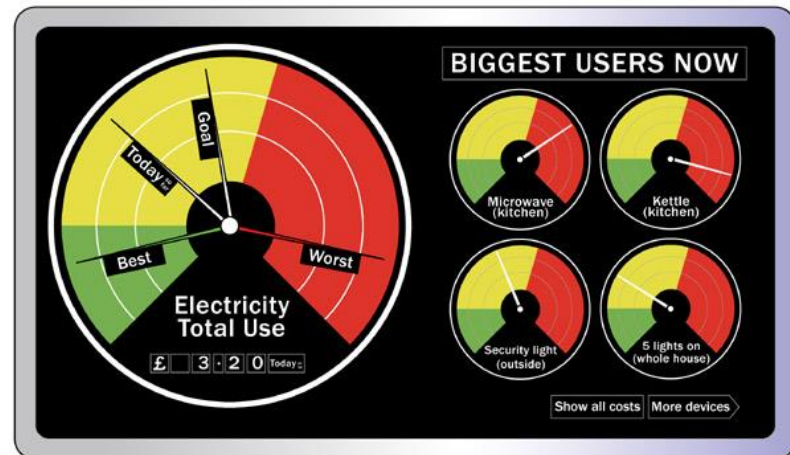
- Heat Recovery
 - Air/water
- Elevator/Escalator Optimization
- Install Pool Cover



And the most important

○ Human Factor

- Training of users and operators
- Energy consciousness
- Awareness thru participation (display, web applications etc.)



THANK YOU FOR YOUR ATTENTION

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