

BEYOND

SMART CITIES

ENERGY SIMULATION OF HIGH PERFORMANCE GREEN BUILDINGS

FOR ENERGY AND GREEN BUILDING SPECIALISTS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

ENERGY SPECIALIST CURRICULUM





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ENERGY CONSERVATION MEASURES

FOR ENERGY AND GREEN BUILDING PROFESSIONALS

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LEARNING OBJECTIVES





Energy Conservation Measures

Typical Measures Considered

Behavioral & No-cost ECMs

HVAC Energy Conservation Measure

Renewable Energy Measures

O&M, Commissioning & Re-commissioning



ENERGY CONSERVATION MEASURES

The Energy Management Continuum

Energy Awareness
Load Management
Rate Analysis
Energy Audits
Meters
Commissioning
Fine-Tune
Lighting Retrofits
Building Envelope
ECMs
Renewables
Chiller/Boiler Replacement

O&M Improvements

Equipment Replacement

No Cost Low Cost Expensive

Investment Requirements

✓Energy conservation measures are the upgrades, retrofits, repairs and replacements that businesses can implement to become more energy efficient. These measures can significantly reduce operating costs while providing operational benefits by allowing businesses to replace old, outdated equipment.

TYPICAL MEASURES CONSIDERED

These are the overall steps followed to create an energy model

✓Energy Conservation Measures (ECMs)

- Heating, Ventilating, and Air-Conditioning (HVAC)
- Lighting
- Plug Loads
- Building Envelope

✓Water Conservation Measures (WCMs)Heating,

✓Renewable Energy Measures (REMs)

- ECMs are typically more financially viable when compared to REMs
- REMs can be sized to meet the reduced loads after ECMs are implemented

✓O&M, Commissioning & Re-commissioning

BEHAVIOURAL & NO-COST ECMS

✓Analyze utility rate structure and track billing history

✓Run an energy awareness campaign, promote occupants to:

- Turn off lights in unoccupied rooms such as break rooms, private offices, conference rooms, etc.
- Turn off exterior lighting during daytime hours
- Wash hands, dishes, etc. with cold water
- Turn off computers at nighttime; use automatic power settings when they're inactive
- Eliminate and remove personal printers, refrigerators, coffeepots, etc.

✓Use setback temperatures on all HVAC equipment

Your electricity usage

Month	Usage (kWh)
Jan	100
Feb	120
Mar	150
Apr	180
May	200
Jun	220
Jul	250
Aug	280
Sep	300
Oct	250
Nov	200
Dec	150

Your greenhouse gas emissions

Month	Emissions (tons CO2e)
Jan	10
Feb	12
Mar	15
Apr	18
May	20
Jun	22
Jul	25
Aug	28
Sep	30
Oct	25
Nov	20
Dec	15

ENERGY CONSERVATION MEASURE - HVAC

✓HVAC

- Install programmable thermostats for all zones and HVAC equipment.
- Install high coefficient of performance (COP) cooling system.
- Replace regular fan and motor belts with cogged V-belts.
- Regularly replace HVAC filters.
- Convert constant air volume (CAV) system to variable air volume (VAV) system.
- Reduce outside airflow as per ASHRAE 62.1.
- Implement chilled water reset.
- Install variable frequency drive (VFD)
- Incrementally replace old motors with NEPA premium efficiency motors.



VFD
Source: Santek Systems

ENERGY CONSERVATION MEASURE - LIGHTING

✓Lighting

- Replace all incandescent and CFL bulbs with LEDs.
- Replace all T-12 fluorescent lamps and magnetic ballasts with low wattage T-8 lamps and electronic ballasts or LED replacements.
- Implement task lighting.
- Install LED exit signs.
- Install occupancy sensors in common rooms, corridors, restrooms, etc.
- Install light sensors on exterior lighting.
- Reduce lighting level in over lit areas by De-Lamping.
- Install wireless lighting controls.

✓Plug Loads

- Select Energy Star office equipment and appliances.
- Use network printers to reduce the number of personal printers.
- Activate power management on computers and monitors.
- Use laptops and LCD monitors instead of desktops and CRT monitors.
- Install vending machine misers and remove advertising lighting.
- Install power management surge protectors in offices.



ENERGY CONSERVATION MEASURE - ENVELOPE

✓Roofs

- Increase the amount of roof insulation.
- Retrofit existing roof with green roof.
- Retrofit existing roof with cool roof.

✓Walls

- Install additional insulation in exterior walls.
- Seal off all the infiltration points in exterior wall.

✓Windows

- Replace old or single pane window.
- Add shading features to south-facing facades for solar shading.

✓Doors

- Replace traditional doors with revolving doors.
- Create an entrance vestibule with two doors.
- Install adequate weather stripping.



RENEWABLE ENERGY CONSERVATION MEASURE

✓Common renewable energy technologies are

- Onsite Photovoltaic Array
- Onsite Solar Hot Water System
- Wind
- Biomass
- Solar Vent Preheat



O&M, COMMISSIONING & RE-COMMISSIONING

General Operations and Maintenance (O&M)

✓Energy Saving Strategies

- Verify Operation of HVAC Components
- Calibrate HVAC Sensors
- Periodically Retro-Commission HVAC Equipment

✓The goals of commissioning (Cx) are to:

- Provide a safe and healthy facility
- Improve energy performance and minimize energy consumption
- Reduce operating costs
- Ensure adequate O&M staff orientation and training.
- Improve systems documentation

✓O&M programs targeting energy efficiency are estimated to save 5% to 20% on energy bills without a significant capital investment. Many can be achieved with minimal cash outlays.

RE-COMMISSIONING

✓Re-commissioning (Rx) is an ongoing process to:

- Resolve operational problems
- Improve comfort
- Optimize energy use
- Rx does not ensure that the systems function as originally designed - Ensures the buildings and systems operate optimally to the current requirements


