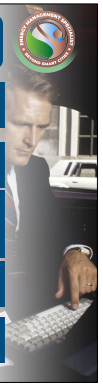
BEYOND
SMART CITIES
ENERGY MANAGEMENT AND AUDIT - CEM
REFRESHER TRAINING COURSE
KRISHNAJI PAWAR, LEED AP BD+C,GSAS CGP,ISO 14001:2015,GCP
CEM REFRESHER TRAINING COURSE

BEYOND
SMART CITIES
THE NEED FOR ENERGY MANAGEMENT
FOR ENERGY PROFESSIONALS
KRISHNAJI PAWAR, LEED AP BD+C,GSAS CGP,ISO 14001:2015,GCP
ENERGY SPECIALIST CURRICULUM COURSE

WHAT SHOULD YOU LEARN
Why Energy Management is Important and basics
Global trends on Energy, Economy and Our Environment
Non-Technical Drivers that Create the Need for Energy Projects
Driving Factors in Major Investments For Business and Industry

THREE MAJOR PROBLEMS



Three global priorities dictate saving energy:

1. Energy Security - Reduce oil imports and balance of payments
2. Economic Competitiveness - Reduce costs and create jobs
3. Environmental Quality - Reduce global warming and acid rain

None of these goals can be fully attained without an energy efficient economy

PROFESSIONAL INTEREST ENERGY MANAGEMENT JOBS

- ❑ Building/facility/plant energy manager
- ❑ Building/facility/plant maintenance manager
- ❑ Utility energy auditor/energy analyst
- ❑ Regional/national agency energy analyst
- ❑ Consulting energy auditor and analyst
- ❑ ESCO energy auditor and analyst

TQM & ENERGY MANAGEMENT

Total Quality Management (TQM) - an integrated approach to operating a facility
-Energy cost control should be part of overall TQM program. Also CI, Six Sigma, Lean.

TQM - based on principle that front-line employees should have authority to make changes and other decisions at the lowest operating levels of a facility.

Energy management is a natural part of TQM; employees should have some training in energy management so that they can make correct energy decisions.

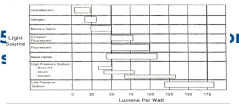
ENERGY MANAGEMENT

Energy management - the use of engineering and economic principles to control the cost of energy to provide needed services in buildings and industries.

- ☑ Most savings in energy costs will come from improvements in energy efficiency.
- ☑ Some savings will come from changing the patterns of energy use, and possibly shifting to other sources of energy.

COMMON ENERGY COST SAVINGS

- ☑ Low cost operation and maintenance, or short payback projects less than 2 years - 5 to 15 percent savings
- ☑ Medium length 2 – 4 year payback actions 15 to 30 percent savings
- ☑ Higher-cost, 5 ons 30 to 50 percent savings



ENERGY SAVINGS IN THE EUROPEAN UNION

Energy efficiency is a key component of any 21st century energy policy, and is crucial to meet climate change targets, particularly those agreed at the December 2015 COP21 summit in Paris.

Currently, however, the EU is unlikely to meet its 2020 target of improving energy efficiency by 20% (primary energy savings are projected to reach only 17.6% by 2020), and needs to be even more ambitious if it is to become a low-carbon economy by 2050.

Energy is at the heart of the European economy; the EU consumes 11% of global energy, importing more than 50% at a cost of more than EUR 400 billion per year. Energy efficiency could cut this dependence and this cost, but is not delivering on its promise.

USA FEDERAL ENERGY EFFICIENCY REQUIREMENTS

DOE Releases Energy-Saving Rules for Federal Buildings and Proposes New Standards for Consumer Appliances

Federal Building Energy Code Requirements and Residential Appliance Proposals Would Save Americans Millions in Energy Costs and Advance Carbon Reduction Efforts. Biden Administration to Finalize 100 Actions to Save Households $100 Annually.

Beginning in April 2023, all new buildings and major retrofits constructed by the Federal government must comply with the 2021 International Energy Conservation Code (IECC) and the 2019 American Society of Heating, Refrigerating, and Air Conditioning Engineers Standard 90.1 building energy codes. DOE estimates that this measure will save $4.2 million dollars in operating costs within the first year of implementation.

ENERGY INTENSITY OF COUNTRIES & REGIONS

Global energy intensity improvement in 2021 is below the 2000-2019 average (-1%, vs. -1.5%/year over 2000-2019).

China's energy intensity remained stable in 2020 (-0.1%, compared to a 2.8%/year improvement over the 2000-2019 period). In 2021, its energy intensity went back to the 2000-2019 average with an improvement of 2.7%.

In 2021, energy intensity improved in Asia (especially in India and China), in Australia, in the Middle East, and in Latin America (improvements in Argentina, Chile, Colombia and Mexico).

New energy efficiency improvement in India in 2021, above the 2% average of the 2000-2019 period.

CEM EXAM FORMULAS

- GEOMETRY
- Area of circle = $\Pi * r^2$
- Circumference of circle = $\Pi * D$
- Area of rectangle = L * W
- Perimeter of rectangle = 2*L + 2*W

- ELECTRICAL
- V = I * R Ohm's Law (single phase)
- P = $I^2 * R$ Ohm's law for power (single phase)
- kW = (V × A × 1.73 × PF)/1000 (3 phase) PF = Cos phi
- kW = kVA * PF PF = Cos phi
- kVA = 1.73 x kV x A (3 phase)

- MOTORS
  - Percent load = (NLRPM-RPM)/(NLRPM - FLRPM)
  - Synchronous speed = (frequency × 50)/ (number of pole pairs)
  - kW × Percent load = (V × A × 1.73 × PF × Efficiency) (3 phase)
  - PF = kW/kVA = Cos phi
- FANS AND FAN LAWS
  - LPSn/LPSo = (RPMn/RPMo) n=new; o=old
  - SPn /S Po = $(RPMn /RPMo)^2$
  - kWn/kWo = $(RPMn /RPMo)^3$
  - RPM-driven × diameter-driven = RPM-driver × diameter-driver
- Percent OA = (RAT - MAT)/(RAT - OAT)

CEM EXAM FORMULAS

- LIGHTING
- RCR = (2.5 × cavity height × perimeter)/(area) General
- RCR = (5 x height x (L + W))/(L*W) Rectangular room
- Number of lamps = (LUX desired × area)/(Lumens-per-lamp × Cu × L1 × L2)
- Lux = Lumens/d^2
- Efficacy = Lumens/watt

- HEAT FLOW
- q = u × A × Δt W
- q = M × Cp × ΔT W sensible heat only
- q = M × Δh W sensible and latent heat
- Q cooling = U × A × 24 × CDD Wh/yr
- Q heating= U × A × 24 × HDD Wh/yr

- MISCELLANEOUS
- q = LPS × 1.2 × ΔT W (sensible heat for air)
- q = LPS × 4.2 × Δt kW (sensible heat for water)
- POU energy cost = (output/efficiency) x (cost per unit)
- Density of dry air at standard conditions 1.204 kg/m^3
- Specific heat of dry air at standard conditions 1.006 kJ/ kg°C
- Density of water at standard conditions 1 kg/L
- Specific heat of water at standard conditions 4.2 kJ/kg°C
- Density of water 1000 kg/m^3

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