eEnergy Training for Building Operations

Course Introduction

- Introduction
  - Welcome
  - Success Stories
  - Topic Introduction
  - How to Approach this Course
  - Icons and Use
  - Developers

Energy Mgt. Overview

- Introduction
  - Objectives
- Benefits
  - Energy Management Defined
  - Managing Energy Costs
  - Organizational Perspective
  - Reasons for Energy Mgt.
  - Everyone Benefits
  - Key Dimensions
  - Why Energy Management?
  - Importance for the Operator
- Process and Players
  - The Eight Key Players
  - Stakeholders' Needs
  - Energy Case Study
  - The Operator's Role
- Savings Opportunities
  - Identify Savings
  - Case Study Activity
- Recap
  - Recap
- Chapter Quiz
  - Chapter Quiz

Behavioural Opportunities

- Introduction
  - Objectives
- Awareness
  - Awareness Building
  - Where Savings Come From
- Proactive Actions
  - Computer Shut Down
  - Saving Energy in Your Office
  - Kitchen Equipment
  - Turn Off Unnecessary Lights
  - Tips for Renovations
  - Building Contractor Action
- Communication
  - Communication Strategies
  - Building Awareness
  - Plug in Power Meter
  - Case Study

- Marketing Your Program
- Case Study
- How Aware is Your Facility?

- Motivating Change
  - Motivating People
  - Energy Awareness Quiz
- Recap
  - Recap
- Chapter Quiz
  - Chapter Quiz

Energy Basics

- Introduction
  - Objectives
- Electrical Energy
  - Basic Electricity Terms
  - DC Circuits
  - AC Circuits
  - Power and Energy
  - Activity - Run the Numbers
  - Using Power Calculations
  - Demand and PF Charges
  - Voltage and Current in Phase
  - Current lagging
  - Power Factor Examples
  - How Can I Correct PF?
  - Efficiency Defined
  - Efficiency Examples
  - Power and Energy Efficiency
  - Fluid or Air Power
  - Activity - Electrical Problems
- Thermal Energy
  - Thermal Energy Units
  - Refrigeration Basics
  - Heat Transfer Fundamentals
  - Conduction
  - Convection
  - Thermal Radiation
  - Specific Heat
  - Sensible and Latent Heat
  - Observations
  - Properties of Steam
  - Psychrometry
  - Reading Psychrometric Chart
  - Thermal Energy Problems
- Recap
  - Recap
- Chapter Quiz
  - Chapter Quiz

Metering and Billing

- Introduction
  - Objectives

- Metering and Billing
  - Electrical Metering
  - The Electricity Meter
  - Reading Demand
  - Meter Response
  - Reading the Meter
  - Activity
  - Demand Meter Sees...
  - Metering Fuels
  - Understand Electrical Costs
  - Understanding Fuel Costs
  - Sub-Metering
  - Real-Time Energy Monitoring
- Data Analysis
  - Energy Performance
  - Impact of Climate (Weather)
  - Collecting Weather Data
  - Tracking Consumption
  - Using Historical Billing Data
  - Graphical Analysis
  - Comparing Analysis
- Benchmarking
  - Benchmarking Defined
  - Types of Comparisons
  - Energy Action Cycle
  - Best Practices
  - Case Study
  - Dealing With Differences
  - Total Intensity
- Measurement
  - Taking Measurements
  - Types of Measurement
  - Hand-held Wattmeter
  - Portable Wattmeter
  - Power Metering Video
  - Digital Power Meter
  - Data Loggers
  - Identify Safety Issues
- Recap
  - Recap
- Chapter Quiz
  - Chapter Quiz

Lighting Systems

- Introduction
  - Objectives
- Technical Basics
  - Light Defined
  - Lighting Systems
  - Light Sources
  - Light Sources - Efficacy
  - Light Sources - Fluorescents
  - Compact Fluorescent

- High Intensity Discharge (HID)
- Light Sources - Incandescent
- Halogen Lamps
- Light Emitting Diode (LED)
- Ballasts and Transformers
- Lighting Quality
- Illumination Levels
- Lighting Quality - Uniformity
- Absence of Glare
- Correlated Colour Temp.
- Colour Rendering Index

Measuring & Metering
- Light Level Measurement
- Light Level Readings

O & M Best Practices
- Energy Savings Opportunities
- Questions to Consider
- Turn it Off!
- Delamping
- Cleaning
- Maintenance Practices

Upgrade Opportunities
- Lighting Opportunities
- Lighting Controls
- Manual Controls
- Automatic Controls
- Occupancy Sensors
- Ultrasonic Sensors (US)
- Passive Infrared Sensors
- Dual-Technology Sensors
- Daylight Controls
- Preferred Strategy
- Preset Controls
- Time Controls
- Centralized Control Mgt.
- Lighting Worksheet
- Lamp and Ballast Retrofits
- Fluorescent Lamps
- Compact Fluorescent
- Light Sources - HID Retrofits
- Light Sources - LED Retrofits
- LED Example - Vancity
- Induction Lighting
- Opportunities Summary

Recap
- Recap

Chapter Quiz
- Chapter Quiz

Electrical Systems

Introduction
- Objectives

Electrical Demand

- Demand Reduction
- Manual Demand Readings
- Hourly Demand Profile
- Getting More Results
- Analyzing the Profile
- Obtaining a Demand Profile
- Portable Power Meter
- Permanent Demand Metering
- Savings Opportunities
- Daily Profiling in Action
- Activity Demand Profiling

Motor Opportunities
- Motors and Loads
- Motor Selection
- Motor Operating Conditions
- Match the Motor to the Load
- Motor Efficiency Compared
- Motor Rewinding
- Changing Motors
- Motor Strategy
- Activity

Power Factor Correction
- Power Factor Defined
- Adding Capacitance
- Activity - PF and Demand

Transformers
- Transformers
- Transformers-Opportunities

Voltage Optimization
- Voltage Optimization Defined
- Preferred Voltage Levels
- Your Building's Voltage
- Voltage Drop In a Building
- Measuring Fluctuation
- Implementation Options
- Effects on Lighting
- Effects on Motors
- Name Plate Voltage
- Decreasing Imbalance
- Effect on Plug Loads
- Other Benefits

Recap
- Recap

Chapter Quiz
- Chapter Quiz

HVAC Systems

Introduction
- Objectives

Technical Basics
- HVAC Defined
- HVAC Systems and Comfort
- Energy Flow Diagram

- HVAC System Components
- Constant-Volume System
- Constant-Volume - Example
- Variable-Air-Volume (VAV)
- VAV System - Example
- Variable Frequency Drives
- VFD Power Consumption
- Fan Coil System
- Heat Pump System
- Heat Pump Schematic
- HVAC Controls

Measuring & Metering
- Assessment Instruments

O&M Best Practices
- Practices to Save Energy
- Pipe Heat Loss and Gain
- Heat Loss Gain Exercise
- Outside Air Damper Leakage
- Upgrade Opportunities

Upgrade Opportunities
- Fans
- Power Calculations
- Fan Capacity Control Method
- Fan Comparison
- Fan Assessment Questions
- Fan Assessment- Example
- Pumps
- Pump Assessment-Example
- Excessive Throttling-Example
- Pump Impeller Trimming
- Fan and Pump Summary
- HVAC System
- HVAC Economizer Savings

Recap
- Recap

Chapter Quiz
- Chapter Quiz

Heating Systems

Introduction
- Objectives

Technical Basics
- Heat in a Building
- Boiler Plant Components
- Boiler Plant System Efficiency
- Cycling
- Fuel Combustion
- Boiler Types
- Fuel Used in Heating Plants

Measuring & Metering
- Combustion Analysis
- Combustion Measurement
- Measuring Efficiency

- Thermography
- O&M Best Practices
  - Efficiency and Safety
  - Effect of Scale
  - Heating and DHW
  - Heating Plant Maintenance
  - Savings Example
  - Efficiency for Natural Gas
  - Upgrade Opportunities
- Upgrade Opportunities
  - Improve Combustion Control
  - Relocating Air Intake
  - Smaller Boilers Turbulators
  - Stack Dampers
  - Boiler Isolation Valves
  - Optimizing Multiple Units
  - Right Size Boilers
  - Replacing Boilers
  - Installing H.E. Boilers
  - Energy Information
  - Technical Considerations
  - Features to Look For
  - Insulation
  - Domestic Hot Water
  - Heat Recovery
  - Heat Recovery-Boiler Stacks
  - Heat Recovery-Steam
  - Heat Recovery- Other
- Recap
  - Recap
- Chapter Quiz
  - Chapter Quiz

Cooling Systems

- Introduction
  - Objectives
- Technical Basics
  - The Refrigeration Cycle
  - Cooling Systems in Buildings
  - The Compressor
  - Chiller Components
  - Chilled-Water System
  - Compressor Types
  - Condenser Types
  - Cooling Efficiency
  - Chiller Comparison
  - Equipment Rating Standards
  - Part-Load Efficiency Rating
  - Standard Rating Conditions
  - Flow Rate & Temperature
  - Chiller Evaporator Flow
  - Reducing Flow Rates
  - Low-Flow Systems

- Variable-Primary-Flow
- Critical VPF Requirements
- Condenser-Water
- O & M Best Practices
  - Measurements and Metering
  - Meeting the Need
  - Cleaning and Maintenance
  - Chiller Controls
  - System Optimization
  - Chilled Water Reset
  - Server Rooms
  - Operational Indicator Activity
  - Upgrade Opportunities
- Upgrade Opportunities
  - Efficiency Improvement
  - Cooling Plant Exercise
  - Fan Speed Control
  - Airside Economizer
  - Free Cooling
  - Strainer Cycle
  - Heat Exchanger
  - Refrigerant Migration
  - Deep Lake Water Cooling
  - Chiller Retrofit Case Study
- Recap
  - Recap
- Chapter Quiz
  - Chapter Quiz

Building Controls

- Introduction
  - Objectives
  - Why Controls Optimization?
- Technical Basics
  - Building Controls
  - HVAC Control
  - How Controls Affect HVAC
  - The Control Loop
  - Control Components
  - Direct Digital Control
  - Control Methods
  - Two Position Control
  - Floating Control
  - Proportional Control
  - Proportional Plus Integral
  - Control Loop Limitations
  - DCC - Bad Control
  - DCC - Poor Control
  - DCC - Good Control
  - Activity - DDC Control System
- Savings Opportunities
  - Energy Saving Opportunities
  - Operating Schedules

- Temperature and Humidity
- Deadband
- Outdoor Ventilation
- Operating Parameters
- Pressure Control Strategies
- Fan Systems
- Optimized Static-Pressure
- Hydronic Systems
- Unoccupied Operation
- Optimum Start
- Operation/Maintenance Issue
- Activity - Optimizing Controls
- Sensor Readings
- Manual Overrides
- Trend & Historical Logs
- Trend/Historical Log Sample
- Trend/Historical Log Example
- Alarms
- Expanding DDC Control

Recap
- Recap

Chapter Quiz
- Chapter Quiz

Selling the Project

Introduction
- Objectives

Business Case
- Possible Target Audiences
- Investment Appraisal
- Making the Business Case
- Need for a Business Case
- How to Make Business Case
- Writing an Energy Proposal
- Assessing Costs&Benefits
- Investment Criteria
- Simple Payback
- Cash Flow Analysis
- Activity - Estimating IRR
- Risk and Sensitivity Analysis
- Activity-Sensitivity Analysis
- Activity - Selling Projects

Incentive Programs
- Incentive Programs
- Greenhouse Gas Emissions
- Reduce GHG Emissions
- Activity - Apply Incentives

Recap
- Recap

Final Exam

Take the Final Exam