



Sample Energy Problems for Energy Management Professional Study



Updated April 2025



Units of Measure – Conversions

British Thermal Unit (Btu) – measure of heat (energy) content of fuels. The quantity of heat required to raise the temperature of 1 pound of liquid water by 1°F at the temperature that water has its greatest density (approx. 39°F).

Electricity	1 kilowatt hour	= 3,412 Btu
Natural Gas	1 cubic foot	= 1,023 Btu
Motor Gasoline	1 gallon	= 124,238 Btu
Diesel Fuel	1 gallon	= 138,690 Btu
Heating Oil	1 gallon	= 139,600 Btu
Propane	1 gallon	= 91,333 Btu
Electric horsepower	1 HP	= 2,545 Btu

BTUH – BTUs per hour (often used to define equipment capacity)

Ton of refrigeration = 12,000 BTUH

Use Consistent Units through Calculations



#1 - Heating Degree Days

The average daily temperatures for one week in January in Asheville, NC are as follows:

- Monday 48°F
- Tuesday 52°F
- Wednesday 53°F
- Thursday 66°F
- Friday 49°F
- Saturday 47°F
- Sunday 50°F

What is the total number of Heating Degree Days (HDD) for the one-week period?



#2 - Cooling Degree Days

The average daily temperatures for one week in May in Asheville, NC are as follows:

- Monday 88°F
- Tuesday 79°F
- Wednesday 77°F
- Thursday 78°F
- Friday 64°F
- Saturday 79°F
- Sunday 72°F

What is the total number of Cooling Degree Days (CDD) for the one-week period?



#3 - Performance Metrics – EUI Problem

A client owns and manages a 180,000 SF office building and wants to know how it is performing. The client provides the following information to the EMP, (next slide).

What is the Energy Use Intensity (Index) (or EUI) for the building?



#3 - Performance Metrics – EUI Problem

Month	Electrical (kWh)	Natural Gas (MCF)
January	170,000	903
February	160,400	794
March	180,880	856
April	192,000	706
May	240,900	648
June	262,500	581
July	241,700	521
August	234,650	509
September	234,000	572
October	228,000	713
November	195,700	761
December	186,200	817
TOTAL	<u> kWh </u>	<u> MCF </u>



#4 – Site EUI / SEU Problem

An 80,000 SF office building includes gas boilers for heating and has a ‘demand response’ agreement with the local utility to utilize its on-site generator during high demand periods. Its annual metered energy usage, per fuel, is as follows:

- Electricity: 859,000 kWh
- Natural Gas: 1,499,641 cu. ft.
- Diesel oil: 2,000 gallons

1. What is the Site EUI?



#4 (continued) – Site EUI / SEU Problem

2. What is the Source Energy Use (SEU) using the following table from Portfolio Manager?

Figure 1 – Source-Site Ratios for all Portfolio Manager Energy Meter Types

Energy Type	U.S. Ratio	Canadian Ratio
Electricity (Grid Purchase)	2.80	1.96
Electricity (Onsite Solar or Wind - regardless of REC ownership)	1.00	1.00
Natural Gas	1.05	1.01
Fuel Oil (No. 1,2,4,5,6, Diesel, Kerosene)	1.01	1.01
Propane & Liquid Propane	1.01	1.04
Steam	1.20	1.33
Hot Water	1.20	1.33
Chilled Water	0.91	0.57
Wood	1.00	1.00
Coal/Coke	1.00	1.00
Other	1.00	1.00



#5 – Energy Performance Indicators

Sometimes Owners use energy performance indicators (EnPI) as metrics to assess the efficiency of their building.

A hotel has a floor area of 200,000 SF, 400 guest rooms, and 50 employees. The annual energy bills, converted to a common unit, total 20,000,000 BTU/yr.

What are the EnPI values for each of the following metrics?

- BTU/SF per year
- BTU/guest room per year
- BTU/ employee per year



#6 – Energy Performance Indicators

An industrial plant makes ‘widgets’ and management forecasts a 12% increase in annual production during 2018 over their production in 2017. The production (process) electricity is metered separately from the balance of the plant. Using the information below:

1. What is the expected monthly electrical cost in 2018?
2. What is the total electricity cost for each widget the plant produces in 2018?

- Every widget requires 0.2875 kWh of electricity (intensity)
- 2017 production volume = 12,500,000 widgets
- Monthly electrical consumption unrelated to production = 224,373 kWh
- Pro-rated electricity cost (demand and consumption) = \$0.075 / kWh



#7 – Energy Performance Indicators

AN EMP evaluates a data center and calculates the IT equipment load is 180 kW, while the facility equipment load is 100 kW. What is the Power Usage Effectiveness (PUE) of the data center?

What is the Data Center Infrastructure Efficiency (DCiE) of the data center?



#8 – Evaluating Energy Opportunities

An EMP identifies three ECMs with the following estimated costs and projected annual savings.

	<u>Cost (\$)</u>	<u>Annual Savings (\$)</u>
ECM #1	5,400	1,200
ECM #2	3,500	800
ECM #3	4,700	1,000

The Owner decides to implement all three of the measures

What is the simple payback for the project?

What is the projected ROI for the project?



#9 – Evaluating Energy Opportunities

If a school's O&M staff has only enough time to implement one of the following ECMs during the next school break, which one would you recommend based on the District's criteria to maximize investment across a 10-year payback period? The school has the budget to afford any one of the following project costs.

ECM Number	Initial Cost	Savings, \$/yr	SPB, years	10 years savings	10 year savings minus Initial Cost
1	\$500	\$1000	0.50		
2	\$4000	\$4000	1.00		
3	\$11,000	\$10,000	1.10		
4	\$20,000	\$15,000	1.33		



#10 – Evaluating ECMs

An EMP for a corporation is tasked with reviewing the results of an energy audit. Measures that improve product manufacturing and delivery processes are the first priority for management. All utility-related projects are subject to financial requirements that include a maximum four-year simple payback.

Based upon the options offered in the following table, what measure should the Owner select?



#10 – Evaluating ECMs – Data Table

ECM / FIM	Savings	Implementation Costs
HVAC Control System Modifications in Office	\$28,000	\$12,000
Lighting Retrofit in Office Areas	\$22,000	\$56,000
Compressed Air System Pressure Restoration in Packaging	\$ 9,000	\$24,000
Water Efficiency Improvements In Manufacturing	\$ 3,500	\$18,000



#11 - ECM – Calculating Savings

During an energy audit, it is discovered that a laboratory hood exhaust fan is operating continuously; 24 hours a day, 365 days a year.

In discussion with the Users of the building, it is determined that the fan only needs to operate from 8:00 AM to 5:00 PM for five (5) days a week.

The fan motor is $\frac{1}{2}$ horsepower, single phase with a power factor of .85. The nameplate on the motor lists 4.9 amps at 230 volts.

The electricity costs \$.06 / Kwh.

By reducing the run time of the fan, what are the approximate savings per year?



Pump and Fan – Affinity Laws

$$\left(\frac{P1}{P2}\right) = \left(\frac{N1}{N2}\right)^3$$

P – Power (e.g. hp, kW)

$$\left(\frac{Q1}{Q2}\right) = \left(\frac{N1}{N2}\right)$$

N – Speed (e.g. rpm, Hz)

$$\left(\frac{H1}{H2}\right) = \left(\frac{N1}{N2}\right)^2$$

Q – Volumetric Flow (e.g. gpm, cfm)

H – Head Pressure (e.g. ft H₂O), psi, in. H₂O)

$$\left(\frac{Q1}{Q2}\right) = \left(\frac{D1}{D2}\right)$$

D – Impeller Diameter (e.g. inches)

$$\left(\frac{P1}{P2}\right) = \left(\frac{D1}{D2}\right)^3$$

$$\text{Fan Power (hp)} = \frac{(CFM)(in)}{(6,346)(\% \text{ eff})}$$

$$\text{Pump Power (hp)} = \frac{(GPM)(ft)}{(3,960)(\% \text{ eff})}$$

$$\left(\frac{H1}{H2}\right) = \left(\frac{D1}{D2}\right)^2$$

$$\text{Fan Efficiency} = \frac{CFM \times TP}{6,356 \times BHP}$$



#12 - ECM - Pump Laws

An EMP has been engaged by an industrial client for energy-related services. During the course of his work, the client identifies a process pump that currently operates at a capacity of 150 gpm, with a 10 HP motor operating at 1800 rpm.

The client wants to increase the pump capacity to 300 gpm, but would like to know the impact on horsepower.

Assuming a constant diameter impeller, what resulting changes to pump speed and horsepower are required to meet the increase to 300 gpm?



#13 – ECM - Affinity Law

An EMP notices that several spaces within a subject building require lower airflow than the capacity available through the existing fans. The fans are all equipped with VFDs.

The EMP knows that in reducing air flow from 100% of the fan rating to 80% airflow (by reducing the fan speed via the VFD), approximately 50% of the fans power consumption can be saved.

Use the Affinity Laws to identify the anticipated savings in the following scenario:

An existing 10 hp fan produces 10,000 cfm when the VFD is a 100%. What would the savings in electric power input to this fan be if the airflow is reduced to 8,000 cfm?



#14 - ECM - U-value / Insulation

An EMP is exploring the feasibility of adding insulation to the walls of a warehouse to decrease the heat loss. He has calculated the existing U-value of the wall as 0.20 and the R-value of the proposed insulation is 11.0.

The building has a total of 40,000 SF of exterior wall (no windows) and the design temperatures are 24 deg. F outside and 70 deg. F inside.

What is the decrease in heat loss (Btuh) if the insulation is added?



#15 - Interactions – Lighting & Cooling Energy

An EMP is evaluating an ECM upgrading a building with a more efficient lighting system. The existing lighting load is 3,200 kW and will be reduced to 1,800 kW with the upgrade.

Existing operating hours for the lighting system in July is 200 hours (no anticipated change)

The air conditioning system uses 1 kWh of cooling energy to remove the heat from 3 kWh of lighting energy.

What is the total electricity savings in kWh for the month of July considering both lighting and cooling system savings?



#16 – Interactions - Lighting & Cooling Energy

An EMP is analyzing a potential ECM for a 10,000 SF single-story office space in Orlando, FL. The building manager indicated lighting operation is 11 hours per day, 5 days per week.

There are 120 existing 2x4 lay-in troffer fixtures, each with (3) T-8, 32W lamps. Ballast loss is estimated to be 5%.

The option being considered is a 4-foot T-8 fixture LED retrofit kit which consumes 36W. The Owner can direct purchase the fixtures for \$85 each. The Owner's on-contract electrician has quoted \$70 each for installation (including disposal charges for the existing lamps and ballasts).



#16 – Interactions - Lighting & Cooling Energy

The EMP has previously calculated the following for this building and fixture type:

- BLENDED energy cost of \$0.100 /kWh
- A cooling season of 46 weeks
- A previously-calculated overall HVAC system efficiency of 0.9 kW/ton
- Calculated annual maintenance cost differential, per fixture, of \$12

Per the Owner, prospective ECMs must meet a simple payback threshold of 4.0 years or less to be considered for implementation. Does this ECM meet the threshold?



#17 - ECM – Domestic Hot Water

An EMP is performing an energy audit of a community center. During the audit, it is discovered the domestic water heating system serving the locker room showers has been leaking 0.5 gal. / minute from an old storage tank.

Domestic water arrives at the building from underground piping at 70 deg. F and is heated and stored at 140 deg. F, before being distributed through a thermostatic mixing valve.

What is the rate of heat loss?



#18 – Utility Rates

An electric billing rate schedule with two or more rates for different usage amounts is called a ?

- A. Seasonal Flat Rate
- B. Tiered Energy Charge
- C. Time of Use (TOU) Rate
- D. Demand Charge



#19 – Utility Rate Comparison

A small commercial client has asked an EMP to evaluate which of two alternate electrical rate plans offered by the local utility he should choose. Their average monthly consumption is 2,800 kWh.

Fixed Rate Option: \$0.13 / kWh

Tiered Rate Option:

1 to 400 kWh - \$0.09 / kWh

Greater than 400 kWh - \$0.12 / kWh

Greater than 1000 kWh - \$0.15 / kWh

Which rate plan should the EMP recommend?



#20 - Utility Rate Problem

An EMP is preparing for an upcoming audit and retro-commissioning project on a state university campus. The state university facilities operations staff has provided the combined previous 12 months of electric and natural gas data for the buildings that will be included in the project. The EMP has also obtained the utility rate structure that is applicable.

Month	Electrical Consumption (kWh)	Electrical Demand (kW)	Natural Gas (MCF)
Jan	180,000	1,480	950
Feb	168,800	1,526	836
Mar	190,400	1,782	901
Apr	202,000	1,966	743
May	253,600	2,214	682
Jun	276,400	2,348	612

Month	Electrical Consumption (kWh)	Electrical Demand (kW)	Natural Gas (MCF)
Jul	254,400	2,456	548
Aug	247,000	2,648	536
Sep	246,400	2,342	602
Oct	240,000	2,134	751
Nov	206,000	1,896	801
Dec	196,000	1,688	860
Total	2,661,000	24,480	8,822



#20 - Utility Rate Problem

- The utility tariff that applies for the campus has the following components:
- Winter Energy Charge - \$0.043/kWh
- Summer Energy Charge - \$0.068/kWh
- T & D Charges - \$0.076/kWh
- Demand - \$10.00/kW
- Local Usage Tax – 4.0%
- Winter Natural Gas tariff - \$8.34/MCF
- Summer Natural Gas tariff - \$6.86/MCF
- Summer – May to September, inclusive

What is the blended electric rate that may be used for preliminary assessment of ECMs?



#21 - Utility Bill Analysis

Using the consumption information for the same project, identify what dollar savings would be achieved on the July bill for a cooling ECM that saves 100,000 kWh and 5 kW.

Month	Electrical Consumption (kWh)	Electrical Demand (kW)	Natural Gas (MCF)
Jan	180,000	1,480	950
Feb	168,800	1,526	836
Mar	190,400	1,782	901
Apr	202,000	1,966	743
May	253,600	2,214	682
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Month	Electrical Consumption (kWh)	Electrical Demand (kW)	Natural Gas (MCF)
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Oct	240,000	2,134	751
Nov	206,000	1,896	801
Dec	196,000	1,688	860
Total	2,661,000	24,480	8,822



#22 - Utility Invoice Audit

Month	Electrical Consumption (kWh)	Electric Demand (kW)	Natural Gas (MCF)
Jan	300,000	12,000	1100
Feb	298,000	16,000	900
Mar	355,500	14,500	901
Apr	425,200	16,800	899
May	555,500	17,000	750
Jun	688,800	18,200	612
Jul	825,000	19,300	599
Aug	900,000	20,000	536
Sep	855,000	19,500	602
Oct	769,000	16,900	751
Nov	627,900	14,900	827
Dec	550,000	13,200	1050
Total	7,149,900	198,300	9,527

Consumption (Charge) = \$0.074/kWH

T&D = \$0.083/kWH

Demand = \$5.00/kW

What are the demand charges for August?

What is the total electrical cost for August?

What is the blended electrical energy rate?



#23 - Utility Rate Analysis

Utility charges and terminology changes from one Utility Company to the next. Sometimes, charges and terminology can be a little complicated.

See actual utility rate charges from a San Antonio, TX provider company:

MONTHLY BILL

<u>Rate</u>	
\$ 8.75	Service Availability Charge
	<u>Energy Charge</u>
	Summer Billing (June - September)
\$ 0.0691	Per KWH for all KWH
	Non-Summer Billing (October - May)
\$ 0.0691	Per KWH for the first 600 KWH
\$ 0.0592	Per KWH for all KWH in excess of 600 KWH
	<u>Peak Capacity Charge*</u>
\$ 0.0198	Per KWH for all KWH in excess of 600 KWH

*Peak Capacity Charge is applicable only during the summer billing period (June - September).



#23 - Utility Rate Analysis

Utility charges and terminology changes from one Utility Company to the next. Sometimes, charges and terminology can be a little complicated.

See actual utility data from a San Antonio, TX provider company:

Month	Total kWh	First block kWh	Second block kWh	Service Availability Charge	Energy Charge per kWh, first block	Energy Charge per kWh, second block	Peak Capacity Charge per kWh	Total charge per kWh, first block	Total charge per kWh, second block
Jan	1000								
July	2000								

1. Complete the Table using the Utility rate structure on the previous slide.
2. What is one difference between Summer and Winter rates at this Utility?



#24 - EUI Calculation

A client owns and manages an apartment building that is 130,000 SF and wants to know how it compares to other buildings of similar nature. The client provides the following information to the energy manager.

Month	Electrical Consumption (kWh)	Natural Gas Consumption (MCF)
Jan	180,000	950
Feb	168,800	836
Mar	190,400	901
Apr	202,000	743
May	253,600	682
Jun	276,400	612
Jul	254,400	548
Aug	247,000	536
Sep	246,400	602
Oct	240,000	751
Nov	206,000	801
Dec	196,000	860
Total	2,661,000	8,822



#24 - EUI Calculation

What is the approximate EUI for the building?

- A. 21
- B. 70
- C. 88
- D. 139



#25 – Standards

Which of the following standards was written as a model building performance standard (BPS) that includes carbon emission performance requirements alongside energy efficiency as overall performance requirements for existing buildings?

- A. Standard 90.1-2022
- B. Standard 100-2024
- C. Standard 202-2024
- D. Standard 211-2018



#26 – Energy Audit and RCx

An energy manager is preparing for an upcoming audit and retro-commissioning project on a corporate campus. As part of the preparation, the energy manager is requesting that the client provide certain information.

Which of the following items should be requested from the client by the energy manager?

- A. Age of the facilities
- B. Planned changes in schedules
- C. Utility rate schedules
- D. Maintenance staff capabilities



#27 – Analyzing Energy Data

After reviewing 12 months of energy consumption following an equipment chiller replacement, the energy manager notes, that costs actually increased over the previous year, see below.

Month	Baseline Energy Consumption	Post-EEM Energy Consumption
	Electricity (kWh)	Electricity (kWh)
Jan	142,500	190,000
Feb	148,512	190,400
Mar	135,040	168,800
Apr	165,640	202,000
May	215,560	254,600
Jun	248,760	276,400
Jul	228,960	253,400
Aug	217,888	246,600
Sept	204,512	247,400
Oct	199,200	240,000
Nov	160,680	206,000
Dec	135,000	180,000
Year	2,202,252	2,655,600



#27 – Analyzing Energy Data

What is MOST likely to be the cause of the increased energy use?

- A. boiler water set points not resetting
- B. negative pressure in lobby
- C. building operating schedule overridden ON
- D. lights left on



#28 – Heating Degree Days

The average temperature for 4 days is 60 degrees F.

What is the number of Heating Degree Days (HDD) for the 4-day period.

- A. 5 Degrees F
- B. 10 Degrees F
- C. 15 Degrees F
- D. 20 Degrees F



#29 – Metering

An organization enters into a sell all/buy all agreement with a utility company by installing a photovoltaic system to offset part of their electric consumption.

What is required to be metered in this type of agreement?

- A. HVAC and domestic hot water loads
- B. Solar panels and inverters
- C. Power generated and power purchased
- D. Plug loads and lighting loads



#30 – Equipment Familiarization

Which of the following equipment could be found in a refrigeration plant?

- A. DOAS unit (dedicated outdoor air system)
- B. Variable refrigerant flow (VRF) condensing unit
- C. Reverse Osmosis (RO) unit
- D. Absorption chiller



#31 – Energy Conservation Strategies

To reduce compressor energy use, the EMP should consider which of the following energy conservation strategies:

- A. Increase chilled water flow through the chiller
- B. Reset leaving water temperature of the chiller
- C. Increase condenser water flow through the chiller
- D. Increase insulation around the evaporator shell of the chiller



#32 – ECM Implementation

An energy audit yields a number of favorable ECMs, exhibiting energy savings as well as projected reductions in maintenance costs and improved performance. However, the total cost for implementation of these measures will exceed the Owner's budget. The Energy Management Professional meets with the Owner and offers several strategies to consider in developing a plan for implementation, including:

- A. Engage an ESCO to perform the work under a performance contract
- B. Investigate alternative funding sources such as utility company incentives, government grants and/or low cost loans
- C. Discuss priorities with the Owner regarding postponing select ECMs for future implementation
- D. Investigate whether some ECMs can be implemented by in-house O&M staff

In which order should these strategies be considered; i.e. best to least favorable?



#33 – Evaluating Energy Performance

What is the best method for an energy manager to compare energy performance between various buildings in his portfolio?

- A. Compare the total costs of all metered utilities for each building
- B. Calculate the Energy Use Index (EUI) of each facility
- C. Utilize submetering to identify and compare major energy-consuming loads.
- D. Compare the energy consumption per occupant, based upon full time occupants.



#34 – Evaluating Energy Performance

An energy management professional does not have data from field M&V instruments but does have limited trend log data from the BAS; only reflecting operational status of the HVAC and lighting systems connected to same. For which of the following ECMs can the EMP verify improvement without the field data.

- A. Installation of a new high efficiency chiller
- B. Replacement of lighting fixtures with higher efficiency fixtures
- C. Implementation of demand control ventilation for outdoor air
- D. Conversion of a constant volume air handling system to a VAV system



#35 – Evaluating Energy Performance

An Owner requests an energy management professional review the terms and conditions of a performance contract proposed by an Owner, prior to executing same. After performing an Investment Grade Audit and determining the baseline energy use, the ESCO has provided a guarantee of energy savings associated with the implemented ECMs.

Which of the following would typically be included in an ESCO contract for adjustments to the baseline energy usage?

- A. Changes in occupancy; changes in operating schedules; projected escalation rates for utility costs; and changes due to abnormal weather conditions Heating Degree Days (HDD) and Cooling Degree Days (CDD)
- B. Changes in occupancy; changes in operating schedules; adjustments due to inadequate maintenance; and changes due to abnormal weather conditions Heating Degree Days (HDD) and Cooling Degree Days (CDD)
- C. Changes in operating schedules, projected escalation rates for utility costs, adjustments due to inadequate maintenance; and changes due to abnormal weather conditions Heating Degree Days (HDD) and Cooling Degree Days (CDD)
- D. Changes in occupancy, changes in operating schedules; projected escalation rates for utility costs, and adjustments due to inadequate maintenance



#36 – Evaluating Energy Performance

An Owner is presented with four ECMs based on an ASHRAE Level 2 Audit by an EMP. Annual energy savings and project installation cost is outlined for each ECM in the table below.

	Annual Energy Savings (BTU)	Annual Energy Savings (\$)	Installed Cost (\$)
1	3,288,794,193	\$56,179	\$284,782
2	1,972,334,842	\$28,397	\$116,498
3	3,009,478,440	\$101,442	\$528,934
4	2,859,667,010	\$49,905	\$214,665
Total	11,130,274,485	\$235,923	\$1,144,879



#36 – Evaluating Energy Performance

What is the approximate simple payback to proceed with all four ECMs?

- A. 2 years
- B. 4 years
- C. 5 years
- D. 7 years



#37 – Evaluating Energy Performance

The Owner of a 10-year-old commercial office building has directed the building's Facility Manager to invest up to \$100,000 in energy saving projects to reduce the facility's carbon footprint and utility bills. The Owner will only invest in individual projects with a minimum energy savings of 25,000 kWh/yr due to local utility costs and a simple payback of two years or less. The following ECM Matrix was provided last week, as a result of an energy analysis.



#37 – Evaluating Energy Performance

Item	Description	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings (\$/yr)	Annual Nat Gas Energy Savings (therms/yr)	Annual Nat Gas Cost Savings (\$/yr)	Installation Cost (\$)	Simple Payback (years)
1	Turn Off AHU Serving Theater during Unocc Hours	36,420	\$2,667	0	\$0	\$2,280	0.85
2	Operate AS-21 Only When Laundry is Being Used	7,159	\$524	5,122	\$4,393	\$8,650	1.76
3	Coordinate Operation Schedules of Kit Exh Fan and MAU with Kitchen Use	51,068	\$3,740	26,300	\$22,556	\$6,890	0.26
4	Repair Electric Radiant Floor Heating Controls	62,458	\$4,574	0	\$0	\$6,600	1.44
5	Manage Water Flow thru Coils to Achieve Design Heat Transfer	253,477	\$20,545	0	\$0	\$44,730	2.18

Which projects should the Energy Manager execute?

- A. ECM 1, 3, 4 and 5
- B. ECM 1, 3 and 4
- C. ECM 1, 2, 3, 4 and 5
- D. ECM 1, 2, 3 and 4



#38 – Evaluating ECMs

During a preliminary assessment, the EMP will conduct a building walk through to observe system conditions and begin to identify operational issues and potential FIMs and ECMs. Which of the following is a common example of a low-cost ECM?

- A. Replace 2-way with 3-way valves
- B. Implementing a Trending/ Data Logging Plan
- C. Replace damaged dampers and actuators
- D. Thermostat calibration



#39 – ECM Recommendation

An EMP has been engaged to conduct an energy study for a large school with several air handling units. After collecting operational information and analyzing AHU trend data, the EMP identifies that the AHU's Morning Warm Up cycle often had little or no impact on the RAT during startup hours, meaning that the building's temperature conditions on most days were about the same, whether or not Warm-Up was initiated.

Which of the following is the EMP's recommended ECM?

- A. Reprogram Morning Warm Up based upon an appropriate OAT
- B. Reprogram to eliminate Morning Warm Up and Cool Down modes
- C. Reprogram to increase the Outside Air flow rate
- D. Have the manufacturer decrease the coil leaving air temperature



#40 – Blended Electric Rate

An EMP is preparing for an upcoming audit and retro-commissioning project on a state university campus. The state university facilities operations staff has provided the combined previous 12 months of electric and natural gas data for the buildings that will be included in the project. The EMP has also obtained the utility rate structure that is applicable.

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#40 – Blended Electric Rate

The utility tariff that applies for the campus has the following components:

- Winter Energy Charge - \$0.043/kWh
- Summer Energy Charge - \$0.068/kWh
- T & D Charges - \$0.076/kWh
- Demand - \$10.00/kW
- Local Usage Tax – 4.0%
- Winter Natural Gas tariff - \$8.34/MCF
- Summer Natural Gas tariff - \$6.86/MCF
- Summer – May to September, inclusive

What is the blended electric rate that could be used for preliminary assessment of ECMs?



#41 – Energy Consumption / Degree Days

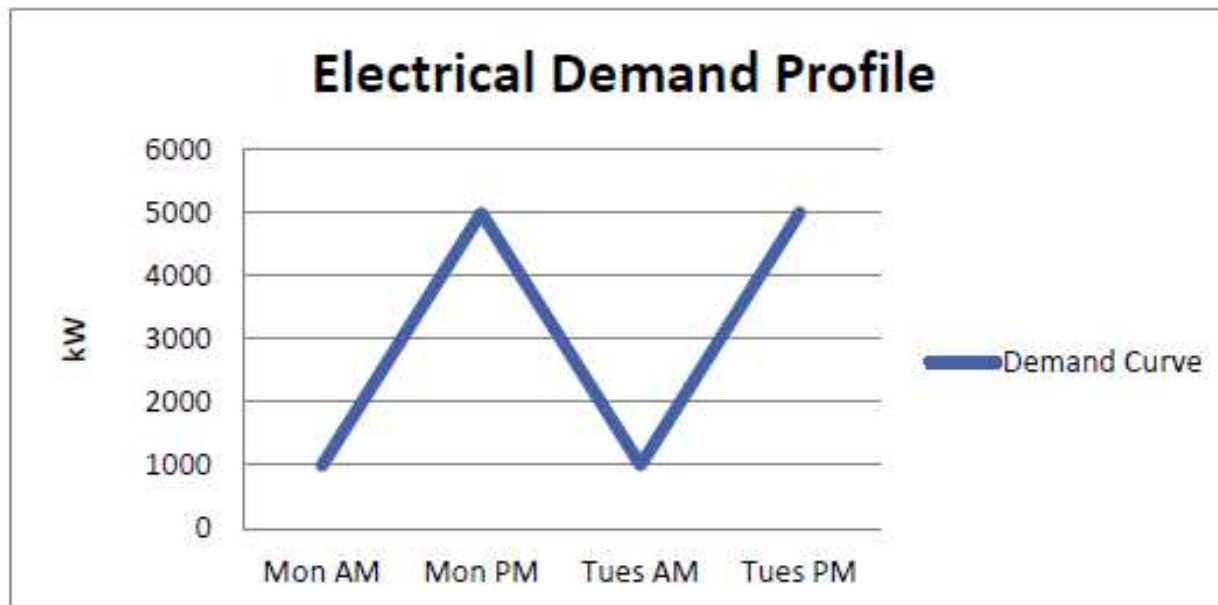
What insight can be gained by analyzing historical monthly energy consumption versus degree days for a given location and time period?

- A. Energy consumption versus general seasonal changes
- B. Correlation of energy consumption to levels of daylight
- C. Energy consumption correlation to weather-based loads
- D. Energy consumption correlation to seasonal occupancy



#42 – Evaluating Graphic Data

During an energy audit, an electrical demand profile graph takes the form of a saw tooth pattern with consistent equal steep “teeth”.





#42 – Evaluating Graphic Data

Which of the following ECMs does this graph suggest might be in play?

- A. Optimal start
- B. Outdoor air temperature reset
- C. Discharge air temperature reset
- D. Demand Start



#43 – Energy Conservation Behavior

An EMP invests in sub-meters to monitor energy consumed by each department of a company. One department has improved energy performance by reducing energy usage. The EMP wants to use that success to motivate other departments.

Which of the options below offers the best approach to motivate other departments based on one department's success?

- A. Congratulate the successful department and thank them for their effort
- B. Publish monthly department progress in the company newsletter
- C. Make reducing energy usage a competition between departments with modest incentive prizes for the winning department
- D. Write an e-mail to the other departments notifying them that their energy efficiency methods are not acceptable



#44 – Commissioning

On a project in a jurisdiction that has adopted the 2024 International Energy Conservation Code, (IECC), what commissioning provisions would the EMP anticipate as project requirements.

- A. Lighting controls, HVAC systems and HVAC Controls commissioning are required
- B. Lighting controls, HVAC systems and HVAC Controls, and domestic / service water heating commissioning are required
- C. HVAC systems, HVAC Controls, domestic / service water heating and renewable energy systems commissioning are required
- D. Lighting controls, HVAC systems, HVAC Controls, domestic / service water heating, continuous air barrier, and renewable energy systems commissioning are required



#45 – Health Care Considerations

As part of a central utility plant upgrade project, an energy manager is tasked with making efficiency improvement recommendations. The central plant serves a multiple building healthcare campus. What priorities should the energy manager consider as a priority?

- A. Energy efficiency impacts
- B. First cost for construction
- C. Total cost of ownership
- D. Operational resiliency



#46 – AHU Analysis

An EMP suspects an air handling system is utilizing a higher percentage of outdoor air than originally designed. He cannot directly measure the outdoor air but collects the following measurements:

Supply Air = 25,000 CFM
Return air temp. = 75° F

Outdoor air temp. = 98° F
Mixed air temp. = 82° F

What is the percentage of outdoor air at these conditions?

What is the mixed air temperature required for 15% outdoor air?

How would you balance to achieve 15% outdoor air?



#47 – AHU Analysis

An EMP takes the following measurements at an air handling unit cooling coil in the field in an effort to discern its performance.

Airflow across the coil: 24,000 CFM

Entering air temperature to coil: 76° F (dry bulb) / 66° F (wet bulb)

Leaving air temperature from coil: 58° F (dry bulb) / 56° F (wet bulb)

What is the cooling capacity being provided by the coil in Btuh?

What is the cooling capacity being provided by the coil in tons of refrigeration?



#48 – Coil Analysis

In the previous problem where the EMP has determined the coil's cooling capacity, he also takes entering and leaving water temperatures:

Entering water temperature to coil: 45° F

Leaving water temperature from coil: 55° F

If the coil is a counterflow coil, what is the water flow through the coil?



#49 – Present Worth Analysis

An EMP is evaluating two alternate HVAC replacement systems, each with a life of 12 years (n) and assuming an annual interest rate, $i = 10\%$. The costs associated with each alternative are shown below. Which alternate should be selected, based upon present worth analysis?

Alternate No. 1

First Cost: \$25,000

Annual Operating Cost: \$10,000

Salvage Value: \$2,000

Alternate No. 2

First Cost: \$35,000

Annual Operating Cost: \$7,500

Salvage Value: \$4,500



#50 – HVAC Knowledge

The economizer section in an air handling unit consists of:

- A. An automatic changeover thermostat and discharge air damper
- B. A pre-heat coil and a pre-cooling coil
- C. A supply damper, return air damper and an outdoor air damper
- D. A return air damper, a relief air damper, and an outdoor air damper



#51 – HVAC Knowledge

A reversing valve can be found in:

- A. A hermetic compressor
- B. A water chiller
- C. A heat pump
- D. An absorption air-conditioning unit



#52 – Prioritizing ECMs

When prioritizing favorable energy measures (ECMs), an energy management professional should:

- A. Always select the measures with the largest projected savings
- B. Always select the measures with the lowest first costs
- C. Consider the Owner's budget and goals
- D. Ignore intangible benefits not associated with energy