While waiting for the workshop to start…

Get ready to participate!

- Turn on your camera
- Find the unmute button and say "Hi" to check your audio

- Find the "raise hand" button

Answer our opening question!

What HVAC projects are you planning?

Answer in chat or raise hand and unmute

NOVEMBER 7, 2024

Save on Energy webinar: Estimating project savings- HVAC

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Follow along in the Participant Workbook!

Have the workbook open or printed out

Where to find the workbook:

- In the chat

SAVE ON ENERGY | DELIVERY PARTNER

ESTIMATING HVAC PROJECT SAVINGS

PARTICIPANT WORKBOOK

How do you know if an energy-saving opportunity is worth pursuing? After identifying an opportunity, you'll likely want to estimate the savings to evaluate if it's worth putting more effort and resources into it.

Understanding how to develop a reasonable estimate of energy savings can be very useful, but you need to know what tools or calculations to use, what assumptions are going into those estimates, and under what conditions they're valid.

IN THIS WORKSHOP, PARTICIPANTS WILL:

- Apply the four-step framework to estimate savings on HVAC projects.
- Identify areas where a different estimate approach is required depending on applicability and available data.
- Gain expert insights to confidently address questions and refine techniques for estimating savings.

This workshop will be hosted over Teams.

Watch for this icon to help follow along

1

Pathway to estimating project savings

- Apply the four-step framework to estimate savings
- Include specific considerations for HVAC
- Gain expert insights

Applying a structured approach to estimating savings

Reduce the risk of savings estimation errors by:

- Aligning savings estimates with the required level of accuracy.
- Avoiding assumptions that don’t apply to your specific system.
- Making it easier to identify unreasonable savings.

Four-step framework to estimate savings

Assess available data

- Know if you have the right data to meet your required level of uncertainty.

Establish a baseline

- Understand total energy use to ensure savings estimates are in the right ballpark

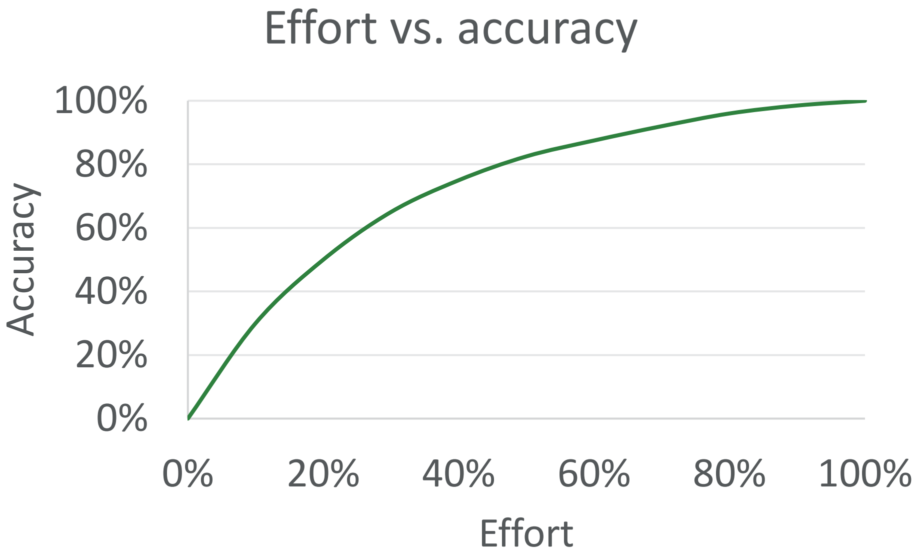
Understand savings mechanisms

- Assess how your system reacts to changes to avoid incorrect assumptions in estimates

Estimate savings

- Choose the right calculations or rules of thumb

Appropriate accuracy



- What decision are you trying to make?
- What are the risks associated with the decision?

Decision / risk examples

- Capital spend / underperformance
- Proceed with further study / non-viable
- Trial a setpoint change / reverse decision

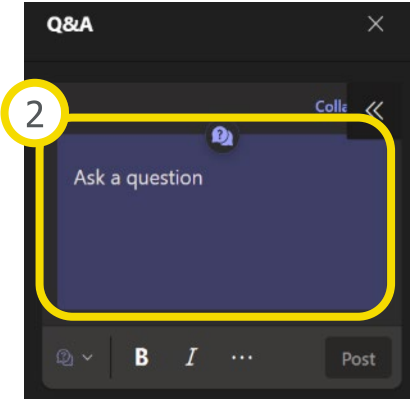
Welcome our guest expert

Michel Parent

Consulting Engineer, Eng, M.A.Sc

Ask the experts

Use the Q&A function to type out your questions.



Feel free to turn on your camera to ask questions as well!

Assess available data

The first step in a structured approach is to determine what data is available:

- Gather equipment details and specifications
- Control sequences or control logic
- Understand usage patterns
- Establish the facility's requirements
- Identify what is metered and how data is logged

What do we need?

The evaluation of HVAC opportunities require having at least some of the specifications for the equipment, such as:

- Motor size (hp)
- Pump flow, head
  - Fan flow, static pressure
  - Operating conditions, etc.

Start by verifying what already exists, such as equipment/asset lists, plans, previous energy studies.

Collecting HVAC data

1. Nameplate information
2. Type of system
3. How is it controlled? (and *where*)
4. Condition of unit and known issues
    - Talk to personnel such as O&M (operations and maintenance) and staff on the production floor

Nameplate data

Useful information for motor-driven systems include:

- Motor hp, efficiency, power factor
- Driven system nameplate – flow, pressure, etc.

For heating and cooling equipment:

- Capacity (kW, BTU/h, Tons, etc.)
- Nameplate efficiency
- Flow (air, water)
- Modulation capacity

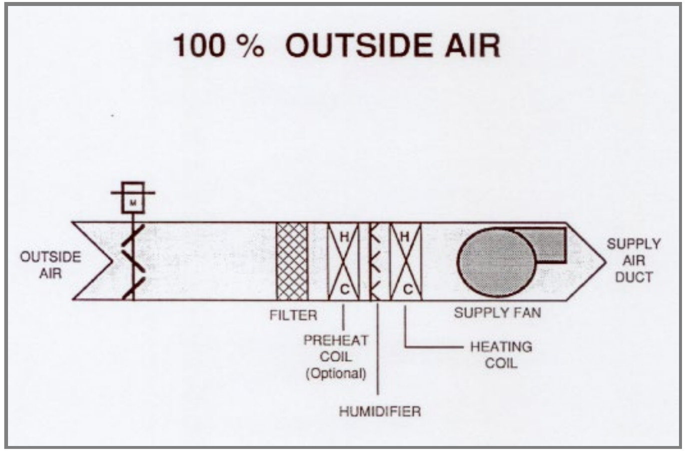
Type of system: ventilation

- HVAC, mainly ventilation, are important elements in the consumption of facilities
- It is crucial to fully understand the elements of the HVAC systems, including:
    - Type of systems that are in place
    - Operating requirements and current setup/configuration.
- The same measure may not be applicable from one system to another only due to configuration!

Common HVAC Systems: makeup air unit

Makeup Air Unit – MUA (100% outside air)

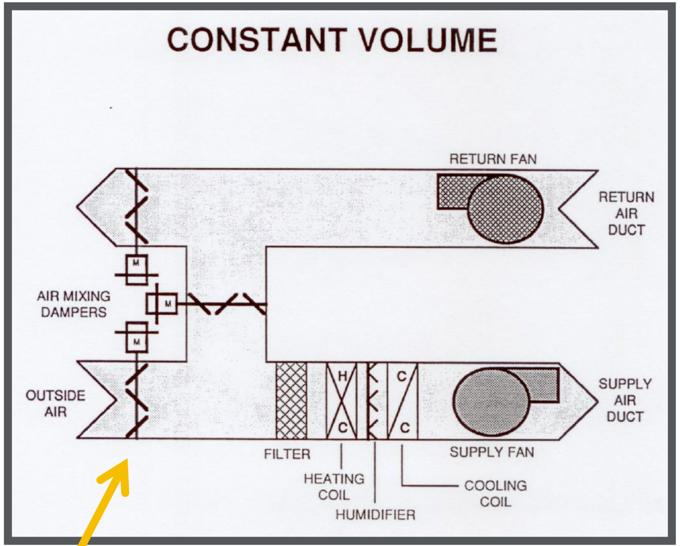
- System used in laboratories, kitchen but also when distributed heating and cooling systems are present
- Heating and cooling usually controlled by a duct sensor
- Efficiency is strongly impacted by the supply temperature control logic
- Very suitable for heat recovery and demand control ventilation
- Constant or variable flow



Common HVAC systems: single zone packaged

Single Zone Packaged (e.g. rooftop units)

- One space thermostat controls the units heating and cooling
- Often on roofs - maintenance is often more difficult
- Comfort issues when serving multiple spaces
- Works just like a furnace (heating/cooling)

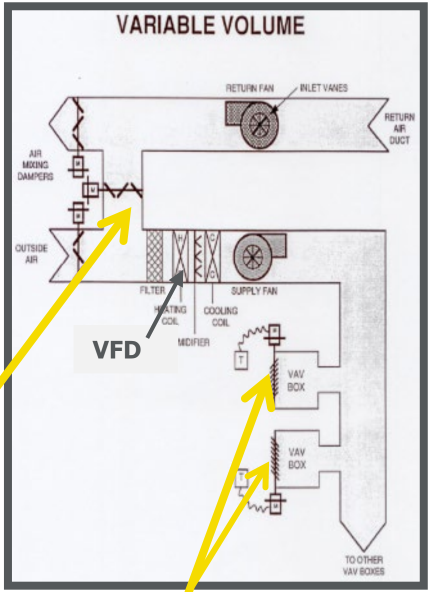


Typical: 10% to 15%

Common HVAC systems: variable air volume

Variable Air Volume (VAV)

- Common for offices, can serve multiple areas
- More efficient than constant flow systems
- The system is controlled by a duct sensor
- System performance very sensitive to quality of control (BAS)
- VAV boxes control the individual zone temperature
- VAV system are typically not used for heating



Typical: 10% to 15%

Closes down to 20% - 30% minimum

A useful diagnostic equation

$$\% \, Outside \ Air = \frac{(Treturn - Tmixt)}{(Treturn - Toutside)}$$

- Allows verification that dampers and temperature sensors on the BAS are coherent with one-another
- To be used when outdoor temperature is quite different than return temperature.

Considering building envelope measures?

Data on the envelope must be collected:

- Wall, roof, door (incl. overhead) areas
- Estimated R-values of opaque components
- Type of windows (double, clear or tinted)

R-values are often difficult to obtain, especially for walls so typical value must often be used:

- R-5 for pre-1970 building, R-10 for pre-1980 and R-15 for more recent
- Roof value are typically known as re-roofing is common

Question

What data do you typically have available for your HVAC systems?

*Answer in chat or raise hand and unmute

Common errors and omissions

Too often, energy savings estimates fail to deliver due to calculations based on bad data. Here are some common data gathering pitfalls:

- Not gathering operational period of the equipment
- Having no information on the load factor on the equipment
- Misidentification of the type of HVAC system
- Poor estimation of the amount of outside air or exhaust air from a unit
- Not asking about O&M issues.

Outcome of step 1: accurate data assessment

- A reliable and defensible dataset is established
- A foundation of data that meets your accuracy requirements is built
- Uncertainty and data gaps are understood
- By understanding what data is available you can have confidence that your energy savings calculation will reflect the reality of your systems

Establish an energy baseline

The second step in the framework is establishing an accurate baseline of energy consumption:

- Estimate or measure the total energy consumption
- Understand energy consumption over different seasons, production schedules and types of operation
- You cannot save more than the current baseline for a given end-use or equipment!

Building a load inventory

- Based on the data collected, it is possible to establish a load inventory
- The load inventory will provide the energy and demand baseline of a system
- The load inventory applies to HVAC equipment but will often capture all energy-using equipment
  - This allows reconciliation of consumption and demand to your monthly bills
- The load inventory will often be the basis for your savings estimates

Simple load method

Description	Qty (a)	Unit Load (b)	Total kW (c) = a × b	Hrs/ Period (d)	kWh/ Period (e) = d × c	On @ Peak Y or N	Div'ty Factor (f)	Peak kW (g) = f × c	On @ Night Y or N	Night kW
Office floor	50	.047	2.35	290	682	Y	100	2.55	N	0
Warehouse	30	.45	13.5	250	3375	Y	100	13.5	N	0
Corridor	5	.047	.235	129	30	Y	30	.07	Y	.235
Totals	n/a	n/a	n/a	n/a	4087	n/a	n/a	15.9	n/a	.235

*Hours must account for load factor and cycling of equipment– often called Equivalent Full Load Hours (EFLH).

Source: Natural Resources Canada, Dollars to $ense Spot the Energy Savings Opportunities,

Simple calculations

Data Entry Item	Units	Description
Quantity	(a number)	The quantity of this particular item.
Unit Load	kW	The load in kW for one of this particular load.
Total kW	kW	Quantity × Unit Load
Hrs/Period	hours	The estimated hours of use per period.
kWh/Period	kWh	Total kW × Hrs/Period
On @ Peak	Yes/No	Is this load on during the peak period identified in the demand profile?
Diversity Factor	0 – 100%	That fraction of the total load that this particular item contributed to the peak demand.
Peak kW	kW	If the load is on peak, then this value is equal to the Total kW × Diversity Factor
On @ Night	Yes/No	Is this load on at night?
Night kW	kW	If this load is on at night, then this is equal to the Total kW. Otherwise, it is 0.

Source: Natural Resources Canada, Dollars to $ense Spot the Energy Savings Opportunities.

Motor load method

Description	Qty (a)	Motor hp (b)	Motor Load % (c)	Motor Eff % (d)	Total kW (e)	Hrs/ Period (f)	kWh/ Period (g) = e × f	On @ Peak Y or N	Div'ty Factor (h)	Peak kW (i) = e × h	On @ Night Y or N	Night kW
5-hp Air Compressor	1	5	75	78	3.6	120	432	Y	0.5	1.8	Y	1.9
Totals	1	5	75	78	3.6	120	432		n/a	1.8		1.9

Total kW (e) = (a) × (b) × 0.746 × (c) ÷ (d)

Source: Natural Resources Canada, Dollars to $ense Spot the Energy Savings Opportunities.

Motor load calculations

Data Entry Item	Units	Description
Quantity	N/A	The number of units in operation?
Motor hp	hp	The nameplate motor horsepower.
Motor Load %	0 – 100%	The fraction of the nameplate horsepower that this motor is estimated to be delivering to its driven load.
Motor Efficiency %	0 – 100%	The estimated or measured motor efficiency from electrical power input to shaft power output. This value will depend on the Motor Load % – it is not simply the nameplate efficiency.
Total kW	kW	Qty × Motor hp × 0.746 × Motor Load % Motor Eff %
Hrs/Period	hours	The estimated hours of use per period.
kWh/Period	kWh	Total kW × Hrs/Period
On @ Peak	Yes/No	Is this load on during the peak period identified in the demand profile?
Diversity Factor	0 – 100%	That fraction of the total load that this item contributed to the peak demand.
Peak kW	kW	If the load is on peak, then this is equal to the Total kW × Diversity Factor.
On @ Night	Yes/No	Is this load on at night?
Night kW	kW	If this load is on at night, then this is equal to the Total kW. Otherwise, it is 0.

Source: Natural Resources Canada, Dollars to $ense Spot the Energy Savings Opportunities.

Current-voltage method

Description	Qty (a)	Volts (b)	Amps (c)	Phase (d)	PF (e)	Total kW (f)	Hrs/ Period (g)	kWh/ Period (h) = g × f	On @ Peak Y or N	Div'ty Factor (i)	Peak kW (j) = i × f	On @ Night Y or N	Night kW
Roofing Units	10	575	15	3	.85	126.8	242	30 680	Y	.6	76.1	N	0
Totals	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30 680	n/a	n/a	76.1	n/a	0

Total kW = (f) = (a) × (b) × (c) × (d) × (e)

for single phase, use (d) = 1
for three phase, use (d) = $\sqrt{3}$ = 1.73

Source: Natural Resources Canada, Dollars to $ense Spot the Energy Savings Opportunities.

Current-voltage calculations

Data Entry Item	Units	Description
Quantity	N/A	The number of units in operation?
Volts	volts	The line voltage (measured or nameplate) for this load.
Amps	amps	The current drawn by this load. Either measured or from the nameplate. For a three-phase load, record only the current per phase.
Phase	1 or 3	The number of AC phases used by this load.
Power Factor	0 – 100%	The estimated or measured power factor of this load.
Total kW	kW	Quantity × Voltage × Amps × 1.73 × Power Factor
Hrs/Period	hours	The estimated hours of use per period.
kWh/Period	kWh	Total kW × Hrs/Period
On @ Peak	Yes/No	Is this load on during the peak period identified in the demand profile?
Diversity Factor	0 – 100%	That fraction of the total kW for this particular load that contributed to the peak demand.
Peak kW	kW	If the load is on peak, then this value is equal to the Total kW × Diversity Factor.
On @ Night	Yes/No	Is this load on at night?
Night kW	kW	If this load is on at night, then this is equal to the Total kW. Otherwise, it is 0.

Source: Natural Resources Canada, Dollars to $ense Spot the Energy Savings Opportunities.

Baselining heating load: makeup air units & single zone systems

For makeup air unit and single zone systems:

- Q = CV1 * Outdoor Air Flow * HDD * 24 / Efficiency
  - Where CV1 = 1.08 for flow in CFM and .0012 for flow in L/s
  - HDD = heating degree-days at the average supply air temperature
  - Results are in BTU/hr for CFM and kWh for L/s

This equation is based on HDDs and the results will be for the period over which the HDDs are calculated, often yearly.

Baselining heating load: multiple zone & mixed air units

For multiple zone mixed air unit (cold deck such as VAV systems):

- Need to evaluate the outdoor temperature below which the system will require heating of the mixed air

$$T_{balance} = \frac{(\text{Supply Temperature} - 1) - \text{Return Temperature} * \text{Return Flow \%}}{\text{Outdoor Air \%}}$$

- Obtain the HDDs for the Balance Temperature
  - RETScreen, DegreeDays.net, and other resources to obtain the HDDs
- Apply the previous equation to obtain your heating load

Baselining cooling load from ventilation

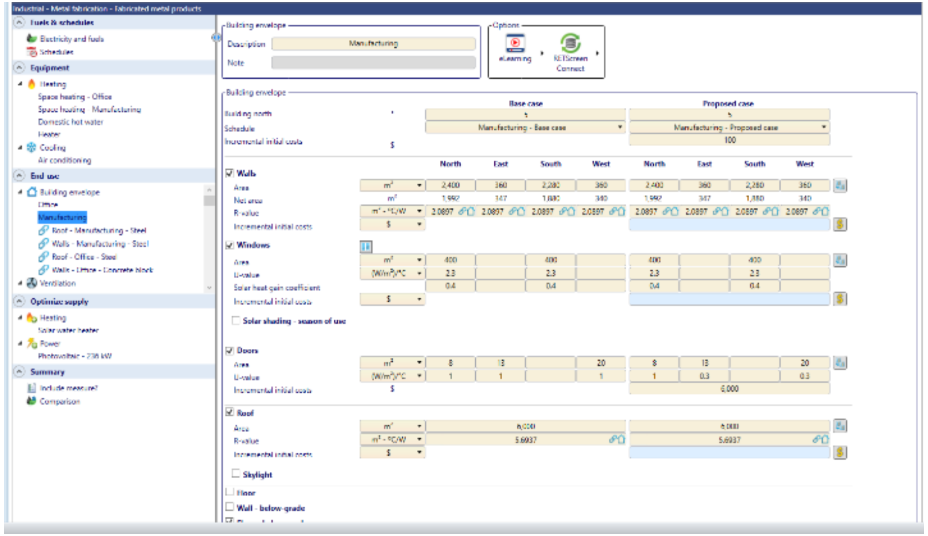
Use the same approach as for heating using cooling-degree days (CDDs) instead of HDDs:

- Result are for the sensible load only – excludes dehumidification
- Cold deck systems can be treated just like single zone systems
- If the latent load is to be included:
  - Either use the enthalpy equation, much more complex
  - Use a very high-level estimate replacing CV1 from 1.08 to 1.5 in IP units

Baselining heating/cooling load from building envelope

Complex calculations that are typically not done manually:

- One of the fastest method to obtain a high-level estimation is to use a computer-based tool, such as **RETScreen**
- Use collected envelope data to populate the tool



Reconciling Inventory to Measured Values

By establishing a baseline, you will:

- Reconciliation should be done for summer, winter and shoulder periods respectively.
- Reconciliation should be done for **energy (kWh)** and **peak demand (kW).**
- Adjust the least known parameter, almost always the estimated diversity for demand and operating periods (or full-load hours) for energy.

Common baselining errors and omissions

- Over or under-estimating the operational period of the equipment
- Not considering the load factor on the equipment
- Not considering the cyclic operation, or part-load operation, of an equipment
- Poor estimation of the amount of outside air or exhaust air from your facility
- Poor estimation of the diversity factors

Question:

What approach do you typically use in estimating your baseline consumption for HVAC?

*Answer in chat or raise hand and unmute

Outcome of step 2: establishing a baseline

By establishing a baseline, you will:

- Develop an understanding of the total energy consumption of the system across all mode of operation is developed.
- Uncover errors in savings estimates that become obvious when seen as an unreasonable percentage of total consumption.

An accurate baseline provides guardrails to keep savings estimates on track.

Understanding the savings mechanism

The third step in the framework is understanding the savings mechanism:

- Understand how changes to the system affect how equipment works and how those changes can lead to energy savings
- Ensure the estimated reflects how the equipment operated to avoid under-or over-estimation
- Verify that the estimated savings reflect reality

One of the biggest challenge in energy auditing is identifying the right measures applicable to various HVAC systems.

HVAC saving mechanisms

All HVAC measures produce savings through three main mechanisms:

1. Reducing the hours of operation
2. Reducing the loads on the systems
3. Improving the systems efficiencies

Many measures will utilize more than one of these mechanisms.

Reducing waste: biggest opportunities are the simplest

- Scheduling and optimal start
- Proper operation of dampers
- Bring in only as much outside air as is needed
- Unoccupied mode shutdown/restart mode
- Heat recovery control

Achieve best performance from existing systems

- Running pumps in parallel is rarely optimal, even with VFDs
- High efficiency chillers are often better at part load and should be run in parallel when possible
- Condensing boilers are often better at part load and should be run in parallel when possible
- Cooling towers with more than a single cell should be run in parallel when VFDs or two speed motors are used, not lead/lag
- VFDs always at 100% (or close to) are inefficiently utilized and the control sequence need to be revised
- Installing a Building Automation System for the HVAC

Optimizing supply is often more capital-intensive

- Exhaust air heat recovery – re-use heat from your ventilation system
- Destratification fans – re-use the heat from within your building
- Process heat recovery for space or water heating – re-use heat from your processes
- Replacement of chillers and boilers with higher efficiency equipment
- Hybrid Rooftop Units (gas/heat pump)
- Renewable Energy (e.g. ground-source)

Common errors in assumptions about savings

- Reducing outdoor air intake results in systematic savings
- Installing VFDs on motors will results in savings...only if there is a working control system actively modulating the VFDs or the systems were over-sized.
- Adding a BAS to the HVAC system will result in systematic savings.
- Speed modulation uses the affinity laws for most HVAC systems, motor savings are not proportional to speed modulation.

Outcome of step 3: understanding the savings mechanism

At the completion of Step 3, you will:

- Have established a list of potential energy and demand savings measures for your various HVAC systems.
- Have a good understanding of the impact of the measures both on energy and demand for your facility.

Establishing a list of measure is one of the more difficult step in the process and requires a rigorous approach to establish all the potential impacts of the measures.

Question

What savings mechanisms do the efficiency opportunities you identified make use of?

*Answer in chat or raise hand and unmute

Calculating savings

The fourth step in the framework is to calculate the savings:

This can include:

- Rules of thumb
- Engineering calculations
- Complex modelling

The baseline evaluation methods should typically be re-used as much as applicable!

Calculating motor savings

Use the equipment inventory:

- For scheduling change, only modify the hours (EFLH) of operation
- For changes impacting the motor load, typically installing a VFD, a change to the load factor is required. This change must consider the affinity laws:

$$Q_2 = Q_1\left(\frac{N_2}{N_1}\right),\ H_2 = H_1\left(\frac{N_2}{N_1}\right)^2,\ \text{and}\ P_2 = P_1\left(\frac{N_2}{N_1}\right)^3$$

N = Fan or Pump speed, typically in revolutions per minute
Q = Flow, typically in CFM, L/s, m^3/h or gpm
H = Head, typically in metres or feet water column for pumps and Pa or in w.g. for fans
P = Power in kW or BHP

- Therefore, a 10% reduction in speed will yield at 27% reduction in power!
- Applies to fans and pumps (centrifugal equipment)

Calculating ventilation heating and cooling savings

Use the baselining equation:

- Consider any change in flow as well as in schedule
- Use the equation provided to estimate the actual percentage of outside air, not just the damper setting
- Always consider any change in supply temperature set point
  - For single zone systems, use the space temperature set point as the supply temperature set point
  - The balance point for multizone system sometimes needs to be revised due to a change in outdoor air flow and supply temperature set point.

Destratification and envelope savings

For building envelope:

- Directly modify the insulation values (R-values)
- Change in set points, including night set-backs, are directly calculated

For destratification:

- Modify the set point for the zone where the roof is located but not for all the walls, often requires to define the roof separately
- To include exfiltration credit, same approach is needed, define the infiltration with the roof or separately so that the remaining Envelope components are not impacted by the change in temperature

Equipment sequencing and high efficiency equipment

For the space heating component, from the building envelope:

- Use the computer-based tool and modify the average yearly efficiency but be careful of overestimating the improvement.

For ventilation units:

- Use the baselining equation and replace the average yearly efficiency by the new estimate.
- For exhaust air heat recovery, multiply the resulting consumption by (1-Effectiveness), with the effectiveness being reduced by about 10% to go from nominal to yearly (high level estimate).

The 4-step framework adds structure and value

1. Assess available data
2. Establish a baseline
3. Understand the savings mechanisms
4. Calculate savings

A case study – food packaging plant

- Beverage packaging plant with hot-fill lines, aseptic filling lines, and fourteen other filling lines
- Over 500,000 ft^2 of total area
- 400,000 GJ/Yr of energy consumption
- 30 AHUs/RTUs all with local controls

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A case study – step 1: inventory (partial)

Service	Tag	Type*	Make	Model	Ventilation (CFM)	Fan (HP)	Cooling Capacity (Tons)	Heating Capacity (MBH)
Upper Offices	RTU-1	RTU	York	JXXZJN	40,000	40.0	90.0	32,00
Middle South	CU-1	CU	York	H3CE240	n/a	5.0	20.0	
Plant Sector A1	RTU-2	RTU	York	ZQG06	2,000	3.0	5.0	145
Plant Sector A3	RTU-3	RTU	York	ZF060	2,000	1.5	5.0	125
Plant Sector A2	RTU-4	RTU	York	ZXG14	5,000	7.5	12.5	250
Plant Sector B4	RTU-5	RTU	York	ZXG12	4,000	7.5	10.0	220
Plant Sector C1	RTU-6	RTU	York	ZF180	6,000	5.0	15.0	300
Plant Sector B2	RTU-7	RTU	York	ZF240	8,000	7.5	20.0	300
Plant Sector C3	RTU-8	RTU	York	ZE060	2,000	1.5	5.0	125
Production A	MUA-1	MUA	CaptiveAire	-	unknown	15.0	5.0	
Plant Office	CU-2	CU	York	CC7B48	n/a	1.0	4.0	
Storage A	CU-3	CU	Lennox	HS29-180	n/a	1.0	15.0	
Plant Sector B2	RTU-11	RTU	York	ZE048	1,600	1.5	4.0	175
Plant Sector B2	RTU-12	RTU	York	ZJ049	1,600	1.5	4.0	175

This was done mostly using a walk-through of the facility, collecting nameplate information.

A case study – from step 1 to step 2

Service	Tag	Type*	Make	Model	Ventilation (CFM)	Fan (HP)	Cooling Capacity (Tons)	Heating Capacity (MBH)
Upper Offices	RTU-1	RTU	York	JXXZJN	40,000	40.0	90.0	32,00
Middle South	CU-1	CU	York	H3CE240	n/a	5.0	20.0	
Plant Sector A1	RTU-2	RTU	York	ZQG06	2,000	3.0	5.0	145
Plant Sector B2	RTU-7	RTU	York	ZF240	8,000	7.5	20.0	300
Plant Sector C3	RTU-8	RTU	York	ZE060	2,000	1.5	5.0	125
Production A	MUA-1	MUA	CaptiveAire	-	unknown	15.0	5.0	
Plant Office	CU-2	CU	York	CC7B48	n/a	1.0	4.0	
Storage A	CU-3	CU	Lennox	HS29-180	n/a	1.0	15.0	
Storage B	CU-4	CU	Lennox	HS29-180	n/a	3.0	15.0	
Sector 27010	MUA-2	MUA	unknown	unknown	unknown	10.0	unknown	None
Plant Sector C2	RTU-9	RTU	Lennox	LCC300	10,000	5.0	25.0	
Plant Sector C2	RTU-10	RTU	Lennox	LCC300	10,000	5.0	25.0	
Plant Sector B2	RTU-11	RTU	York	ZE048	1,600	1.5	4.0	175
Plant Sector B2	RTU-12	RTU	York	ZJ049	1,600	1.5	4.0	175

Motor Energy = 40 hp * 0.746 (kW/hp) * 0.75 (Motor Load) * 8760 (h/Yr) = 196,000 kWh

Case study – step 2: baselining (partial)

Service	Tag	Electricity kWh
Upper Offices	RTU-1	196,000
Middle South	CU-1	24,500
Plant Sector A1	RTU-2	9,800
Plant Sector A3	RTU-3	14,700
Plant Sector A2	RTU-4	7,400
Plant Sector B4	RTU-5	36,800
Plant Sector C1	RTU-6	36,800
Plant Sector B2	RTU-7	24,500
Plant Sector C3	RTU-8	36,800
Production A	MUA-1	67,400
Plant Office	CU-2	4,900
Storage A	CU-3	4,900
Plant Sector B2	RTU-12	7,400

Use the same approach for all equipment unless sub-metering is available (none in this case).
Motor Energy = Motor hp * 0.746 (kW/hp) * Motor Load * Hours/Year = Total Yearly kWh

A case study – from step 3 to step 4

Facility was 24/5, not 24/7

- Reduce run-time by using a variety of methods: BAS, local controls or (least favorable) manual control
- Use the baselining equation with the reduced operation.

For RTU-1
Motor Energy = 40 hp * 0.746 (kW/hp) * 0.75 (Motor Load) * 6000 (h/Yr) = 134,200 kWh
Savings = 196,000 – 134,200 = 61,800 kWh
Savings would also apply to heating and cooling.

A case study – steps 3 & 4

IMPORTANT: Always use the marginal rate for energy and the separate demand rate!

		Estimated Utility Savings			Estimated Cost Savings			
Measure ID	**Description of measure**	**Electricity kWh**	**Gas m3**	**Demand kW**	**Electricity**	**Gas**	**Total**	**GHG Reduction (Tons/Yr)**
#2	Implement set back and scheduling of RTUs	187,000	180,000	0	$22,000	$64,000	$86,000	340
#3	Review VFD operation for RTUs	108,400	3,800	0	$13,000	$1,300	$14,300	10
#4	Review economizer operation and system modes	24,300	4,100	0	$2,900	$1,400	$4,300	8
#5	Control of the AHUs VFDs from the BAS	218,100	2,500	0	$26,000	$900	$26,900	11
#6	Modify pump control sequence to avoid parallel operation	92,000	0	20	$11,300	$0	$11,300	3
#7	Demand reset of the differential pressure set point for the secondary chilled water pumps	34,500	0	0	$4,100	$0	$4,100	1
#8	Centralized HVAC controls - RTUs, ERVs, Unit heaters	250,000	15,000	203	$33,000	$5,300	$38,300	35
#9	Heat pump rooftop units (hybrid)	-260,000	59,000	-344	-$36,500	$21,000	$-15,800	102
#12	Reduce boiler steam pressure	0	3,000	0	$0	$1,100	$1,100	6
#13	Steam trap maintenance	0	5,000	0	$0	$1,800	$1,800	9
#14	Process chiller heat recovery	-248,000	95,000	0	-$29,000	$33,000	$4,000	169

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SAVE ON ENERGY POWER WHAT'S NEXT

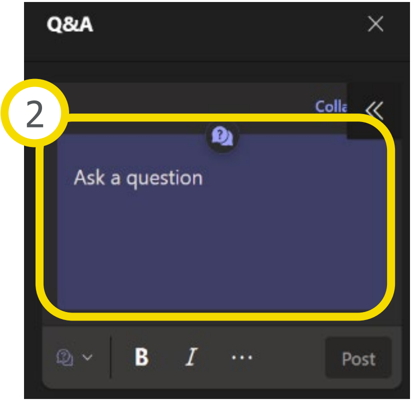
Conclusion

By employing the systematic approach provided by the 4-step framework, you can:

- Be confident that your savings estimates are grounded in reality.
- Avoid inaccurate estimates that put your reputation at risk and question the value of energy efficiency initiatives.

Q&A with Michel Parent

Use the Q&A function to type out your questions.



Feel free to turn on your camera to ask questions as well!

Free expert support available through Save on Energy!

Post your questions on the Energy Manager Learning Platform discussion forum to get advice, coaching, and support on identifying and implementing **industrial energy efficiency projects**

For more information:
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