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Efficient electrification workshop #4 – Part 2: Modelling HVAC with RETScreen Expert Hands-on Practice

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Agenda

- Welcome and introductions
- Overview of RETScreen Expert
- Outline of how to model an HVAC system
- Hands-on activities with up to five (5) cases.
- Wrap-up and Q and A

Quick overview of RETScreen Expert

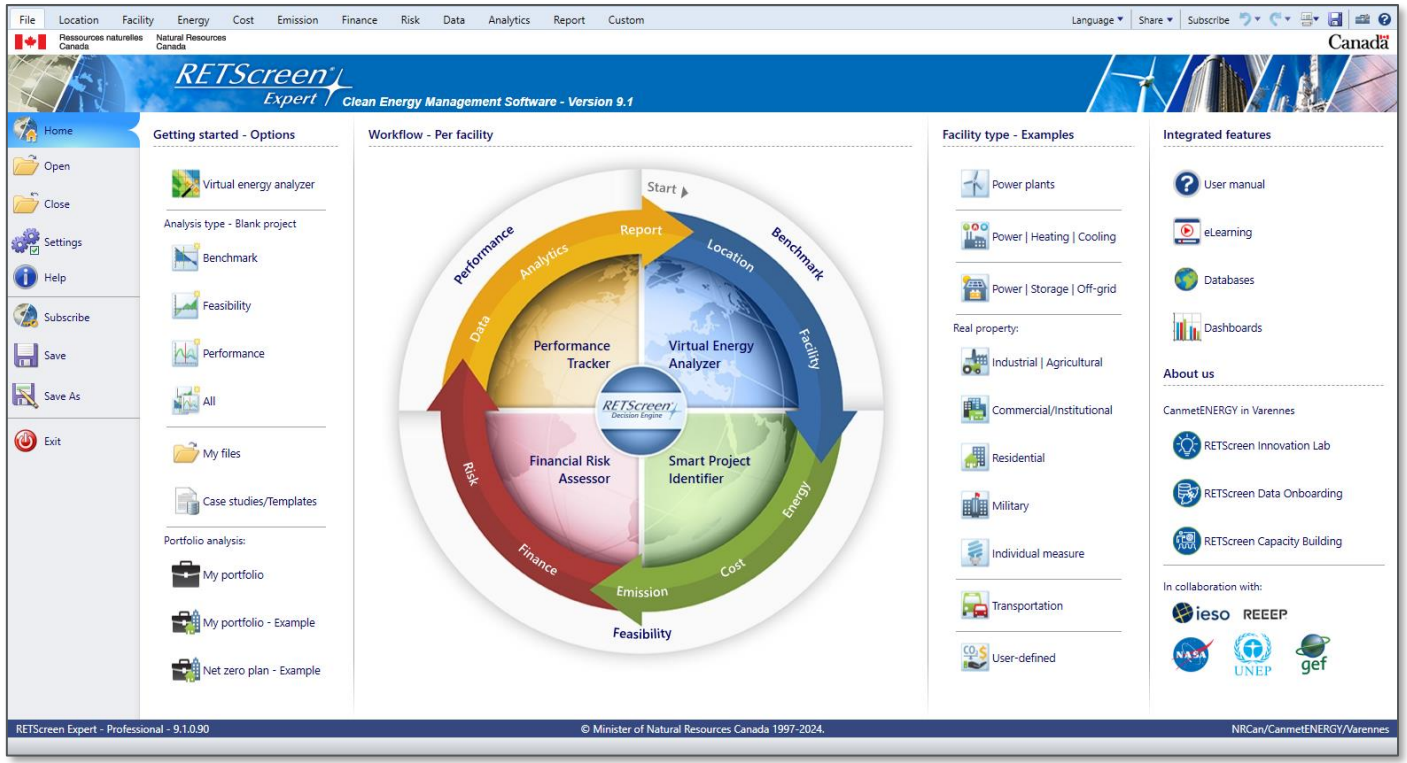
RETScreen Expert

- Intelligent decision support tool to enable stakeholders to rapidly identify, assess, optimize and track the performance of clean energy investments over the entire project life cycle
- 38 languages covering two thirds of the world's population

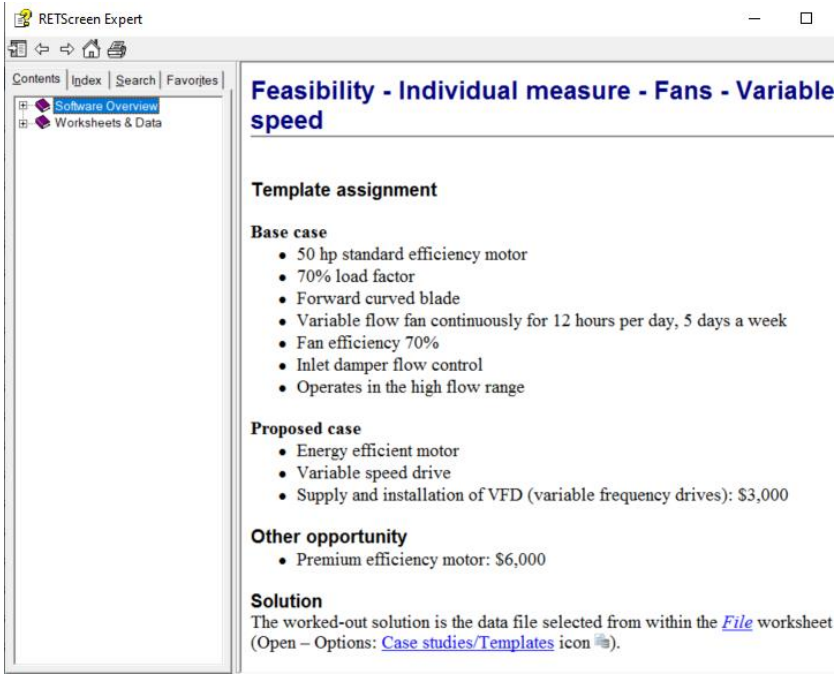
RETScreen development

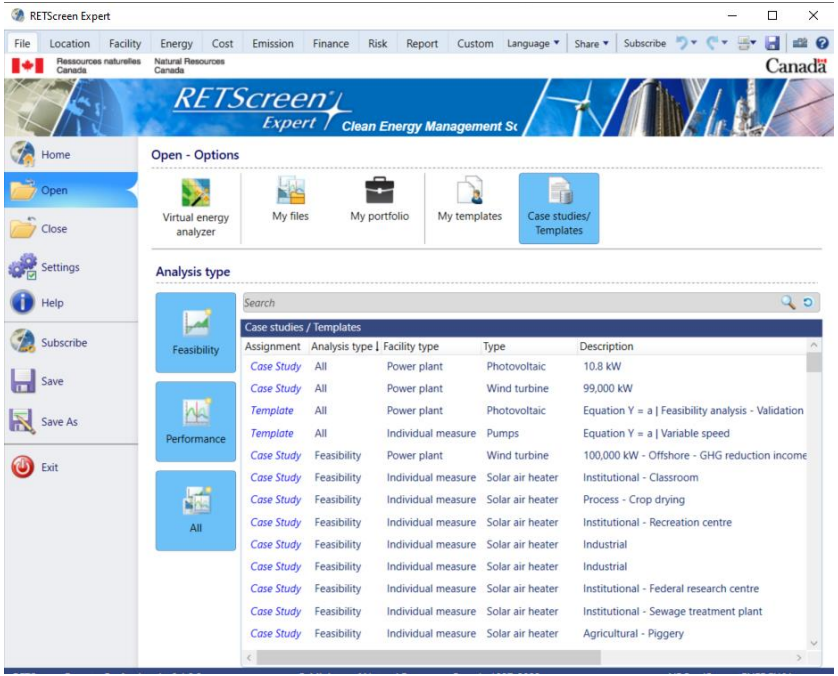
- Natural Resources Canada (CanmetENERGY)
- Renewable Energy and Energy Efficiency Partnership
- Independent Electricity System Operator
- United Nations Environment Programme
- National Aeronautics and Space Administration
- Global Environment Facility

The complete toolbox! Let's take a quick look

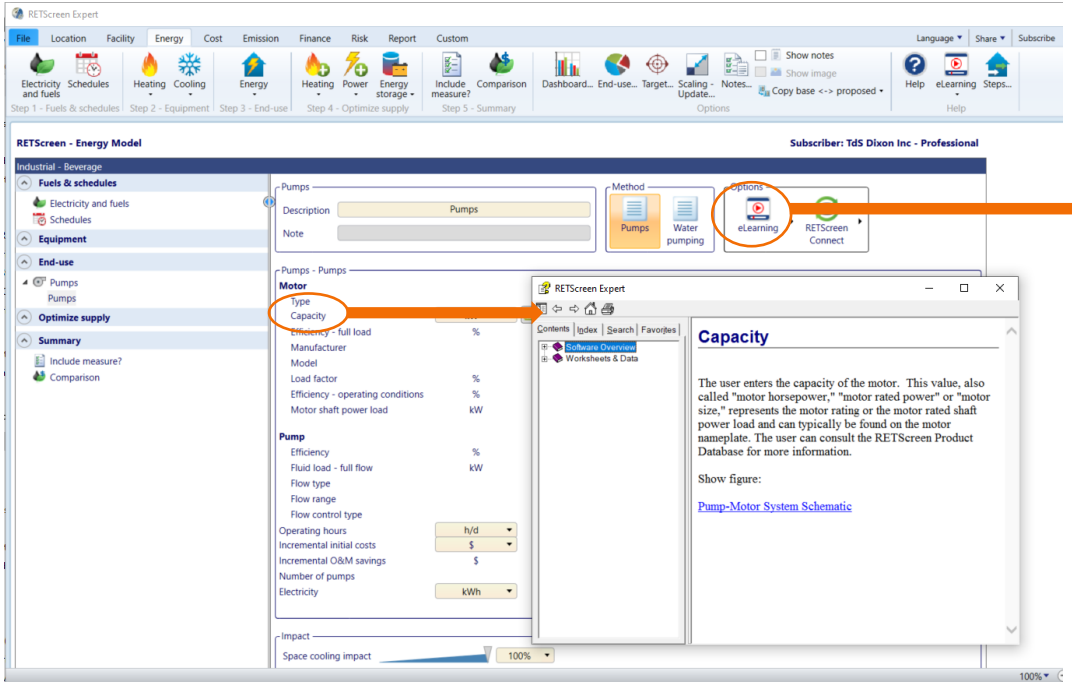


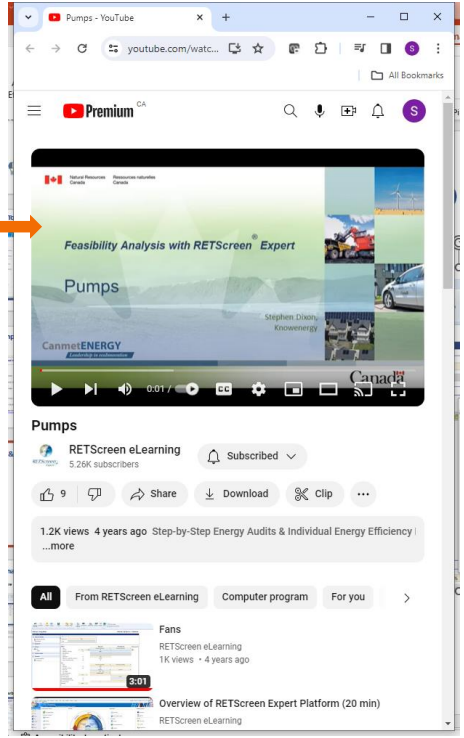
Learning resource – case studies and templates





Learning resource – contextual text and video help





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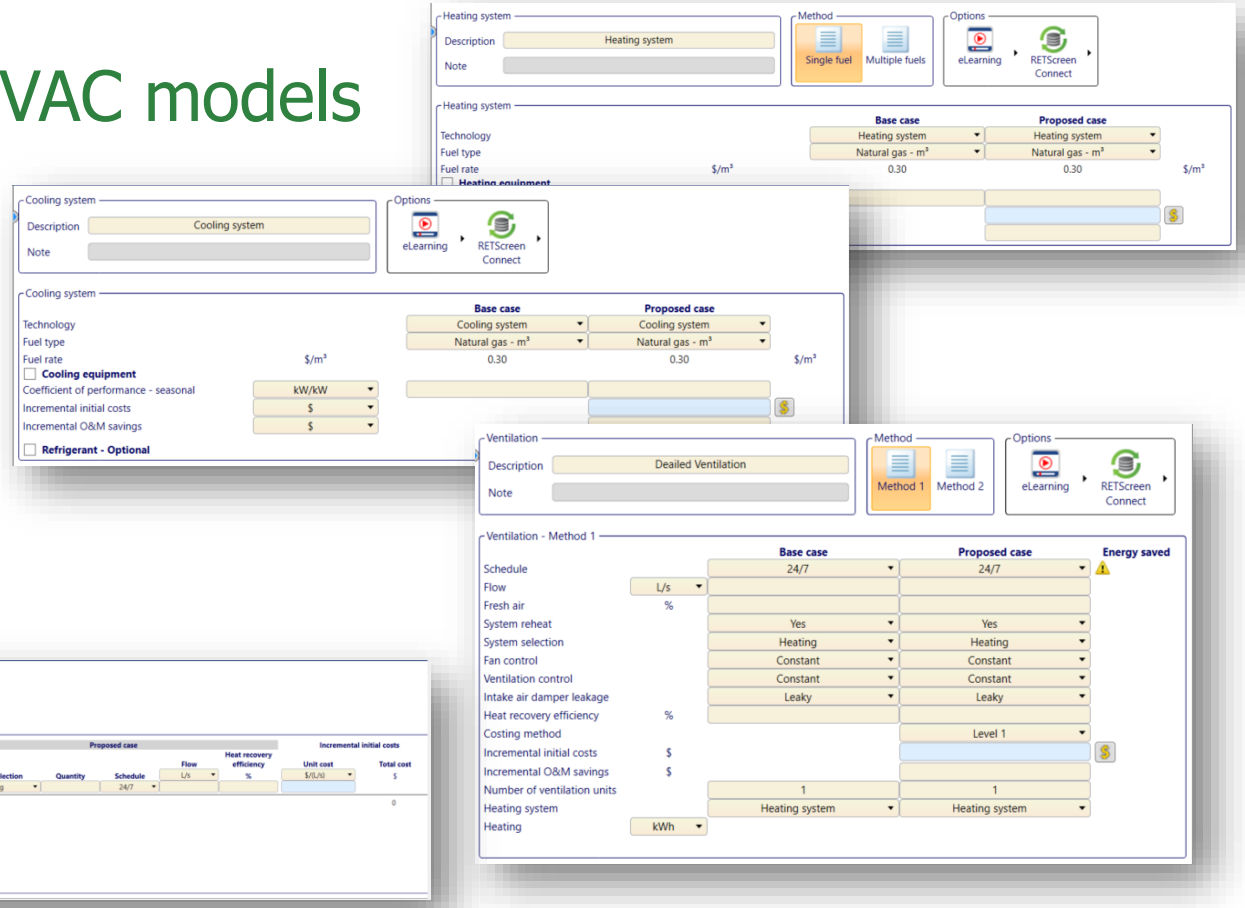
SAVE ON ENERGY POWER WHAT'S NEXT

Modelling a basic HVAC system

The RETScreen HVAC models

- Heating systems
- Cooling systems
- Ventilation models
  - Level 1: Detailed
  - Level 2: Simple



Demonstration – build the system

There is one rooftop unit providing space heating and cooling to the building:

- The heating equipment is a furnace with a seasonal efficiency of 80%
- The cooling equipment is a compressor unit with a seasonal COP of 3.0

Base Case – Office and Warehouse Ventilation (Method 1)

- Building is cooled to 21°C, on the same schedule as heating
- 5,000 cfm capacity rooftop unit provides ventilation, with heating and cooling as required
- Ventilation (fresh air) is 20% of system airflow
- The fan is driven by a 5hp motor (measured at 3.5 kW) (set heating and cooling impact to 0%)
- The ventilation system operates 24 hours 7 days a week (constant)
- Dampers have medium leakage
- The system does not have heat recovery

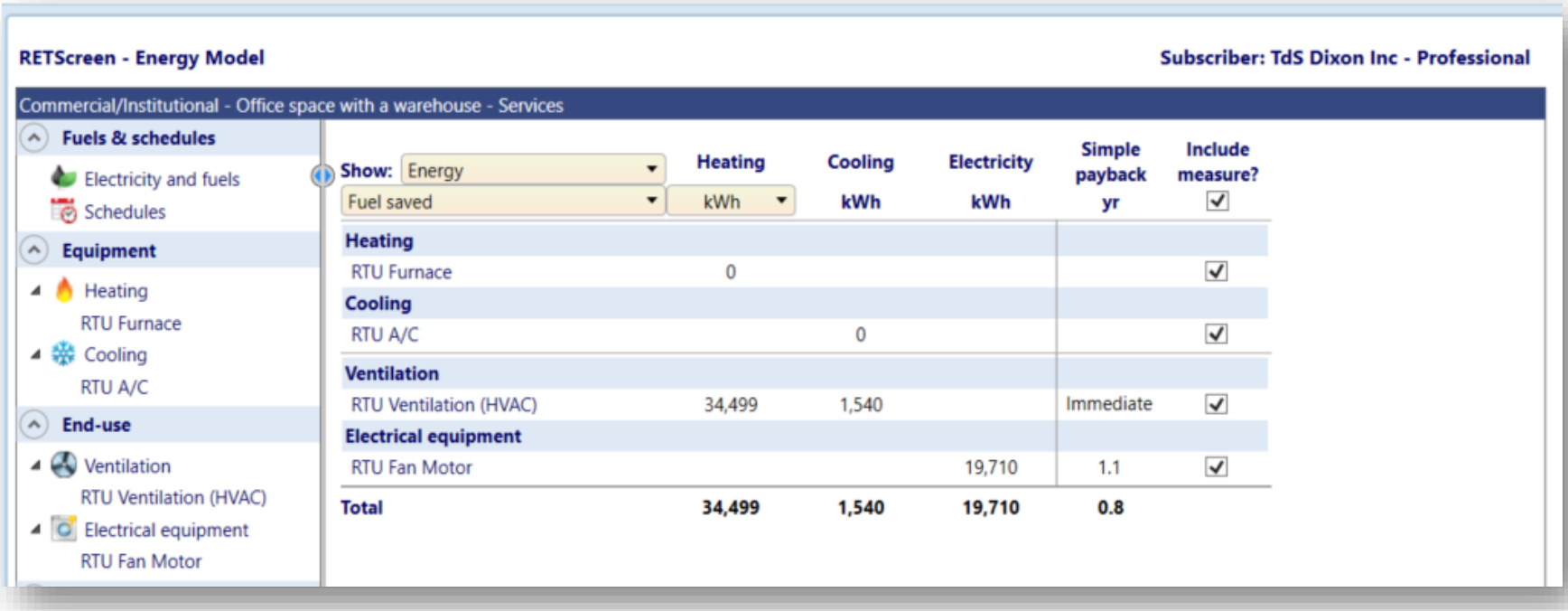
Now let’s improve the system

Proposed Case

- The building is only occupied 10 hours per day, 6 days per week
- Modify the fan and ventilation control to operate according to the occupancy schedule
  - You will need to add a schedule in the model
- Implement a nighttime setback and set up of 4°C during unoccupied periods
- Cost of controls to implement fan, ventilation, and temperature control is $3,000

Hint: You need to define a new Schedule, Heating equipment, Cooling equipment, two Ventilation equipment sheets and a Fan motor sheet (under Electrical equipment)

Results of model



RETScreen - Energy Model — **Subscriber: TdS Dixon Inc - Professional**

Commercial/Institutional - Office space with a warehouse - Services

Fuels & schedules
- Electricity and fuels
- Schedules

Equipment
- Heating
  - RTU Furnace
- Cooling
  - RTU A/C

End-use
- Ventilation
  - RTU Ventilation (HVAC)
- Electrical equipment
  - RTU Fan Motor

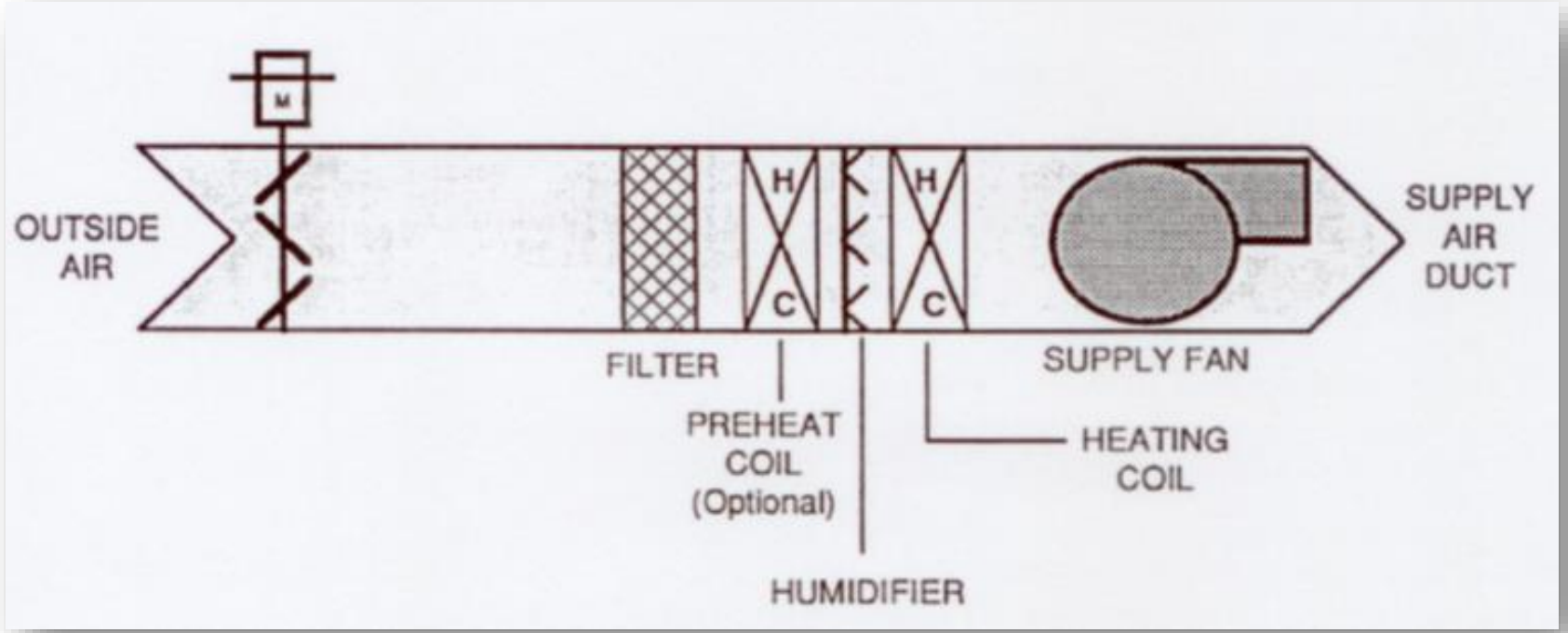
Show: Energy — Fuel saved

	Heating	Cooling	Electricity	Simple payback	Include measure?
	kWh	kWh	kWh	yr	☑
Heating					
RTU Furnace	0				☑
Cooling					
RTU A/C		0			☑
Ventilation					
RTU Ventilation (HVAC)	34,499	1,540		Immediate	☑
Electrical equipment					
RTU Fan Motor			19,710	1.1	☑
Total	**34,499**	**1,540**	**19,710**	**0.8**	

Circumstance/scenario 1

Case study situation

- Make-up air (MUA) system



Services provided

- Ventilation only!
- MUA will pre-condition the outdoor air but does not provide space heating, cooling, humidification and filtration
  - The presence of filters, heating and cooling coils and a humidifier does not mean it is used for space air conditioning
  - It is a **cold-deck** system

Cold-deck system: A cold-deck system refers to a design whereby air is distributed to various zones or areas within a building at a temperature at or below a space temperature set point. Cold deck systems are often contrasted with hot-deck systems whereby air is heated and then distributed.

1. Make-up air (MUA) system

Overall

- Location is in Canada, Climate data location is Toronto, ON
- Marginal gas price of $\$0.45/m^3$
- Marginal electricity price of $0.12/kWh

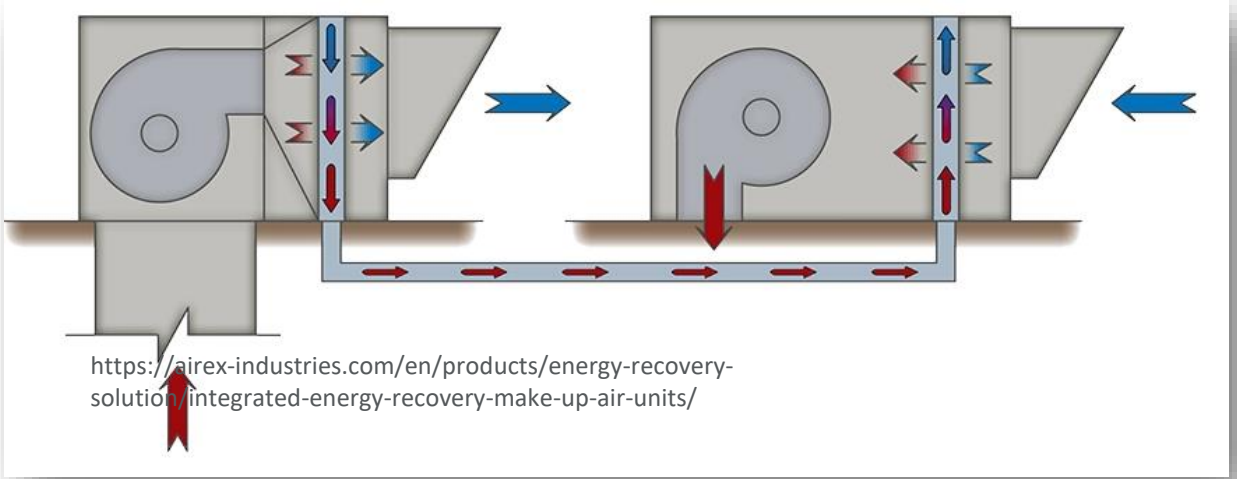
Base case conditions

- MUA providing outside air to perimeter fan-coils in an office building
- 22°C space temperature (during heating and cooling seasons)
- Hours of operation: 16 h/day, Monday to Friday
- Supply: 5,000 cfm, Supply fan motor: 5 brake horsepower
- Exhaust: 5,000 cfm, Exhaust fan motor: 3 brake horsepower
- Estimated motor efficiency: 92%
- Gas-fired heating section, nominal efficiency: 80%
- Gas heating controlled by a duct sensor, typical set point of 18 °C
- No cooling section

Now let’s improve the system

Proposed case conditions

- Install a heat recovery system at 0.5 effectiveness, additional motor load of 20%
- Installed cost: $30,000

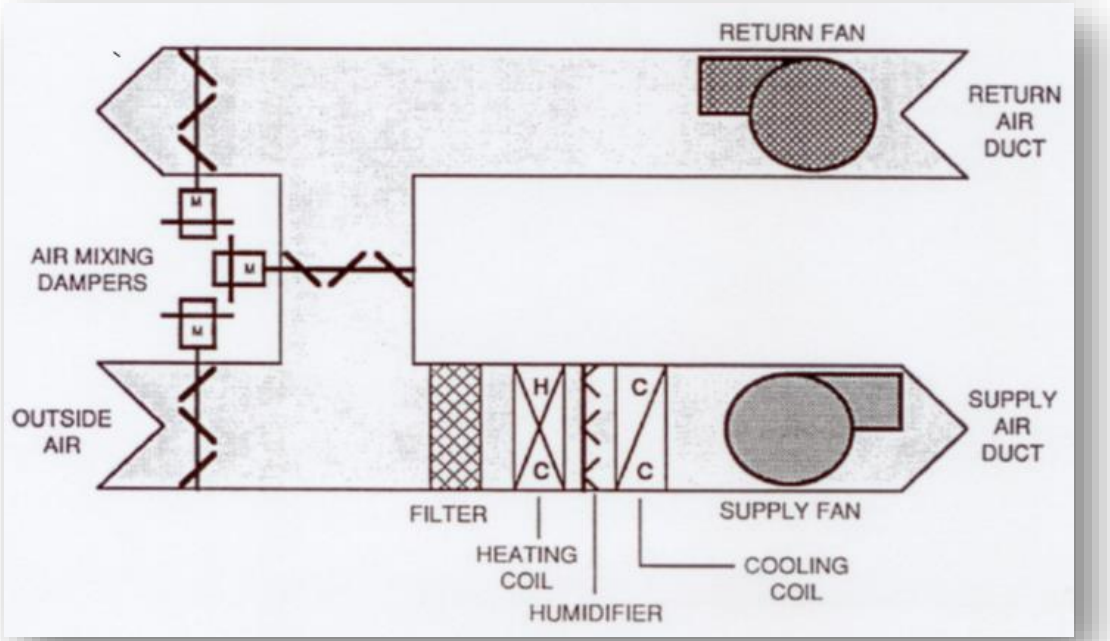


https://airex-industries.com/en/products/energy-recovery-solution/integrated-energy-recovery-make-up-air-units/

Circumstance/scenario 2

Case study situation

- Constant volume system – single zone



Services provided

- This system can provide all 5 services
- It is typically controlled by a space thermostat
  - It is a **switch-over** being cold-deck when there is a cooling call and hot-deck when there is a heating call
- This system is the basis for the ventilation element in RETScreen

2. Constant volume system – single zone

Overall

- Location is in Canada, Climate data location is Guelph, ON
- Marginal gas price of $\$0.45/m^3$
- Marginal electricity price of $0.12/kWh

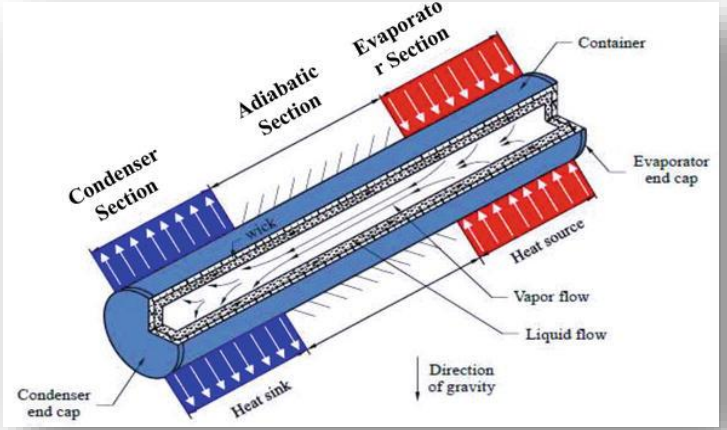
Base case conditions

- 22°C space temperature (during heating and cooling seasons)
- Hours of operation: 24h/day
- Heating/cooling changeover temperature is 16°C
- Supply: 10,000 cfm, Supply fan motor: 5 hp
- Minimum outside air: 15%
- Separate exhaust: 1,000 cfm, Exhaust fan motor: 1 hp
- No return fan
- Unit has hydronic heating and DX cooling with a gas efficiency of 75% annual and a cooling COP of 3.5 nominal
- Dampers are in adequate condition

Now let’s improve the system

Proposed case conditions

- Install a heat recovery system at 0.6 effectiveness, additional motor load of 25%
- Note that no change is made to the existing separate exhaust
- Installed cost: $15,000

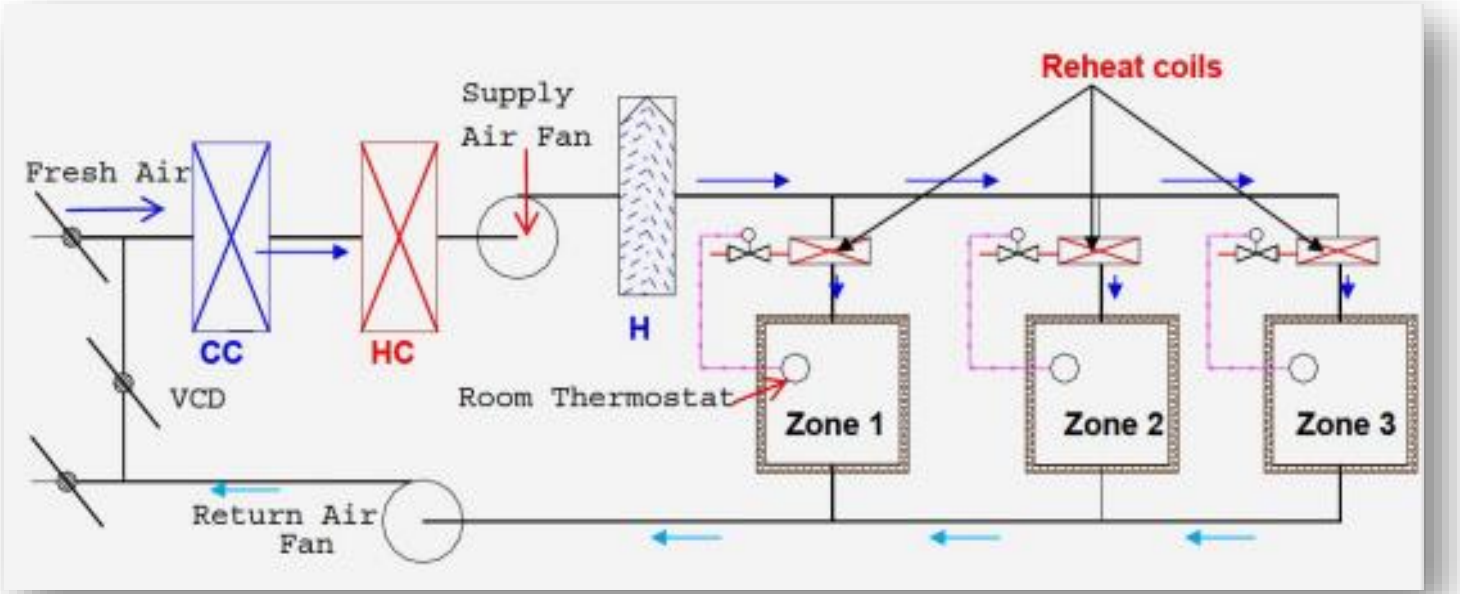


https://www.intechopen.com/chapters/76428

Circumstance/scenario 3

Case study situation

- Constant volume system with reheat



https://www.ijirset.com/upload/2016/april/242_68_Basic.pdf

Services provided

- This system provides 4 of the 5 services
  - It is not typically used for space heating
- It is typically controlled by a supply duct temperature sensor
  - It is a cold-deck system
- Reheat coils are typically not used as the primary source of space heating (excluding fan-powered boxes)

3. Constant volume system with reheat

Base case conditions

- 22°C space temperature (during heating and cooling seasons)
- Hours of operation: 14h/day, Monday to Friday
- Heating/cooling changeover temperature is 16°C
- Supply: 15,000 cfm, Supply fan motor: 15 brake horsepower
- Return fan motor is 5 brake horsepower
- Estimated motor efficiency: 94%
- Minimum outside air: 15%
- Hydronic heating, boiler nominal efficiency of 80%
- Chilled water cooling, plant annual COP of 4.5
- New low-leakage dampers
- Supply set point for the air of 15 °C in the winter
- 20% of distribution has active reheat coils, boilers are off 5 months/year

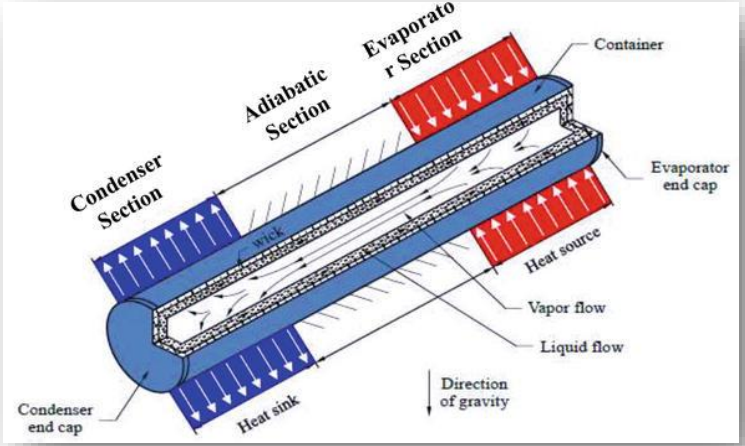
Overall

- Location is in Canada, Climate data location is Ottawa, ON
- Marginal gas price of $\$0.45/m^3$
- Marginal electricity price of $0.12/kWh

Now let’s improve the system

Proposed case conditions

- Install a heat recovery system at 0.6 effectiveness, additional motor load of 25%
- Installed cost: $21,000



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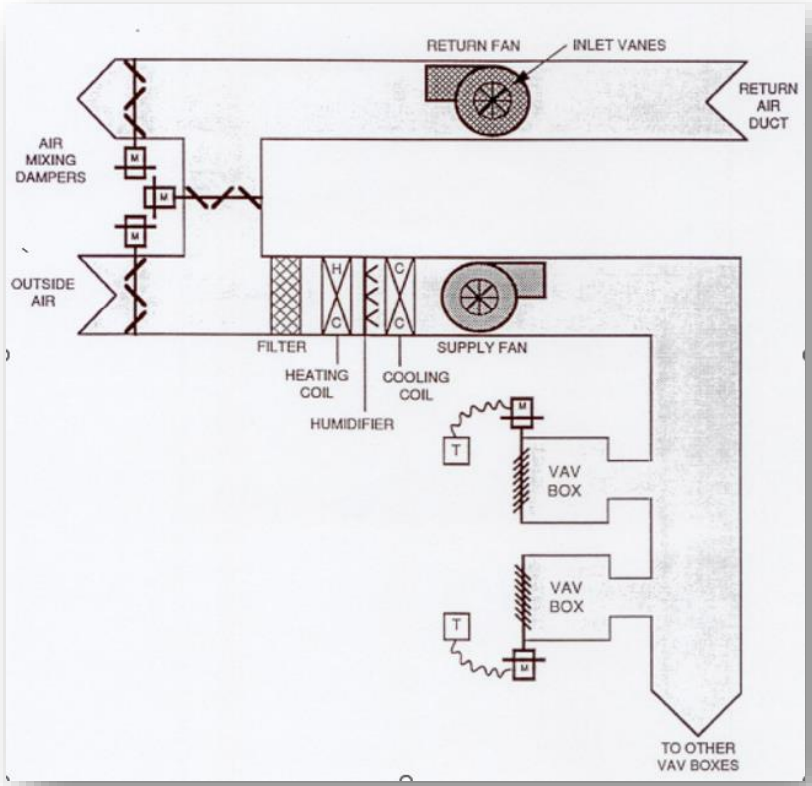
Circumstance/scenario 4

Case study situation

- Variable air volume (VAV) systems



Services provided

- This system provides 4 of the 5 services
  - It is not typically used for space heating
- It is typically controlled by a supply duct temperature sensor
  - It is a cold-deck system
- Reheat coils can be used but are not the primary source of space heating (excluding fan-powered boxes)

4. Variable air volume (VAV) system

Base case conditions

- 22°C space temperature (during heating and cooling seasons)
- Hours of operation: 14h/day, Monday to Friday
- Heating/cooling changeover temperature is 16°C
- Supply: 15,000 cfm, Supply fan motor: 20 brake horsepower
- Return fan motor is 5 brake horsepower
- Estimated motor efficiency: 94%
- Minimum outside air: 15%
- Hydronic heating, boiler nominal efficiency of 80%, chilled water cooling, plant annual COP of 4.5
- Poor quality dampers
- Supply set point for the air of 15 °C in the winter
- VFDs on supply and return fans, average speed of 80% over the year
- 20% of distribution has active reheat coils, boilers are off 5 months/year

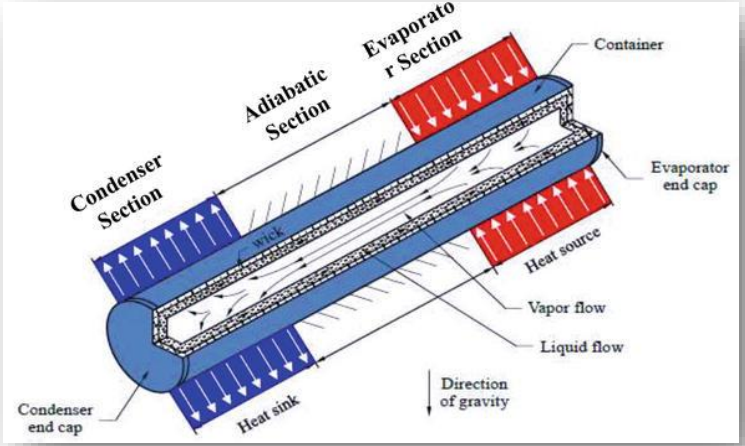
Overall

- Location is in Canada, Climate data location is Ottawa, ON
- Marginal gas price of $\$0.45/m^3$
- Marginal electricity price of $0.12/kWh

Now let’s improve the system

Proposed case conditions

- Install a heat recovery system at 0.6 effectiveness, additional motor load of 25%
- Installed cost: $21,000



https://www.intechopen.com/chapters/76428

Circumstance/scenario 5 - Optional Content

Case study situation

- Washroom, kitchen, process or general exhaust

5. Kitchen Demand Controlled Ventilation

Base case conditions

- Heating/cooling changeover temperature is 16°C
- Building heating temperature of 20°C and cooling of 21°C
- Exhaust: 10,000 CFM
- Exhaust fan motor is 5 horsepower

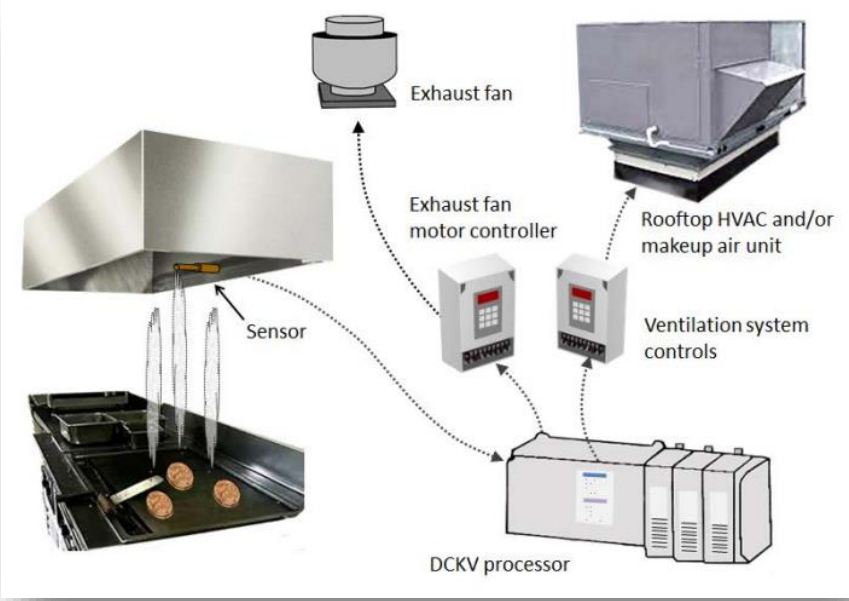
Overall

- Location is in Mississauga Canada, Climate data location is YYZ - Toronto International Airport
- Marginal gas price of $\$0.45/m^3$
- Marginal electricity price of $0.12/kWh

Now let’s improve the system

Proposed case conditions

- A two-speed fan motor and controls are installed to deliver:
  - Low speed, 2,500 cfm operation for 12 hours/day
  - Full speed 10,000 cfm operation for 6 hours/day
  - Shut down for 6 hours/day
- Installed cost: $8,000



https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Guidance-on-Demand-Controlled-Kitchen-Ventilation.pdf

Q and A period

Efficient Electrification Toolkit and Helpdesk

The webinar materials will be shared with you by email.

The webinar recording can be accessed at SaveonEnergy.ca/Training-and-Support. Select your sector and then "Efficient Electrification".

For questions and technical support regarding the Efficient Electrification Toolkit, including RETScreen, contact trainingandsupport@ieso.ca.

Please use "EE toolkit helpdesk" as your email subject line. Requests will be triaged and addressed in the order they are received.

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