NOVEMBER 15, 2022

Save on Energy Workshop: Efficient Building Electrification for Municipalities

Presented by the Save on Energy Team

ieso Connecting Today. Powering Tomorrow.

SAVE ON ENERGY POWER WHAT'S NEXT

Agenda

1. Introduction
2. Electrification in the Ontario municipal sector
3. The Efficient Electrification Toolkit
   - Building Electrification Interactive Fact Sheet
   - Building Electrification RETScreen Tools
4. What's next?

About the IESO

Reliably operate Ontario's Province-wide system 24/7

Plan for Ontario's future energy needs

Enable competition and create efficient electricity markets

Enable province-wide energy efficiency

Purposefully engage to enable informed decisions

Support innovation

Cybersecurity leadership

Smart Metering Entity

New Program Launches in 2023

The IESO also continues to develop new programs in response to customer feedback. The following programs will be launched in 2023:

- Strategic Energy Management program, an evolution of the Energy Manager program that provides training, resources and enhanced technical support to companies with a dedicated energy management team.
- Existing Building Commissioning program, to help companies find opportunities to optimize operations and improve energy efficiency based on their current facility requirements.
- Commercial Midstream Lighting program with lighting incentives for lighting distributors to increase sales of energy-efficient lighting through point-of-sale discounts
- Additional local initiatives in targeted areas of the province where electricity constraints exist.

2021 Energy Manager Awards

Come celebrate with the Energy Manager community!
Thursday, November 24
8:30 a.m. to noon
International Centre, Mississauga

- In-person networking with your peers
- Interactive panel discussion with award winners on their key success factors
- Free to attend; continental breakfast provided

For more information, please email admin@energymanagerprogram.ca

Register now ➔
Space is limited!

2020 Award Winners

ieso Connecting Today. Powering Tomorrow.

SAVE ON ENERGY POWER WHAT'S NEXT

Electrification Overview

Combustion Heating

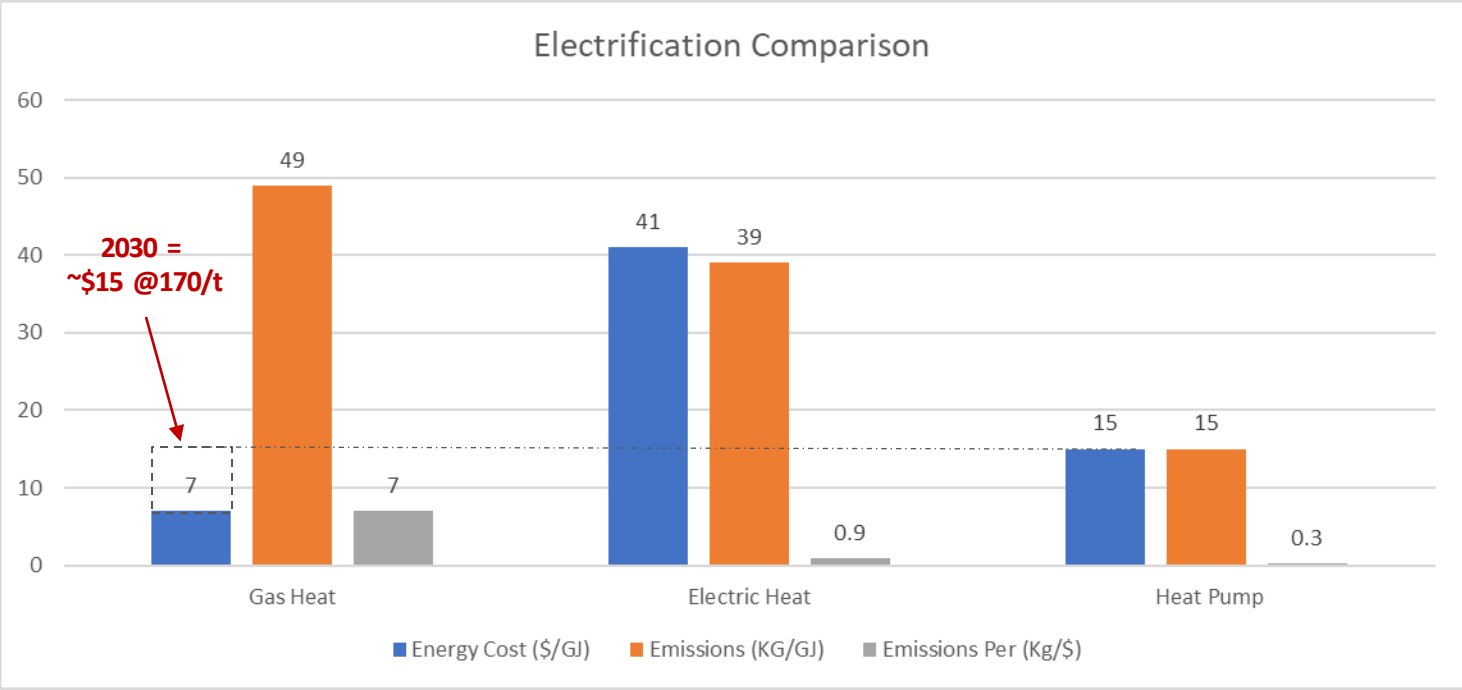
Resistance Heating

Heat Pump Heating/Cooling

All values approximate

Efficiency	80% – 98%	Close to 100%	2.5 - 4.0 Coefficient of Performance (COP)
Energy Cost	$0.27/m3	$0.15/kWh	$10GJ - $20/GJ
Emissions	1900 gCO2e/m3	134 gCO2e/kWh	10 – 20 kg CO2e/GJ

Electrification Cost and Carbon Overview



Energy Efficiency Is the First Fuel

Your energy-efficiency game has to be on point!

1. Reduce load
2. Match load
3. Reuse energy
4. Generate/ Switch fuel

Size your new heat pump only after 1,2,3 are done!

Electrification must be an extension of the EE continuum

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SAVE ON ENERGY POWER WHAT'S NEXT

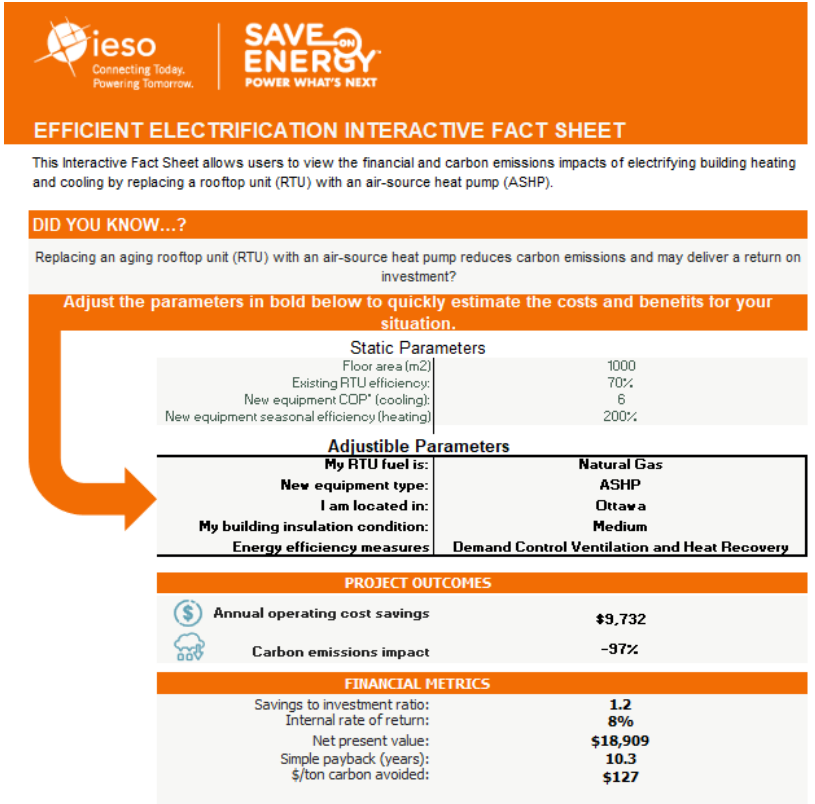
Electrification in Ontario Municipalities: Your Feedback

Based on 2021 workshops and interviews:

- Climate targets are a near-term priority
- Many projects are already underway
- Replacement of gas RTU with ASHP is the most common retrofit measure
- Cost of abated carbon a key screening metric
- Electrical service constraints a common challenge
- Lack of tools for early-stage project analysis

What's in the Toolkit?

- **Interactive Fact Sheet MS Excel tool**
- RETScreen Expert whole building model templates using building archtypes from the RETScreen Expert Virtual Energy Analyzer:
  - Small Office (600m^2)
  - Laboratory (2250m^2)
  - Fire Station (600 m^2)
- RETScreen Expert Heating/Cooling model templates – created based upon the archetypical buildings with conversion from natural gas to ASHPs:
  - Small Office (600m^2)
  - Laboratory (2250m^2)
  - Fire Station (600 m^2)
- Overview & Guidance



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EFFICIENT ELECTRIFICATION INTERACTIVE FACT SHEET

This Interactive Fact Sheet allows users to view the financial and carbon emissions impacts of electrifying building heating and cooling by replacing a rooftop unit (RTU) with an air-source heat pump (ASHP).

DID YOU KNOW...?

Replacing an aging rooftop unit (RTU) with an air-source heat pump reduces carbon emissions and may deliver a return on investment?

Adjust the parameters in bold below to quickly estimate the costs and benefits for your situation.

Static Parameters

Floor area (m2)	1000
Existing RTU efficiency:	70%
New equipment COP* (cooling):	6
New equipment seasonal efficiency (heating)	200%

Adjustible Parameters

My RTU fuel is:	**Natural Gas**
New equipment type:	**ASHP**
I am located in:	**Ottawa**
My building insulation condition:	**Medium**
Energy efficiency measures	**Demand Control Ventilation and Heat Recovery**

PROJECT OUTCOMES

Annual operating cost savings	$9,732
Carbon emissions impact	-97%

FINANCIAL METRICS

Savings to investment ratio:	1.2
Internal rate of return:	8%
Net present value:	$18,909
Simple payback (years):	10.3
$/ton carbon avoided:	$127

Efficient Electrification Interactive Fact Sheet

Efficient Electrification RETScreen Expert Tools

Using RETScreen Expert for Natural Gas Heating to Electric ASHP Conversion Analysis – A Toolkit

Overview & Guidance

Toolkit Approach

- This toolkit is built upon the feasibility models of the RETScreen Expert analysis software and thereby relies upon the user to possessing RETScreen navigation and feasibility modelling skills.
- Guidance is provided for two situations:
  1. Whole facility where historical data is available for electricity and natural gas with a heating/cooling consumption breakdown by end-use and an estimate of efficiency improvement measures.
  2. For a partial facility or whole facility where historical data is not available for electricity and natural gas but there is no breakdown by end-use for heating/cooling or efficiency measures. In this case we present a building (energy) model to represent a base case buildings fuel consumption, a breakdown by end use and efficiency measures to represent a proposed case.
- For both cases, a heating/cooling (load) model to analyze the conversion of the building with efficiency measures heated with gas to a building heated with an ASHP.
  - Building archetypes, from the Virtual Energy Analyzer, for three building types, are used to represent an existing building and as a source of data to populate and calibrate a Power/Heating/Cooling model.
- The Power/Heating/Cooling model is then used to size a heat pump systems and determine energy cost and carbon reductions thereby facilitating an informed decision to convert to air source heat pumps (ASHPs).

What's in the Toolkit?

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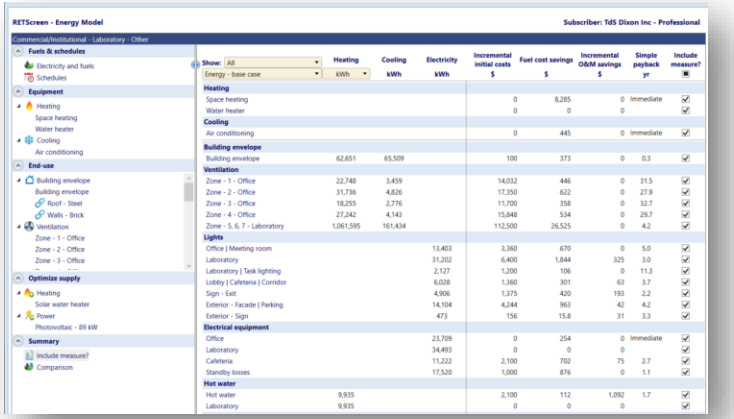
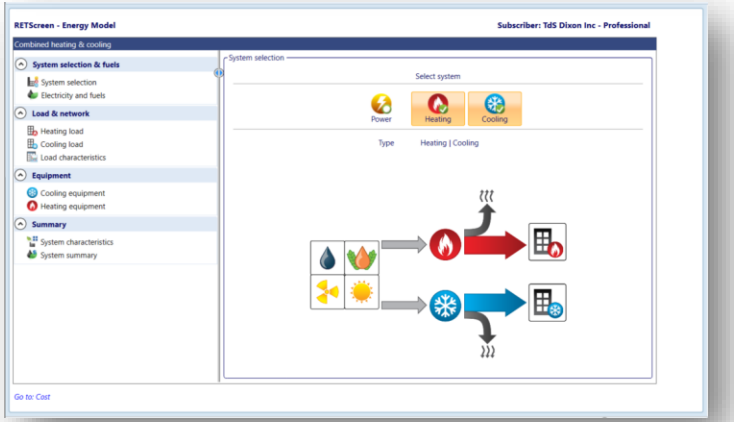
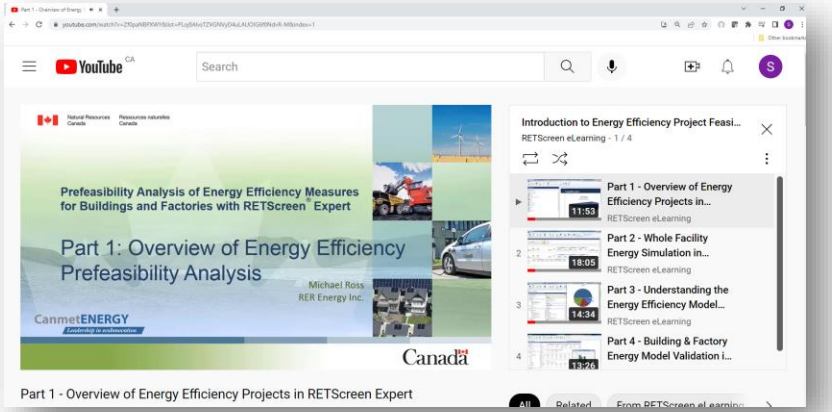
  - Fire Station (600 m²)
- Overview & Guidance
- RETScreen Expert Help
  - https://www.youtube.com/channel/UCyFMjG_OXXGtRVnsiTim0IQ





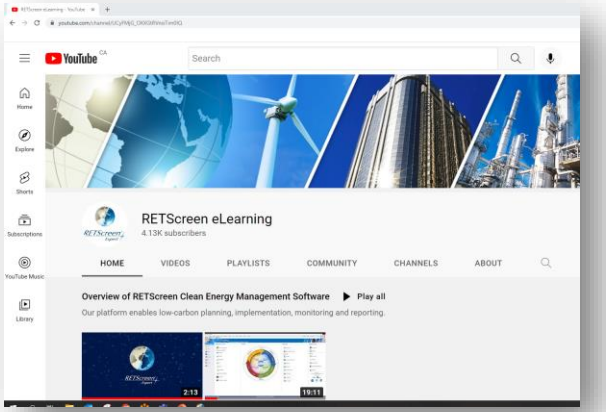
HELP With RETSCreen Use and Navigation

Creating RETScreen Expert Whole Building Modelling



https://www.youtube.com/watch?v=Zf0paNBPXWY&list=PLoj8AlvsTZVGNVyD4uLAUOIG6f0NdvR-M

RETScreen Expert eLearning Channel



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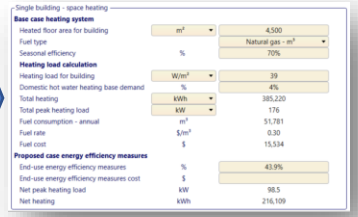
Two Paths

1. Whole Facility (with historical gas & electricity data)

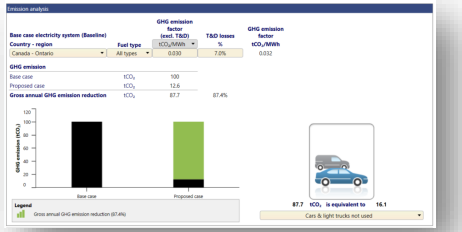
Basic Site Data
(an energy audit could be source)

Historical Data
Floor Area
Heat/Cool Load (W/m²)
Heat/Cool Efficiency

RETScreen Export Heat/Cool/Power Model



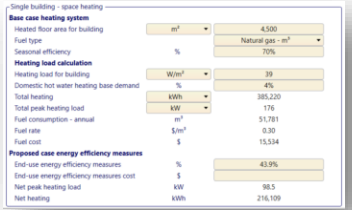
Carbon & Financial Case



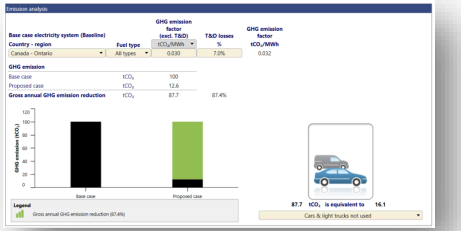
2. Partial Facility (or whole facility with no historical data)

RETScreen (Whole/Partial) Building Model

RETScreen Export Heat/Cool/Power Model



Carbon & Financial Case

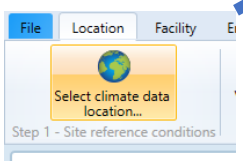


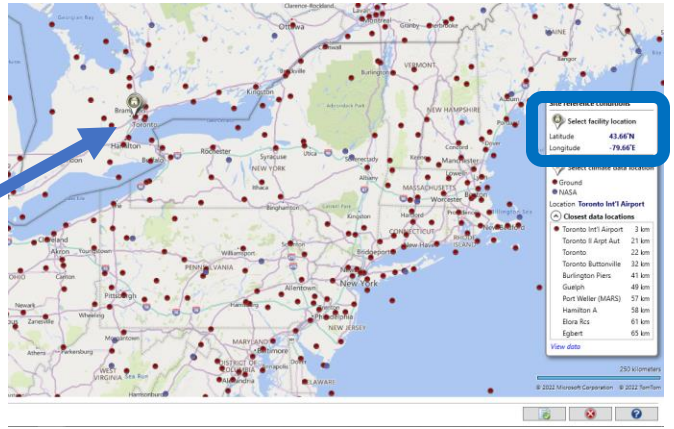
Method 1: Whole Facility

From historical data possibly supported by an energy audit providing an end-use breakdown and efficiency measures.

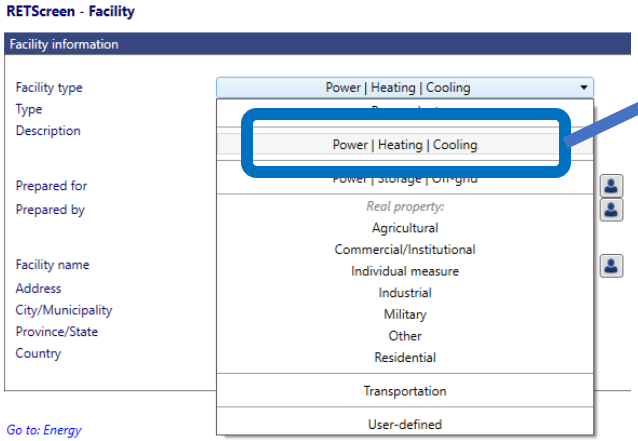
Accessing RETScreen Power/Heating Cooling Model and Setting Location

- Open Retscreen Expert and Navigate to the Location tab across the top bar
- Default location for template files are in Toronto, if a different location is required click 'select climate data location…' button and select building location





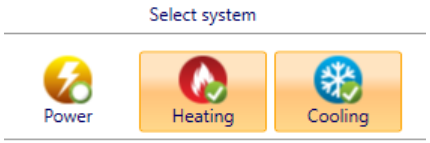
- Note: if location is energy rates and fuels select may need to be changed to match building location
- To setup Retscreen's power/heating/ cooling model, navigate to the Facility page and under 'facility type' select 'Power/ Heating/ Cooling' and proceed to Energy tab to begin analysis



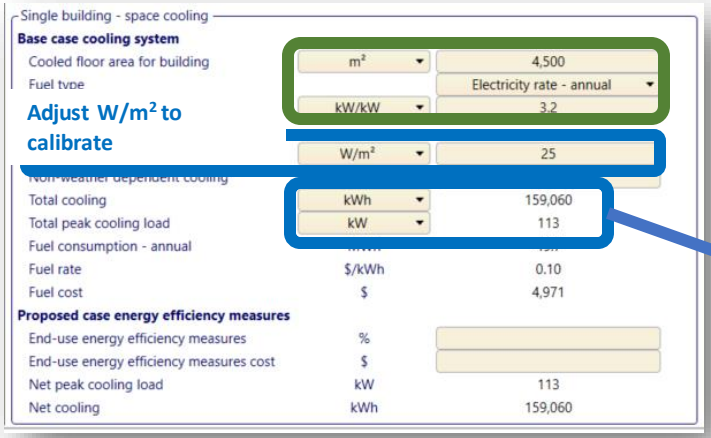
Next step

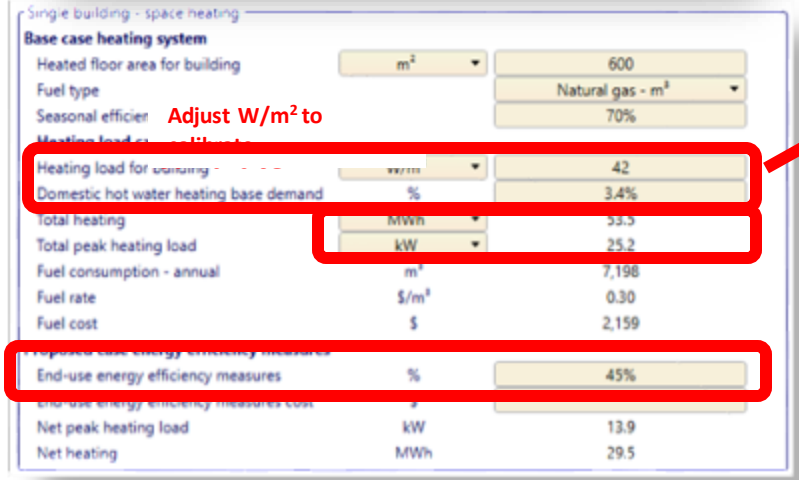
Calibrate Power Model

- Select Heating and Cooling for 'system selection' (not power) and set fuel rates
- Navigate to 'Load & network' section and proceed to populate building data



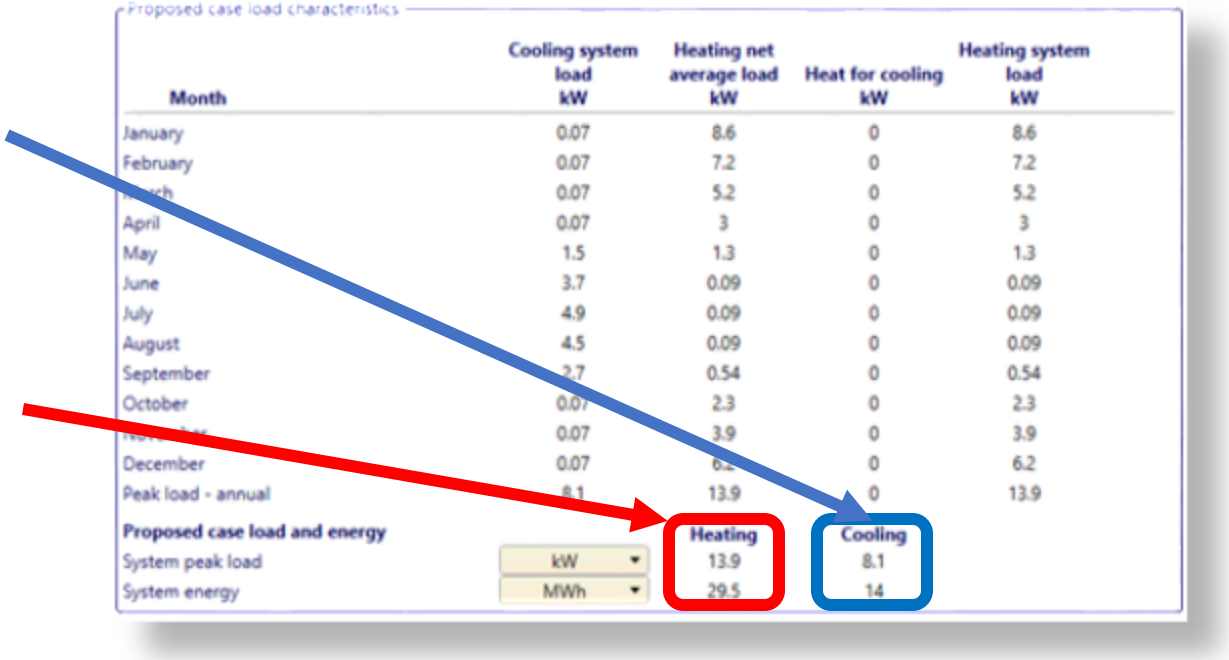
- Populate the base case system with correct floor area and equipment efficiency (green box)
- Calibrate the heating and cooling models to the heating and cooling values calculated from historical data – for example from an existing energy audit. (use help section for guidance based on design temperature on location tab)
- Determine % hot water usage for heating and non weather cooling load % based historical consumption and demand data. (see excel template)
- Populate 'end-use energy efficiency measures' based on projects in the building if necessary





Next step

Calibration continued…



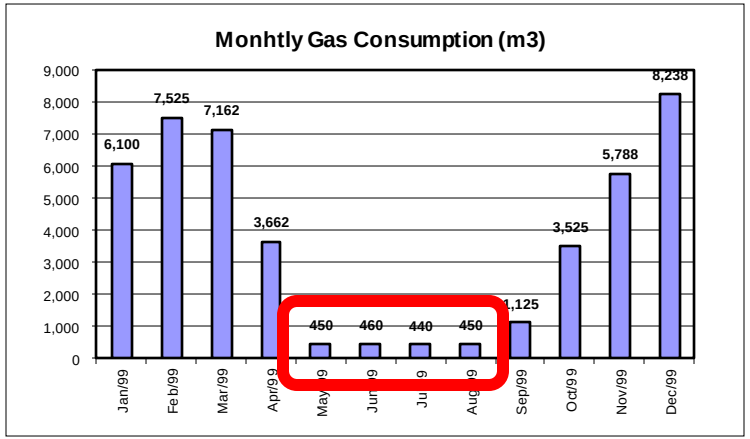
Proposed case load characteristics

Month	Cooling system load kW	Heating net average load kW	Heat for cooling kW	Heating system load kW
January	0.07	8.6	0	8.6
February	0.07	7.2	0	7.2
[illegible]ch	0.07	5.2	0	5.2
April	0.07	3	0	3
May	1.5	1.3	0	1.3
June	3.7	0.09	0	0.09
July	4.9	0.09	0	0.09
August	4.5	0.09	0	0.09
September	2.7	0.54	0	0.54
October	0.07	2.3	0	2.3
[illegible]	0.07	3.9	0	3.9
December	0.07	6.2	0	6.2
Peak load - annual	8.1	13.9	0	13.9

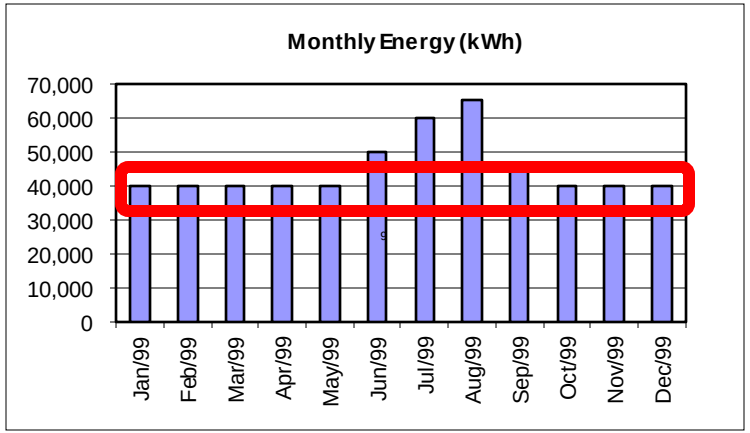
Proposed case load and energy		Heating	Cooling
System peak load	kW	13.9	8.1
System energy	MWh	29.5	14

- Once Base case system have been defined and efficiency measures accounted for, jump to 'Load characteristics'
- On this page you will see the 'Proposed Case load characteristics' that are used to determine the proposed case systems
- Record these numbers for further inputs

Calibration continued…determining Heating and Cooling Energy



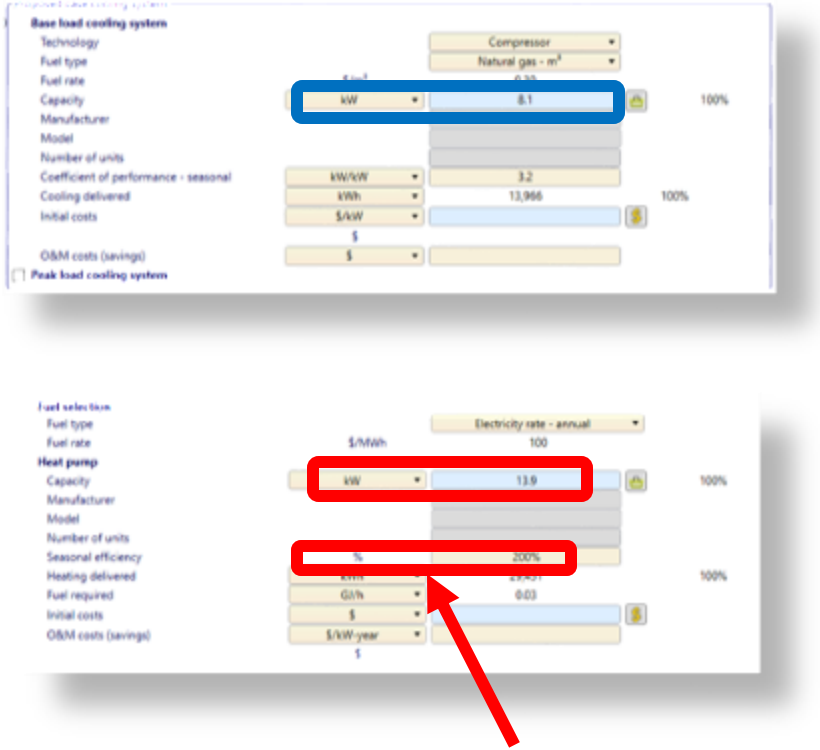
- For Gas, we want to know the percentage of total consumption that is for Domestic hot water, to do this:
  - take the total m3 in the non-cooling season as a percentage of total gas consumption



- For Electricity the process is similar to determine you cooling energy to calibrate, to do this:
  - Take the total kWh in the non-cooling season and subtract that from the total kWh for the year, this will be the energy required for cooling

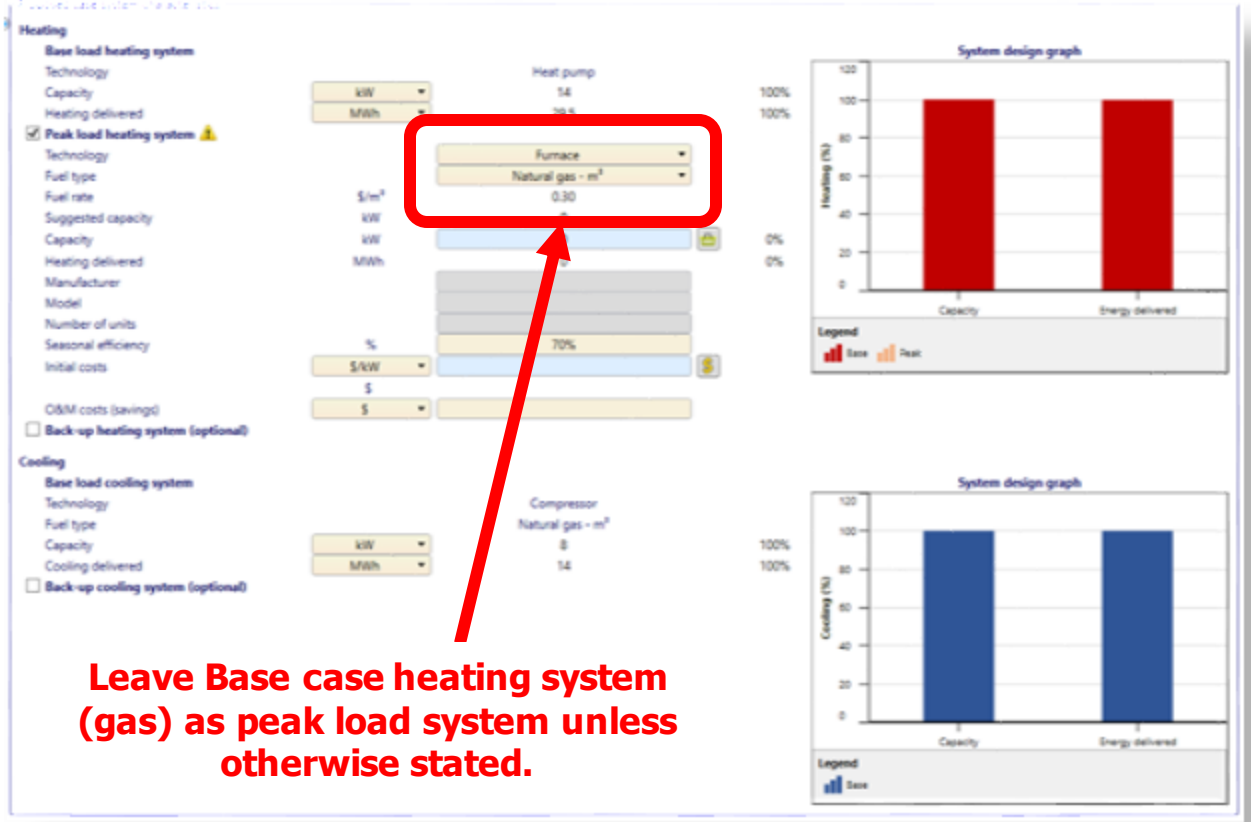
Use Proposed Heat/Cool Loads to Model 100% Heat Pump System

- 'Size' the proposed case system appropriately based on previously calculated capacities for both heating and cooling
- Use the RETSCreen Database to find a system, but be careful heating and cooling system are not linked
- In Demo models, capacity in proposed case matches calculated values simply for demo purposes, exact sizing will be based on systems available to meet the building needs
- Costing for new systems will need to be calculated by user



Proposed case electric load (demand) for heat pump system at proposed COP!

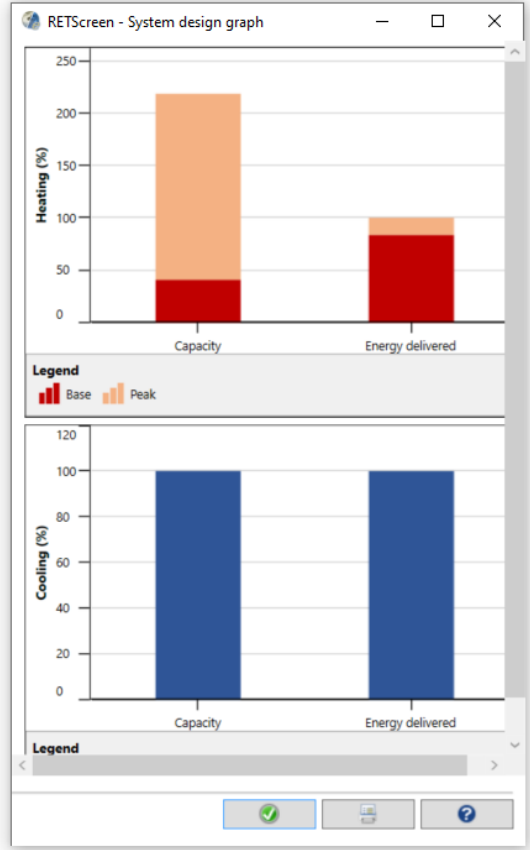
Peak Load System & Fraction (%) of Heat Delivered

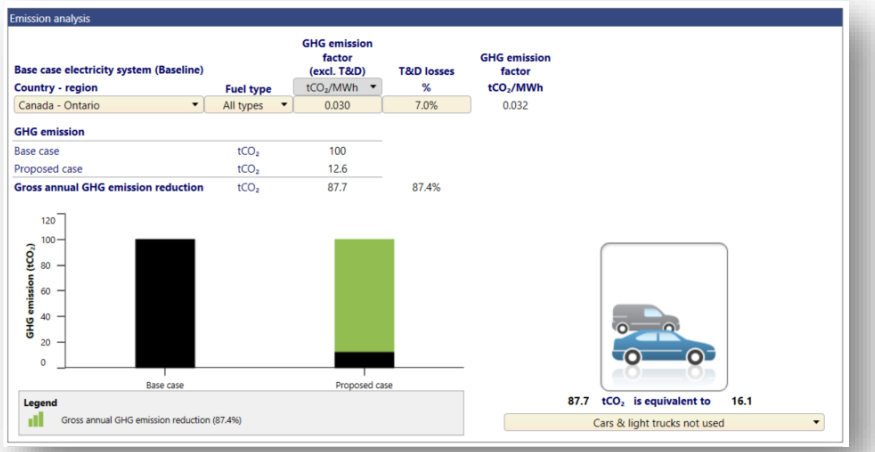


Leave Base case heating system (gas) as peak load system unless otherwise stated.

- 'Size' the proposed case system appropriately based on previously calculated capacities for both heating and cooling
- Use the RETSCreen Database to find a system, but be careful heating and cooling system are not linked
- In Demo models, capacity in proposed case matches calculated values simply for demo purposes, exact sizing will be based on systems available to meet the building needs

Fraction (%) of Heat Delivered Versus Carbon Reduction



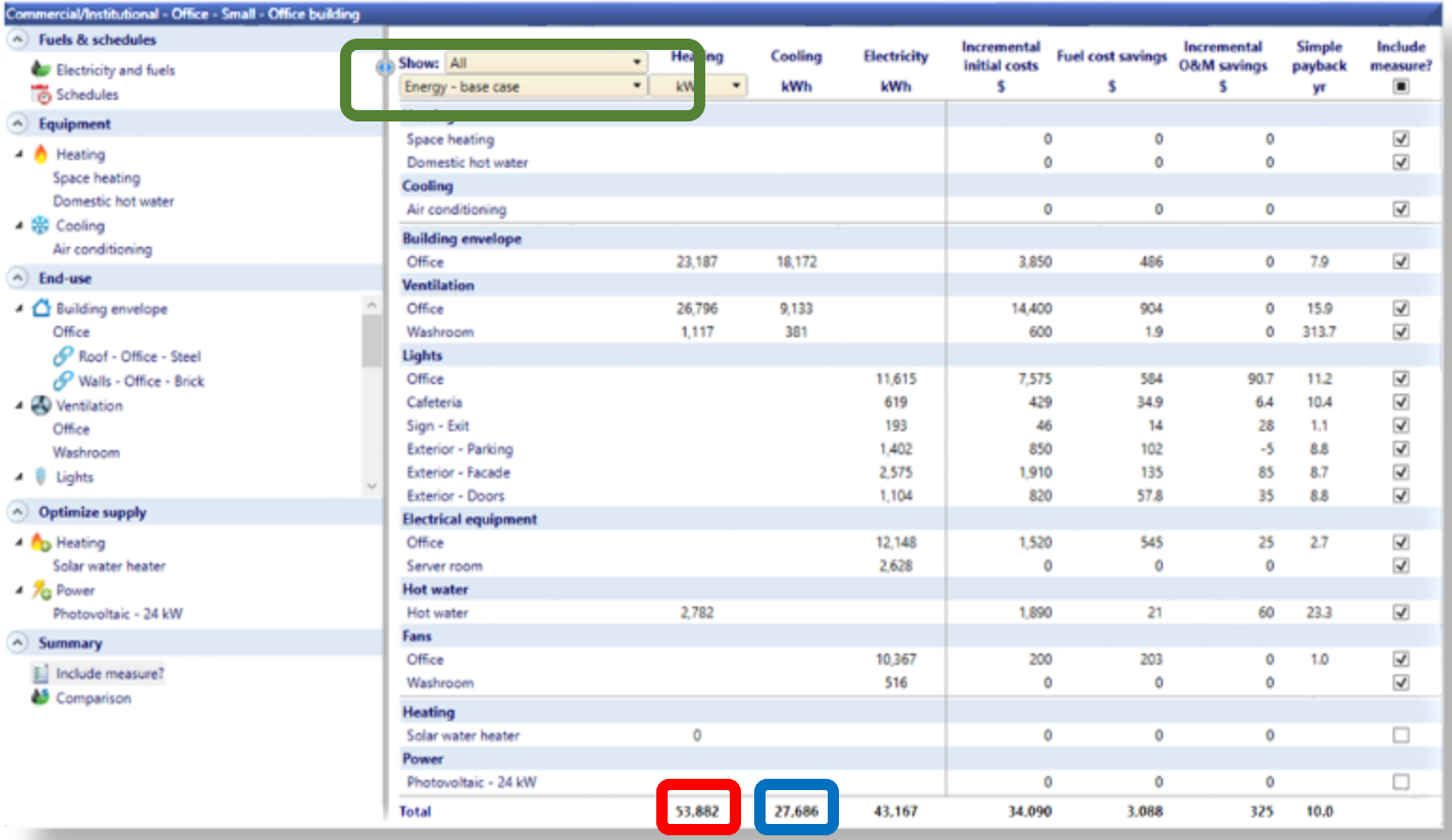


- In some cases the energy delivered may not meet the needs of the building, therefore a gas backup system may be required for peak load heating, rather that installing a larger system…
- We can see carbon reduction is still likely to be very high vs the cost of putting the larger peaking system, which could be costly

Method 2: Partial Facility or No Historical Data/ End-Use Breakdown

Using RETScreen Expert Building Model Data

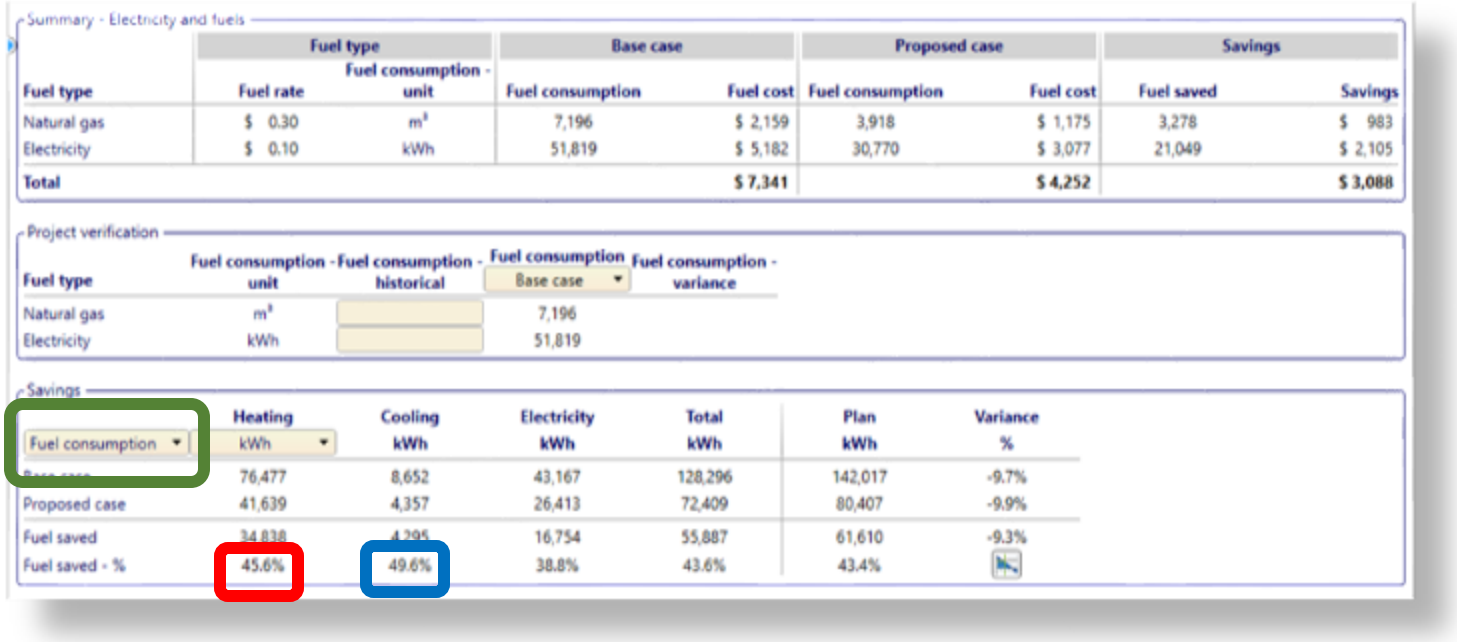
Use Energy Model: Heating, Cooling & Electricity & Interactions



- Start with RETScreen ArcheType Building (virtual Energy Analyzer) similar to your building supplied with tool
- OR Build an Energy Model of your building based on current building characteristics
- Use data From include measure screen to determine Heating and cooling consumption
- Ensure you are viewing 'Energy – base case'

Use Energy Model: Determine Efficiency Improvement (%)

- In "Comparison" section determine Fuel saved %



Summary - Electricity and fuels

	Fuel type		Base case		Proposed case		Savings	
Fuel type	Fuel rate	Fuel consumption - unit	Fuel consumption	Fuel cost	Fuel consumption	Fuel cost	Fuel saved	Savings
Natural gas	$ 0.30	m^3	7,196	$ 2,159	3,918	$ 1,175	3,278	$ 983
Electricity	$ 0.10	kWh	51,819	$ 5,182	30,770	$ 3,077	21,049	$ 2,105
Total				**$ 7,341**		**$ 4,252**		**$ 3,088**

Project verification

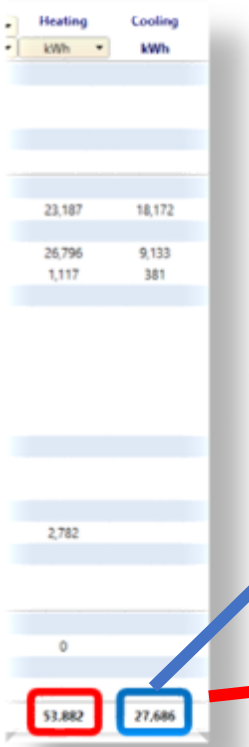
Fuel type	Fuel consumption - unit	Fuel consumption - historical	Fuel consumption: Base case	Fuel consumption - variance
Natural gas	m^3		7,196	
Electricity	kWh		51,819	

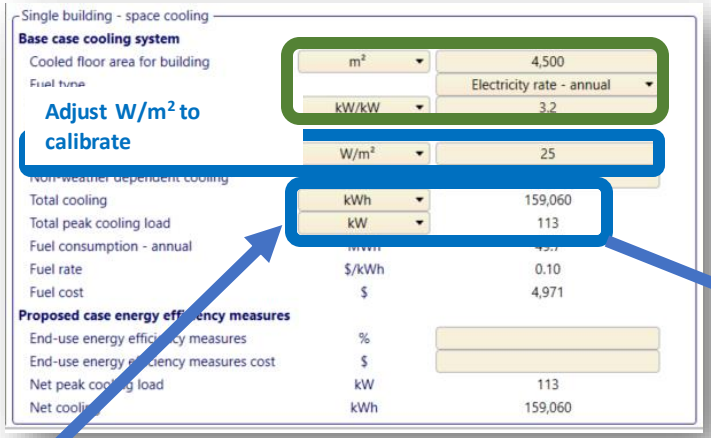
Savings

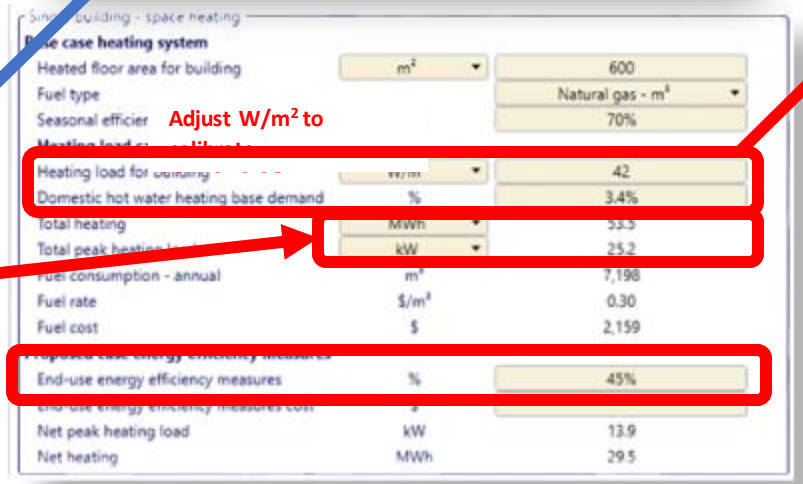
Fuel consumption	Heating: kWh	Cooling: kWh	Electricity: kWh	Total: kWh	Plan: kWh	Variance: %
Base case	76,477	8,652	43,167	128,296	142,017	-9.7%
Proposed case	41,639	4,357	26,413	72,409	80,407	-9.9%
Fuel saved	34,838	4,295	16,754	55,887	61,610	-9.3%
Fuel saved - %	45.6%	49.6%	38.8%	43.6%	43.4%	

Calibrate Energy Model to Power Model (ignore non-weather usage)

- Open New RETScreen Model, Select Power, Heating and Cooling on Facility Page
- Select Heating and Cooling for system selection (not power) and set fuel rates
- Populate the base case system with correct floor area and equipment efficiency (green box)
- Calibrate the heating and cooling models to the heating and cooling values in efficiency model, adjust w/m2 as needed within reasonable values
- Determine % hot water usage for heating and non weather cooling load % based on the 'include measure' screen data in the building model
- Populate 'end-use energy efficiency measures' input based on values from comparison

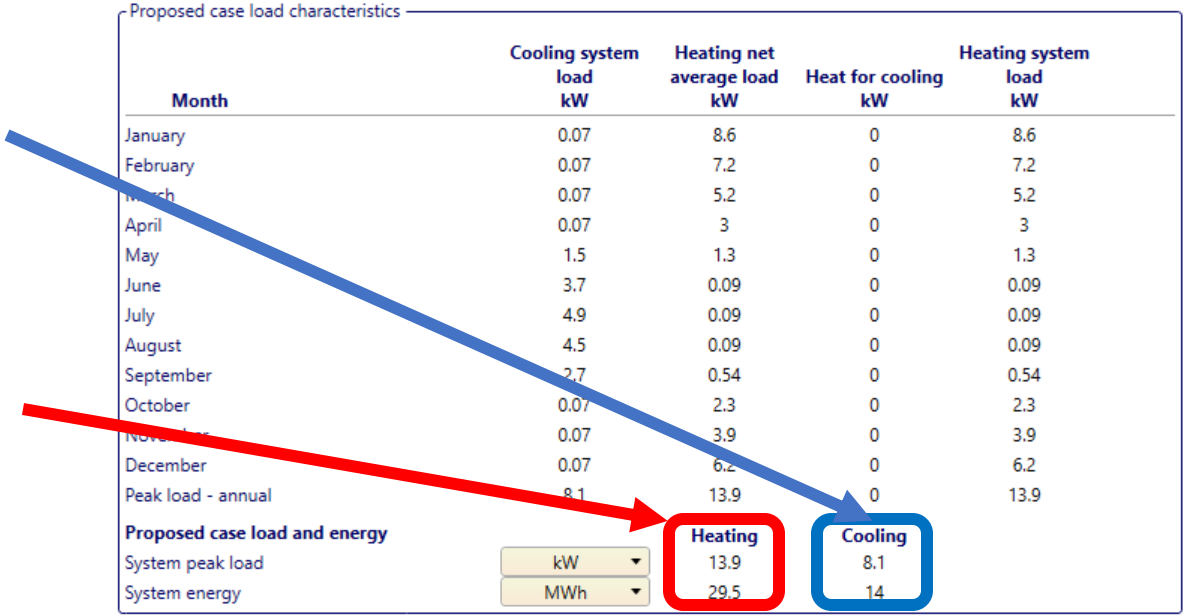






Next step

Calibration continued…



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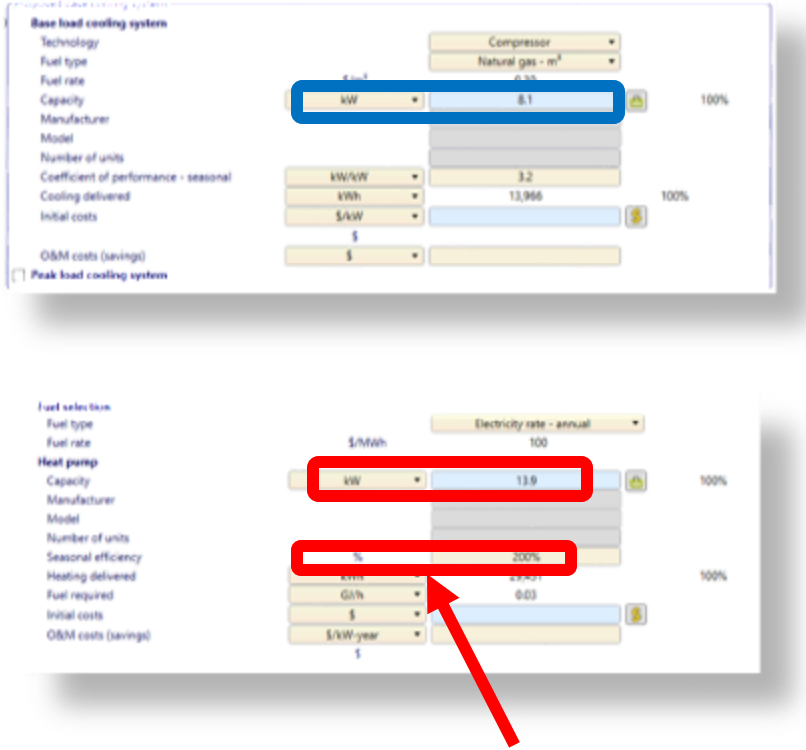
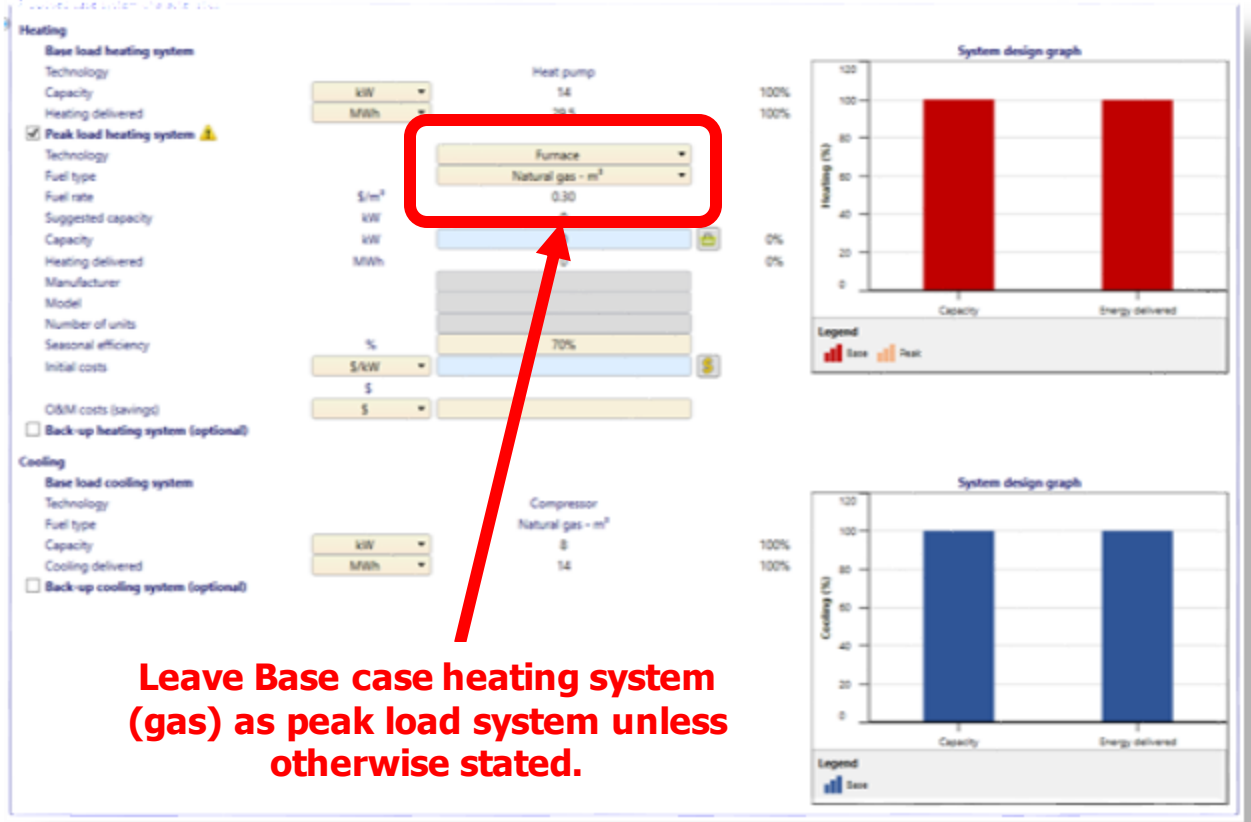
- Use the RETSCreen Database to find a system, but be careful heating and cooling system are not linked
- In Demo models, capacity in proposed case matches calculated values simply for demo purposes, exact sizing will be based on systems available to meet the building needs



Proposed case electric load (demand) for heat pump system at proposed COP!

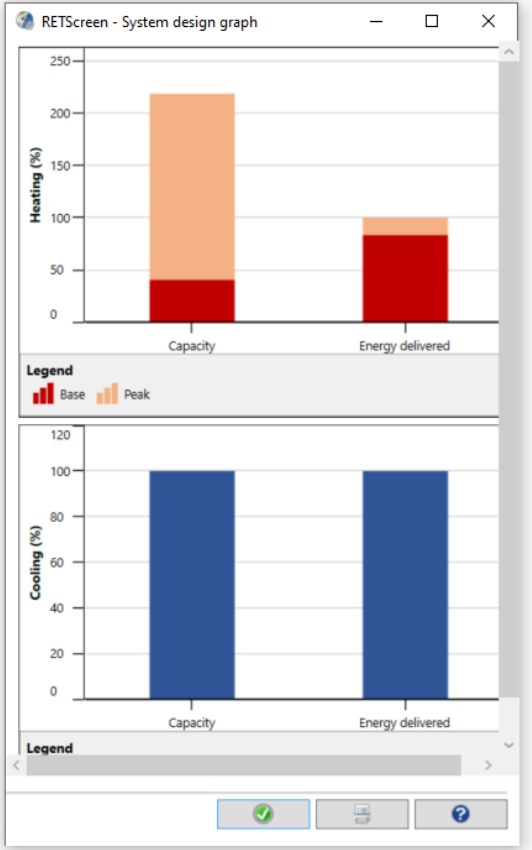
Peak Load System & Fraction (%) of Heat Delivered

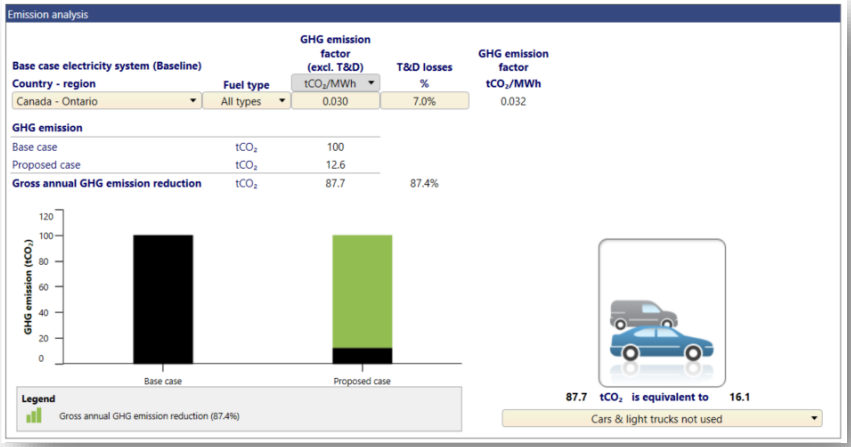


Leave Base case heating system (gas) as peak load system unless otherwise stated.

- 'Size' the proposed case system appropriately based on previously calculated capacities for both heating and cooling
- Use the RETSCreen Database to find a system, but be careful heating and cooling system are not linked
- In Demo models, capacity in proposed case matches calculated values simply for demo purposes, exact sizing will be based on systems available to meet the building needs

Fraction (%) of Heat Delivered versus Carbon Reduction

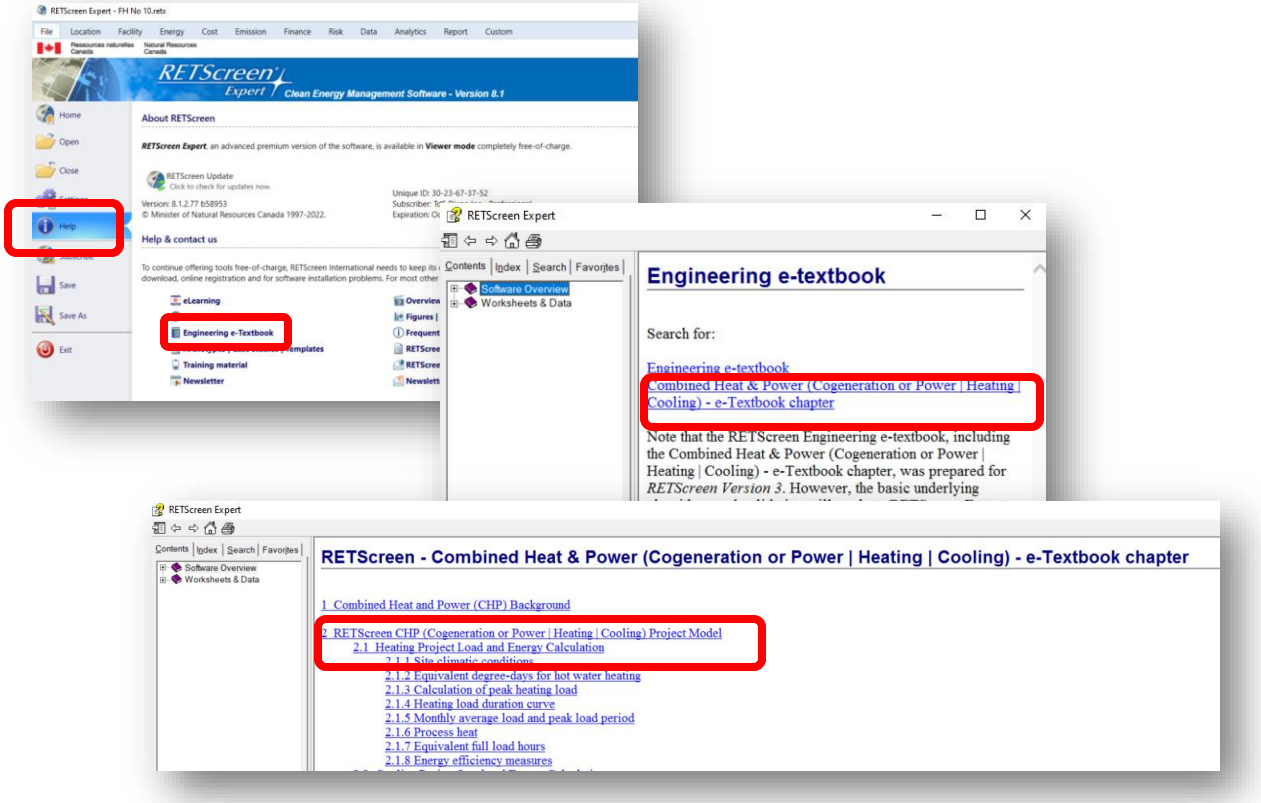




- In some cases the energy delivered may not meet the needs of the building, therefore a gas backup system may be required for peak load heating, rather that installing a larger system…
- We can see carbon reduction is still likely to be very high vs the cost of putting the larger peaking system, which could be costly

Reference for the Heating Cooling Load Model

- Click HELP and select Engineering e-Textbook
- Select Combined Heat & Power…
  …chapter
- Model is detailed in Section 2.1 (heating) & 2.2 (cooling)



Thank You!

Adam Trela, City of London (formerly)

Alex Bogun, Region of Peel

Amanda Martin, City of Markham

Dave Cano Tinoco, Town of Oakville

Jodi Janwin, City of Burlington

Jose Rocha, Region of Waterloo

Sokol Aliko, City of Windsor

Dave Gerrish, Queens University

Frank Misicek, Mohawk College

Mary Quintana, Brock University

Robert McCallum, Laurier College

Webinar Follow Up

The webinar recording and materials will be shared with you by email.

For questions regarding the Efficient Electrification RETScreen Expert® tools contact adam@knowenergy.com.

Please help us by taking two minutes to complete a survey about this session! See the link to the survey in the Chat now.

Thank you

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