

RETScreen® Expert Clean Energy Management Software

Enabler for low-carbon planning, implementation,
monitoring and reporting.

Dec 10th, 2024



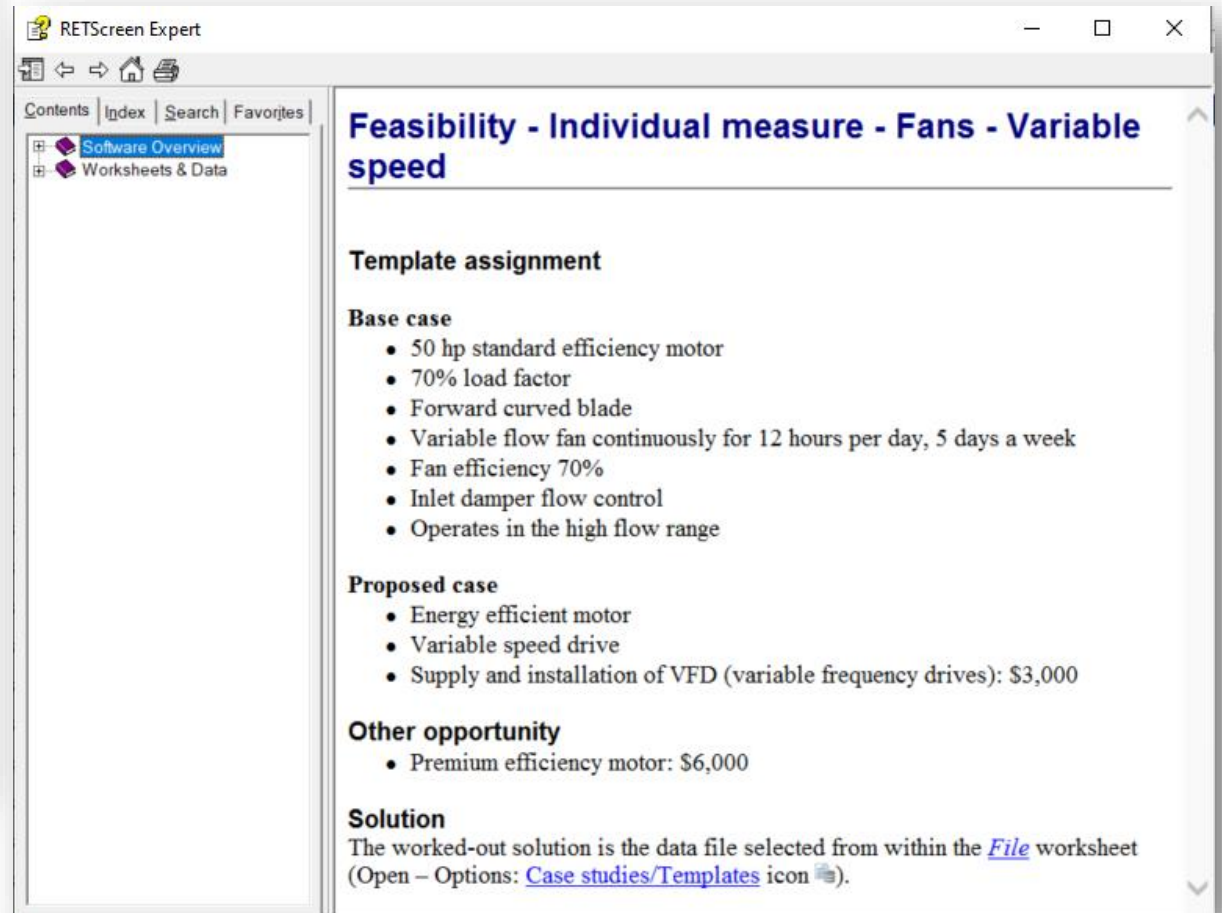
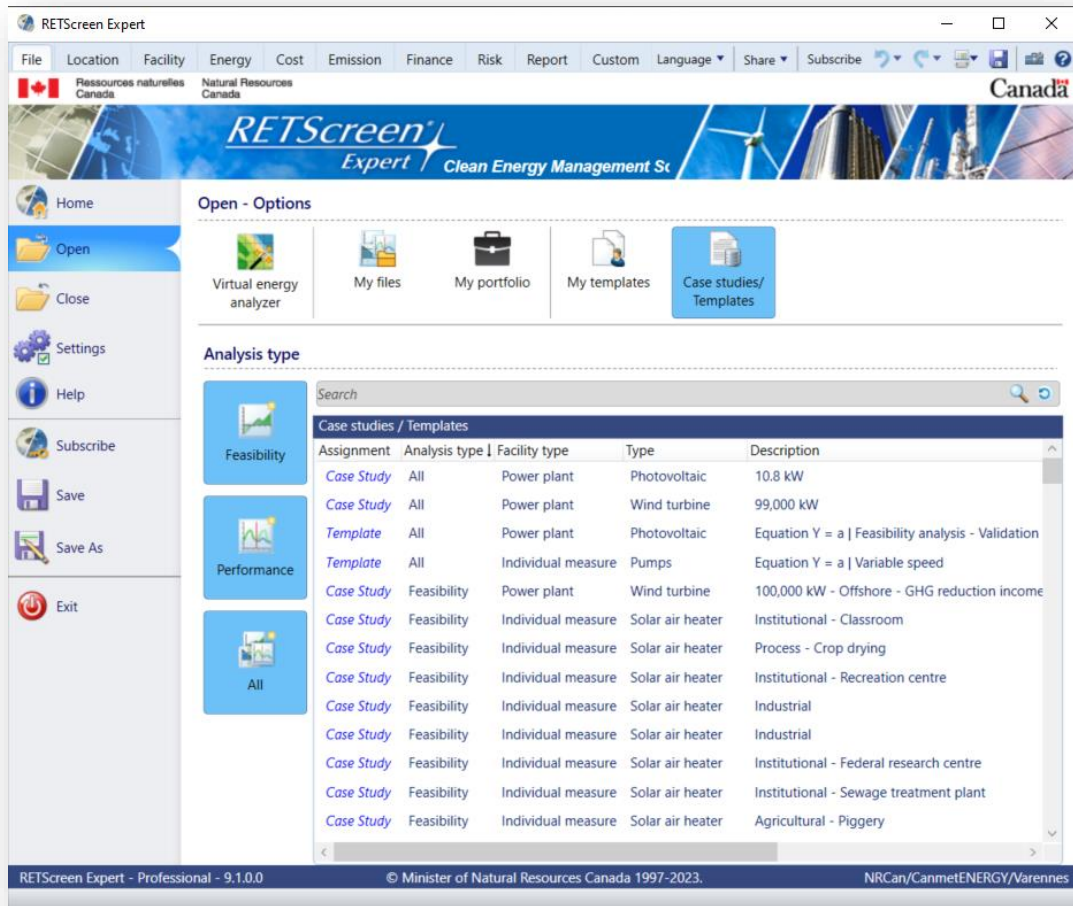
The Complete Toolbox! Let's Take a Quick Look.

The screenshot displays the RETScreen Expert software interface, version 9.0.0.0. The interface is organized into several sections:

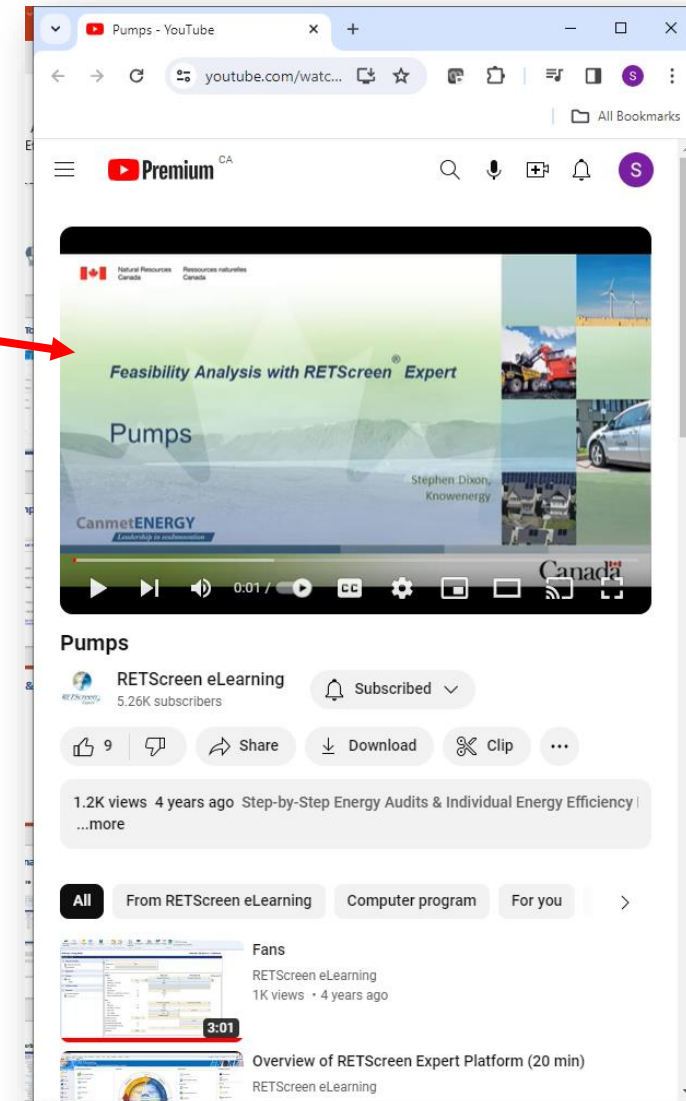
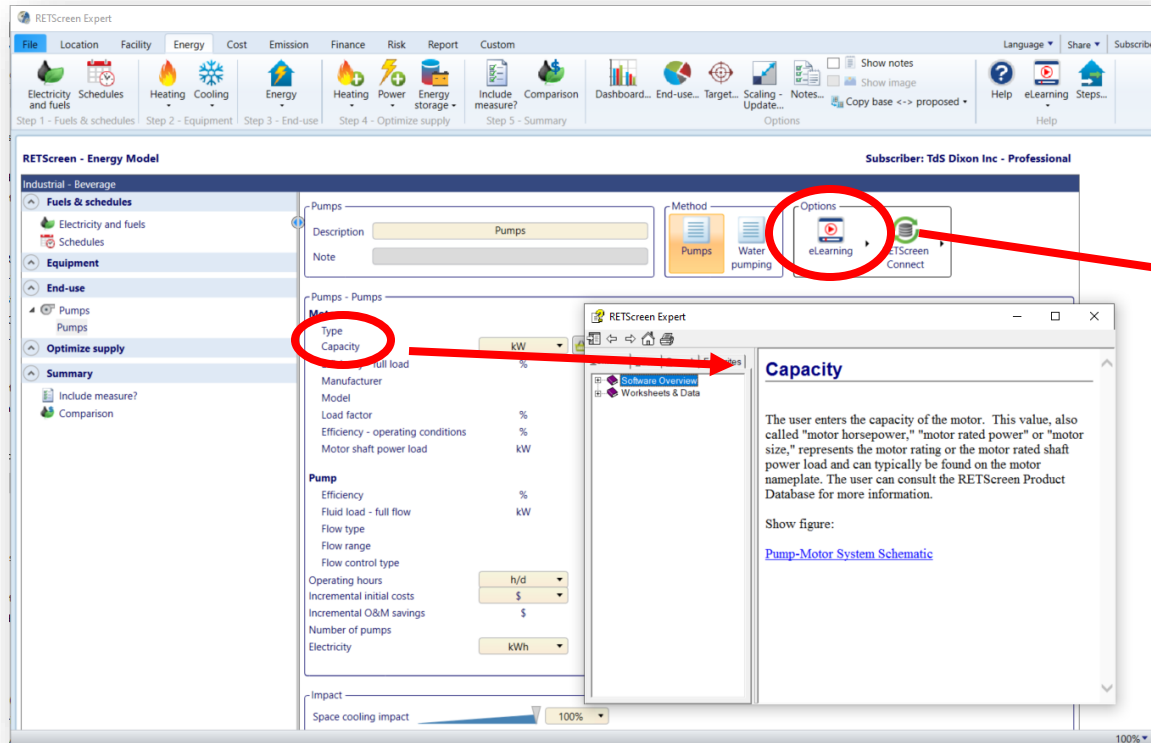
- Top Menu Bar:** Includes File, Location, Facility, Energy, Cost, Emission, Finance, Risk, Data, Analytics, Report, and Custom. It also features a Language dropdown, Share, and Subscribe options.
- Left Sidebar:** Contains navigation icons for Home, Open, Close, Settings, Help, Subscribe, Save, Save As, and Exit.
- Getting started - Options:** A section on the left with icons for Virtual energy analyzer, Analysis type - Blank project, Benchmark, Feasibility, Performance, All, My files, My templates, Case studies/Templates, and Portfolio analysis: My portfolio.
- Workflow - Per facility:** A central circular diagram illustrating the workflow. It is divided into four quadrants: Performance Tracker (top-left), Virtual Energy Analyzer (top-right), Financial Risk Assessor (bottom-left), and Smart Project Identifier (bottom-right). The workflow is represented by a circular arrow with labels: Start, Report, Benchmark, Facility, Energy, Cost, Emission, Feasibility, Finance, Risk, Data, and Analytics.
- Facility type - Examples:** A section on the right listing various facility types: Power plants, Power | Heating | Cooling, Power | Storage | Off-grid, Industrial | Agricultural, Commercial/Institutional, Residential, Military, Individual measure, Transportation, and User-defined.
- Integrated features:** A section on the right listing features: User manual, eLearning, Databases, Dashboards, About us, CanmetENERGY in Varennes, RETScreen Innovation Lab, RETScreen Data Onboarding, RETScreen Capacity Building, and logos for ieso, REEEP, NASA, and nef.

The bottom status bar indicates: RETScreen Expert - Professional - 9.0.0.0, © Minister of Natural Resources Canada 1997-2022, and NRCan/CanmetENERGY/Varennes.

Learning Resource - Case Studies & Templates

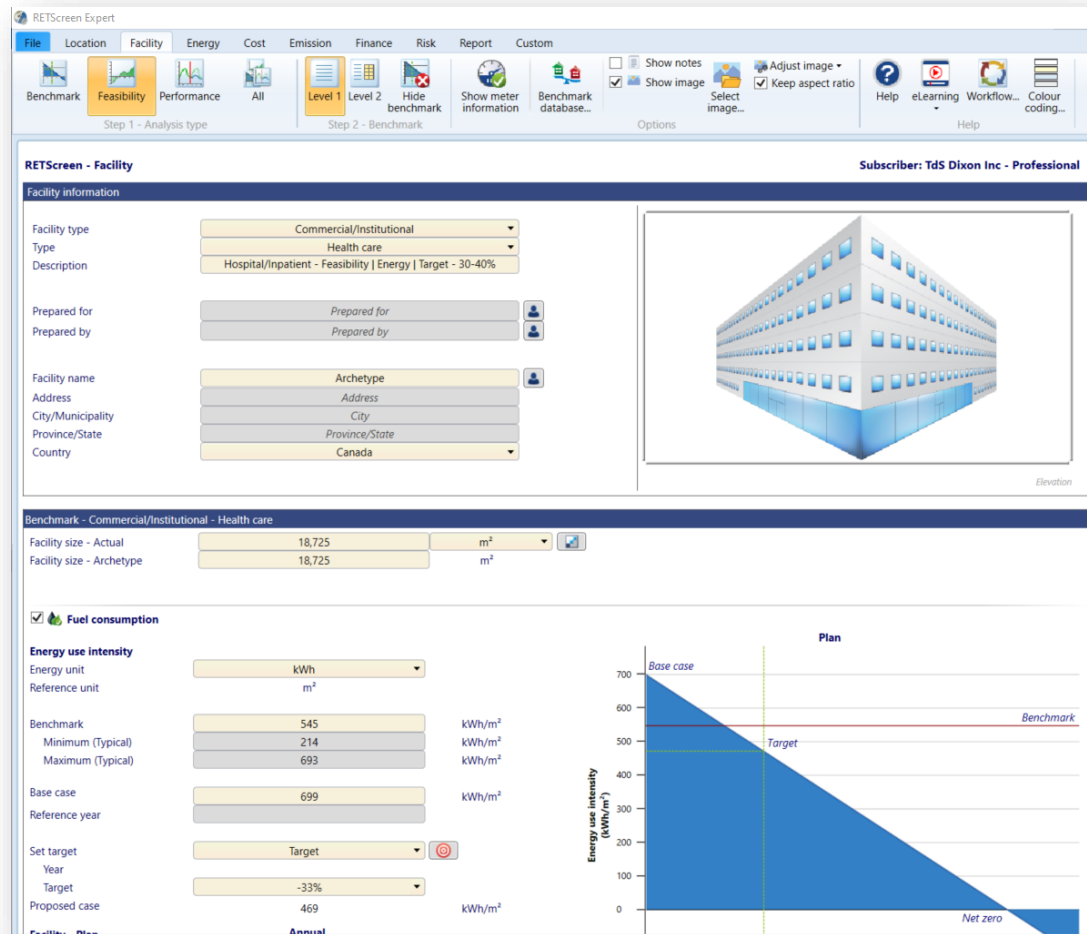


Learning Resources – Contextual Text & Video Help

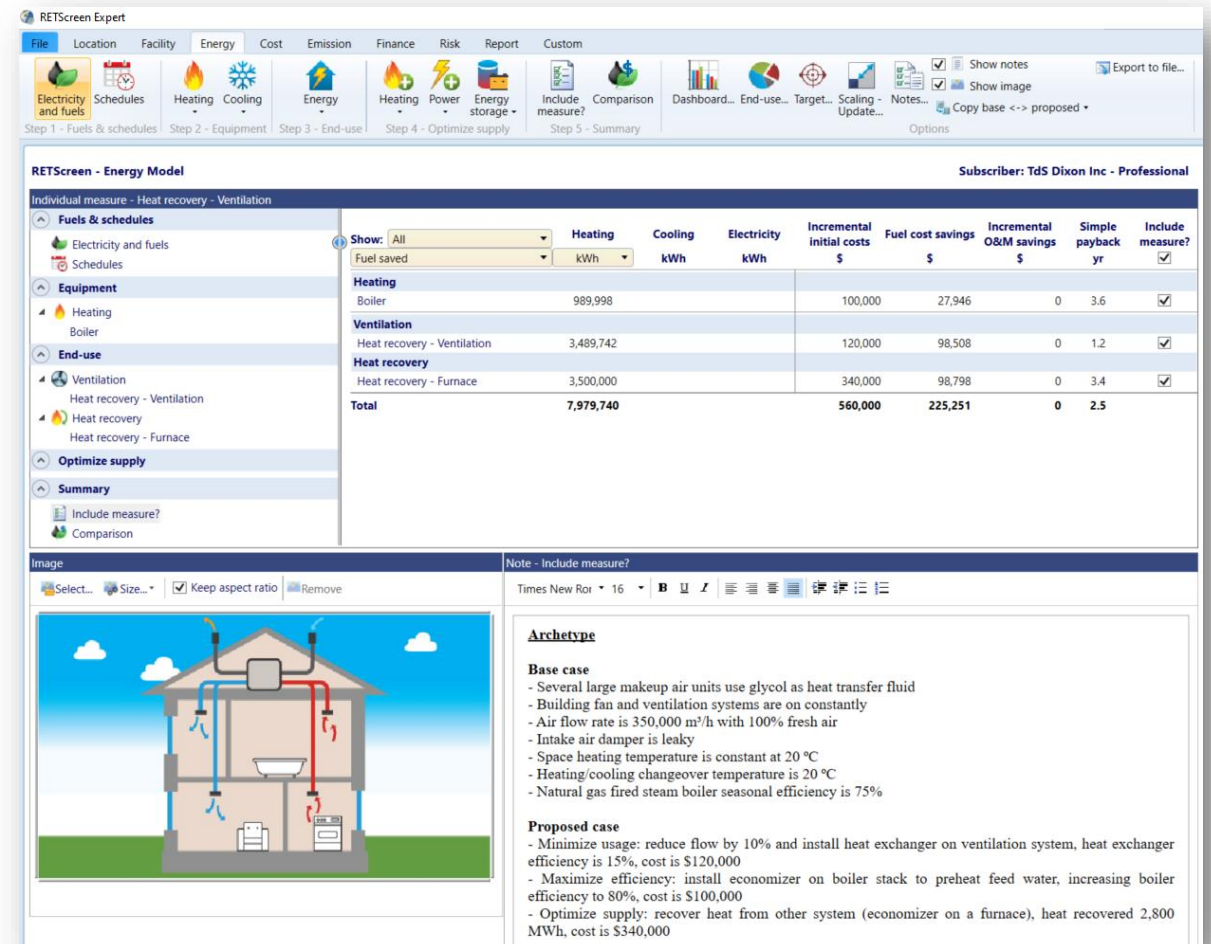


Getting Started – The Virtual Energy Analyzer

By Facility Type



By Measure



Let's Tour a Couple of Archetypes

Hospital/Inpatient – 40% Energy

Clinic/Outpatient- 80-90% Carbon Reduction

RETScreen Expert

Subscriber: TdS Dixon Inc - Professional

Commercial/Institutional - Hospital/Inpatient - Feasibility | Energy | Target - 30-40% - Health care

Step 1 - Fuels & schedules

RETScreen - Energy Model

Heating Cooling Electricity Incremental initial costs Fuel cost savings Incremental O&M savings Simple payback yr Include measure?

Heating

Space heating 404,479 750,000 11,418 0 65.7

Kitchen - Equipment 0 0 0

Domestic hot water 0 0 0

Cooling

Chiller - Air conditioning 0 0 0

Cooler - Walk-in 0 0 0

Freezer - Walk-in 0 0 0

Building envelope

Hospital 19,566 17,939 10,100 2,346 0 4.3

Ventilation

Office 35,635 1,198 300 1,126 0 0.3

Hospital 4,120 -481 0 68.2 0 Immediate

Cafeteria 456,296 21,142 177,450 14,995 0 11.8

Patient room 49,493 1,663 0 1,563 0 Immediate

Examination room 357,686 24,881 249,435 12,585 0 19.8

Operating room 98,985 3,326 0 3,127 0 Immediate

Physical therapy 6,438 -752 0 107 0 Immediate

Triage 1,288 -150 0 21.3 0 Immediate

Trauma 11,589 -1,353 0 192 0 Immediate

Laboratory 44,543 1,497 0 1,407 0 Immediate

Medical imaging 15,451 -1,804 0 256 0 Immediate

Nurse station - Patient room 699,091 32,980 177,435 23,032 0 7.7

Nurse station - Intensive care 79,188 2,661 0 2,501 0 Immediate

Nurse station - Operating room 118,782 3,992 0 3,752 0 Immediate

Nurse station - Trauma 158,376 5,322 0 5,003 0 Immediate

Lobby 59,391 1,996 0 1,876 0 Immediate

Kitchen 196,523 5,322 300 6,080 0 0.0

Lights

Office 13,578 16,420 1,358 750 7.8

Cafeteria 18,396 8,700 1,840 972 3.1

Patient room 25,404 23,200 2,540 1,296 6.0

Examination room 3,387 3,712 339 173 7.3

Operating room 18,396 20,880 1,840 972 7.4

Operating room - Task lighting 2,628 72,200 263 -3,000 None

Physical therapy 6,351 6,960 635 324 7.3

Triage 4,065 1,856 406 207 3.0

RETScreen Expert

Subscriber: TdS Dixon Inc - Professional

Commercial/Institutional - Clinic/Outpatient - Feasibility | Energy | Target - 80-90% - Health care

Step 4 - Optimize supply

RETScreen - Energy Model

Heating Cooling Electricity Incremental initial costs Fuel cost savings Incremental O&M savings Simple payback yr Include measure?

Heating

Space heating 50,846 90,838 866 -838 3,203.7

Domestic hot water 5,138 46,775 -681 0 None

Cooling

Air conditioning 0 0 0 0

Building envelope

Clinic 51,003 9,527 188,400 1,644 0 114.6

Ventilation

Office/Corridor 20,321 1,089 8,000 595 0 13.5

Lobby 13,985

Physical therapy 50,698

Radiology 9,808

Lights

Office

Office - Task lighting

Lobby

Corridor

Physical therapy

Radiology

Washroom

Sign - Exit

Exterior - Parking

Exterior - Facade

Exterior - Doors

Electrical equipment

Office

Physical therapy

Radiology

Vending machine/Microwave oven

Hot water

Hot water 9,135

Fans

Office/Corridor - Supply

Office/Corridor - Exhaust

Lobby

Physical therapy

RETScreen - Emission Analysis

Subscriber: TdS Dixon Inc - Professional

Emission analysis

Base case electricity system (Baseline)

Country - region Fuel type GHG emission factor (excl. T&D) T&D losses GHG emission factor kgCO₂/kWh

Canada - Ontario All types 0.025 7.0% 0.027

GHG emissions

Base case tCO₂ 55.7

Proposed case tCO₂ 5.6

Gross annual GHG emission reduction tCO₂ 50.1 90%

GHG emissions (tCO₂)

Base case Proposed case

Legend

Gross annual GHG emission reduction (90%)

50.1 tCO₂ is equivalent to 9.2 Cars & light trucks not used

Feasibility Analysis

Base Case versus Proposed Case – What If I Change This to That...

Lighting Analysis – Savings from Efficiency & Control

Lights

Description

Patient room

Note

Level

Level 1

Level 2

Options

eLearning

RETScreen Connect

Lights - Level 2

☐ Illumination level – calculator

		Base case	Proposed case	Energy saved
Lamp & fixture type		Fluorescent T5 - electronic ballast	Light emitting diode (LED)	
Efficiency	lm/W	90.6	100	
Electricity load per lamp	W	28	15	
Number of lamps per fixture		2	2	
Miscellaneous losses	W	3	0	
Electricity load per fixture	W	59	30	
Number of fixtures		2	2	
Number of lamps - total		4	4	
Operating hours	h/d	12	12	
Costing method		Level 2		
Number of lamps - initial costs	lamp	0	4	
Initial costs - lamp	\$/lamp	38	58	
Incremental initial costs - other	\$		0	
Incremental initial costs - total	\$		232	
Lamp life	h	20,000	50,000	
Lamp replacement frequency	yr	4.6	11.4	
Incremental O&M savings			13	
Number of units		100	100	
Electricity	kWh	51,684	26,280	25,404 49.2%

Impact

Space cooling impact

70%

Space heating impact

70%



<https://a.netzero-usa.com/case-studies/>

Impact of Schedules & Temperatures

RETScreen - Energy Model Subscriber: Tds Dixon Inc - Professional

Commercial/Institutional - Clinic/Outpatient - Feasibility | Emission | Target - 80-90% - Health care

Fuels & schedules

- Electricity and fuels
- Schedules

Equipment

- Heating
 - Space heating
 - Domestic hot water
- Cooling
 - Air conditioning

End-use

- Building envelope
 - Clinic
 - Roof - Steel
 - Walls - Glazing
- Ventilation
 - Office/Corridor
 - Lobby
 - Physical therapy

Optimize supply

- Heating
 - Solar water heater
- Power
 - Photovoltaic - 12 kW (20% of roof)
 - Offsite renewables

Summary

- Include measure?
- Comparison

Building envelope

Description:

Note:

Options

eLearning RETScreen Connect

Building envelope

	Base case				Proposed case			
Building north	-7				-7			
Schedule	Clinic - Base case				Clinic - Proposed case			
Incremental initial costs	\$				100			

Walls

	North	East	South	West	North	East	South	West
Area	m² 210	210	210	210	210	210	210	210
Net area	m² 100	132	54	152	100	132	54	152
R-value	m² · °C/W 3.0806	3.0806	3.0806	3.0806	3.0806	3.0806	3.0806	3.0806
Incremental initial costs	\$							

Windows

Area: 24/7

U-value: Hospital, Operating room, Kitchen - Proposed case, Exhaust fan - Base case, Exhaust fan - Proposed case, Utility room/Storage - Props

Solar heat gain coefficient: 22, 21, 20, 23, 20, 20

Incremental initial costs: 22, 24, 21, 24, 23, 24

Solar shading - seasonal

Solar shading - winter: 22, 21, 20, 23, 20, 20

Solar shading - summer: 22, 24, 21, 24, 23, 24

Incremental initial costs: 22, 24, 21, 24, 23, 24

Occupancy rate - daily

	Hospital	Operating room	Kitchen - Proposed case	Exhaust fan - Base case	Exhaust fan - Proposed case	Utility room/Storage - Props
Monday	24	10	24	15	15	24
Tuesday	24	10	24	15	15	24
Wednesday	24	10	24	15	15	24
Thursday	24	10	24	15	15	24
Friday	24	10	24	15	15	24
Saturday	24	10	24	15	15	24
Sunday	24	10	24	15	15	24
Occupancy rate - annual	8,760	3,650	8,760	5,475	5,475	8,760
	100%	41.7%	100%	62.5%	62.5%	100%

Heating/cooling changeover temperature: 15 °C

Length of heating season: 228 d

Length of cooling season: 137 d

Ventilation Dampers & Heat Recovery Upgrade

Commercial/Institutional - Clinic/Outpatient - Feasibility | Emission | Target - 80-90% - Health care

Fuels & schedules

- Electricity and fuels
- Schedules

Equipment

- Heating
 - Space heating
 - Domestic hot water
- Cooling
 - Air conditioning

End-use

- Walls - Glazing
- Ventilation
 - Office/Corridor
 - Lobby
 - Physical therapy
 - Radiology
- Lights
 - Office
 - Office Task lighting

Optimize supply

- Heating
 - Solar water heater
- Power
 - Photovoltaic - 12 kW (20% of roof)
 - Offsite renewables

Summary

- Include measure?
- Comparison

Ventilation

Description: Physical therapy

Note: Linked to: Fans - Physical therapy

Method: Method 1, Method 2

Options: eLearning, RETScreen Connect

Ventilation - Method 1

	Base case	Proposed case	Energy saved
Schedule	Physical therapy - Base case	Physical therapy - Proposed case	
Flow	L/s	1,200	
Fresh air	%	70%	
System reheat	No	No	
System selection	Heating & cooling	Heating & cooling	
Fan control	Schedule	Schedule	
Ventilation control	Schedule	Schedule	
Intake air damper leakage	Medium	Tight	
Heat recovery efficiency	%	0%	
Costing method		Level 1	
Incremental initial costs	\$	9,600	\$
Incremental O&M savings	\$		
Number of ventilation units	2	2	
Heating system	Space heating	Space heating	
Heating	kWh	75,793	54,138
		21,655	71.4%
Cooling system	Air conditioning	Air conditioning	
Cooling	kWh	8,792	6,701
		2,091	76.2%



<https://cbphysiotherapy.in/blog/10-benefits-of-visiting-a-physiotherapy-clinic>

Demo: Evaluate Option to Increase Roof Insulation



Location is Ontario

Electricity price is \$ 0.14 /kWh

Heating Fuel is NG at \$ 0.40 /m³

Base Case

- Heating and cool Temperature is 21 degree C
- Changeover Temperature is 16 degrees C
- Boiler efficiency is 75%
- A/C has COP of 3.0
- Roof Area is 10,000 sq.ft.
- R-value of 10

Proposed Case

- Increase the R-value in the Roof to 20
- The incremental cost of the project is \$1.20 per sq.ft.

Project Savings:

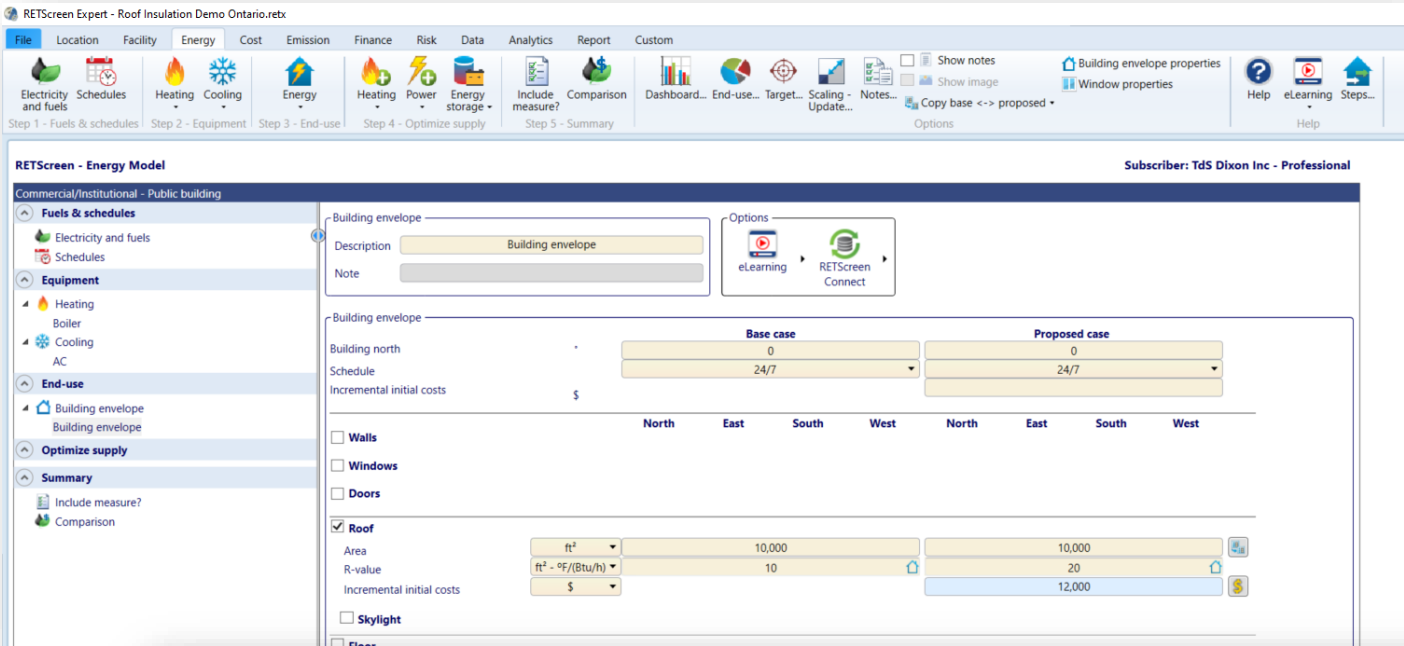
_____ kWh/year

\$ _____/year

Simple Payback:

_____ years

Roof Insulation Results



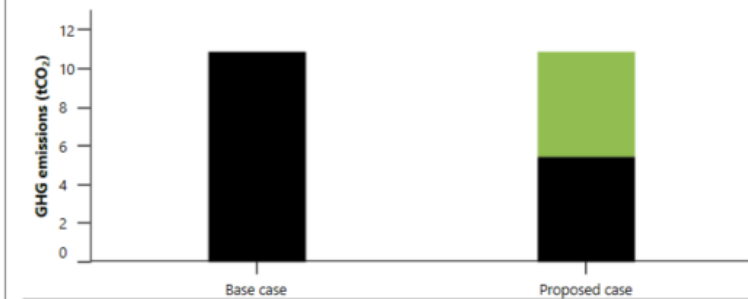
RETScreen - Emission Analysis

Emission analysis

Base case electricity system (Baseline)		GHG emission factor (excl. T&D)	T&D losses
Country - region	Fuel type	tCO ₂ /MWh	%
Canada - Ontario	All types	0.025	7.0%

GHG emissions

Base case	tCO ₂	10.9
Proposed case	tCO ₂	5.4
Gross annual GHG emission reduction		5.4 50%



Show: All	Heating	Cooling	Electricity	Incremental initial costs	Fuel cost savings	Incremental O&M savings	Simple payback	Include measure?
Fuel saved	kWh	kWh	kWh	\$	\$	\$	yr	✓
Heating								
Boiler	0			0	0	0		✓
Cooling								
AC		0		0	0	0		✓
Building envelope								
Building envelope	30,148	1,090		12,000	1,401	0	8.6	✓
Total	30,148	1,090		12,000	1,401	0	8.6	

Carbon & Energy Savings for Heat Pump Conversion

Heating system

DescriptionSpace heating

NoteAir-source heat pump (Air-to-Air)

Method

Single fuel

Multiple fuels

Options

eLearning

RETScreen Connect

Heating system

TechnologyHeating system

Fuel typeNatural gas - m³

Fuel rate0.30

Heating equipment

Capacity421 kW

Manufacturer

Model

Number of units

Seasonal efficiency75%

Percentage of energy supplied100%

Incremental initial costs\$1,676

Incremental O&M savings\$-1,456

Base case

Proposed case

TechnologyHeating system

Fuel typeNatural gas - m³

Fuel rate0.30

Heating equipment

Capacity245 kW

Manufacturer

Model

Number of units

Seasonal efficiency85%

Percentage of energy supplied30%

Incremental initial costs\$320

Incremental O&M savings\$-3,920



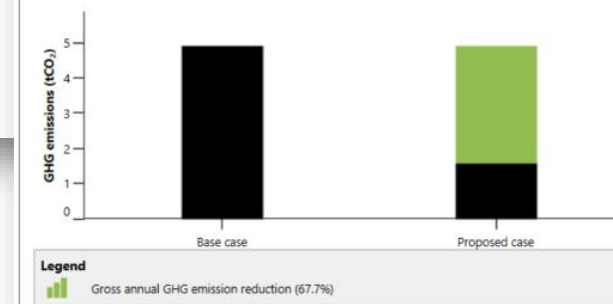
RETScreen - Emission Analysis

Subscriber: TdS Dixon Inc - Professional

Emission analysis

Base case electricity system (Baseline)		GHG emission factor (excl. T&D)	T&D losses	GHG emission factor
Country - region	Fuel type	kgCO ₂ /kWh	%	kgCO ₂ /kWh
Canada - Ontario	All types	0.095	7.0%	0.102

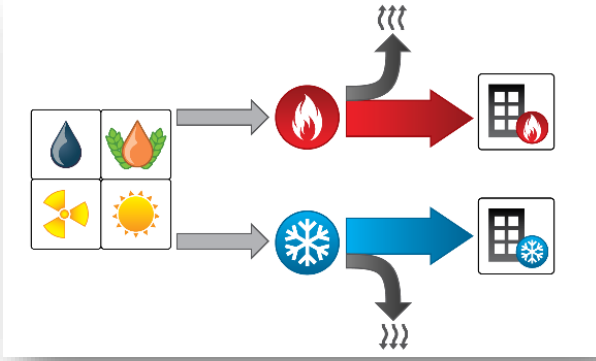
GHG emissions	
Base case	tCO ₂ 4.9
Proposed case	tCO ₂ 1.6
Gross annual GHG emission reduction	tCO₂ 3.3 67.7%



3.3 tCO₂ is equivalent to 0.61

Cars & light trucks not used

Advanced Feature - Heat Pump Sizing & Conversions

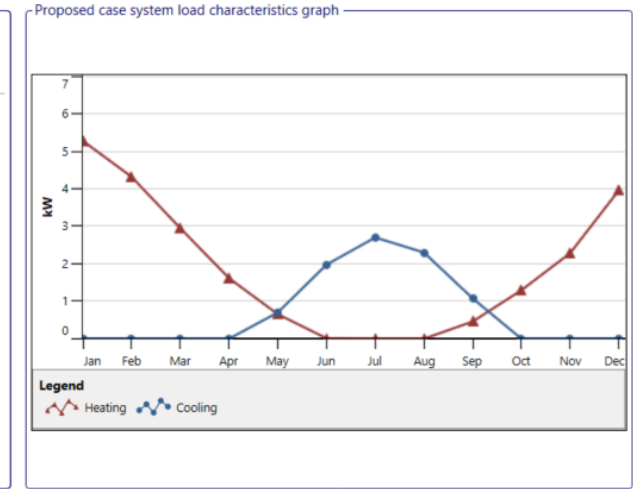


Proposed case load characteristics

Month	Cooling system load kW	Heating net average load kW	Heat for cooling kW	Heating system load kW
January	0	5.3	0	5.3
February	0	4.3	0	4.3
March	0	2.9	0	2.9
April	0	1.6	0	1.6
May	0.7	0.66	0	0.66
June	2	0.01	0	0.01
July	2.7	0	0	0
August	2.3	0	0	0
September	1.1	0.46	0	0.46
October	0	1.3	0	1.3
November	0	2.3	0	2.3
December	0	4	0	4
Peak load - annual	4.7	8.1	0	8.1

Proposed case load and energy

	Heating	Cooling
System peak load	8.1 kW	4.7 kW
System energy	17.5 MWh	7 MWh



Heating load

Single building | Single building - multiple zones | Multiple buildings

Load type

Space heating | Process heating

Single building - space heating

Base case heating system

Heated floor area for building: m² 150

Fuel type: Natural gas - m³

Seasonal efficiency: % 75%

Heating load calculation

Heating load for building: W/m² 60

Domestic hot water heating base demand: % 0%

Total heating: MWh 19.4

Total peak heating load: kW 9

Fuel consumption - annual: m³ 2,433

Fuel rate: \$/m³ 0.35

Fuel cost: \$ 852

Proposed case energy efficiency measures

End-use energy efficiency measures: % 10%

End-use energy efficiency measures cost: \$

Net peak heating load: kW 8.1

Net heating: MWh 17.5

Proposed case heating system

Base load heating system

Technology: Heat pump

Fuel selection method

Single fuel | Multiple fuels - monthly | Multiple fuels - percentage

Fuel selection

Fuel type: Electricity rate - annual

Fuel rate: \$/MWh 100

Heat pump

Capacity: kW 3.2 39.5%

Manufacturer:

Model:

Number of units:

Seasonal efficiency: % 250%

Heating delivered: kWh 13,938 79.9%

Fuel required: GJ/h 0.005

Initial costs: \$

O&M costs (savings): \$/kW-year

☐ Intermediate load heating system

Using RETScreen Expert for Pump Variable Speed Savings Estimates

Pumps

Description: Circulating pump - Variable speed

Note:

Method: Pumps, Water pumping

eLearning:

Pumps - Pumps

Motor

	Base case	Proposed case	Energy saved
Type	Standard efficiency	User-defined	
Capacity	3 hp	3	
Efficiency - full load	84.7%	91.4%	
Manufacturer			
Model			
Load factor	70%	64.6%	
Efficiency - operating conditions	83.8%	90.3%	
Motor shaft power load	2.1 hp	1.9	

Pump

Efficiency	60%	65%	
Fluid load - full flow	1.3 hp	1.3	
Flow type	Constant	Variable	
Flow range		High	
Flow control type		Variable speed	
Operating hours	24 h/d	24	
Incremental initial costs	\$	1,000	
Incremental O&M savings	\$		
Number of pumps	1	1	
Electricity	16,205 kWh	7,588	8,617 53.2%

Fans

Description: Exhaust Fan

Note:

Options: eLearning, RETScreen Connect

Fans

Motor

	Base case	Proposed case	Energy saved
Type	Standard efficiency	Energy efficient	
Capacity	50 hp	50	
Efficiency - full load	90.9%	94.3%	
Manufacturer			
Model			
Load factor	70%	70%	
Efficiency - operating conditions	90%	93.4%	
Motor shaft power load	35 hp	35	

Fan

Type	Forward curved fan	Forward curved fan	
Efficiency	70%	70%	
Fan load - full flow	24.5 hp	24.5	
Flow type	Variable	Variable	
Flow range	High	High	
Flow control type	Inlet damper	Variable speed	
Operating hours	60 h/w	60	
Costing method		Level 1	
Incremental initial costs	\$	3,000	
Incremental O&M savings	\$		
Number of fans	1	1	
Electricity	60,243 kWh	48,452	11,791 19.6%

PV System Modelled

- 407 – 305 Watt Modules
- 100 kW inverter
- Cost of
\$2.58/Watt
- 9.5 T CO₂ (BC)
- 130 T CO₂ (AB)
- IRR of 9.6%



Photovoltaic - Level 2

Resource assessment

Solar tracking mode		Fixed
Slope		30
Azimuth		0

⌵ Show data

Photovoltaic

Type		mono-Si
Power capacity	kW	124.135
Manufacturer		Canadian Solar
Model		mono-Si - CS6K-305MS - SuperPower
Number of units		407
Efficiency	%	18.63%
Nominal operating cell temperature	°C	45
Temperature coefficient	% / °C	0.4%
Solar collector area	m ²	666
Miscellaneous losses	%	2%

Inverter

Efficiency	%	95%
Capacity	kW	100
Miscellaneous losses	%	

Summary

Capacity factor	%	14.4%
Initial costs	\$	320,000
O&M costs (savings)	\$	0
Energy saved	kWh	156,516

Geothermal System Modelled

- Gas heating
- Electric cooling
- 1,500 m² clinic
- Electric GSHP
- 37 T CO₂ (BC)
- IRR = 8.5%

Single building - space heating

Base case heating system

Heated floor area for building m²

Fuel type

Seasonal efficiency %

Heating load calculation

Heating load for building W/m²

Domestic hot water heating base demand %

Total heating MWh

Total peak heating load kW

Fuel consumption - annual m³

Fuel rate \$/m³

Fuel cost \$

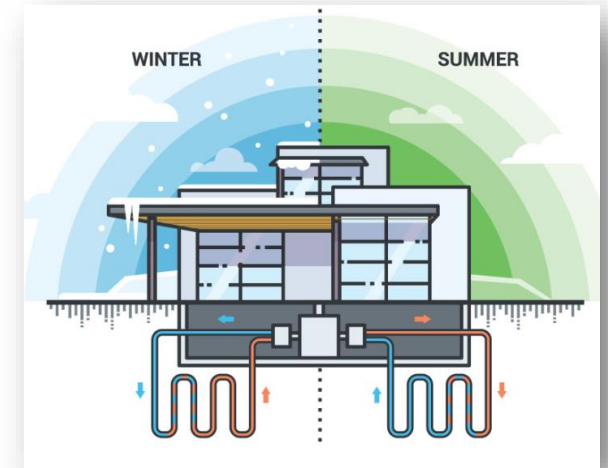
Proposed case energy efficiency measures

End-use energy efficiency measures %

End-use energy efficiency measures cost \$

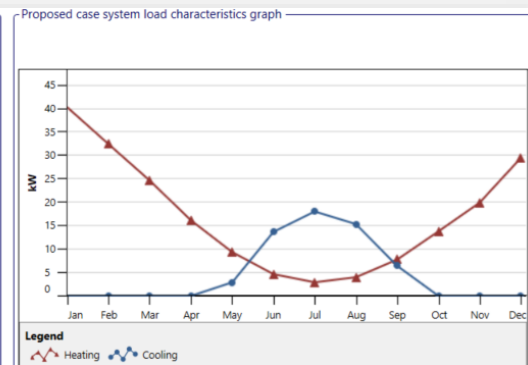
Net peak heating load kW

Net heating MWh



Proposed case load characteristics

Month	Cooling system load kW	Heating net average load kW	Heat for cooling kW	Heating system load kW
January	0	40.3	0	40.3
February	0	32.4	0	32.4
March	0	24.6	0	24.6
April	0	16.1	0	16.1
May	2.9	9.3	0	9.3
June	13.7	4.6	0	4.6
July	18	2.9	0	2.9
August	15.3	4	0	4
September	6.4	7.8	0	7.8
October	0	13.8	0	13.8
November	0	19.9	0	19.9
December	0	29.5	0	29.5
Peak load - annual	37.5	60	0	60



Proposed case heating system

Base load heating system

Technology

Fuel selection method

☒ Single fuel ☐ Multiple fuels - monthly ☐ Multiple fuels - percentage

Fuel selection

Fuel type

Fuel rate \$/MWh

Heat pump

Capacity kW

Manufacturer

Model

Number of units

Seasonal efficiency %

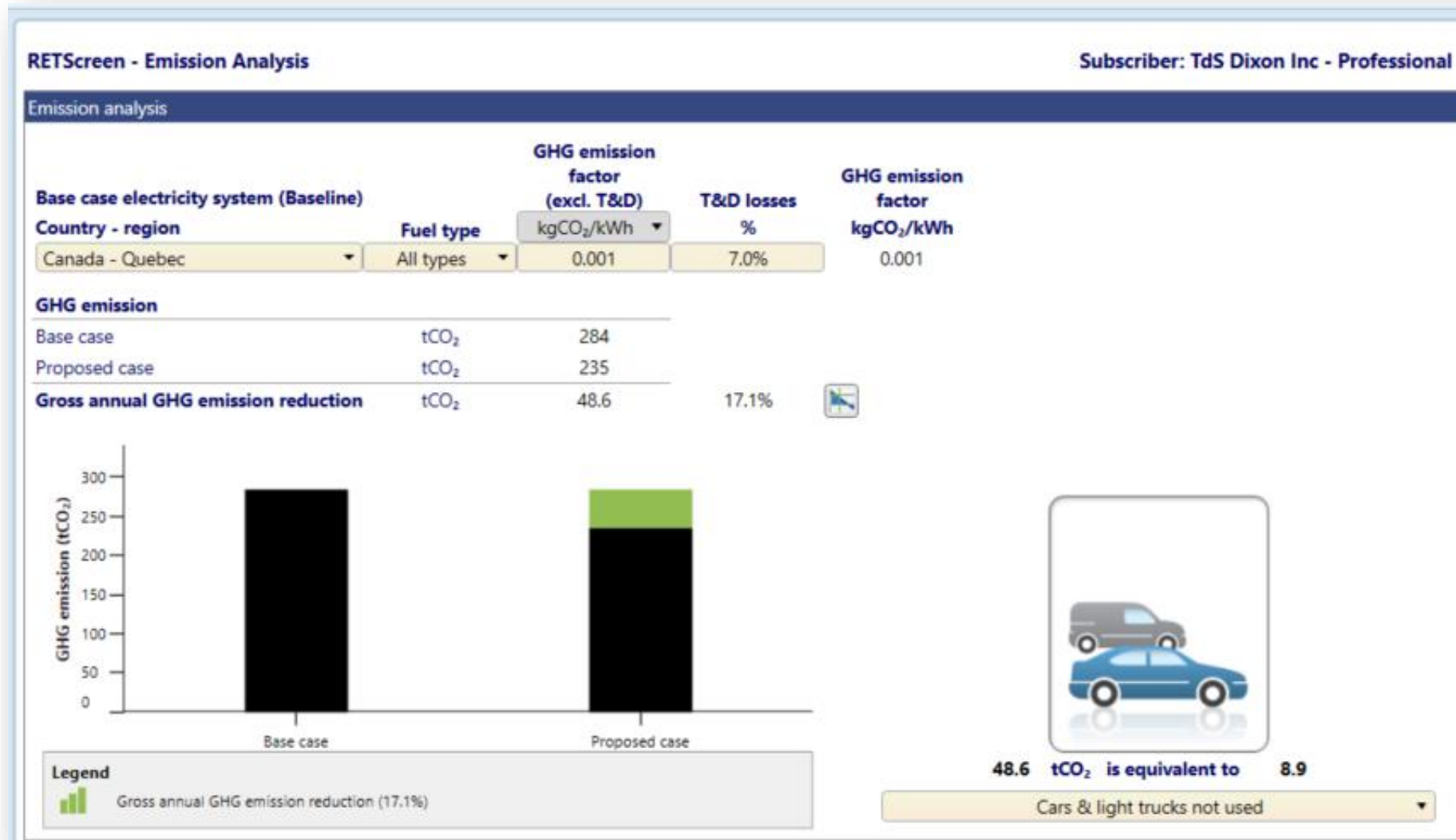
Heating delivered kWh

Fuel required GJ/h

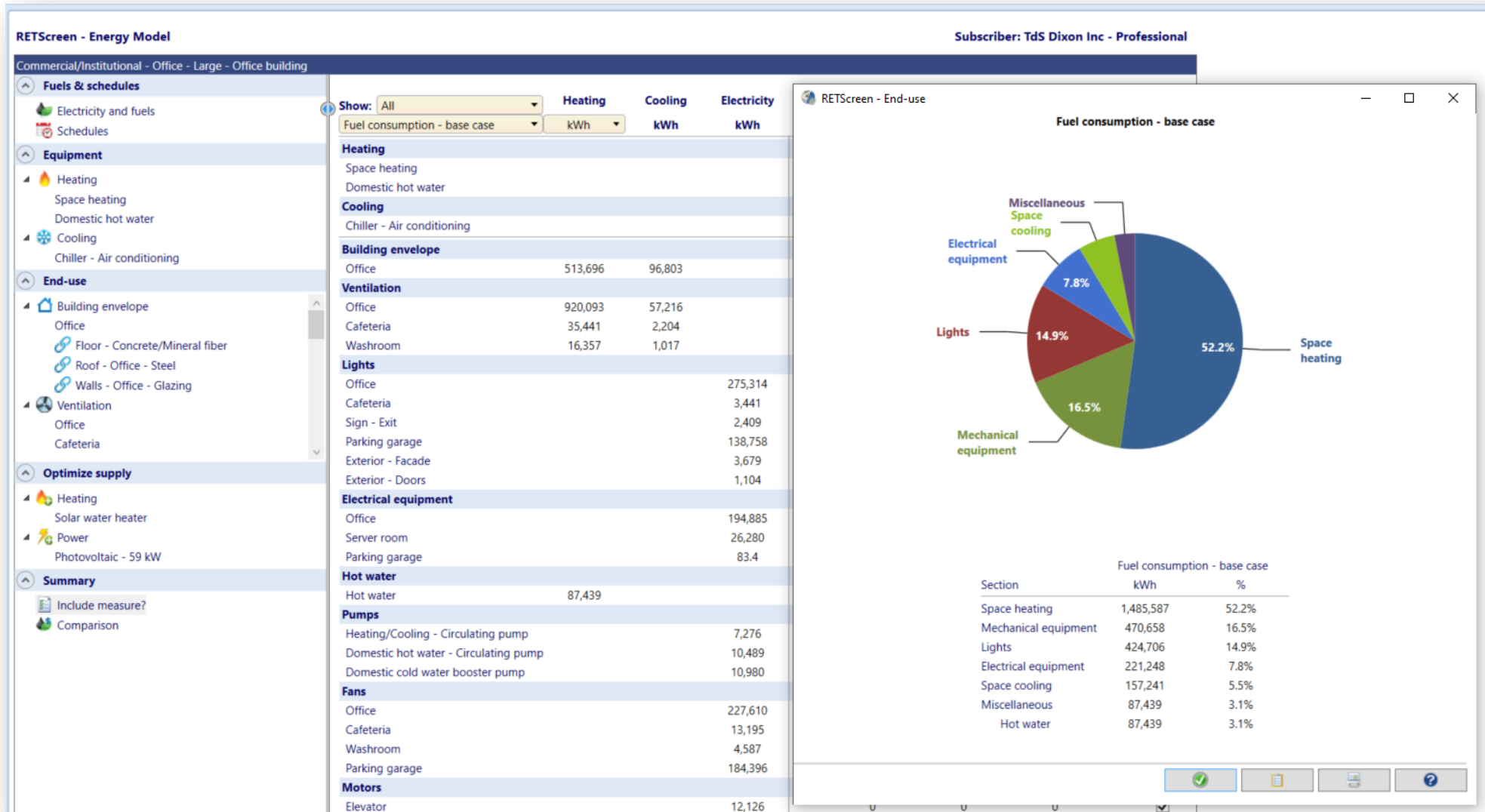
Initial costs \$

O&M costs (savings) \$/kW-year

Result: Carbon Reduction...



Results Feasibility Analysis – Base Case Inventory



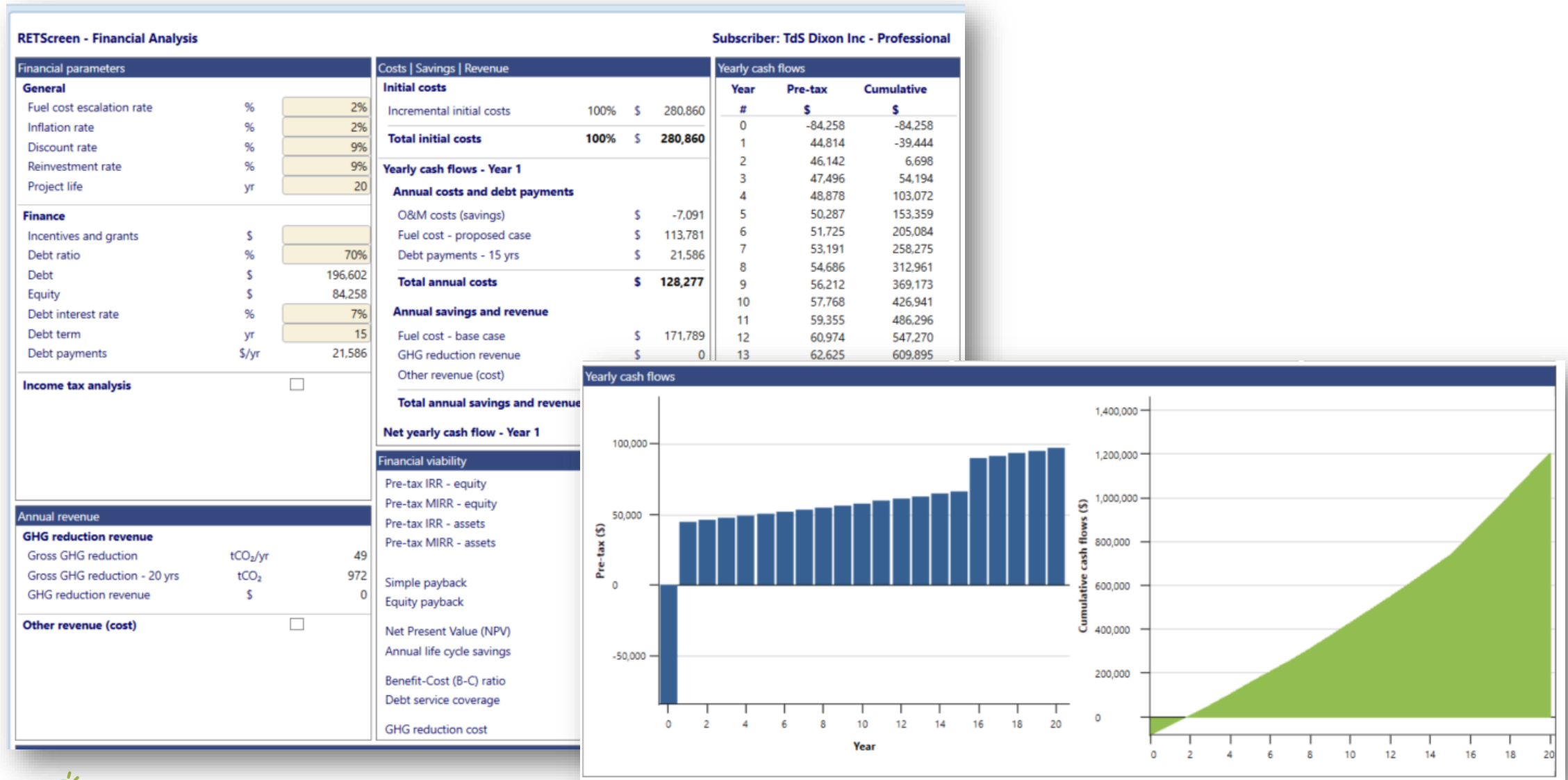
Results: A Selection of Proposed Case Opportunities...

RETScreen - Energy Model Subscriber: TdS Dixon Inc - Professional

Commercial/Institutional - Office - Large - Office building

	Show: All	Heating	Cooling	Electricity	Incremental initial costs	Fuel cost savings	Incremental O&M savings	Simple payback	Include measure?
	Fuel consumption - base case	kWh	kWh	kWh	\$	\$	\$	yr	☒
Fuels & schedules									
Electricity and fuels									
Schedules									
Equipment									
Heating									
Space heating					0	0	0		☒
Domestic hot water					0	0	0		☒
Cooling									
Chiller - Air conditioning					0	0	0		☒
Building envelope									
Office	513,696	96,803			20,100	8,899	0	2.3	☒
Ventilation									
Office	920,093	57,216			5,400	3,977	0	1.4	☒
Cafeteria	35,441	2,204			300	220	0	1.4	☒
Washroom	16,357	1,017			4,800	-5.1	0	None	☒
Lights									
Office				275,314	159,100	14,016	2,219	9.8	☒
Cafeteria				3,441	2,145	194	35.7	9.3	☒
Sign - Exit				2,409	575	175	350	1.1	☒
Parking garage				138,758	18,615	11,984	3,196	1.2	☒
Exterior - Facade				3,679	4,250	175	-220	None	☒
Exterior - Doors				1,104	1,275	52.6	-65	None	☒
Electrical equipment									
Office				194,885	32,200	8,046	150	3.9	☒
Server room				26,280	0	0	0		☒
Parking garage				83.4	0	0	0		☒
Hot water									
Hot water	87,439				14,700	508	1,425	7.6	☒
Pumps									
Heating/Cooling - Circulating pump				7,276	1,000	360	0	2.8	☒
Domestic hot water - Circulating pump				10,489	400	744	0	0.5	☒
Optimize supply									
Heating									
Solar water heater									
Power									
Photovoltaic - 59 kW									
Summary									
Include measure?									
Comparison									

Result: A Compelling Financial/Business Case...



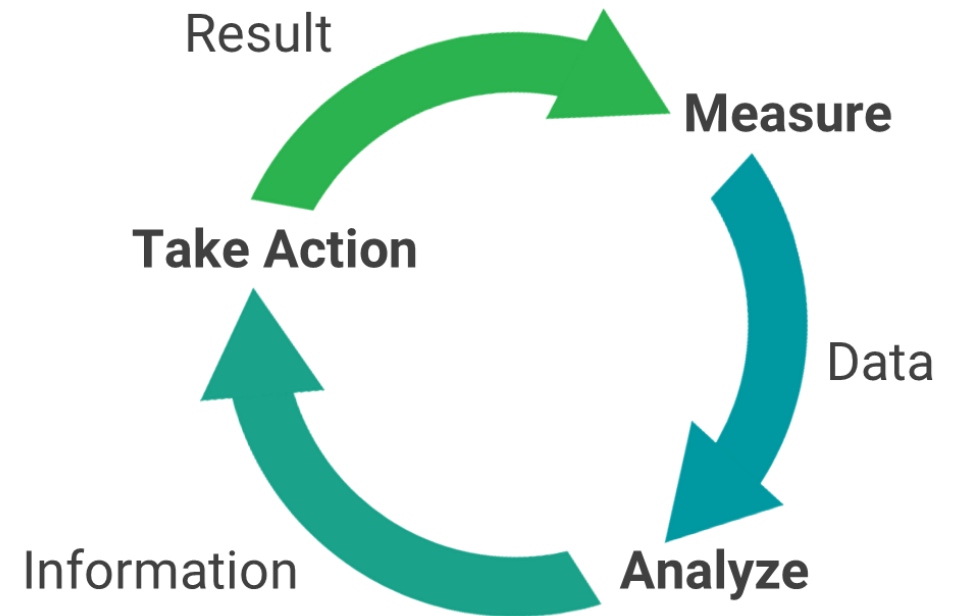
Performance Analysis

Tracking Improvement and Other Changes in Performance

Measure & Analyze Performance!

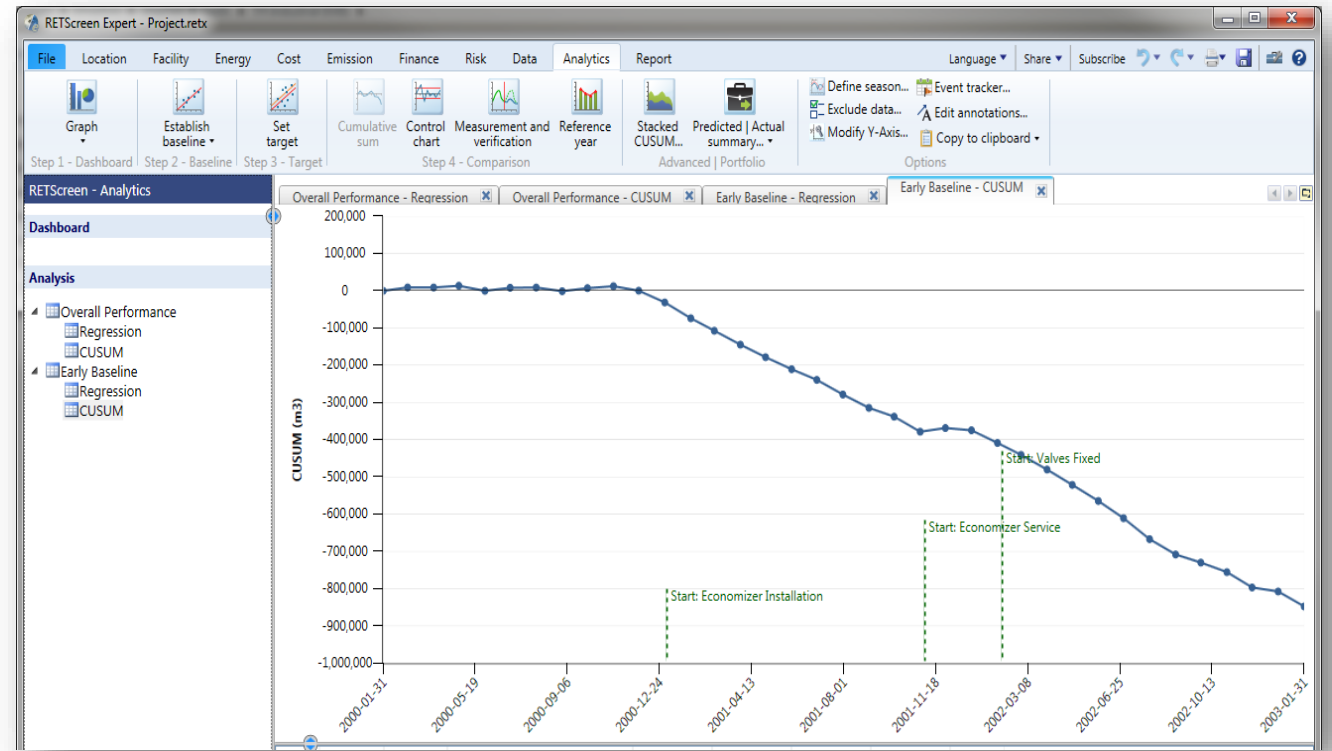
Performance = consumption versus influences

- If you can't measure your energy savings...they may not exist!
- The easiest conversation to have is one surrounding variance in consumption
- You CAN start with just MONTHLY bills!
- Every facility needs a CUSUM
 - **Cumulative Sum** of difference between Actual & Expected Consumption
 - It needs to be maintained and shared at least monthly.
 - More frequently if daily/weekly data used.

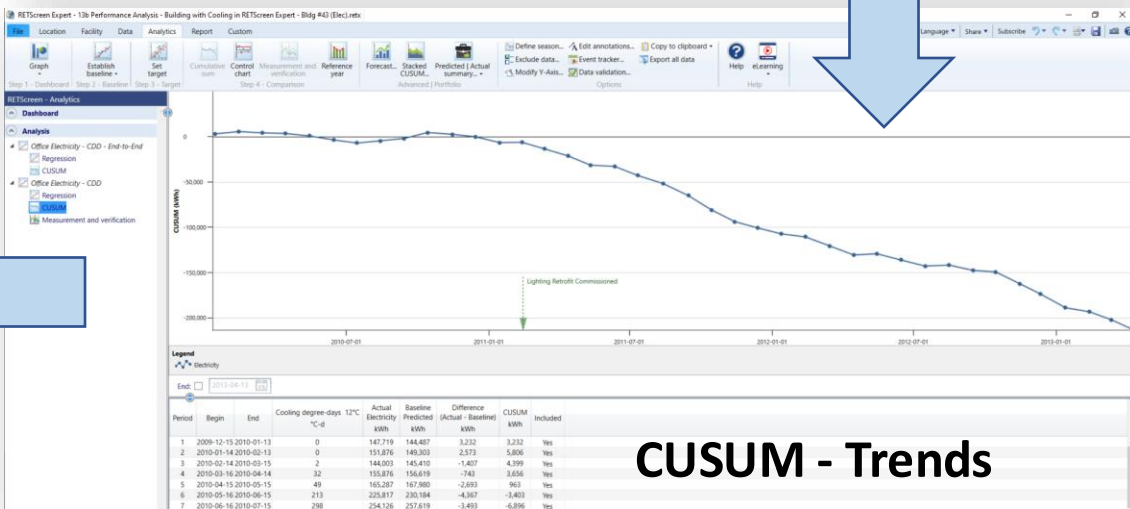
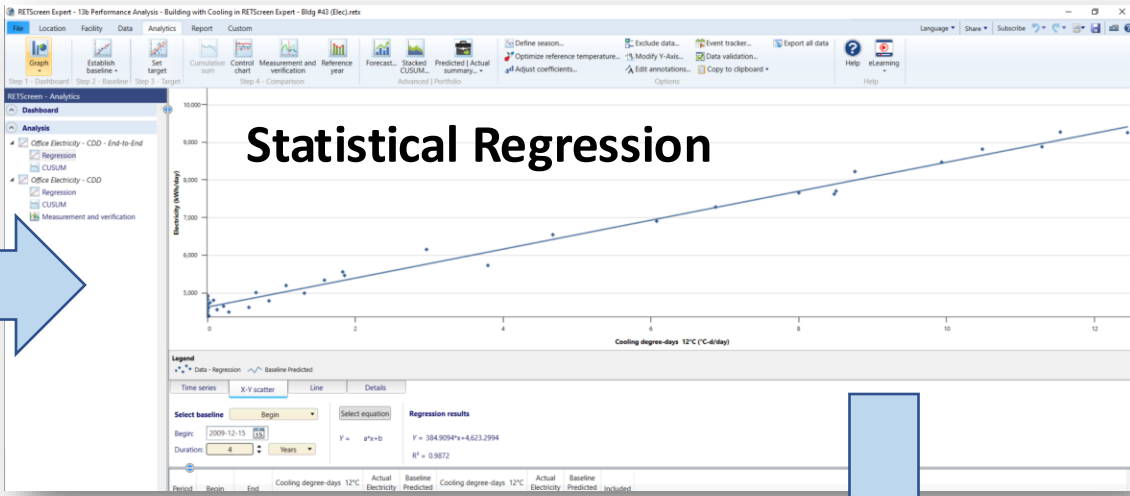
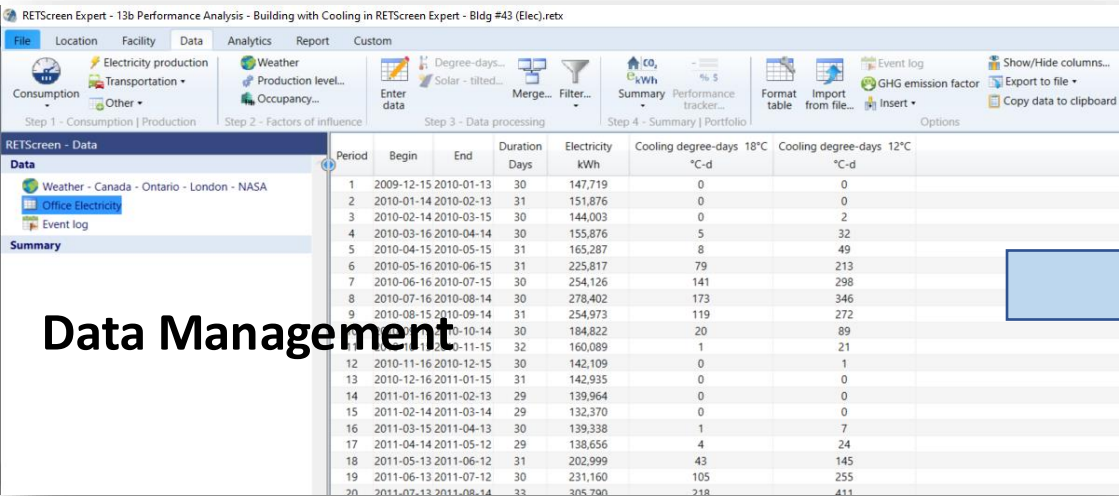


Why Monitor

- Measure and Verify Savings
 - Performance Assurance
- Catch those things that can go wrong – early detection?
 - Equipment non performance.
 - BAS schedules reset and setpoint overrides.
 - With LED lighting folks don't turn off lights.
 - Other loads increase.
 - A lot!

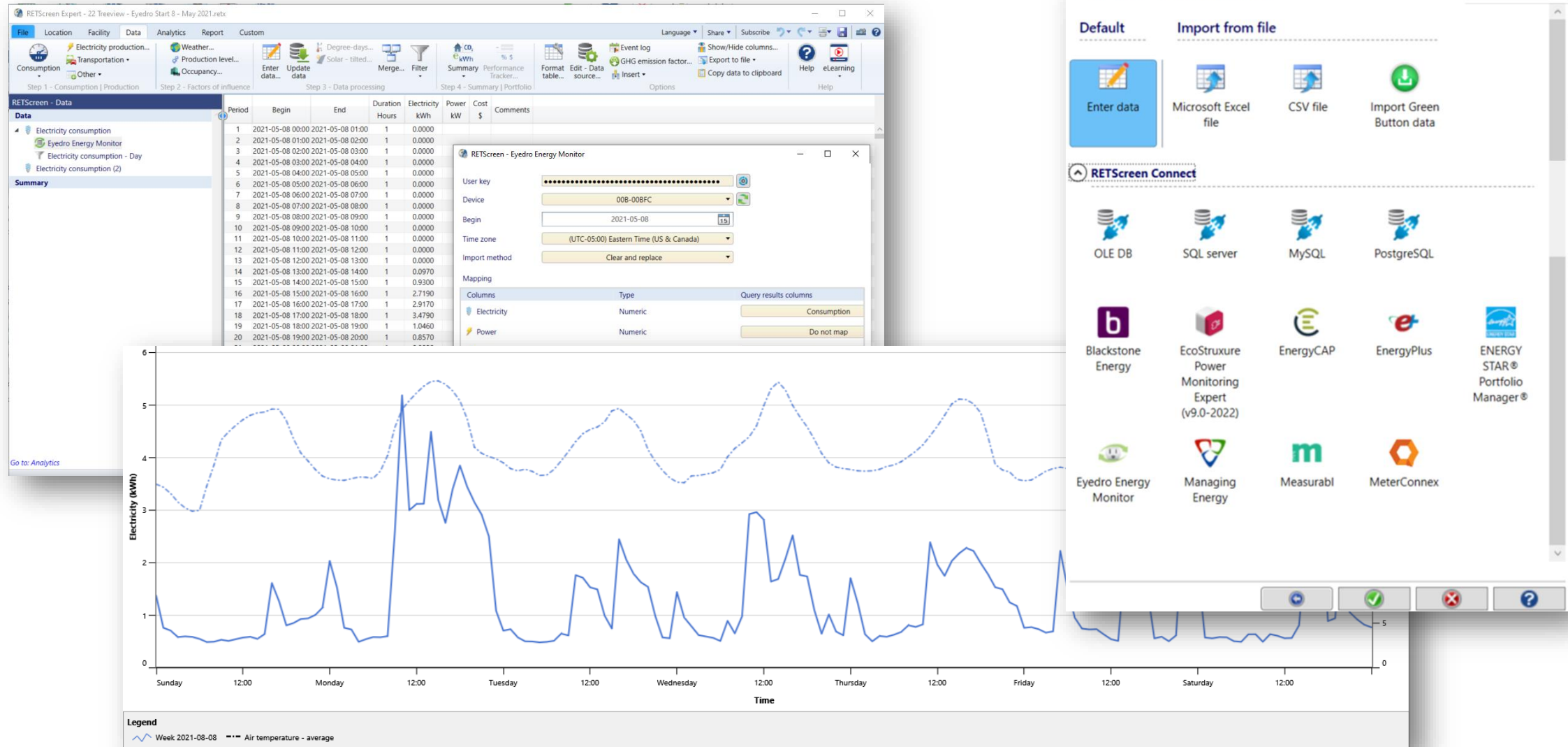


End to End Performance Analysis Tools



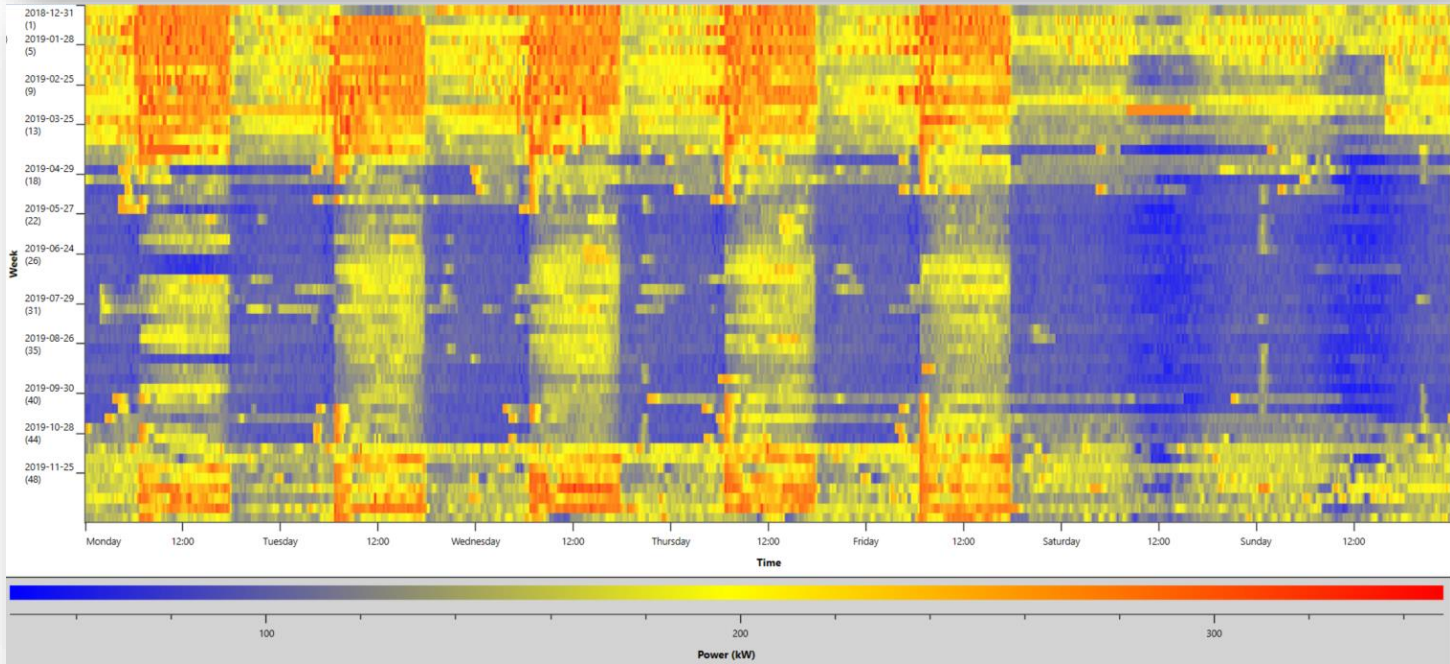
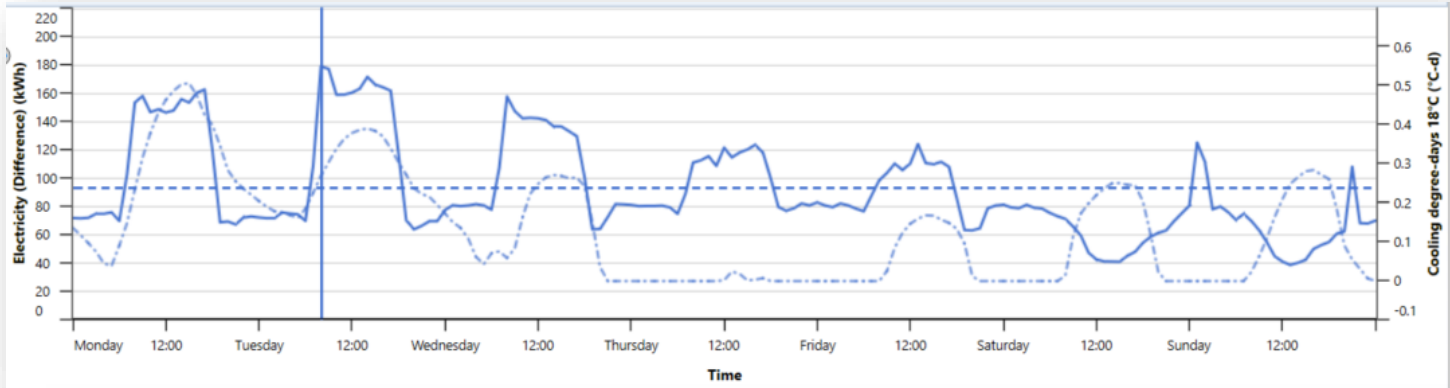
Note: CUSUM = Cumulative Sum of Differences

Case: Using RETScreen Expert to Analyzes Meter Data

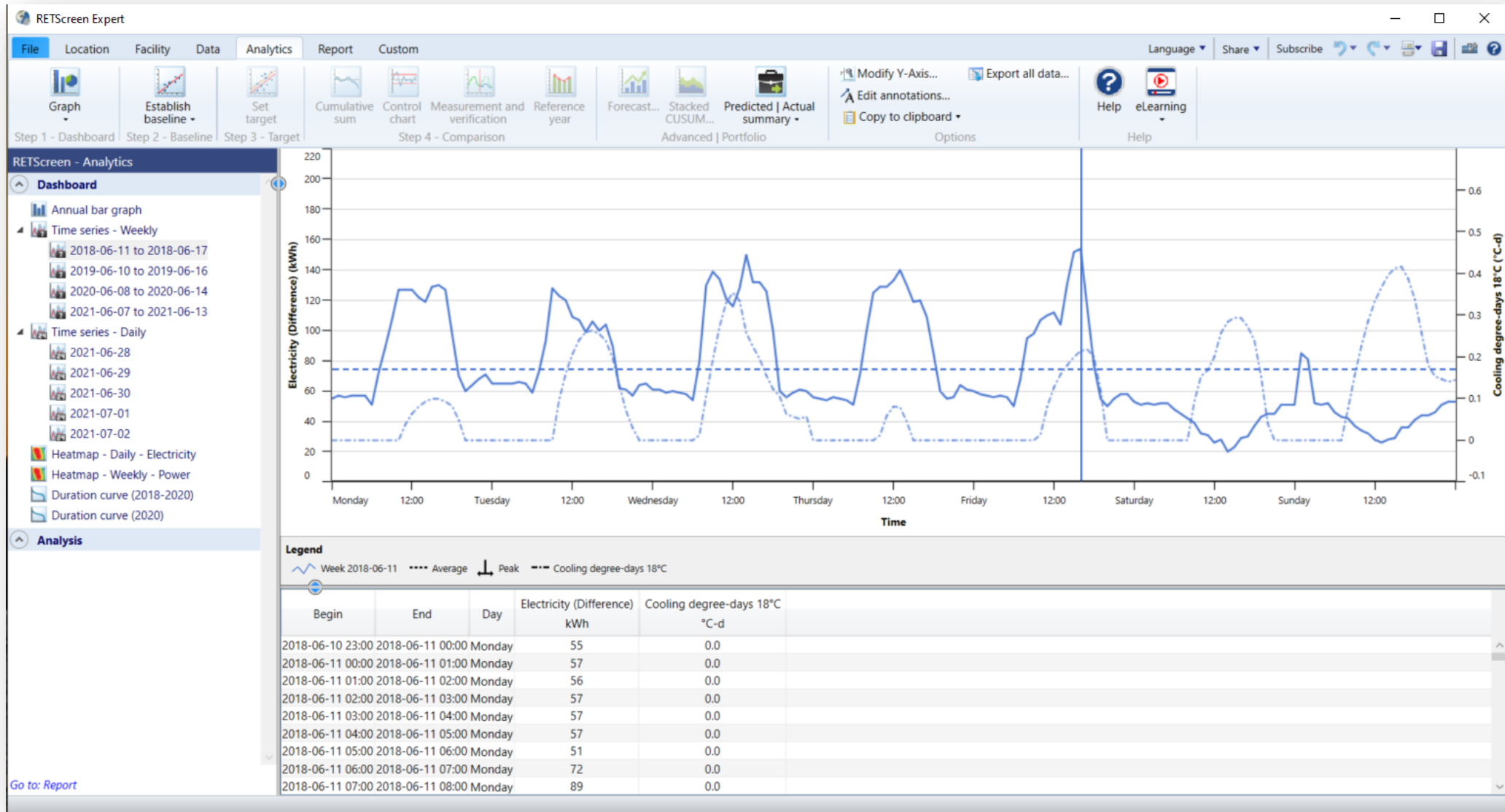


Visualization of 15 Minute Electric Demand Data

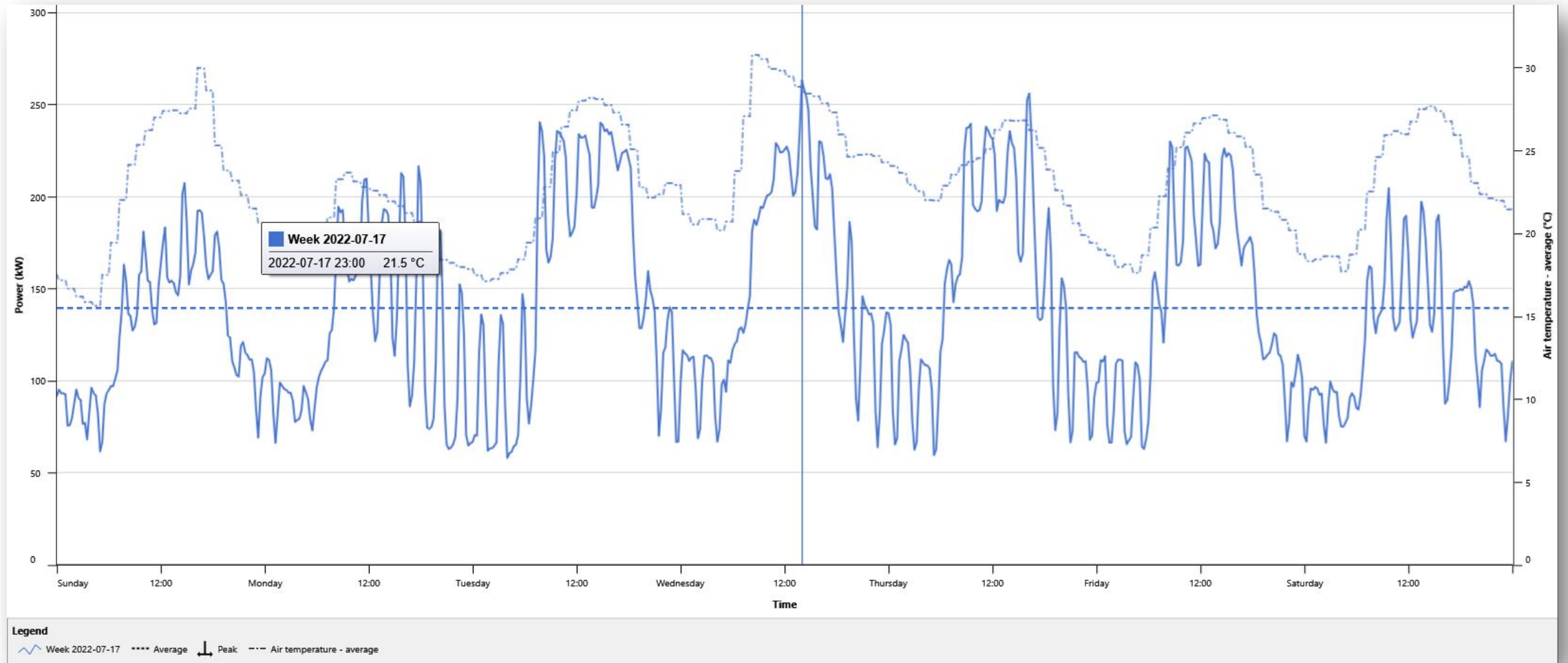
Begin	End	Duration Minutes	Electricity (Meter reading) kWh	Electricity (Difference) kWh	Power kW
2017-12-31 23:45	2018-01-01 00:00	15	7,906,632		207
2018-01-01 00:00	2018-01-01 00:15	15	7,906,674	42	207
2018-01-01 00:15	2018-01-01 00:30	15	7,906,725	51	251
2018-01-01 00:30	2018-01-01 00:45	15	7,906,772	47	239
2018-01-01 00:45	2018-01-01 01:00	15	7,906,810	39	215
2018-01-01 01:00	2018-01-01 01:15	15	7,906,859	49	233
2018-01-01 01:15	2018-01-01 01:30	15	7,906,906	47	221
2018-01-01 01:30	2018-01-01 01:45	15	7,906,944	38	208
2018-01-01 01:45	2018-01-01 02:00	15	7,906,993	49	257
2018-01-01 02:00	2018-01-01 02:15	15	7,907,039	46	246
2018-01-01 02:15	2018-01-01 02:30	15	7,907,077	38	199
2018-01-01 02:30	2018-01-01 02:45	15	7,907,123	46	227
2018-01-01 02:45	2018-01-01 03:00	15	7,907,170	48	220
2018-01-01 03:00	2018-01-01 03:15	15	7,907,206	36	174
2018-01-01 03:15	2018-01-01 03:30	15	7,907,251	46	250
2018-01-01 03:30	2018-01-01 03:45	15	7,907,296	45	209
2018-01-01 03:45	2018-01-01 04:00	15	7,907,335	39	195
2018-01-01 04:00	2018-01-01 04:15	15	7,907,376	42	215
2018-01-01 04:15	2018-01-01 04:30	15	7,907,424	48	231
2018-01-01 04:30	2018-01-01 04:45	15	7,907,461	37	183
2018-01-01 04:45	2018-01-01 05:00	15	7,907,504	43	227
2018-01-01 05:00	2018-01-01 05:15	15	7,907,552	48	224
2018-01-01 05:15	2018-01-01 05:30	15	7,907,594	43	212
2018-01-01 05:30	2018-01-01 05:45	15	7,907,632	38	207
2018-01-01 05:45	2018-01-01 06:00	15	7,907,683	51	258
2018-01-01 06:00	2018-01-01 06:15	15	7,907,727	44	211
2018-01-01 06:15	2018-01-01 06:30	15	7,907,767	40	200
2018-01-01 06:30	2018-01-01 06:45	15	7,907,819	53	257
2018-01-01 06:45	2018-01-01 07:00	15	7,907,878	59	296
2018-01-01 07:00	2018-01-01 07:15	15	7,907,929	51	245
2018-01-01 07:15	2018-01-01 07:30	15	7,907,980	51	240
2018-01-01 07:30	2018-01-01 07:45	15	7,908,035	56	276



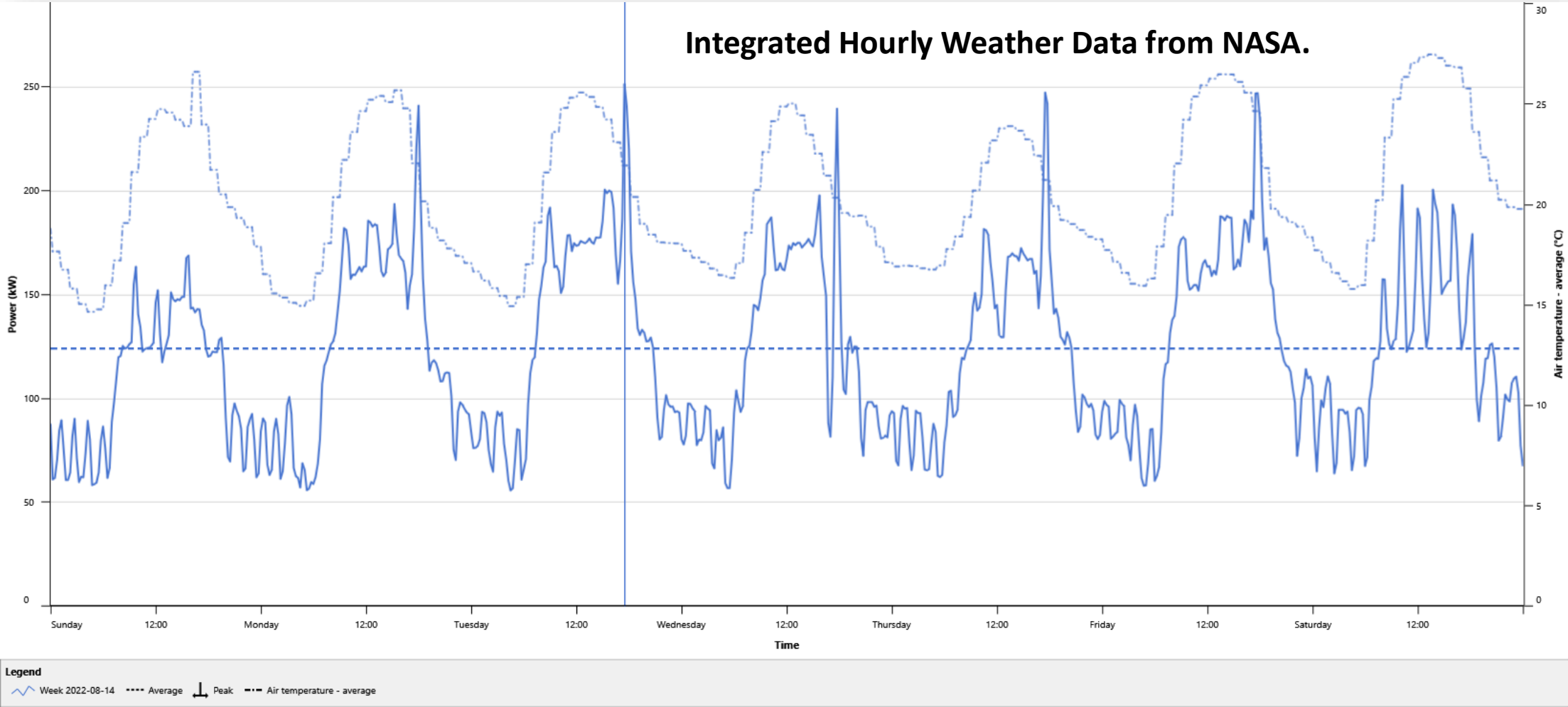
Sub Daily Demand Profile – Always an Opportunity!



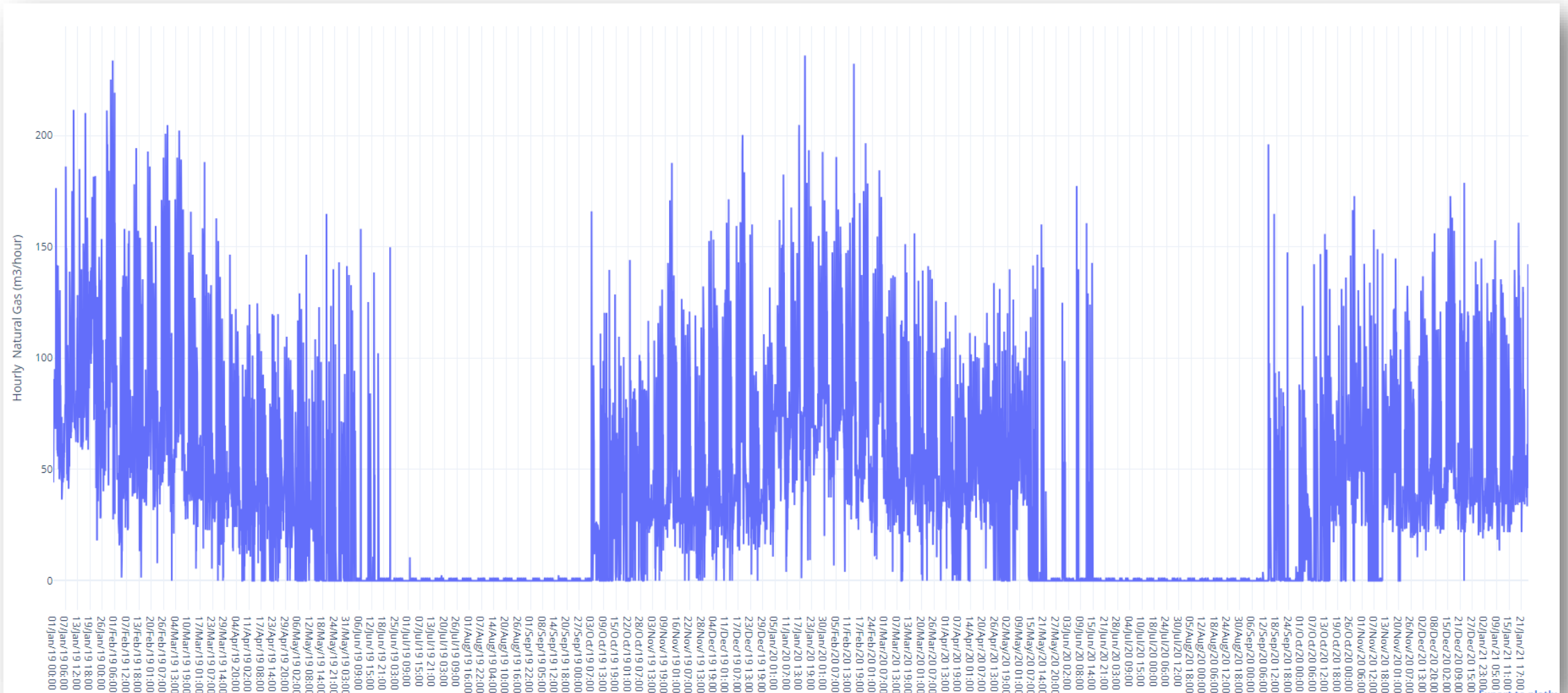
15 Min Data Reveals Compressor Cycling Problem



15 Min Data Reveals HVAC Control Conflict

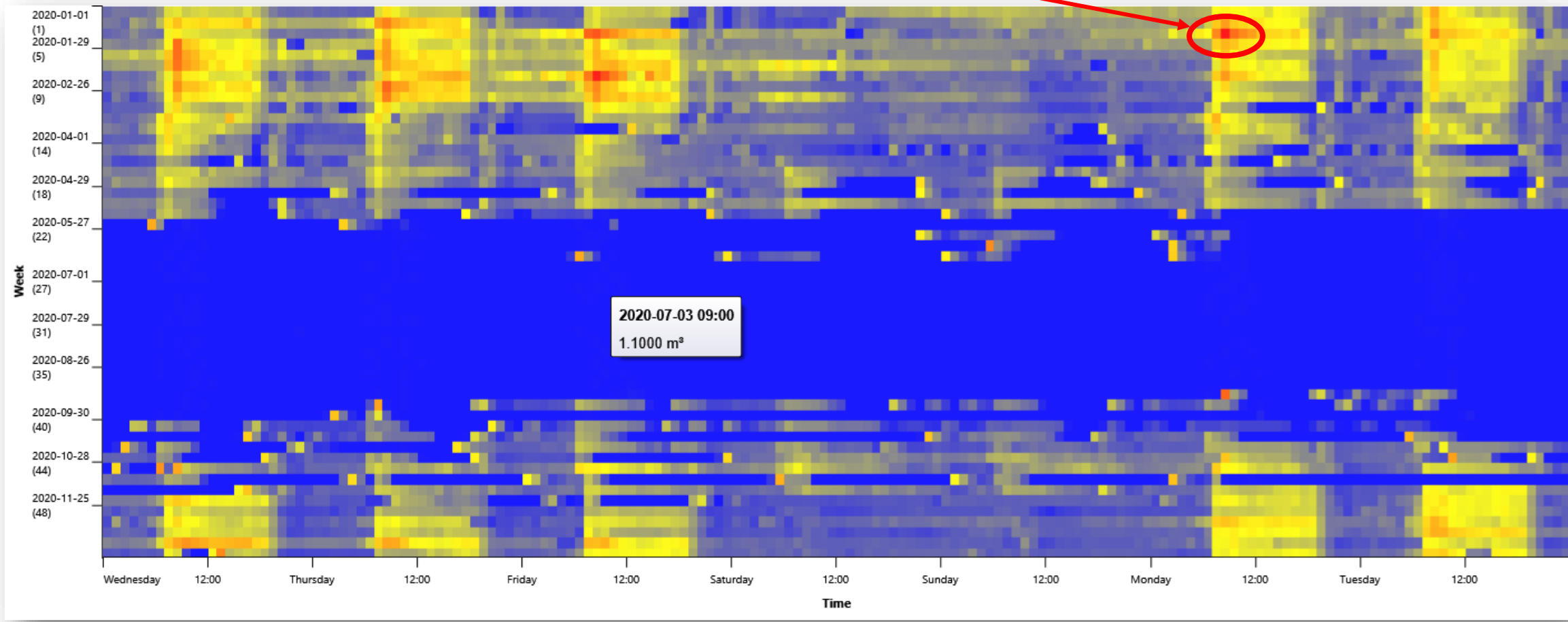


Hourly Gas Interval Data for Electrification Analysis



The Heat Map For Gas Data – Making Sizing Easier

Peak Heating Load

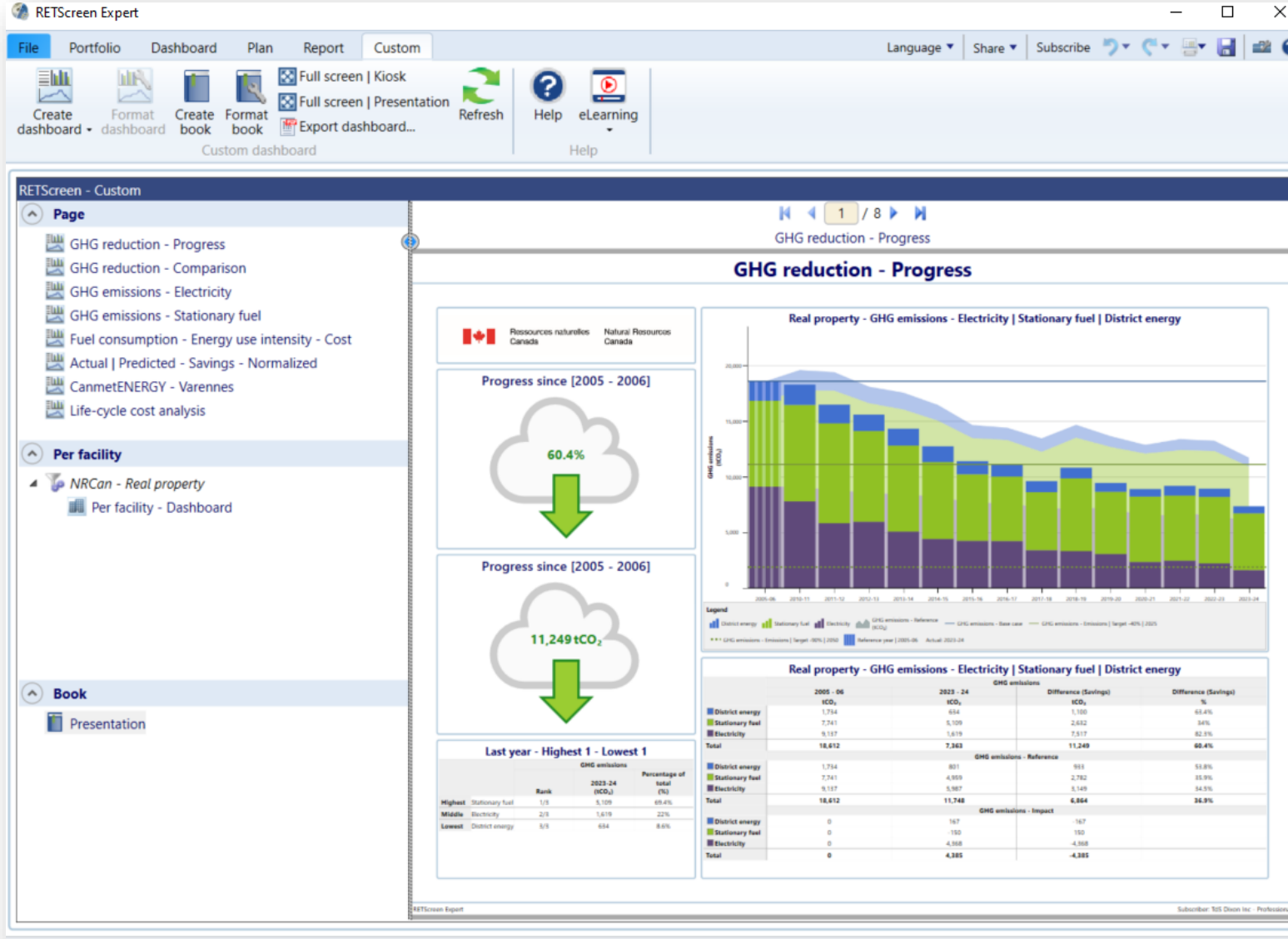


Reporting Features

One Click Reporting – Print, E-mail & Export to PDF

The screenshot displays the RETScreen Expert software interface. The title bar reads "RETScreen Expert - Bells Corners Complex.retx [Read-only]". The menu bar includes File, Location, Facility, Data, Analytics, Report, and Custom. The toolbar contains icons for creating, opening, closing, deleting, formatting, and printing reports, as well as a zoom slider. The left sidebar shows a tree view of the report structure, with "Performance report" selected. The main content area displays the "Performance report" for the "Bells Corners Complex Laboratory". It features an aerial photograph of the facility and a list of report sections on the left, including Executive summary, Location | Climate data, Benchmark, Performance tracker, and various annual and monthly bar graphs for fuel consumption, GHG emissions, and fuel cost. The bottom of the report area is labeled "Commercial/Institutional - Other".

Custom Dashboards – Pages & Books



RETScreen - Custom dashboard - Book

Name Presentation

- ☒ GHG reduction - Progress
- ☒ GHG reduction - Comparison
- ☒ GHG emissions - Electricity
- ☒ GHG emissions - Stationary fuel
- ☒ Fuel consumption - Energy use intensity - Cost
- ☒ Actual | Predicted - Savings - Normalized
- ☒ CanmetENERGY - Varennes
- ☒ Life-cycle cost analysis

Select all Select none Move up Move down

Full screen | Kiosk - Advanced

✓ ✗ ?

Newsletters – Granular Performance Reporting



Portfolio Analysis

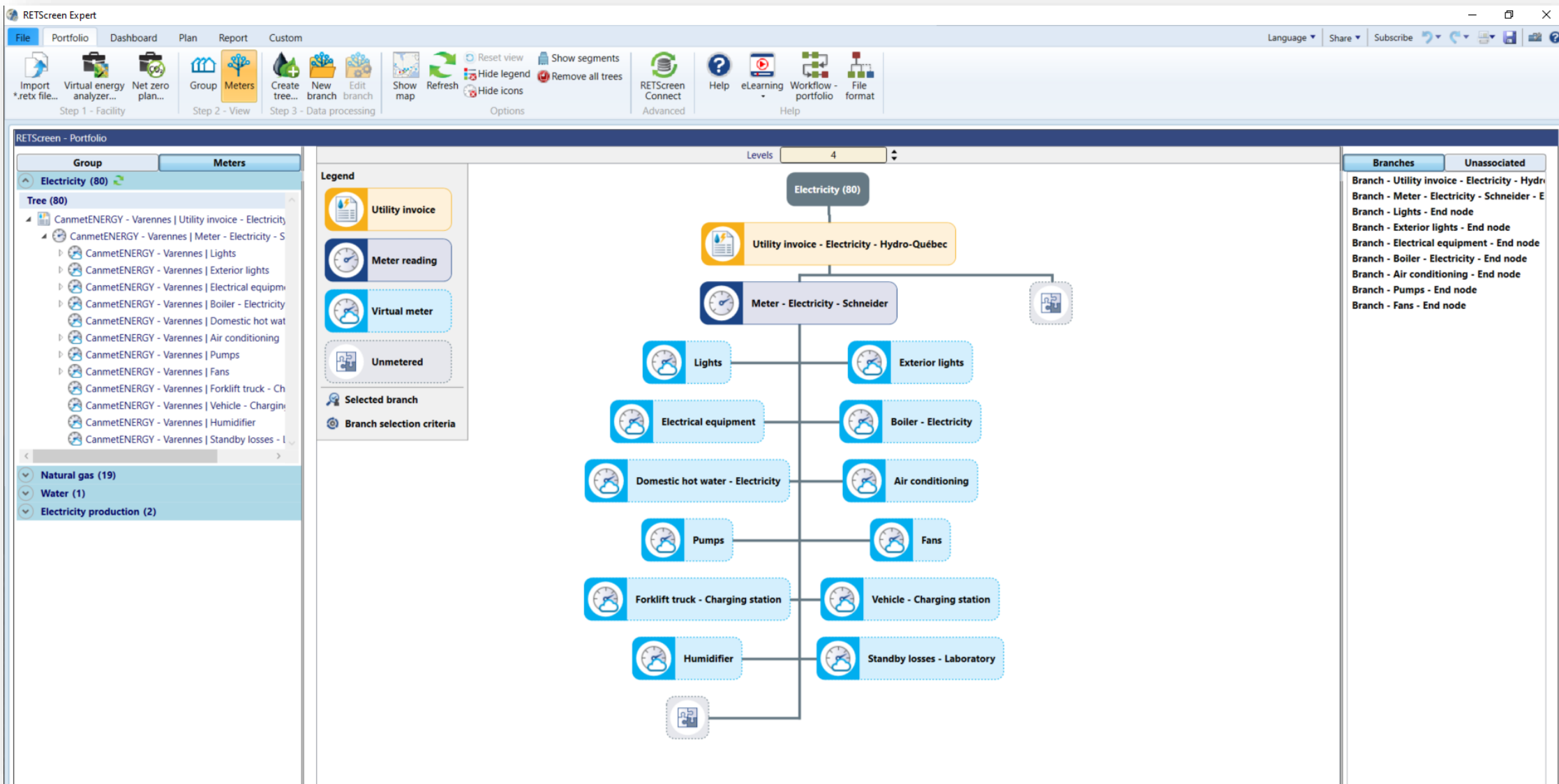
Including RETScreen Connect & The Net Zero Plan

The Portfolio View – Let's Take a Quick Tour

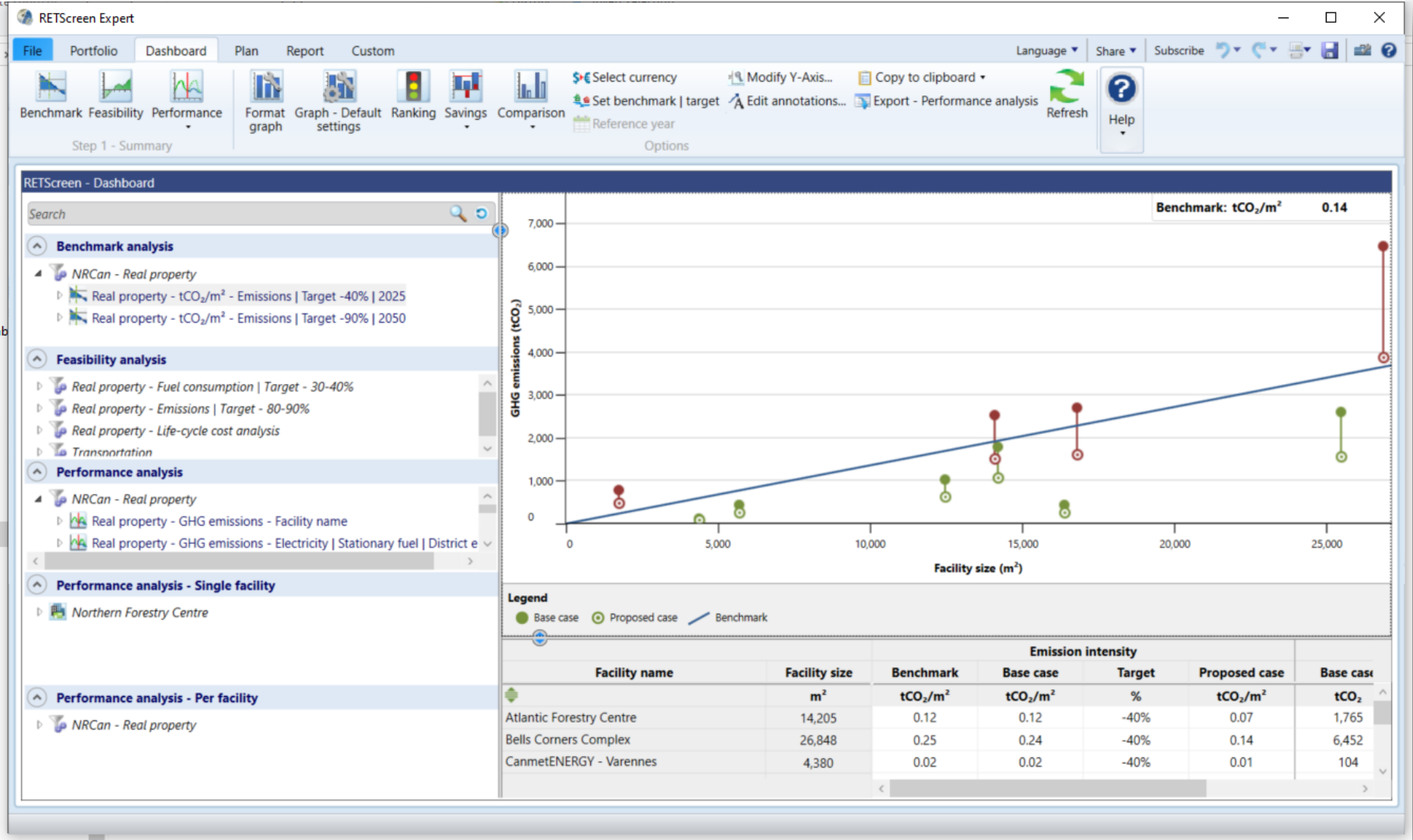
The screenshot shows the RETScreen Expert software interface. The main window is titled "RETScreen - Portfolio". On the left, there is a tree view showing the hierarchy of groups and facilities. The right pane displays a table of facilities with columns for File, Facility name, Facility type, Description, Facility size, Units, Analysis type, City/Municipality, Province/State, Country, and Image.

File	Facility name	Facility type	Description	Facility size	Units	Analysis type	City/Municipality	Province/State	Country	Image
✓	Atlantic Forestry Centre	Commercial/Institutional	Laboratory	14,205	m ²	Performance	Fredericton	NB	Canada	Show ima..
✓	Bells Corners Complex	Commercial/Institutional	Laboratory	26,848	m ²	Performance	Ottawa	ON	Canada	Show ima..
✓	CanmetENERGY - Varennes - Fleet	Transportation	On-road vehicles	50,000	km	All	Varennes	QC	Canada	Show ima..
✓	CanmetENERGY - Varennes	Commercial/Institutional	Laboratory	4,380	m ²	All	Varennes	QC	Canada	Show ima..
✓	Central Experimental Farm	Commercial/Institutional	Office	5,717	m ²	Performance	Ottawa	ON	Canada	Show ima..
✓	Geological Survey of Canada - Calgary	Commercial/Institutional	Office	16,792	m ²	Performance	Calgary	AB	Canada	Show image
✓	Great Lakes Forestry Centre	Commercial/Institutional	Laboratory	25,458	m ²	All	Sault Ste. Marie	ON	Canada	Show image
✓	Laurentian Forestry Centre	Commercial/Institutional	Laboratory	12,473	m ²	Performance	Quebec	QC	Canada	Show image
✓	Northern Forestry Centre	Commercial/Institutional	Laboratory	14,095	m ²	All	Edmonton	AB	Canada	Show image
✓	Pacific Forestry Centre	Commercial/Institutional	Laboratory	16,373	m ²	Performance	Victoria	BC	Canada	Show image

Portfolio View – Meter Mapping

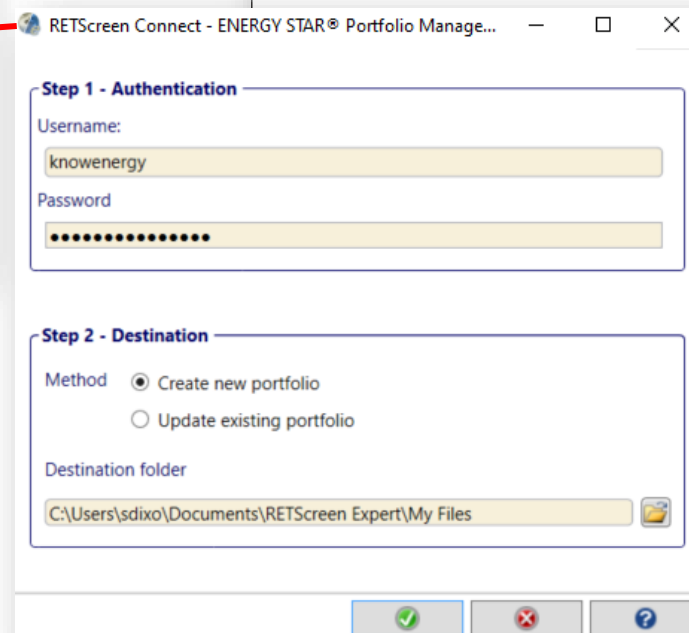
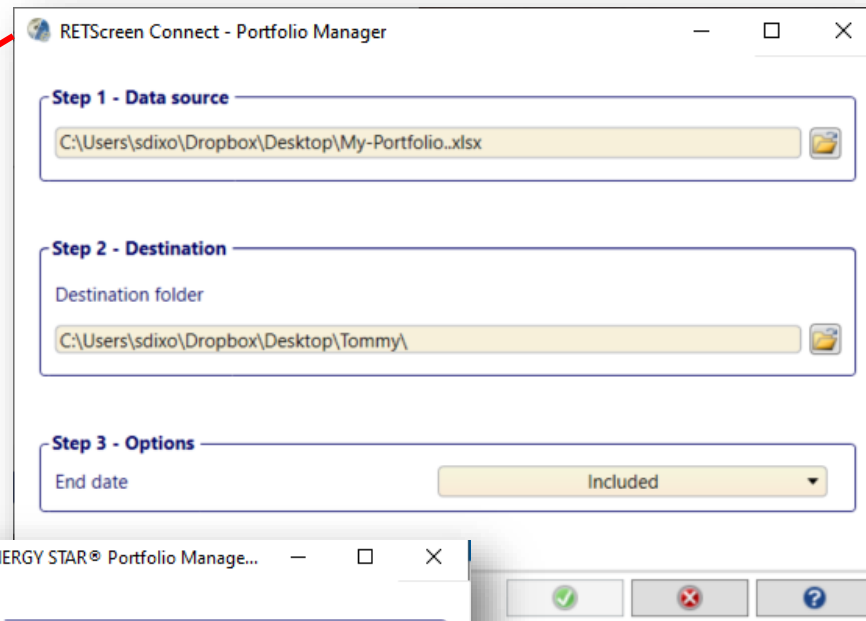
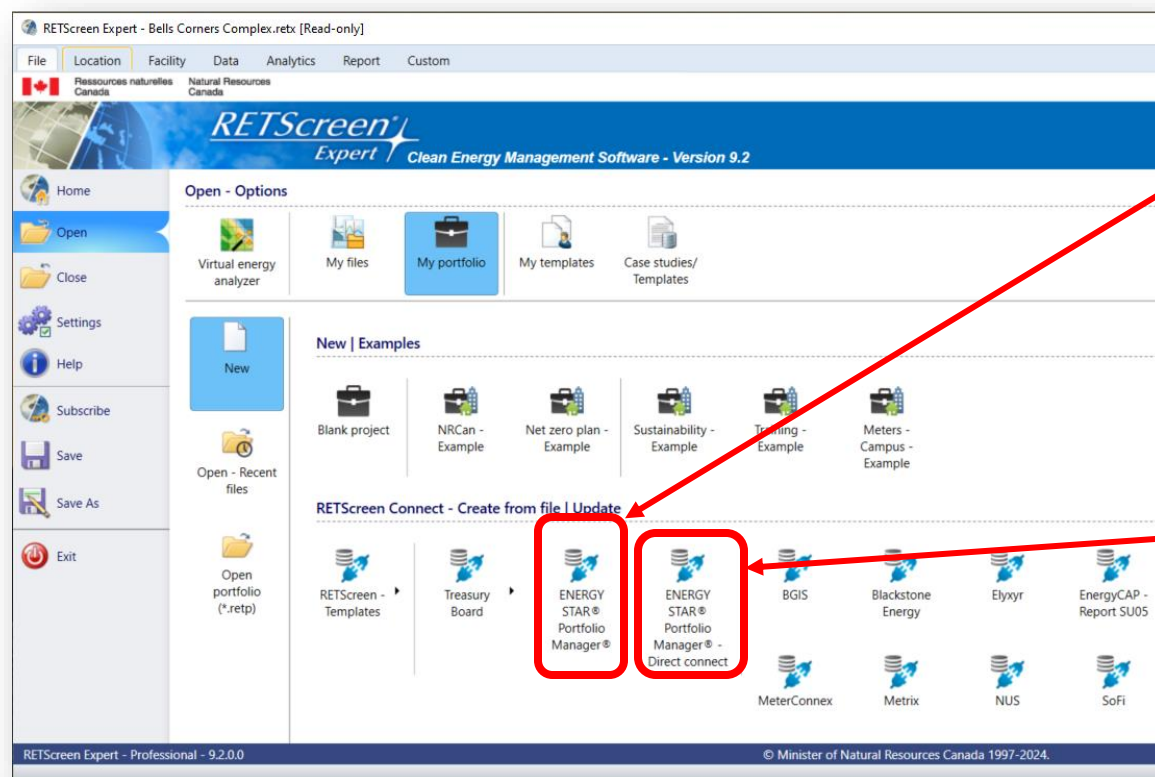


Portfolio Dashboard – Benchmarking – My Favourite

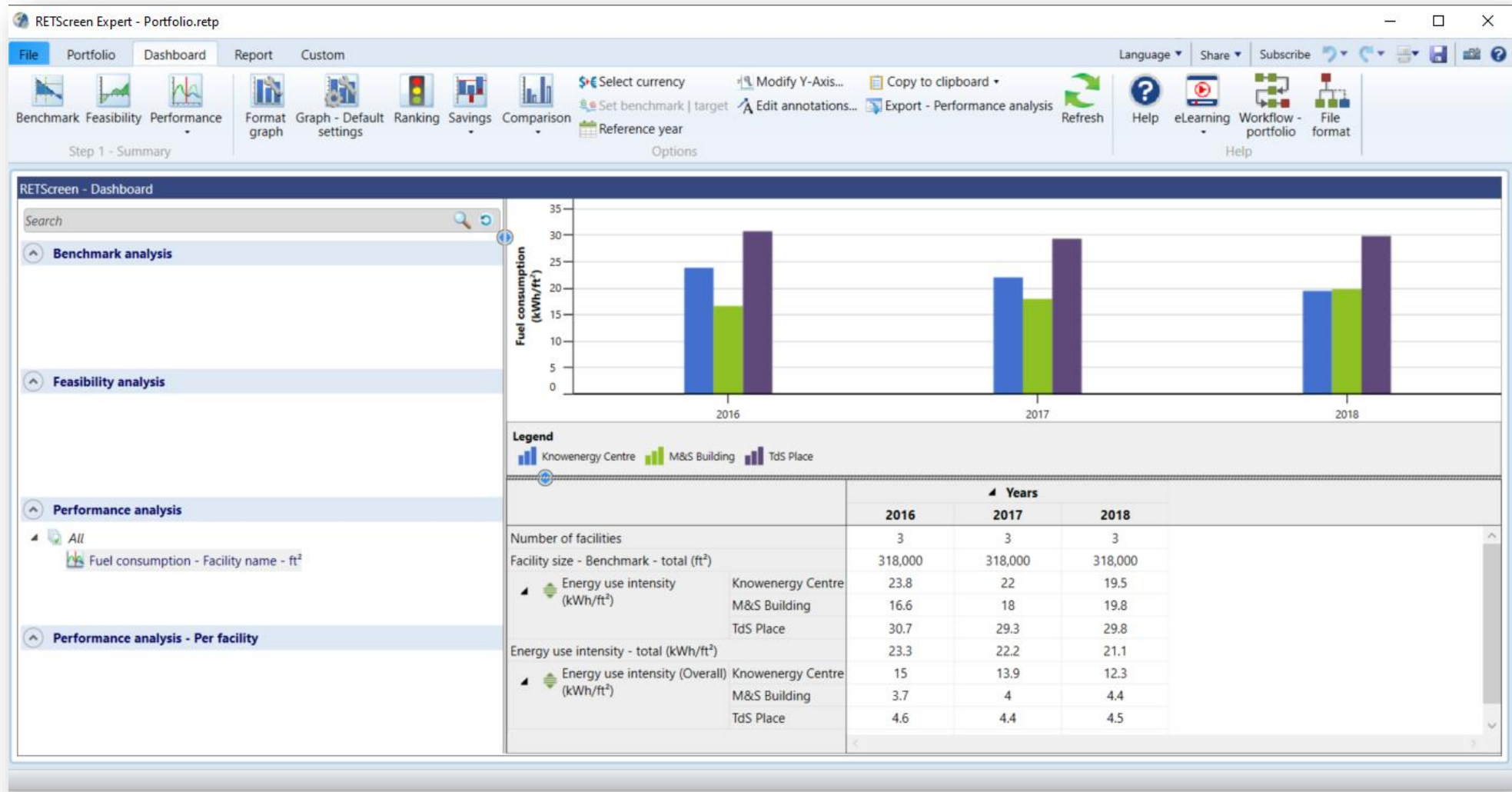


Portfolio Manager to RETScreen Data Connection

...Two Methods – Create from File or Direct Connect with API



A Few Clicks - The Result – Analysis Ready in RETScreen



The Net Zero Planner – Towards a Low Carbon Portfolio

RETScreen - Net zero plan - Real property

Destination folder
File location C:\Users\sdixo\Documents\RETScreen Expert\My Files\ Browse...
Group - Name Net zero plan

Default
Climate data location Canada - Quebec - Varennes
Facility location Canada - QC - Varennes

Archetypal facilities ★★★★★
Facility type Commercial/Institutional
Type Office building
Description Office - Large

Archetypes
Climate data location Canada - Quebec - Varennes
Facility location Canada - QC - Varennes
Climate zone 6A - Cold - Humid

Facility information
Facility name
Count 1
Disposed facilities - Count
Scaling | Calibration
Facility size - Actual m² 3,600
Exponent - Fuel consumption 1
Exponent - Costs 1

Archetypal facilities ★★★★★
Facility type Commercial/Institutional
Type Health care
Description Clinic/Outpatient

Facility size - Archetype m² 1,200
Factor - Fuel consumption % 300%
Factor - Costs % 300%

Climate data location Canada - Quebec - Varennes
Facility location Canada - QC - Varennes
Climate zone 6A - Cold - Humid

Facility information
Facility name
Count 1
Disposed facilities - Count
Scaling | Calibration

Archetypal facilities ★★★★★
Facility type Commercial/Institutional
Type Office building
Description Office - Small

Comprehensive Video:

https://www.youtube.com/watch?v=9at_7oywNj0

RETScreen - Net zero plan - Real property

Step 1 - Reference GHG emissions and target
☒ Reference 10,000 tCO₂
Reference year 2005
GHG emission reduction - Target 80%
Year 2050

Step 2 - Baseline energy and GHG emissions
GHG emission factor - Electricity Database | Projected
Baseline year 2022
Base case heating system Archetypal facilities

Step 3 - Cleaner electricity grid
☒ GHG emission factor - Electricity Database | Projected
Year 2050

Step 4 - Disposed facilities
Include ☐
Disposed facilities - Group - Name Disposed facilities

Step 5 - Energy efficiency measures
Archetypal facilities: Feasibility | Emission | Target - 80-90%

Step 6 - Electrification of heating
Include ☒
Boiler | Furnace ☒
Air-source heat pump ☒
Ground-source heat pump ☒
Peak load heating system Natural gas
Percentage of energy supplied 30%
Advanced ☒

Step 7 - Onsite renewables
Include - Photovoltaic ☒
Photovoltaic - Solar collector area Rooftop 35% Ground mount 0% % of roof
Boiler | Furnace 50% 25% % of roof
Air-source heat pump 50% 100% % of roof
Ground-source heat pump 50% 100% % of roof

Step 8 - Offsite renewables
Include ☒
Electricity rate - annual 0.16 \$/kWh

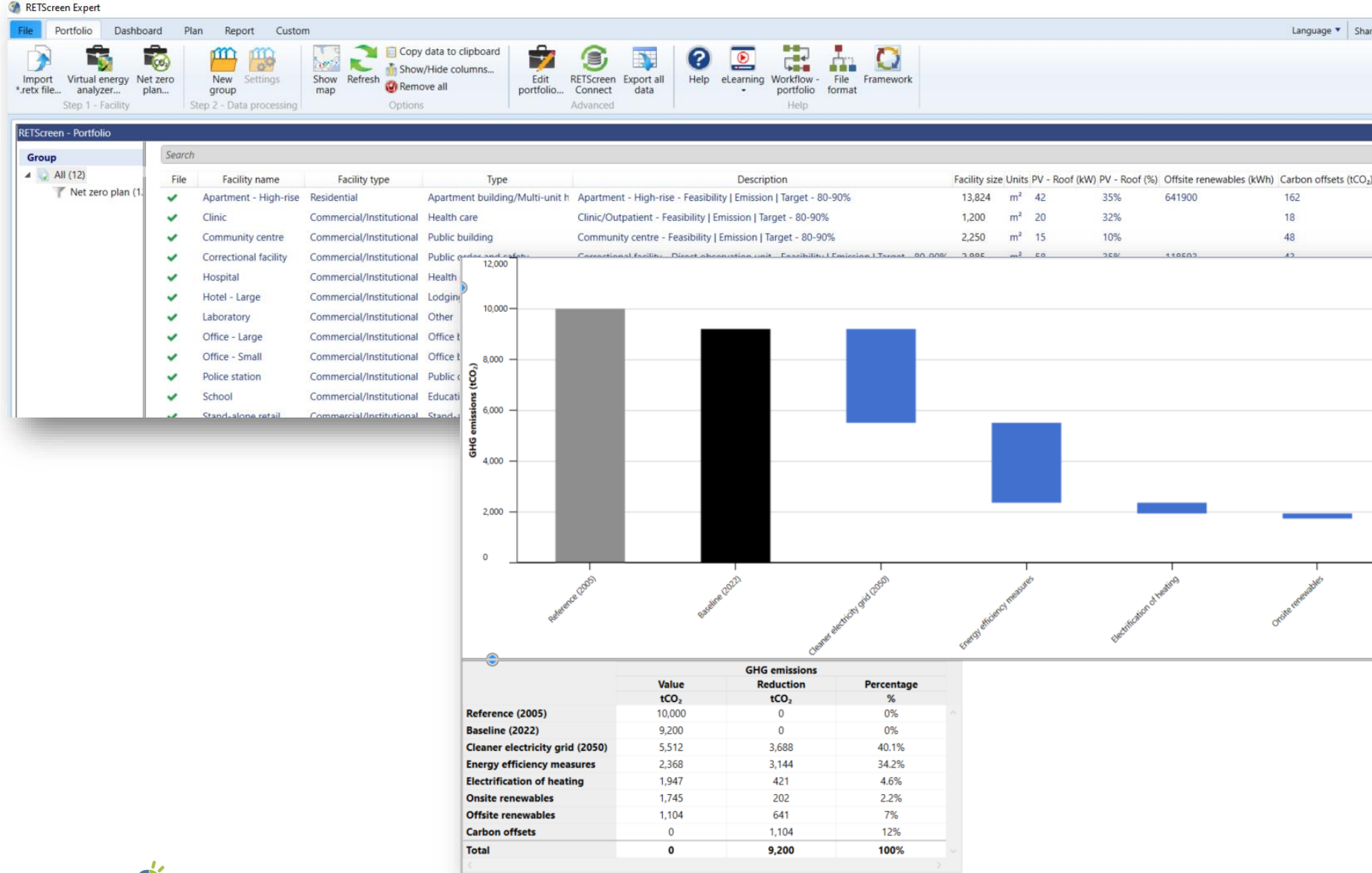
Step 9 - Carbon offsets
Include ☒
Net annual GHG emission reduction 100%
Carbon offsets rate 12 \$/tCO₂

Step 10 - Progress tracking and reporting
See - Performance analysis module
Performance

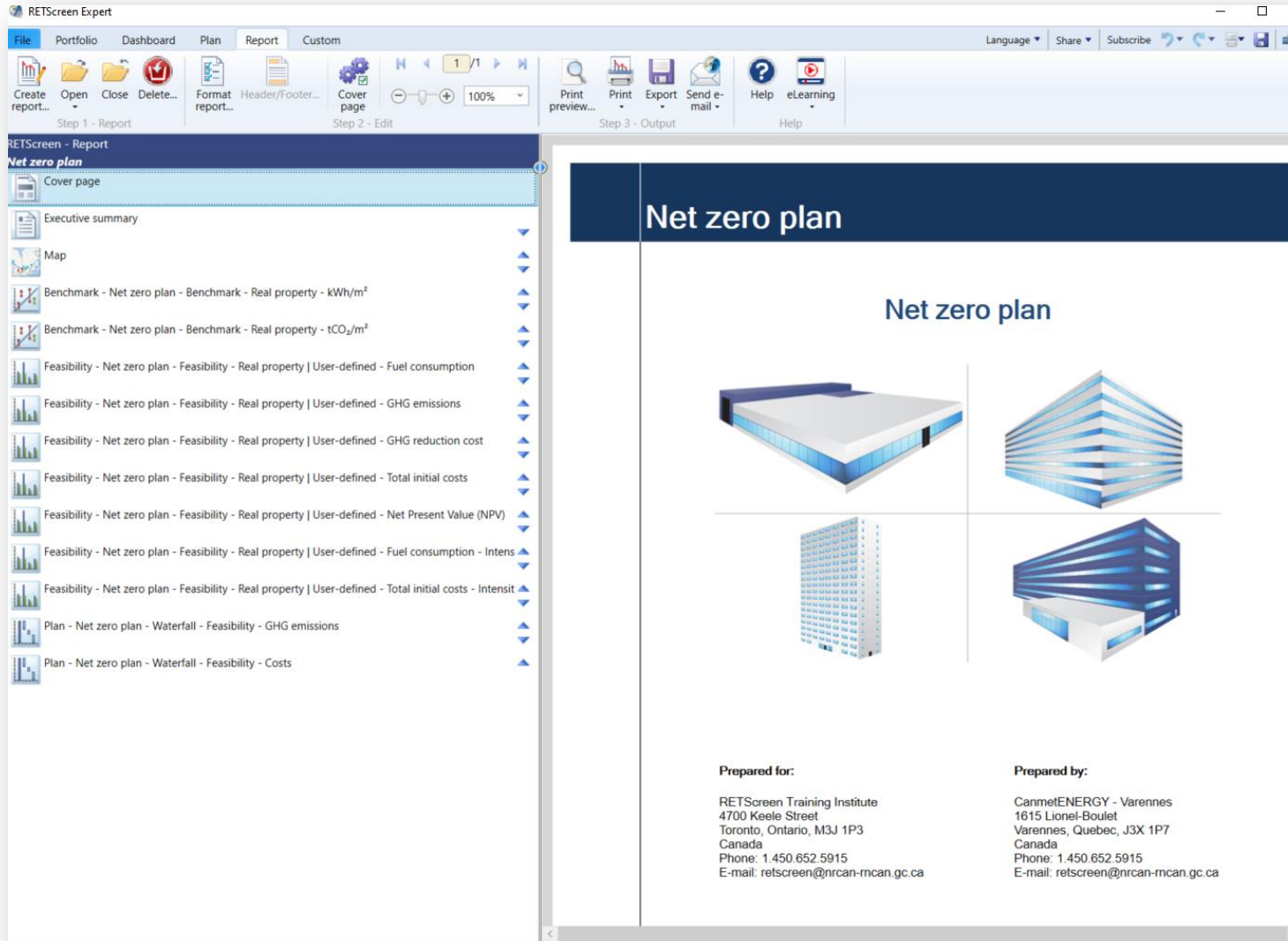
Financial parameters | Emission
Financial parameters
Method TBS - LCCA
Fuel cost escalation rate 2% %
Inflation rate 2% %
Discount rate 3% %
Project life 40 yr
Debt ratio 0% %
Emission
Carbon shadow price | GHG reduction credit rate 300 \$/tCO₂
Carbon shadow price duration | GHG reduction credit duration 40 yr

Display
Benchmark Analysis ☒
Feasibility analysis ☒
Waterfall ☒
Custom ☒

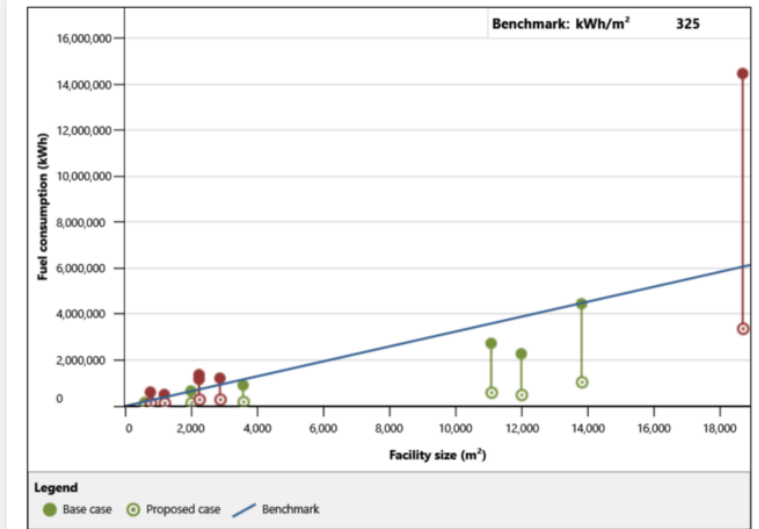
The Portfolio & The Net Zero Plan



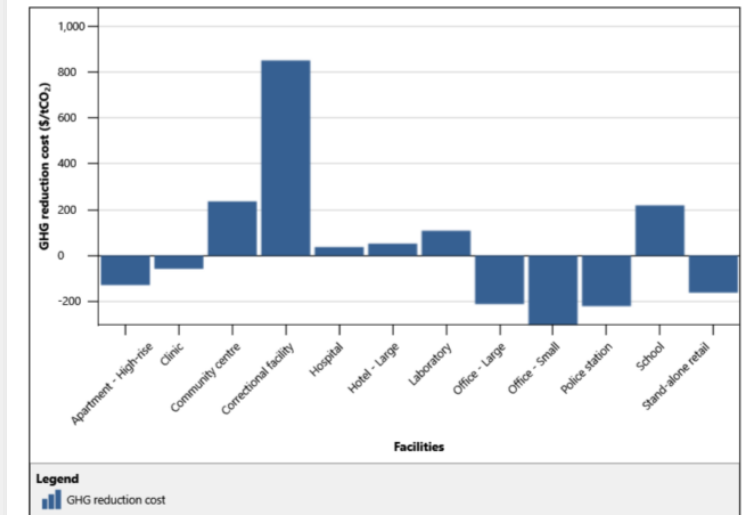
Net Zero Plan Report



Benchmark - Net zero plan - Benchmark - Real property - kWh/m²



Feasibility - Net zero plan - Feasibility - Real property | User-defined - GHG reduction cost



Summary

An All-in-One Energy Project Tool

The screenshot displays the RETScreen Expert software interface, titled "RETScreen Expert - Professional - 8.1.2.44". The interface includes a menu bar with options like File, Location, Facility, Energy, Cost, Emission, Finance, Risk, Data, Analytics, Report, and Custom. A sidebar on the left lists navigation options: Home, Open, Close, Settings, Help, Subscribe, Save, Save As, and Exit. The main workspace features a central circular diagram illustrating the workflow, with segments for Performance, Location, Facility, Energy, Cost, Emission, Feasibility, Finance, Risk, and Data. The central hub is labeled "RETScreen Decision Engine". Surrounding this hub are four main functional areas: Performance Tracker, Virtual Energy Analyzer, Financial Risk Assessor, and Smart Project Identifier. The interface also includes sections for "Getting started - Options" (Virtual energy analyzer, Analysis type - Blank project, Benchmark, Feasibility, Performance, All), "Workflow - Per facility", "Facility type - Examples" (Power plants, Power | Heating | Cooling, Power | Storage | Off-grid, Real property: Industrial | Agricultural, Commercial/Institutional, Residential, Military, Individual measure, Transportation, User-defined), and "Integrated features" (User manual, eLearning, Databases, Dashboards, About us, CanmetENERGY in Varennes, RETScreen Innovation Lab, RETScreen Data Onboarding, RETScreen Capacity Building, In collaboration with: ieso, REEEP, NASA, UNEP, gef). The footer contains copyright information: "© Minister of Natural Resources Canada 1997-2022." and "NRCAN/CanmetENERGY/Varennes".

Why Use RETScreen? Simplification

- How Will RETScreen® Make My Job/Life Easier?
 - It simplifies feasibility assessment so you can test drive different project options
 - It requires minimal user input
 - Practical models
 - Less opportunity for errors
 - Built in databases for first pass costing

RETScreen - Cost database - Lights

Lamp type	Lights - Typical installed cost								Lamp life (hours)
	Initial cost for lamp (\$/lamp)			Installation (\$)					
	Minimum	Average	Maximum	Low				High	
Compact fluorescent light	1.02	4.08	10.20	5.10	10.20	15.30	20.40	25.50	10,000
Fluorescent T5	4.08	6.12	10.20	5.10	10.20	15.30	20.40	25.50	20,000
Fluorescent T8	3.06	5.10	8.16	5.10	10.20	15.30	20.40	25.50	20,000
Fluorescent T12	4.08	5.10	10.20	5.10	10.20	15.30	20.40	25.50	20,000
Halogen	3.06	6.12	15.30	5.10	10.20	15.30	20.40	25.50	2,000
High pressure sodium	10.20	20.40	30.60	5.10	10.20	15.30	20.40	25.50	24,000
Incandescent	1.02	2.04	3.06	5.10	10.20	15.30	20.40	25.50	1,000
Light emitting diode (LED)	4.08	15.30	30.60	5.10	10.20	15.30	20.40	25.50	50,000
Low pressure sodium	25.50	40.80	66.30	5.10	10.20	15.30	20.40	25.50	16,000
Mercury vapour	10.20	30.60	45.90	5.10	10.20	15.30	20.40	25.50	24,000
Metal halide	20.40	35.70	76.50	5.10	10.20	15.30	20.40	25.50	15,000

Note: Typical cost values in Canadian \$ as of January 1, 2019. Purchasing power parity (Exchange rate) approximately 1.25 CAD = 1 USD.

Why Use RETScreen? Standardization

- Standardized procedures for objective comparison of potential projects
- Uses validated methodology to satisfy requirements of incentive programs and reporting standards
- Supports identification of most successful projects
 - Useful for budget prioritization
 - Increases potential for project success
- Reporting of carbon emissions

RETScreen - Emission Analysis Subscriber: TdS Dixon Inc - Professional

Base case electricity system (Baseline)

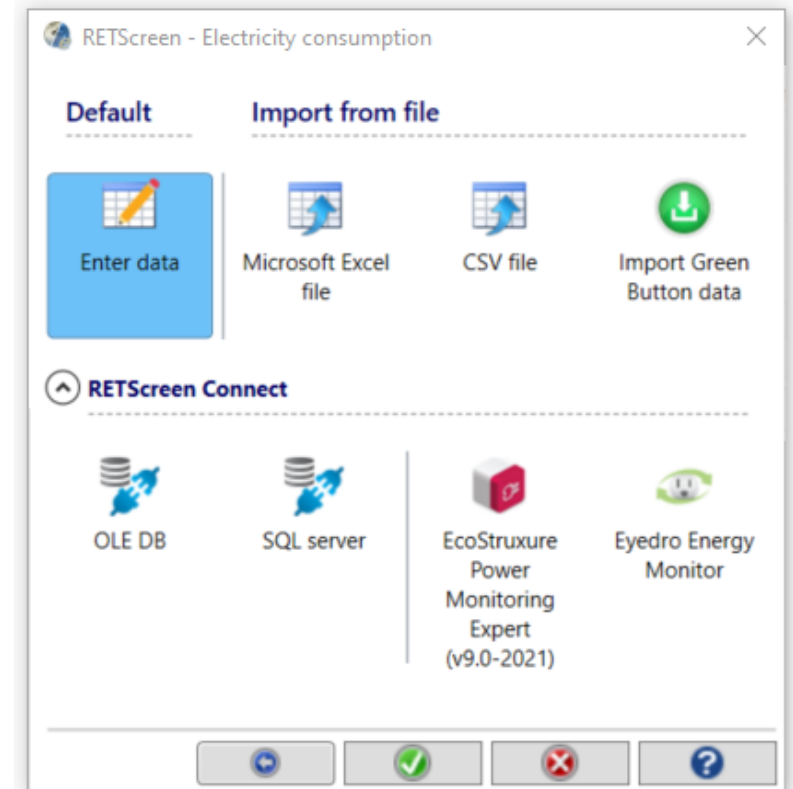
Fuel type	Fuel mix %	CO ₂ emission factor kg/GJ	CH ₄ emission factor kg/GJ	N ₂ O emission factor kg/GJ	Electricity generation efficiency %	T&D losses %	GHG emission factor kgCO ₂ /kWh
- Natural gas +	100.0%	49.6	0.0010	0.0009	40.8%	7.0%	0.473
Electricity mix	100.0%	130.7	0.0025	0.0024		7.0%	0.473
☐ Baseline changes during project life							

Base case system GHG summary (Baseline)

Fuel type	Fuel mix %	CO ₂ emission factor kg/GJ	CH ₄ emission factor kg/GJ	N ₂ O emission factor kg/GJ	Fuel consumption kWh	GHG emission factor kgCO ₂ /kWh	GHG emission tCO ₂
Electricity	44.7%	130.7	0.0025	0.0024	1,273.853	0.473	602
Natural gas	55.3%	49.6	0.0010	0.0009	1,573.026	0.179	282
Total	100.0%	85.9	0.0017	0.0016	2,846.879	0.311	885

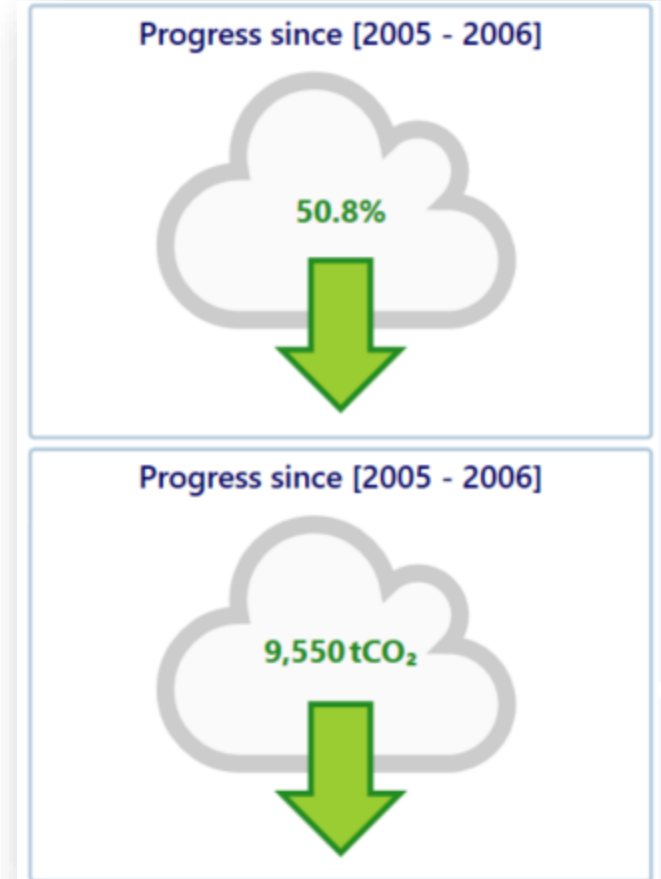
Why Use RETScreen? Interoperability

- RETScreen® is a nice fit with other programs
 - ENERGY STAR® Portfolio Manager
 - Mandatory reporting requirements such as energy use, emissions reporting, carbon reduction targets
- RETScreen Connect – direct connection to many online data sources
 - Green Button
 - OLE DB, SQL Server and many other



Why Use RETScreen? Persuasion

- Provides you with the analytical tools you need to communicate value and success at all levels
 - Graphs – linear regression, CUSUM, pie charts, heat maps, progress charts
 - Reports – automatically generates report including cover page, executive summary, supporting documents
 - Financial analysis – NPV, IRR, Benefit to Cost
 - Attractive custom dashboards
 - Carbon reduction graphics



The Help Desk for the Webinar!

Stephen Dixon

sdixon@knowenergy.com

