

# Recreation Complex with Arena and Pool

Rev A – Aug 2023

# Create RETScreen Eff Elec Template for Arena/Pool

- Augmented RETScreen Expert Arena Archetype with a Pool System
  - Envelope, ventilation, pool model, hot water, pool heater
- Added measures for
  - heat recovery on pool ventilation
  - pool blanket
  - Air leakage reduction
  - Converted DHW to Heat Pump HWH
  - Converted Space Heating to ASHP
  - Converted Pool Water heater to Electric
- Add cooling to existing Arena archetype.
  - Upgraded cooling system COP to reflect ASHP
- Need to adjust benchmarks using Ontario EWRB data.

# Energy Model – Net Zero Ready

Commercial/Institutional - Recreation Complex with Pool and Arena (base upon RETX Archetype) - Public building

		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	<input type="checkbox"/>
<b>Heating</b>										
	Space heating	602,133				0	6,067	0	Immediate	<input checked="" type="checkbox"/>
	Domestic hot water	79,374				0	1,073	0	Immediate	<input checked="" type="checkbox"/>
	Ice resurfacer	33,369				0	-659	0	None	<input checked="" type="checkbox"/>
	Swimming Pool Heater	21,060				0	-681	0	None	<input checked="" type="checkbox"/>
<b>Cooling</b>										
	Refrigeration system		125,747			450,000	15,090	0	29.8	<input checked="" type="checkbox"/>
	Space Cooling		4,736			0	568	0	Immediate	<input checked="" type="checkbox"/>
<b>Building envelope</b>										
	Ice rink	6,905				63,100	79.6	0	792.2	<input checked="" type="checkbox"/>
	Stands	1,252				15,100	-0.83	0	None	<input checked="" type="checkbox"/>
	General	8,571	312			955	-13.2	0	None	<input checked="" type="checkbox"/>
	Maintenance	2,524				245	-17.4	0	None	<input checked="" type="checkbox"/>
	Swimming Pool	5,216	0			0	-56.7	0	None	<input checked="" type="checkbox"/>
<b>Ventilation</b>										
	Ice rink	6,050				17,908	160	0	112.0	<input checked="" type="checkbox"/>
	Stands	47,790				3,600	1,338	0	2.7	<input checked="" type="checkbox"/>
	General	78,106				40,276	1,720	0	23.4	<input checked="" type="checkbox"/>
	Maintenance	24,809				10,800	622	0	17.4	<input checked="" type="checkbox"/>
	Swimming Pool	17,506				0	-99.8	0	None	<input checked="" type="checkbox"/>
<b>Lights</b>										
	Stands & ice rink			34,489		14,688	4,139	156	3.4	<input checked="" type="checkbox"/>
	Lobby   Office			1,597		880	192	0	4.6	<input checked="" type="checkbox"/>
	Corridor   Dressing room			2,541		1,400	305	0	4.6	<input checked="" type="checkbox"/>
	Maintenance			3,292		1,600	395	0	4.1	<input checked="" type="checkbox"/>
	Sign - Exit			3,154		1,031	378	145	2.0	<input checked="" type="checkbox"/>
	Exterior - Parking			13,753		6,063	1,650	30	3.6	<input checked="" type="checkbox"/>
	Exterior - Sign			263		244	31.5	46	3.1	<input checked="" type="checkbox"/>

# Model – Part 2

	ESP	LP	SP	IP	OP	IP
<b>Electrical equipment</b>						
Office	0	0	0	0		<input checked="" type="checkbox"/>
Vending machine	9,712	800	1,165	100	0.6	<input checked="" type="checkbox"/>
Standby losses	876	100	105	0	1.0	<input checked="" type="checkbox"/>
<b>Hot water</b>						
Rink Showers	9,313	4,405	144	2,029	2.0	<input checked="" type="checkbox"/>
Pool Showers	16,574	4,405	208	2,029	2.0	<input checked="" type="checkbox"/>
Ice resurfacing	34,521	0	-731	992	Immediate	<input checked="" type="checkbox"/>
Swimming Pool	42,375	0	-1,370	0	None	<input checked="" type="checkbox"/>
<b>Motors</b>						
Fans	33,174	0	3,981	0	Immediate	<input checked="" type="checkbox"/>
Pumps - Brine	78,632	30,000	9,436	0	3.2	<input checked="" type="checkbox"/>
<b>Process heat</b>						
Ice resurfacers	9,720	145,000	-82.4	5,000	29.5	<input checked="" type="checkbox"/>
<b>Heat recovery</b>						
Refrigeration - Space heating	60,963	89,400	7,316	0	12.2	<input checked="" type="checkbox"/>
Refrigeration - Domestic hot water	21,961	10,500	2,635	0	4.0	<input checked="" type="checkbox"/>
<b>Refrigeration</b>						
Ice rink	69,644	0	8,357	0	Immediate	<input checked="" type="checkbox"/>
<b>Power</b>						
Photovoltaic - 148 kW	177,390	281,200	21,287	-3,700	16.0	<input checked="" type="checkbox"/>
Offsite renewables	0	0	0	0		<input type="checkbox"/>
<b>Total</b>	<b>1,130,092</b>	<b>200,439</b>	<b>358,873</b>	<b>1,193,700</b>	<b>84,730</b>	<b>6,827 13.0</b>

# Measures Implemented

## Archetype - Proposed case

Number of rinks = 1

### **Schedules**

- Adjust temperature settings and schedules.

### **Heating system**

- Ice resurfacers: Switch fuel type. Also see Ventilation and Process heat.
- Convert hot water heating to heat pump
- Convert space heating to air source heat pump
- Convert pool water heater to electric

### **Cooling system**

- Optimize the operation of evaporators, compressors and condensers.
- Install floating head pressure control.

### **Building envelope**

- Stands & ice rink: Install new low-e ceiling.
- Reduce air leakage at windows, doors and building cracks. Apply caulking around building joints and windows. Replace weather stripping on all doors.
- Reduce air leakage in pool area.

### **Ventilation**

- Install high efficiency units. Also see Motors.
- Tighten intake air dampers.
- Install heat recovery system including Pool Ventilation
- Ice rink: Reduce fresh air flow due to ice resurfacer fuel switch.

### **Lights**

- Install LED lamps. O&M savings due to longer life expectancy of LEDs.

### **Electrical equipment**

- Vending machines: De-lamp. Install occupancy sensors.
- Standby losses: Install power bars and train users to shut down properly.

### **Hot water**

- Reduce water usage. O&M savings due to reduced water usage.
- Increase heat recovery from refrigeration systems for water heating with floating head pressure control system.
- Utilize a pool cover during unoccupied times.

### **Motors**

- Install high efficiency units. Also see Ventilation.
- Pumps - Brine: Switch from 2-pass to 4-pass circuit. Install new motors with variable speed drive.

### **Process heat**

- Ice resurfacer: Switch fuel type. Also see Heating system and Ventilation - Ice rink.

# Overall Result

Commercial/Institutional - Recreation Complex with Pool and Arena (base upon RETX Archetype) - Public building

- Fuels & schedules
  - Electricity and fuels
  - Schedules
- Equipment
  - Heating
    - Space heating
    - Domestic hot water
    - Ice resurfacer
    - Swimming Pool Heater
  - Cooling
    - Refrigeration system
    - Space Cooling
- End-use
  - Building envelope
    - Ice rink
    - Stands
    - General
    - Maintenance
    - Swimming Pool
    - Roof - Ice rink
    - Roof - Ice rink - Low-e
- Optimize supply
  - Power
    - Photovoltaic - 148 kW
    - Offsite renewables
- Summary
  - Include measure?
  - Comparison

Summary - Electricity and fuels

Fuel type	Fuel type		Base case		Proposed case		Savings	
	Fuel rate	Fuel consumption - unit	Fuel consumption	Fuel cost	Fuel consumption	Fuel cost	Fuel saved	Savings
Natural gas	\$ 0.30	m <sup>3</sup>	120,983	\$ 36,295	0	\$ 0	120,983	\$ 36,295
Electricity	\$ 0.12	kWh	782,003	\$ 93,840	378,378	\$ 45,405	403,625	\$ 48,435
<b>Total</b>				<b>\$ 130,135</b>		<b>\$ 45,405</b>		<b>\$ 84,730</b>

Project verification

Fuel type	Fuel consumption - unit	Fuel consumption - historical	Fuel consumption - Base case	Fuel consumption - variance
Natural gas	m <sup>3</sup>		120,983	
Electricity	kWh		782,003	

Savings

	Heating kWh	Cooling kWh	Electricity kWh	Total kWh	Plan kWh	Variance %
Base case	1,285,778	443,324	338,679	2,067,782	1,561,698	32.4%
Proposed case	155,687	242,885	-20,194	378,378	391,145	-3.3%
Fuel saved	1,130,092	200,439	358,873	1,689,404	1,170,553	44.3%
Fuel saved - %	87.9%	45.2%	106%	81.7%	75%	

Benchmark

Energy unit: kWh  
Reference unit: m<sup>2</sup> 3,470

Benchmark	Heating kWh/m <sup>2</sup>	Cooling kWh/m <sup>2</sup>	Electricity kWh/m <sup>2</sup>	Total kWh/m <sup>2</sup>	Benchmark kWh/m <sup>2</sup>	Variance %
Base case	371	128	97.6	596	272	119%
Proposed case	44.9	70	-5.8	109	272	-59.9%
Fuel saved	326	57.8	103	487		

# Efficient Electrified Arena/Pool

