Ground Source Heat Pump Case: Barriers & Opportunities

How does it fit into the push for Electrification?

How does it fit Net Zero Energy goals?

How does it fit with Climate Change Mitigation & Carbon Emissions Reductions goals?

How does it fit into Ontario’s Long Term Energy Plan?

Electrification & Net Zero Energy Factors

There is no better solution than Geothermal to help accomplish these goals!

Whatever metric you choose to use;

- Peak Demand, Carbon Emissions reductions, or overall E-kwh's of energy used to heat, produce DHW or for cooling!
- See the following comparison for a residential home;
- 40,000 btu/ hr HL & 20,000 btu/ hr HG

“Net Zero Energy” buildings;
HVAC System, Best Approach?

One question that comes to mind when you are presented with this claim of “Net Zero Energy” buildings, is, are they including only electricity consumption or taking into account all energy, including the eKwh attributed to natural gas heating, consumed in these homes?

If our, collective, goal is to reduce energy & carbon emissions then, my question is, why is there natural gas equipment involved in the HVAC design at all?

There is no better solution than Geothermal to help accomplish these goals!

I am listing a three HVAC Design scenarios for a potential, “Net Zero Energy” home below;

*** Does not include other building electricity consumption; only the HVAC & DHW System**

*** Does not factor carbon emissions from hydro**

1. Hybrid System with (1) natural gas fully modulating furnace with a 2 ton, 19 SEER, Cold Climate Air Source

- Heat Pump (ccASHP) to augment heating demand *(switch over to gas heating @ 5 deg C) and look after all air conditioning demand + (1) ASHP, domestic hot water heater
- Heat Loss @ 40,000 btu/hr & Heat Gain @ 20,000 btu/ hr

• * Total Kwh for ccASHP in heating @ 2,093 kwh

• * Total m3 of gas for heating @ 1,453 m3 = 15,104 eKwh

• * Total carbon emissions at site = 1453 m3 x 2.0 kg/ m3 = 2906 kg or 2.9 tons/ year

• * Total kwh for ccASHP in cooling @ 706 kwh

• Total kwh for ASHP for domestic hot water @ 1,437

• Peak KW demand in heating or cooling = 2.7 KW in cooling * due to gas heating at peak demand

otal Yearly eKwh system usage = 19,340 kwh Solar PV array size required to offset this yearly demand = 17 KW +/- @ $2,800/ KW = $47,600 *

2. (1) 4 ton, 19 SEER, Cold Climate Air Source Heat Pump (ccASHP) system with a 10 KW auxiliary heater

(1) ASHP, domestic hot water heater

- Heat Loss @ 40,000 btu/hr & Heat Gain @ 20,000 btu/ hr•

- * Total Kwh for ccASHP in heating, including auxiliary heater @ 8,387 kwh
- * Total kwh for ccASHP in cooling @ 706 kwh
- * Total kwh for ASHP, for domestic hot water @ 1437 kwh
- Peak KW demand in heating or cooling = 9.6 KW in heating

Total Yearly kwh system usage = 10,530 kwh Solar PV array size required to offset this yearly demand = 10 KW +/- @ $2,800/ KW = $28,000 *

3. (1) 4 ton Geothermal (GSHP) system with a pre-heat domestic hot water system to augment the domestic hot water

(1) ASHP, domestic hot water heater with pre-heat off the GSHP system

- Heat Loss @ 40,000 btu/hr & Heat Gain @ 20,000 btu/ hr• *

• Total Kwh for GSHP in heating @ 5,168 kwh

• Total kwh for GSHP in cooling @ 687 kwh

• Total kwh for ASHP with pre-heat off the GSHP, for domestic hot water @ 525 kwh

• Peak KW demand in heating or cooling = 3.16 KW in heating

Total Yearly kwh system usage = 6,380 kwh Solar PV array size required to offset this yearly demand = 6 KW +/- @ $2,800/ KW = $16,800 *

Electrification Challenges and how Geothermal can support this endeavor

- GSHP’s can accomplish significantly less energy (Ekwh’s) consumption than any other technology on the market
- GSHP, wide scale adoption can significantly reduce peak demand both in heating and cooling more than any other technology on the market
- GSHP, wide scale adoption can significantly reduce carbon emissions to help Municipalities across the Country meet their emissions reductions targets for 2030 & 2050
- The average home, heated with fossil fuels produces 5 tons of carbon emissions with heating alone!

New Gas Communities; Why are we doing this?

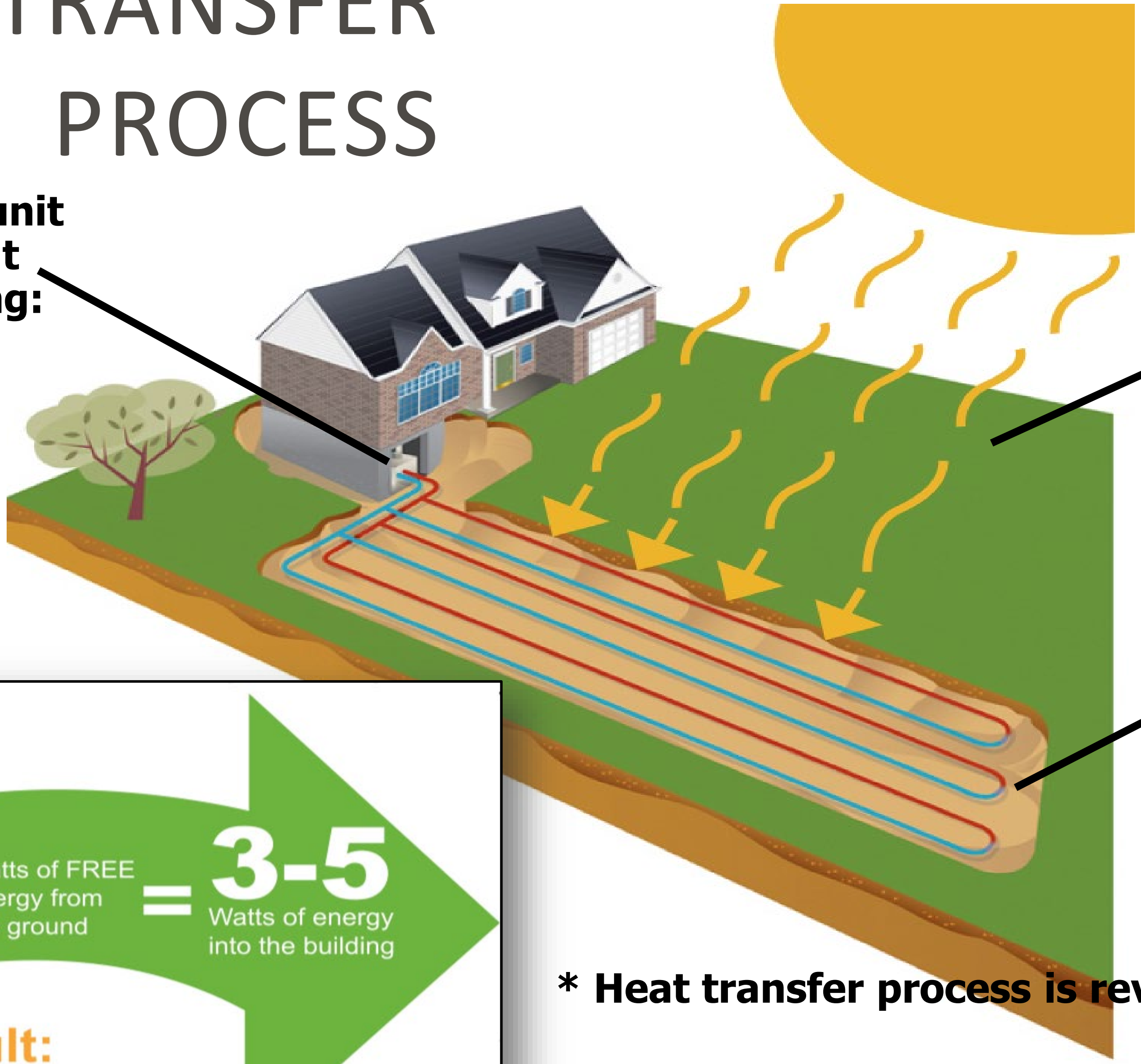
“The nearly $28,000 (2016) cost per home of expanding the gas system to serve new communities is being paid for by a $12 a year surcharge on gas rates of Enbridge’s 3.6 million existing residential customers and by a $0.23 per cubic metre surcharge on the rates of the gas customers in the new gas communities”

Source: An Analysis of the Financial and Climate Benefits of Using Ground Source Heat Pumps to Electrify Ontario’s Gas-Heated Homes, OCAA 2022.

Ontario Geothermal Association

THE HEAT TRANSFER PROCESS

Geothermal unit transfers heat to the building: Forced Air or Hydronic



Energy of the sun

warms the ground

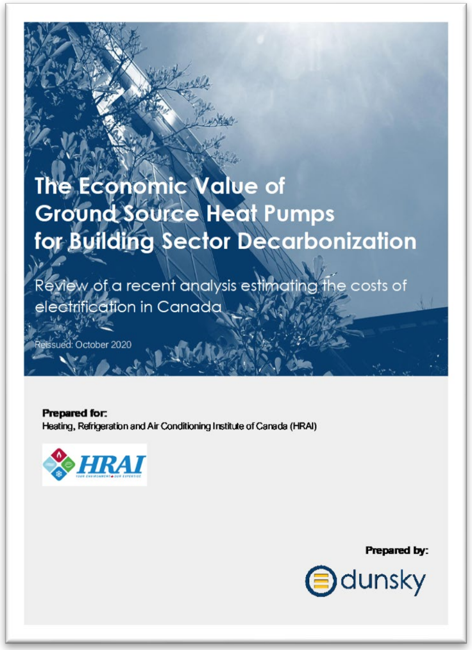
Loop absorbs heat from ground

*** Heat transfer process is reversed for cooling**

Ontario Geothermal Association

Energy
Infrastructure

Energy +
Infrastructure



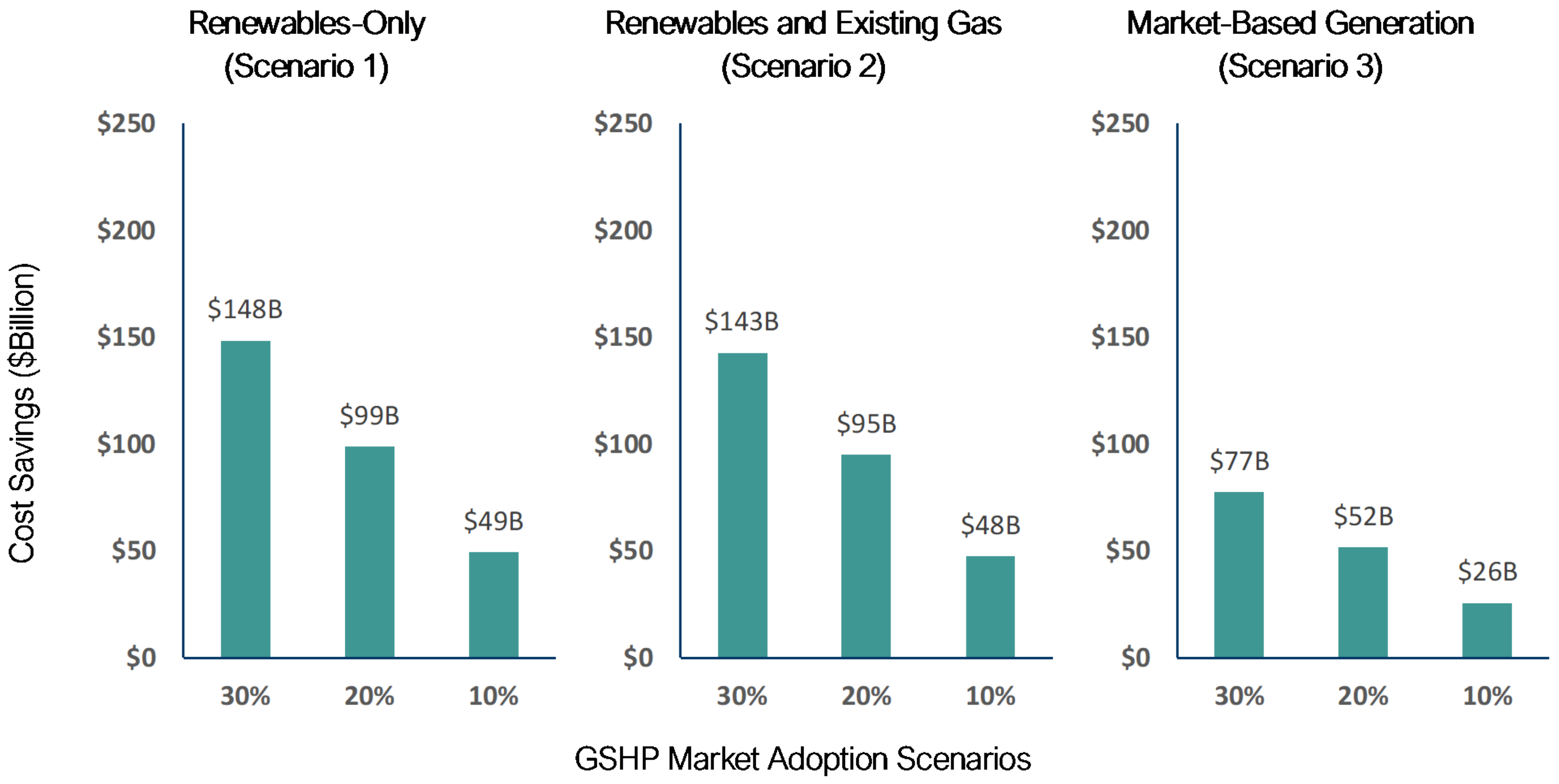
“Our modelling found that increased investment in GSHPs in most parts of Canada can reduce the need to invest in expanded electricity infrastructure by a greater amount – resulting in overall cost reductions for Canadians”.

“In fact, we found that a reasonably ambitious adoption rate of GSHPs could save Canadians between $49 and $148 billion relative to electrification through air-source heat pumps (ASHPs) alone, which comes down to about $40,000 in savings per installed GSHP system.”

- *(Dunsky Energy Consulting, The Economic Value of Ground Source Heat Pumps for Building Sector Decarbonization, October 2020)*

Ontario Geothermal Association

Figure 3. Estimate of Cost Savings Under GSHP Market Adoption Scenarios Relative to Original Study's ASHP-Only Cost Estimates

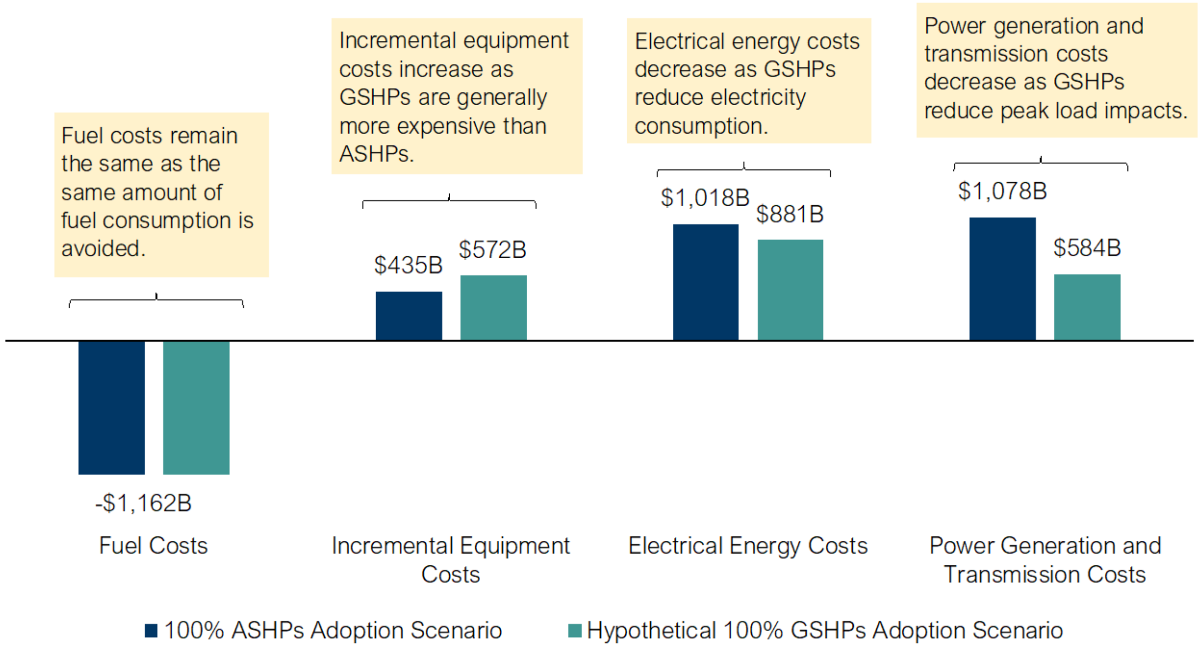


Ontario Geothermal Association

Dunsky: The Economic Value of Ground Source Heat Pumps for Building Sector Decarbonization

- *"including GSHPs as a space heating electrification solution can help to reduce the overall costs of electrification for Canadians by $49B to $148B assuming 10-30% market share, and by nearly $500B assuming a hypothetical 100% market share over the next 30 years."* (Dunsky Energy Consulting, 2020)

Figure 5. Cumulative Costs from 2020 to 2050 by Cost Component Under Renewables-Only Generation Scenario (Scenario 1) Assuming 100% of Buildings Electrify with ASHPs vs. 100% GSHPs ($Billions)



Ontario Geothermal Association

Dunsky: Policies to Drive Ground Source Heat Pump Adoption

Policy	Implementers	Timeline and Strength		
		Short (next 3 years)	Mid (3-10 years)	Long (10+ years)
GSHP-specific power rates		+ + +	+ + +	+ + +
Recurring peak demand incentives or penalties		+ + +	+ + +	+ + +
Federal tax credits		+ + +	+ +	+
Provincial tax credits	P T	+ + +	+ +	+
Upfront incentives	P T	+ + +	+ + +	+ + +
GSHP financing	P T	+ + +	+ + +	+ + +

Federal Government P T Provincial/Territorial Government Utilities

Ontario Geothermal Association

There are so many reasons that GSHP's should be embraced by Ontario Ministry of Energy, the IESO and Governments at all levels!

All we are missing is Political will & market support through policy & incentives to encourage wide scale adoption!

Let's get Started!

Ontario Geothermal Association