Feasibility of a Thermal Energy Storage System for District Heating in Calgary

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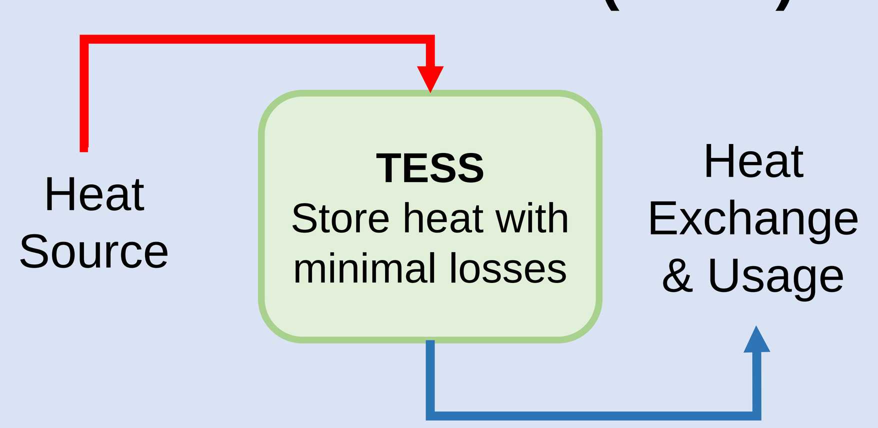
WHAT IS A THERMAL ENERGY STORAGE SYSTEM (TESS)?



BENEFITS OF A TESS

- Cost savings via peak-shavings
- Reduce carbon footprint by enabling district heating to consistently use excess energy

TYPES OF TESS

Table 1: Comparison of TESS Architectures

Category	Sensible	Latent	Chemical
Simplicity	✓		
Low Costs	✓		
Versatility of Storage Mediums	✓		✓
Verification	✓	✓	

COST FEASIBILITY

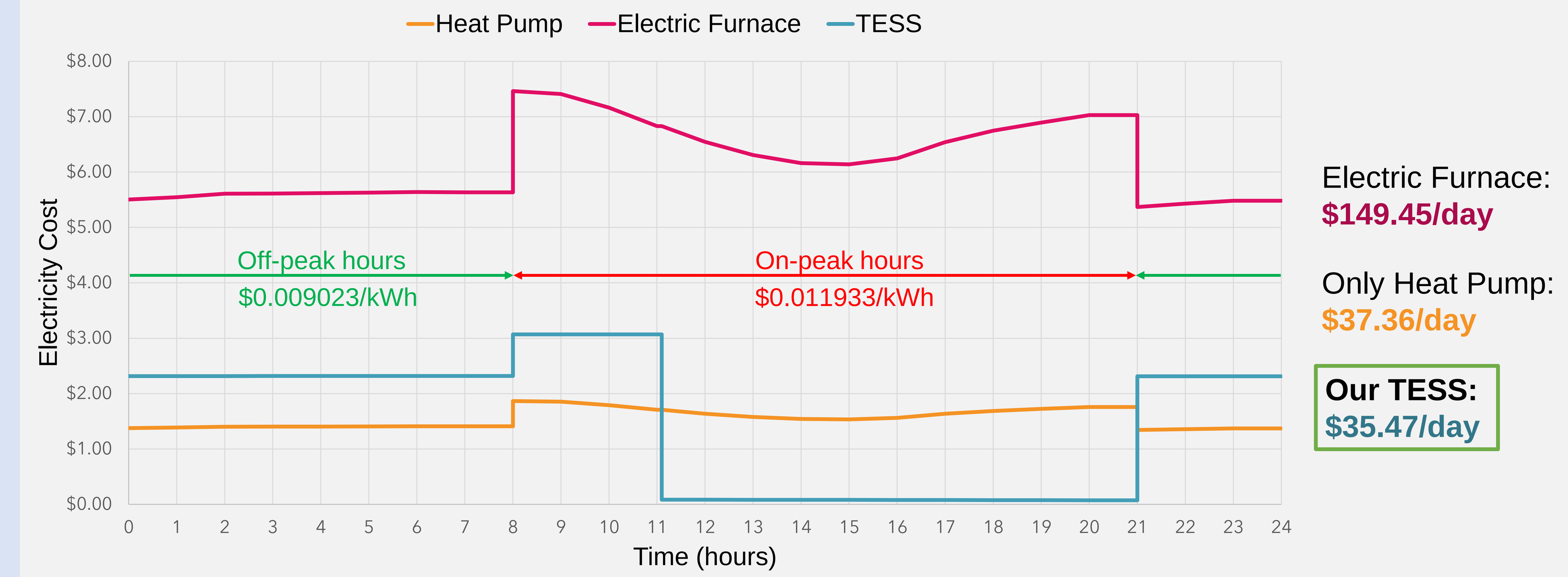


Figure 4. Transient Analysis of Variable Electricity Charges (Average Winter Day).

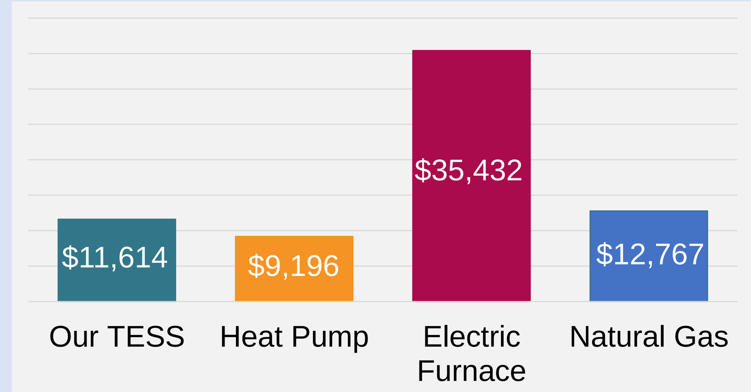


Figure 5. Monthly Electricity Cost Comparison (December).

Figure 4 shows that a TESS will decrease variable electricity costs. However, due to the D310 electricity cost structure, the monthly electricity bill is not the smallest (as seen in Figure 5).

Ask us about this!

Table 4: Cost Comparison of Energy Storage Devices for Large-Scale Peak Shavings

System	Capital Cost	Maintenance Cost	NPV over 20 yr
TESS	$ 352,594	$ 950,600	$ 90,641
TESLA Megapack Battery (2x, 3.9 MWh)	$ 5,569,663	$ 410,353	-$ 6,726,142

APPLICATION

~150 Unit, 20+ Storey Apartment Complex

Rate Code D310

2.4 GWh Annual Electric Heating Consumption

Downtown Calgary

Existing Furnace Heating Infrastructure

DESIGN

- Right Cylinder (Exterior: 7.39m Tall x 7.39m Diameter)
- Water Storage Medium
- Insulation: 1 x 11" Layer of Fiberglass NEXTGEN PINK (R40)
- Coiled Tube Heat Exchanger with Variable Blower Motor
- Stored Underground
- Ground-Sourced Heat Pump - COP 4.0 (Industrial Line Goliath 6900)

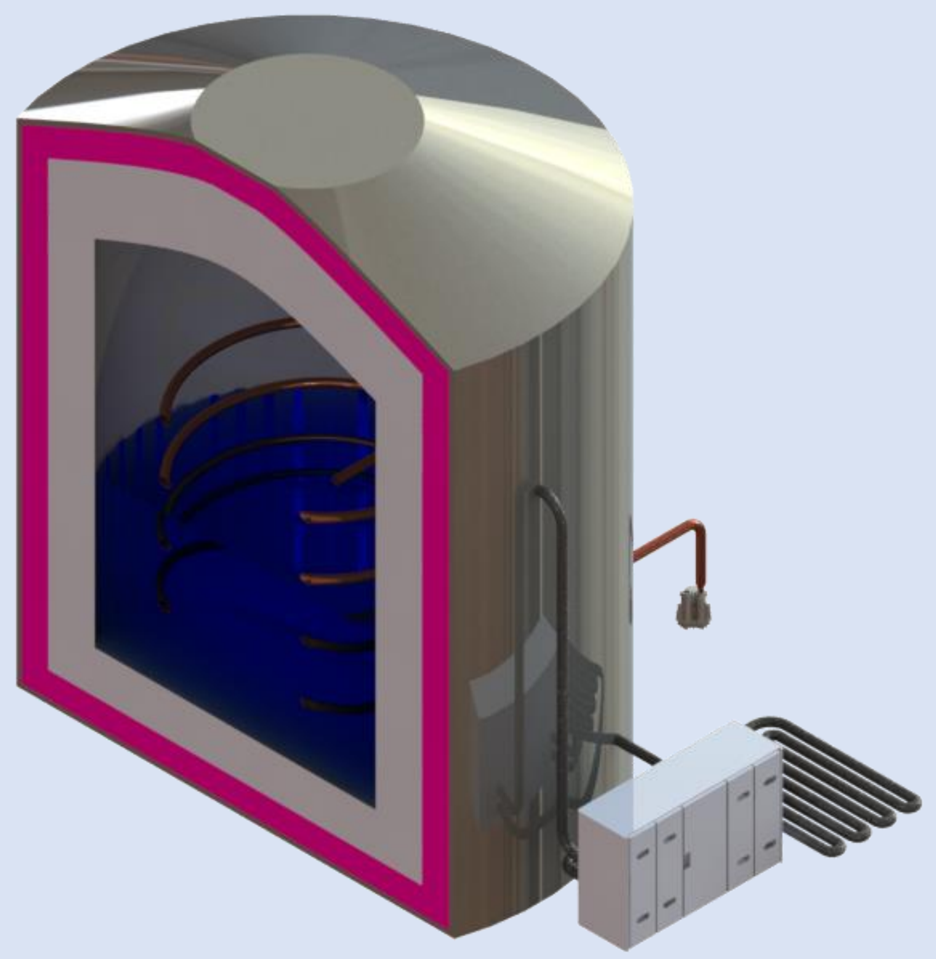


Figure 1: Cross Section of TESS

CONCLUSIONS

1. TESSs are not currently economically feasible in Calgary due to the electricity cost structure.
2. In an ideal system where the TESS is offset from the original peak demand such that it does not increase the overall demand peak, the system would have a payback period of 10 years.
3. TESSs offer a means to store an abundance of renewable energy for use during periods when these sources are scarce, but are cost prohibitive for peak shavings applications.

DAILY OPERATIONAL ANALYSIS

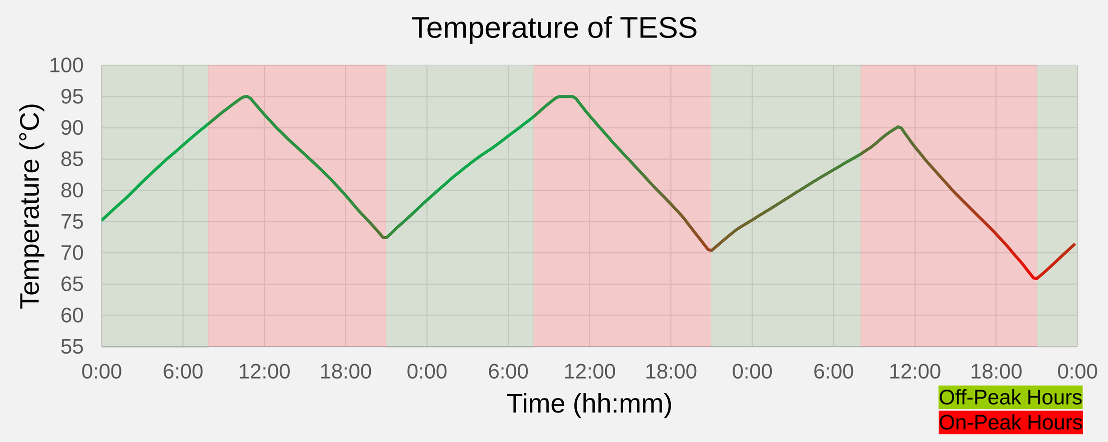


Figure 2: Transient Temperature of TESS

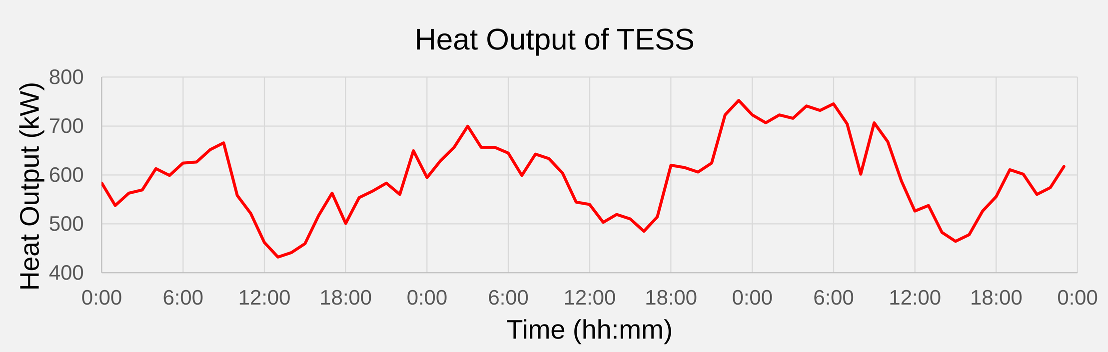


Figure 3: Transient Heat Output of TESS

- 1000kW Input from heat pump
- Cycles vary between 60ºC and 95ºC
- 14 hour cycle charge time, 8 hour discharge
- System is always in use
- Daily heat output based on public government data

COST ESTIMATES

Table 2: General Construction Estimates

Item	Estimated Cost
Tank (Steel)	$ 134,479
Heat Pump	$ 50,000
Variable Blower	$ 5,704
Copper Tubing	$ 17,422
Insulation	$ 4,746
Construction	$ 140,241
Total	$ 352,593

Table 3: Value Added Over Electric Furnace

Parameter	Value
NPV	$ 108,246
IRR	23.1%
Payback Period	10 years

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* All $ are in $CAD