25 Orde Street

2019 Energy Conservation & Demand Management Plan

Sinai Health System

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1. Executive summary

25 Orde Street (Orde) is a state-of-the-art research facility located in downtown Toronto, providing services to a global customer base. Associated annual costs for electricity and steam at the facility are approximately $1.9M.

As part of fulfilling Ontario Regulation 507/18 of the Electricity Act (1998), a detailed review of energy consumption at Orde has been performed, and an updated Energy Conservation Demand Management Plan (ECDMP) has been generated to cover the 5-year period of Jan-2019 to Dec-2023.

A number of potential energy conservation measures (ECMs) have been identified, along with a forecast of total energy savings resulting from implementation. One cost savings measure has also been identified resulting from rate tariff optimization. The annual savings for these initiatives total over $200k and over 11% of annual utility expenditure, as summarized below:

ID #	Energy Conservation Measure	Electricity Savings (kWh/year)	Demand Savings (kW)	Steam Savings (kWh/year)	Total Cost Savings ($/year)	Estimated Project Cost($)	Estimated Capital Incentive ($)	Simple Payback Inc. Incentive (years)	Measure Life (years)	Savings as % of Site Cost
0)	Global Adjustment Class-A Opt-in	-	-	-	$50,000	$0	$0	0	5	2.6%
1)	Lighting LED Retrofits	96,424	19	-	$12,014	$60,700	$4,856	4.6	5	0.6%
2)	Lighting Controls Upgrade	90,134	-	-	$2,395	$25,000	$9,013	6.7	> 5	0.1%
3)	Variable Speed Air Compressor Upgrade	110,143	42	-	$23,178	$60,000	$11,014	2.1	> 5	1.2%
4)	AHU 01 & 02 Setback	900,407	103	942,706	$101,402	$200,000	$140,000	0.6	> 5	5.2%
5)	AHU 03 & 04 Night Time Setback	534,378	-	325,807	$23,692	$10,000	$0	0.4	> 5	1.2%
6)	Air Handling Unit Heat Reclaim Improvement	75,180	- 7	641,883	$17,065	$120,000	$7,518	6.6	> 5	0.9%
	Total	**1,806,667**	**156**	**1,910,396**	**$229,748**	**$475,700**	**$172,402**	**2.1**		**11.8%**

25 Orde Street's central energy conservation goal is to reduce energy consumption, energy demand, operating costs and greenhouse gas emissions without impacting the research environment or staff comfort. Specific goals for Orde are electricity and steam usage reduction through capital project implementation and improved employee awareness and training.

This report subsequently provides analysis of each of the major utilities, their usage and potential savings measures, along with a summary of the previous ECDMP and details of each project identified as part of the updated ECDMP.

2. Background

2.1 Total utility consumption and costs

25 Orde Street is a state-of-the-art research facility located in downtown Toronto, providing services to global customers. Total site utility usage, expenditure and associated GHG emissions for the period of January to December 2018 are provided in the table below:

Utility	Unit	Total Consumption	Total Cost (Ex. Tax)	Average Utility Unit Cost	GHGs Emitted (tCO2e)
Electricity	kWh	9,487,736	$ 1,337,306	$ 0.14	380
Steam	klb	39,932	$ 606,130	$ 15.18	3,005
		TOTALS	**$ 1,943,436**		**3,385**

Figure 1: Jan-18 to Dec-18 utility consumption summary

Trending for utility usage, cost and GHG emissions over this same time period is provided below:

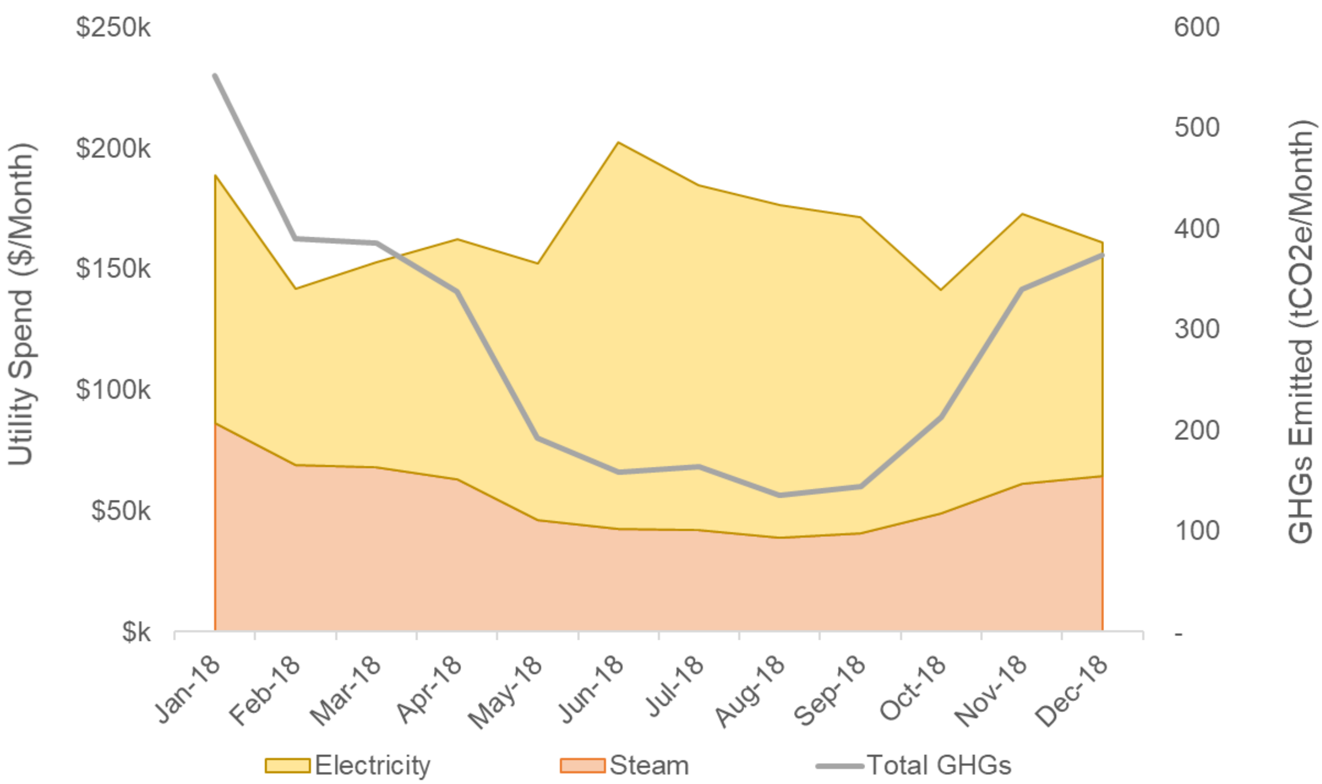

Figure 2: Utility spend and GHGs emissions trend, Jan-18 to Dec-18

2.2 Historical utility consumption

Utility consumption and costs for the most recent periods with available data are shown below for electricity and steam:

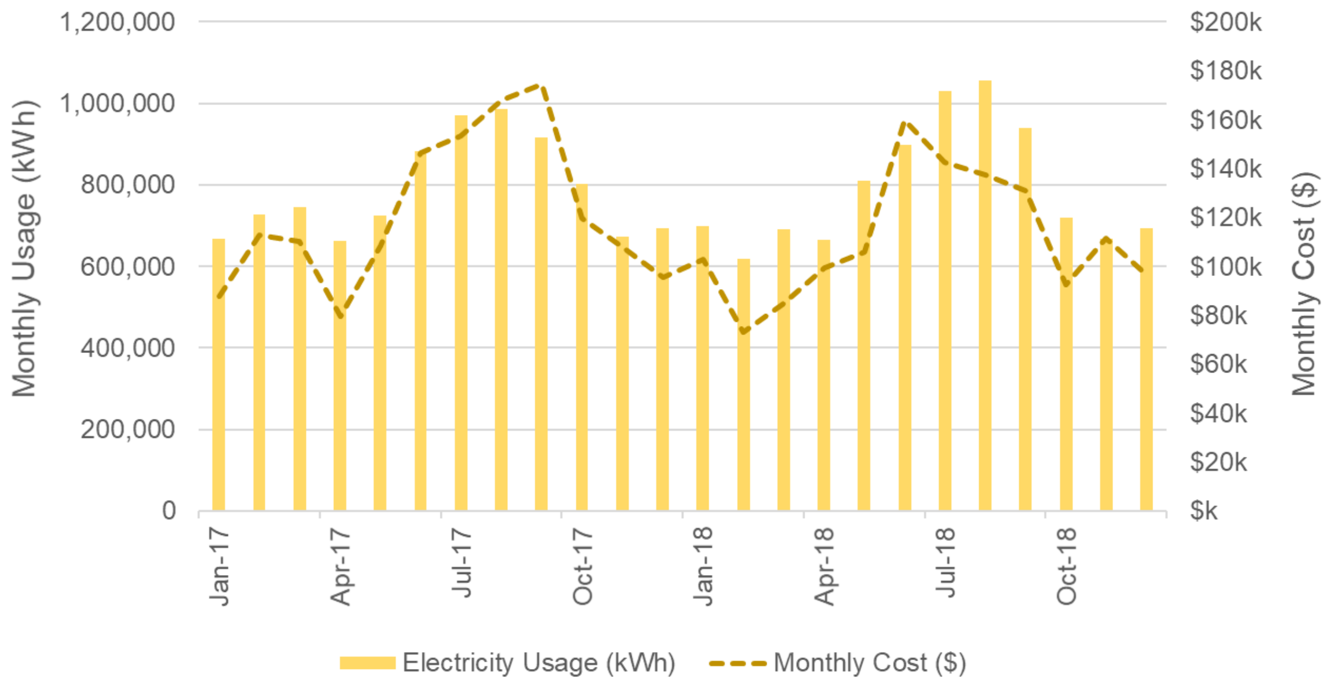

Figure 3: Historical electricity usage and cost

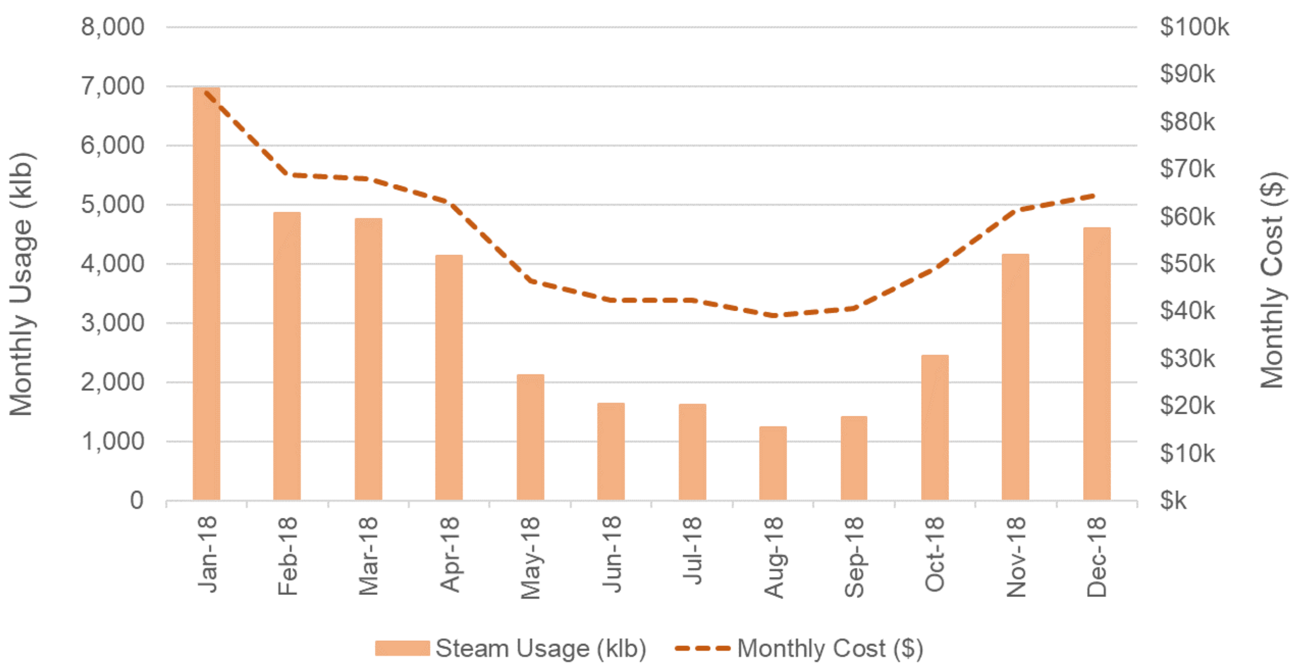

Figure 4: Historical steam usage and cost

Both steam and electricity usage appear to vary cyclically with outdoor air temperature, with steam usage increasing during colder months, and electricity usage increasing during warmer months. This high-level trend is expected given the site's significant space heating and cooling loads, as steam is used to heat and humidify incoming air during colder months, and electricity is used to operate a chiller system to cool incoming air during warmer months.

2.3 Additional energy sources

25 Orde Street does not currently operate any renewable energy generation systems. No ground source or solar energy is harnessed at this time via systems operated by the public agency.

At present there are no plans to operate heat pump technology, thermal air technology or thermal water technology in the future outside of those noted in this report's proposed measures.

3. Utility consumption review

3.1 Electricity

3.1.1 Consumption and cost breakdown

Electricity consumption in 2018 was around 9.4 GWh at a cost of ~$1.3M before tax. Most of this cost (66%) was for Global Adjustment charges, as shown below:

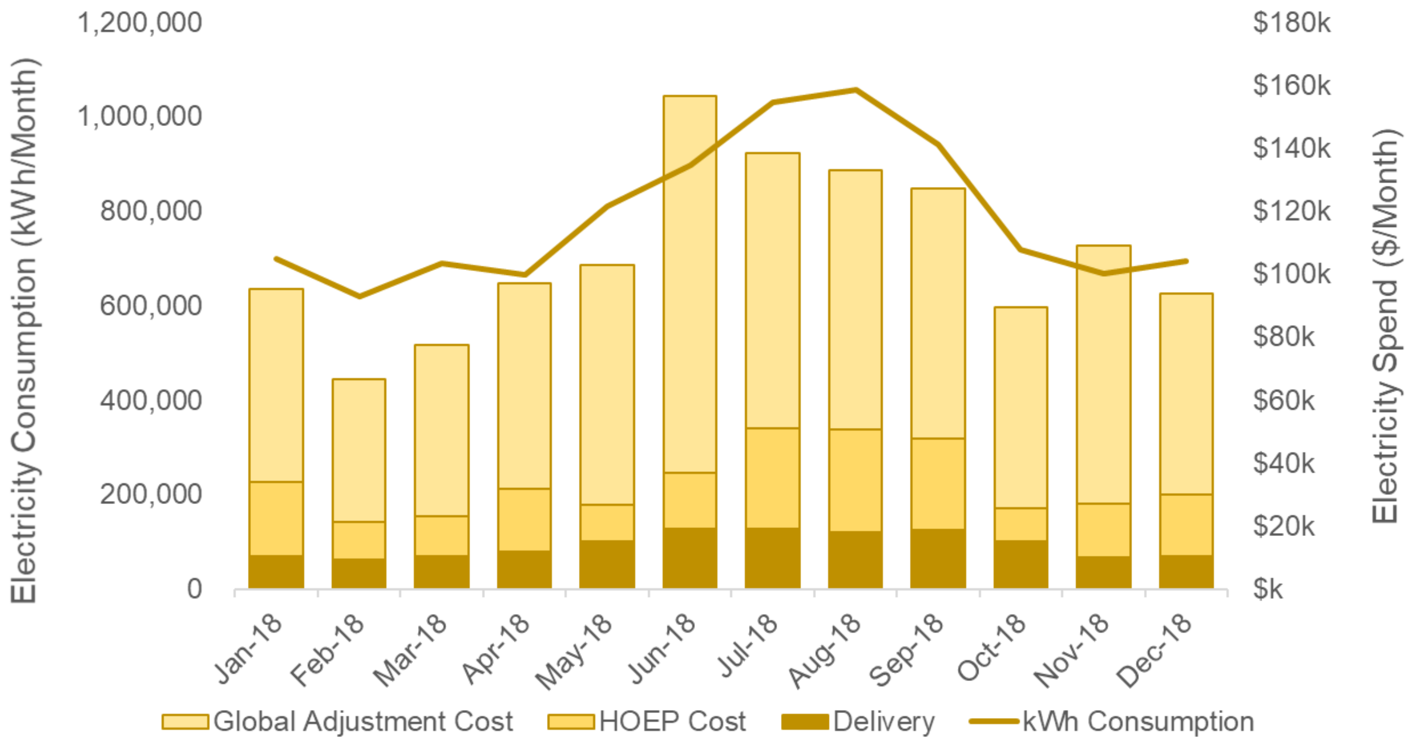

Figure 5: Electricity cost breakdown and consumption

Electricity for 25 Orde Street is currently distributed by Toronto Hydro on the 1,000 kW to 4,999 kW rate tariff, with the commodity component purchased from ECNG. Electricity charges are broken out below:

Description	Cost ($)	Cost Basis
Commodity Cost	Spot	per kWh
Global Adjustment	Variable	Monthly Class B Rate
Transmission Network	$2.5677	per Peak kW per 30 days
Transmission Connection	$2.3030	per Max kW per 30 days
Customer Charge	$983.72	per 30 days
Distribution Volumetric Rate	$6.3766	per kVA per 30 days
Transformer Discount	-$0.62	per kVA per 30 days

Note: Data from Toronto Hydro 1,000 kW to 4,999 kW Tariff (May 1, 2019), Ex. Rate Riders

Table 1: Electricity cost breakdown, 1,000 kW to 4,999 kW rate tariff

3.1.2 Electricity use drivers

Given the large apparent effect of site cooling load on total electricity it was assumed that variation in hourly outdoor temperature (represented as cooling degree hours) would significantly explain variation in electricity consumption at the facility. A regression analysis was performed against this variable yielding the following equation:

Regression	Unit	Y-intercept	Coeff. #1	Coeff. #1 Value	R2
Electricity vs. CDHs	kWh	670,810	CDHs	41.95	95.40%

Table 2 : Electricity regression results

Predicted electricity usage based on the above equation is plotted against actual site electricity consumption below for the period of April 2017 to December 2018:

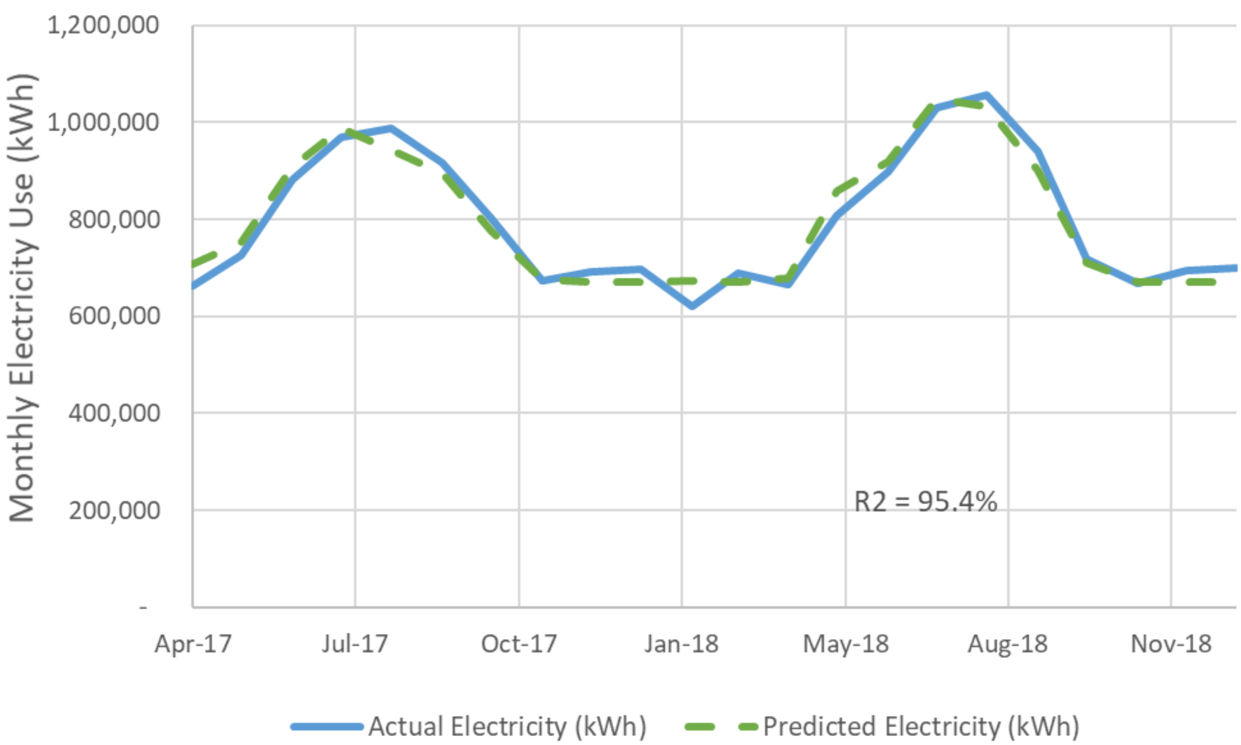

Figure 6 : Actual vs. predicted electricity consumption

The high coefficient of determination (R2) of 95.4% along with other statistical measures demonstrates that this equation can be used to model baseline electricity consumption moving forward and allow high-level savings quantification resulting from any electricity-reduction initiatives.

3.1.3 End-use breakdown

Approximately 60% of total electricity at 25 Orde Street is consumed in the supply, exhaust and return of air through the four air handling units. A further 17% of electricity consumed at the site is for operating a chilled water supply system, which provides cooling for all incoming air during warmer months. The remaining electricity consumption on site is split between lighting, air compressors, general hospital loads, and other site systems. Electricity end-use consumptions have been calculated based on spot measurement data taken from the local building automation system, along with motor sizes, live VSD loading data and estimated loading/run hour data gathered during site visits.

The calculated electricity end-use breakdown for 2018 is provided below, broken out by asset class:

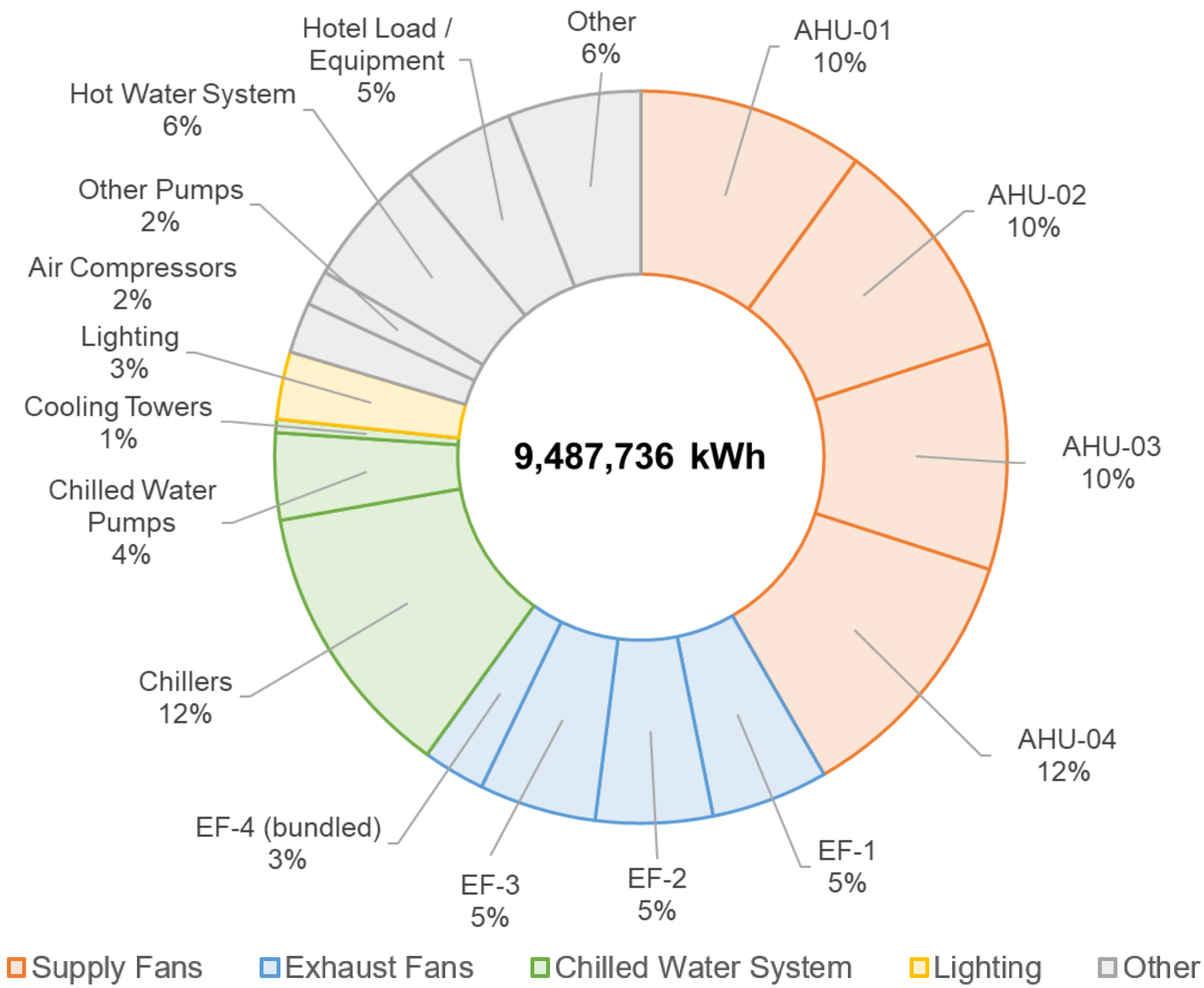

Figure 7 : Estimated 2018 electricity end-use breakdown

3.2 Steam

3.2.1 Consumption and cost breakdown

Steam consumption in 2018 was around 40,000 klbs at a cost of ~$600k before tax. Approximately 57% of this charge is made up by a static monthly "Capacity Charge", with the remainder varying based on steam consumption:

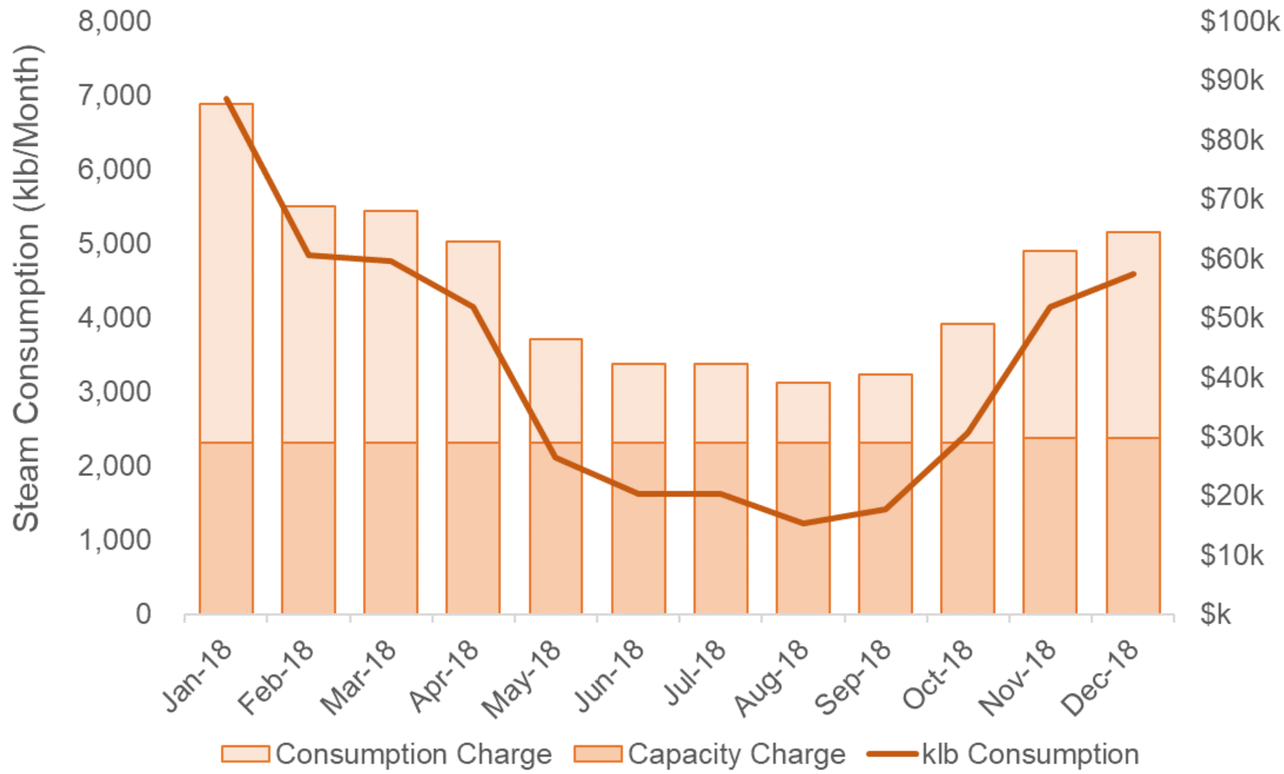

Figure 8: Steam cost breakdown and consumption

Steam for 25 Orde Street is currently purchased through the Enwave Energy Corporation's District Heating System in Toronto. Charges for this utility are broken out below:

Description	Cost ($)	Cost Basis
Steam Consumption	$7.59	per Mlbs
Steam Capacity	$29,664.40	per Month

Note: Data from December 2018 Enwave bill

Table 3 : Steam cost breakdown

3.2.2 Steam use drivers

Regression analysis was performed against hourly outdoor temperature (represented as heating degree hours) to explain variation in steam consumption at the facility throughout the year. This analysis yielded the following equation:

Regression	Unit	Y-intercept	Coeff. #1	Coeff. #1 Value	R2
Steam vs. HDHs	klb	1,225	HDHs	0.278	94.85%

Table 4 : Steam regression results

Predicted steam usage based on the above equation is plotted against actual site steam consumption for the period of January to December 2018:

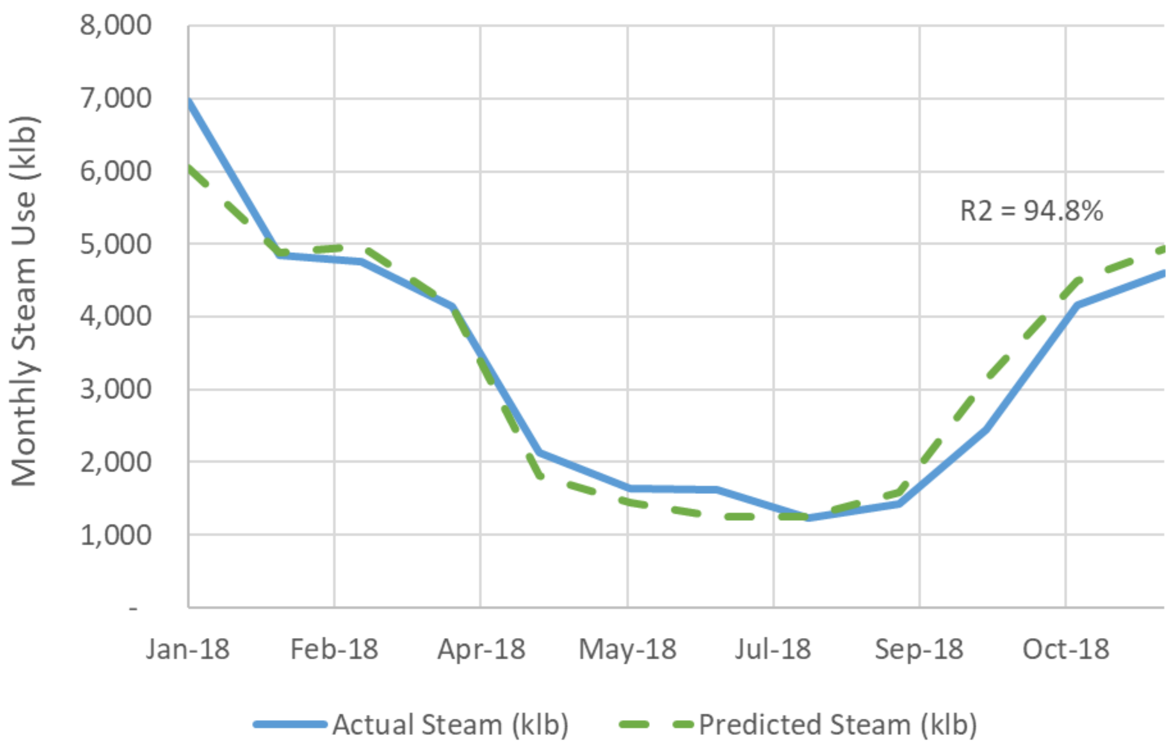

Figure 9 : Actual vs. predicted steam consumption

The high coefficient of determination (R2) of 94.8% along with other statistical measures demonstrates that this equation can be used to model baseline steam consumption moving forward and allow high-level savings quantification resulting from any steam-reduction initiatives.

3.2.3 End-use breakdown

Steam is primarily used at 25 Orde Street for heating and humidifying incoming air, with the remainder used for domestic hot water heating and other heating loads which are performed year-round. A detailed hourly simulation has been generated for all known air handling units using air flow, relative humidity, return air % and temperature setpoint data gathered during site visits to estimate steam consumption.

The calculated steam end-use breakdown for 2018 is provided below with steam energy converted to kWh, broken out by general area served and asset class:

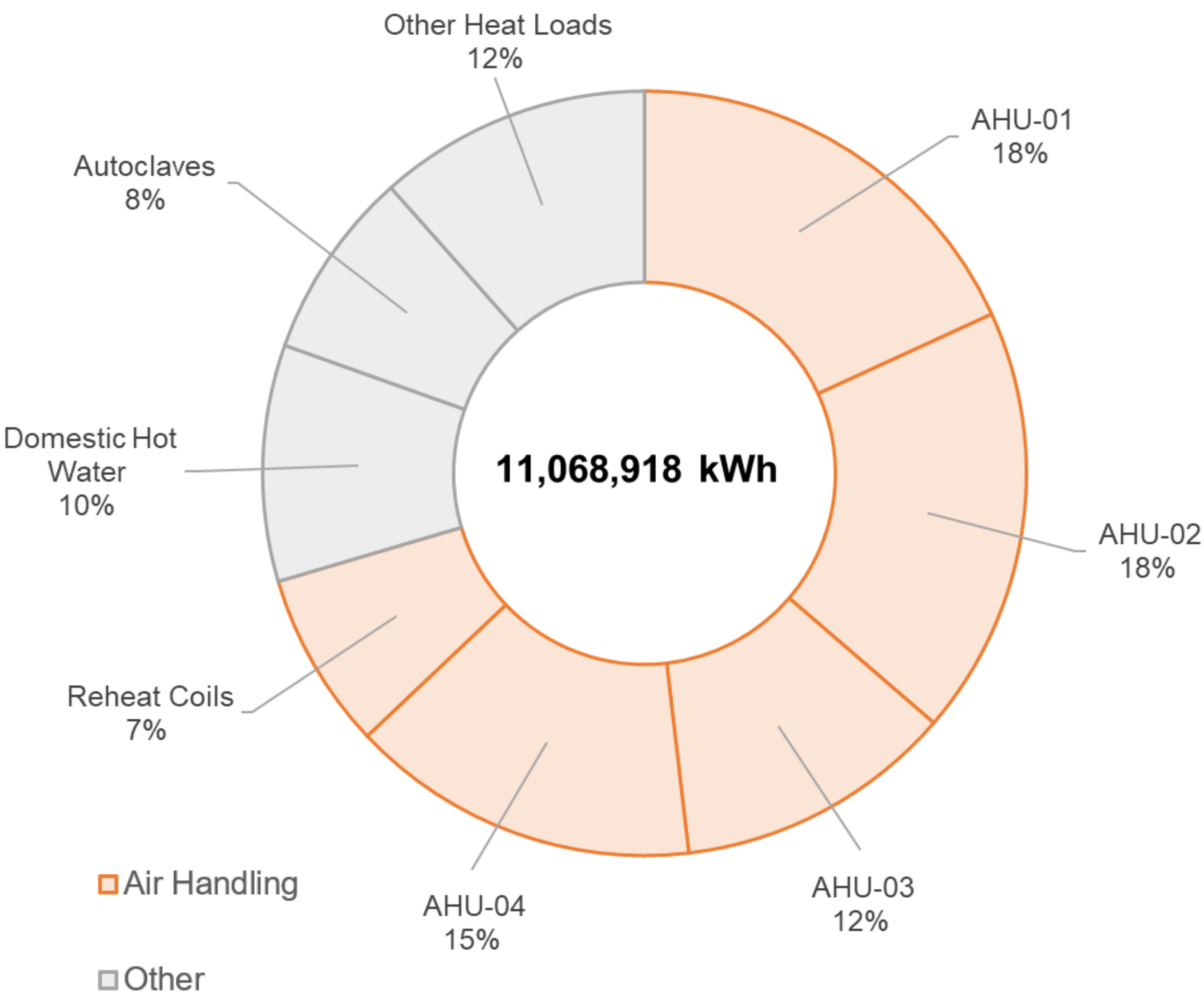

Figure 10 : Estimated 2018 steam end-use breakdown

4. Previous ECDMP (Jan-2014 to Dec-2018)

As part of fulfilling Regulation 397/11 of the Green Energy Act (2009), an Energy Conservation Demand Management Plan (ECDMP) was generated for 25 Orde Street in July 2014, covering the 5-year period of January 2014 to December 2018. Energy conservation measures (ECMs) were identified in this report and proposed for implementation.

4.1 Past ECMs Proposed

A number of "top-down" energy conservation targets were applied against 25 Orde Street's total utility cost and consumption values, to build a picture of potential achievable savings for the facility. These energy target savings are provided in the table below:

Area of Focus	Savings Target (%)	Cost Savings ($/year)
Electric Base	14%	$ 131,535
Thermal Base	33%	$ 57,325
Electric Cooling	29%	$ 45,420
Thermal Heating	35%	$ 22,171
Water	5%	$ 5,683
	TOTAL	**$ 262,134**

Table 5: Past ECDMP energy target savings

A separate list of preliminary energy efficiency measures was then provided to demonstrate a pathway to achieve a portion of the target energy savings. A list of these proposed energy efficiency measures is shown below, along with budget cost and savings estimates for each:

ECM ID	Description	Budget Cost ($)	Cost Savings ($/year)	Estimated Incentive ($)	Simple Payback (Post-Incentive) (years)
1	Lighting System Improvements	$ 226,950	$ 34,119	$ 13,123	6.27
2	HVAC System Testing and Optimization - Study	$ 70,000	TBD		
3	Water conservation	$ 7,500	$ 5,683	$ -	TBD
4	Department /staff engagement	$ 10,000	$ 6,577	$ 5,059	0.75
5	Energy advisor / co-ordination	$ 72,000	$ -	$ -	-
	TOTAL	**$ 386,450**	**$ 46,379**	**$ 18,182**	**7.9**

Table 6: Past ECDMP proposed energy efficiency measures

4.2 Past ECM Implementation

Lighting system improvements identified in the original ECDMP appear to have been made at the site, with upgraded controls and scheduling installed on the upper office floors. It is not possible to claim specific savings resultant from this measure, however based on up-to-date lighting counts and observation of the system's configuration, it is estimated to have saved ~50,000 kWh/year or ~$6k/year in electricity costs at that time.

The remaining measures proposed in the original ECDMP required further study to qualify. Site staff have mentioned that nighttime setback on AHU-04 was attempted in the past which may have arisen from the previous ECDMP and follow up investigation, however the magnitude of savings and lifespan of the measure is not known as the measure was reverted shortly after. Based on an updated review of the site's HVAC system, along with current setpoints (included in further detail in Section 5), it is expected that no measures were implemented or that any measures did not have persistence.

5. Updated ECDMP (Jan-2019 to Dec-2023)

As part of fulfilling Ontario Regulation 507/18 of the Electricity Act (1998), a detailed review of energy consumption at 25 Orde Street has been performed, and an updated ECDMP has been generated to cover the 5-year period of January 2019 to December 2023. A number of ECMs have been identified, along with a forecast of total energy savings resulting from implementation.

Note that as of this ECDMP, 25 Orde Street has "opted-in" to the Class A Global Adjustment rate tariff, which is expected to be in place for 2019-onwards. As such, all electricity savings measures have been calculated assuming the new tariff is in effect.

5.1 Energy Conservation Measures

5.1.1 Lighting technology upgrade

Lighting is estimated to account for approximately 3% of 25 Orde Street's electricity consumption. A detailed lighting count has been performed for the building and identified that virtually all lighting currently consists of fluorescent light fixtures.

Upgrading these fixtures to LED equivalents would provide ongoing electricity demand and consumption savings. The preliminary economics of this project are shown below:

ID #	Energy Conservation Measure	Electricity Savings (kWh/year)	Demand Savings (kW)	Steam Savings (kWh/year)	Total Cost Savings ($/year)	Estimated Project Cost($)	Estimated Capital Incentive ($)	Simple Payback Inc. Incentive (years)	Measure Life (years)	Savings as % of Site Cost
1)	Lighting LED Retrofits	96,424	19	-	$12,014	$60,700	$4,856	4.6	5	0.6%

Figure 11 : Lighting technology upgrade preliminary economics

The lifetime of this measure largely depends upon the LED fixture type chosen; fluorescent lamp "swap-in" fixtures can have a rated life of up to 50,000 hours. A lifetime of 5 years can be assumed for this measure.

5.1.2 Lighting controls improvement

Lighting at 25 Orde Street is already very well controlled, with systems installed on the office levels (3 - 6) linked back to the site's building automation system (BAS) automatically switching off lighting during certain overnight hours. This is combined with motion sensors in lab bench areas to ensure lighting is only in use when needed. An early morning tour of the facility confirmed that limited lighting is in use throughout most of the building at night. There is a potential to switch off additional portions of this lighting, which would involve adding further candidate lights to the existing secondary circuits which can be programmed to switch-off.

A further opportunity was identified with lighting in the 1M and 2M "Interstitial" floors, along with the 3rd floor mechanical room. These areas appear to have a secondary limited lighting circuit installed, but no ability for remote control or scheduling of these lights. A detailed lighting count for these areas has been generated including a list of those lights which were observed to be in use when not needed.

Installing lighting controls in key areas, linking the controls back to the facility's building automation system and controlling based on light level or setback schedule would reduce electricity consumption during sunny days and overnight. The preliminary economics of this project are shown below:

ID #	Energy Conservation Measure	Electricity Savings (kWh/year)	Demand Savings (kW)	Steam Savings (kWh/year)	Total Cost Savings ($/year)	Estimated Project Cost($)	Estimated Capital Incentive ($)	Simple Payback Inc. Incentive (years)	Measure Life (years)	Savings as % of Site Cost
2)	Lighting Controls Upgrade	90,134	-	-	$2,395	$25,000	$9,013	6.7	> 5	0.1%

Figure 12 : Lighting controls improvement preliminary economics

This measure is expected to last over five years, however some level of ongoing review of the system will be required to ensure occupant comfort and energy savings are both optimized. Scheduling may also need to be updated periodically if and when the function of areas change.

5.1.3 Variable speed compressor upgrade

Compressed air at 25 Orde Street is currently generated with two Atlas Copco 60 HP ZT45 Air Compressors, operating in a duty-standby configuration. These compressors appear to be running unloaded a significant portion of the time; data taken in December 2018 demonstrating an average load percentage of 20% is shown below:

Air Compressor	Run Hours	Load Hours	% Loaded
1	33,323	6,805	20.4%
2	32,668	6,162	18.9%
		Average	**19.6%**

Figure 13 : Current air compressor run hours

This low loading indicates that the air compressors spend a significant portion of their operating life unloaded, consuming electricity but making no air. Replacing these units with properly-sized variable speed air compressors would allow the facility to generate compressed air with lower total electricity input. The preliminary economics of this project are shown below:

ID #	Energy Conservation Measure	Electricity Savings (kWh/year)	Demand Savings (kW)	Steam Savings (kWh/year)	Total Cost Savings ($/year)	Estimated Project Cost($)	Estimated Capital Incentive ($)	Simple Payback Inc. Incentive (years)	Measure Life (years)	Savings as % of Site Cost
3)	Variable Speed Air Compressor Upgrade	110,143	42	-	$23,178	$60,000	$11,014	2.1	> 5	1.2%

Figure 14 : Variable speed compressor upgrade preliminary economics

Measurement on the compressed air system should be performed to quantify peak and long-term air demand during different operating times, to ensure that any compressor can handle peak load at the facility. It may be possible to downsize any variable speed compressor based on this information. An upsized receiver tank may also be worthwhile to consider for this measure. This measure is expected to last over five years.

5.1.4 Air handling unit 1 & 2 setback

Detailed information on the quantity, layout and scheduling of the main air handling units (AHUs) at 25 Orde Street has been gathered from the site's building automation system (BAS). This has been combined with spot measurements, as-builts, and site visit data gathered during each of the main seasons (and during overnight hours) to confirm or update BAS data, and understand general air flow, heating, humidifying and cooling trends throughout the year.

A detailed hourly simulation for each main AHU has been performed by applying motor size, setpoint temperatures, return air percentage, current heat reclaim savings and average air flow against outdoor temperature and relative humidity data for 2018; a summary of the results and other pertinent information is provided below:

Air Handling System	Area Fed	Annual Motor kWh	Annual Heating / Humidifying kWh	Annual Cooling kWh	Setback Enabled?	Return Air?	Heat Recovery?
AHU-01	Floors 1 & 2	1,437,691	2,010,273	1,248,552	No	No	Yes, Central Plenum
AHU-02	Floors 1 & 2	1,437,691	2,010,273	1,248,552	No	No	
AHU-03	Floors 3, 4 & 4M	1,437,691	1,309,267	707,980	No	Yes	
AHU-04	Floors 5 & 6	1,372,342	1,636,583	884,976	No	Yes	
	TOTALS	**5,685,415**	**6,966,396**	**4,090,059**			

Figure 15 : Current simulated energy consumption by air handling system

The facility currently has four AHUs fed from a central plenum; AHUs 1 & 2 are identical and both serve the 1st and 2nd floors of the building. AHU 3 is the same size as AHUs 1 & 2 but serves office floors, and uses return air for a portion of its heating duty. A common header for AHUs 1-3 exhausts air from the building.

AHU 4 is a separate system feeding 5th and 6th floor offices in the building; it pulls intake air from the central plenum but exhausts via multiple small distributed fans.

As noted above, none of the facility's AHUs have any setback currently in place. This is mainly due to the end uses for each AHU; research areas fed by AHU 1 & 2 require between 15-20 air changes per hour with 100% fresh air, and without a demand-based system to monitor ongoing air quality this limit must be maintained. Previous air change studies for the 1st and 2nd floors have been performed showing upwards of 20 air changes per hour in certain rooms on these floors.

It may be possible to reduce air changes in certain areas based on updated HVAC guidelines published in February 2019. This updated regulation states that facilities in this class can reduce air changes down to as low as 12 per hour as long as a monitoring, documentation and correction protocol is in place for a select number of air quality indicators. Installing the correct distributed sensors and a system to ensure thresholds are not exceeded could allow an air flow (and associated power / steam) reduction of up to 20%. The preliminary economics of this project are shown below:

ID #	Energy Conservation Measure	Electricity Savings (kWh/year)	Demand Savings (kW)	Steam Savings (kWh/year)	Total Cost Savings ($/year)	Estimated Project Cost($)	Estimated Capital Incentive ($)	Simple Payback Inc. Incentive (years)	Measure Life (years)	Savings as % of Site Cost
4)	AHU 01 & 02 Setback	900,407	103	942,706	$101,402	$200,000	$140,000	0.6	> 5	5.2%

Figure 16 : Air handling unit 1 & 2 setback preliminary economics

Savings associated with this measure have been calculated via simulation, assuming a conservative 10% air flow reduction through each AHU for all operating hours. This measure is expected to last over five years, however will need to be re-visited periodically to ensure air change and air quality thresholds are being met. Consideration for this measure will have to be made to ensure the research environment is not compromised as a result of reduced air changes.

5.1.5 Air handling unit 3 & 4 nighttime setback

Similar to ECM 4 there may be a potential for setback on AHUs 3 & 4 when the offices are not in use, however previous attempts to drastically scale back air flow to the offices allowed pressurized air from the areas fed by AHUs 1 & 2 to infiltrate office areas, compromising staff comfort. It may be possible to slowly setback fan speed in these areas over nighttime hours; even a 15% speed reduction for a limited number of hours would yield substantial savings. The preliminary economics of this project are shown below:

ID #	Energy Conservation Measure	Electricity Savings (kWh/year)	Demand Savings (kW)	Steam Savings (kWh/year)	Total Cost Savings ($/year)	Estimated Project Cost($)	Estimated Capital Incentive ($)	Simple Payback Inc. Incentive (years)	Measure Life (years)	Savings as % of Site Cost
5)	AHU 03 & 04 Night Time Setback	534,378	-	325,807	$23,692	$10,000	$0	0.4	> 5	1.2%

Figure 17 : Air handling unit 3 & 4 setback preliminary economics

Savings associated with this measure have been calculated via simulation, assuming a 15% air flow reduction through each AHU during the hours of 7:00 PM to 6:00 AM, 7 days per week. This measure could be implemented by gradual setpoint changes of 5% every few weeks until a change is detected upstairs by office staff entering the building in the morning. This measure is expected to last over five years, however will need to be re-visited periodically to ensure setpoints are maintaining upstairs staff comfort.

It should be noted that if ECM 4 is implemented, resultant setback to AHUs 3 & 4 can likely be made in tandem to take advantage of the lowered downstairs pressure on the office areas yielding additional savings on top of ECM 4 & 5.

5.1.6 Air handling unit heat reclaim

A glycol loop is currently installed between the main intake air plenum for all AHUs and the exhaust air header for AHUs 1-3; during winter and summer months this loop is in service, providing free heating or cooling to intake air from the exhaust stream. This is sufficient to raise or lower incoming air temperature by 4-5 degrees Celsius during normal operation.

The glycol loop appears to be well-maintained and is shut off during shoulder seasons. Based on simulation calculations, the system is estimated to currently provide approximately 12% heat reclaim benefit. Detailed measurements could be taken on the system to understand exact heat reclaim benefit over a period of time at varying conditions, and this data can be used to both re-tune the existing system as well as investigate the potential for improved heat exchange,

A conservative glycol loop heat reclaim percentage of 18% has been assumed and savings have been calculated over all non-shoulder season hours via simulation. The preliminary economics of this project are shown below:

ID #	Energy Conservation Measure	Electricity Savings (kWh/year)	Demand Savings (kW)	Steam Savings (kWh/year)	Total Cost Savings ($/year)	Estimated Project Cost($)	Estimated Capital Incentive ($)	Simple Payback Inc. Incentive (years)	Measure Life (years)	Savings as % of Site Cost
6)	Air Handling Unit Heat Reclaim Improvement	75,180	- 7	641,883	$17,065	$120,000	$7,518	6.6	> 5	0.9%

Figure 18 : Air handling unit heat reclaim preliminary economics

Note that the savings listed above assume that ECMs 4 and 5 have been implemented to ensure savings are not double-counted. This measure is expected to last over five years, and periodic assessments of the system are recommended to ensure heat reclaim is performing as expected.

6. Approval for ECDMP

X

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X

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Chief Executive Officer

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