APPROACH TO SUSTAINABILITY

CONCEPTS AND GOALS

The University of Ontario Institute of Technology (UOIT) Software and Informatics Research Centre project (SIRC or the Project) is targeting an energy use reduction of 25% below ASHRAE 90.1 2010.

UOIT has chosen to not pursue LEED certification for the Project; however, the proposed design does incorporate many sustainable design features and EllisDon will implement sustainable construction practices.

DESIGN CONSIDERATIONS

Site

Exterior bicycle storage is provided to support the use of alternative transportation and reduce the negative environmental impacts associated with automobile use. Open space is connected to the Project through adjacent green spaces. To help reduce heat island effect, high-albedo roofing is provided to minimize the building's cooling load. Automatic shut-off of non-emergency interior lights and full cut-off exterior lighting is being considered to minimize light trespass and night-sky light pollution. A green roof provides further ecological connections between the built form and the surrounding ecosystem.

Building

Building materials have been selected with a number of factors in mind, such as:

- Thermal Performance: air-tightness of assemblies and insulation values for windows, walls and roof
- Recycled Content: reduce the amount of processing and virgin resources to manufacture new building products
- Regional Content: support local supply economies and reduce the environmental impact of transporting materials over long distances
- Certified Wood: support responsible forest management through wood materials that are Forest Stewardship Council-certified
- Low-Emitting Materials: products that are low in Volatile Organic Compounds (VOC) protect the health of installers and building occupants, and maintain indoor air quality

Building Systems

With the intent to reduce water and energy consumption in the building, a number of sustainable mechanical and electrical strategies are incorporated. Low-flow plumbing fixtures are provided to achieve a water consumption reduction of at least 30% over the conventional baseline.

Spaces are designed to comply with ASHRAE Standard 55, ensuring comfortable operating conditions for occupants. Increased ventilation rates are provided to ensure the required air changes are achieved.

Indoor chemicals and pollutants are controlled and properly vented to ensure contaminants are minimized in occupied areas.

Lighting systems incorporating daylight and occupancy sensors are provided to minimize electricity consumption when adequate daylight is present or when spaces are not in use. High-efficiency heating and cooling is optimized for energy savings and occupant comfort. All systems will undergo an enhanced commissioning process to ensure installed performance meets the intended design. Passive solar strategies are included in the design.

Sustainable Innovations

We are targeting some innovative approaches to sustainable design that go beyond design and construction. These include a green housekeeping program, low-mercury lamp purchasing policy, and a scent-free policy.

The team implemented an integrated design approach to optimize design decisions and trade-offs. The integrated design process involved workshops and weekly meetings with members of the multidisciplinary team and other stakeholders to discuss and make decisions on design challenges.

B13

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ENERGY MODELING REPORT

Refer to the attached Energy Modeling Report prepared and submitted by MCW Consultants Ltd.

B13: Energy Model Report

ENERGY MODEL REPORT

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY SOFTWARE AND INFORMATICS RESEARCH CENTRE (SIRC)

25/05/2016 – REVISION 2

MCW Consultants Ltd.

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ENERGY MODEL REPORT
UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY SOFTWARE AND INFORMATICS RESEARCH CENTRE (SIRC)
25/05/2016 – REVISION 2

MCW Consultants Ltd.

1 EXECUTIVE SUMMARY

The Software and Informatics Research Centre (SIRC) building at the University of Ontario Institute of Technology (UOIT) is a new four storey building proposed to be built to house a mix of administrative, classroom, and laboratory space. The building has an ambitious energy target of 25% energy savings over ASHRAE90.1-2010 Appendix G. The first two floors will be fit-out initially while the third and fourth floors will be shelled for future fit-out. This report provides an analysis of the proposed design with respect to this target.

The proposed design achieves:

44% Annual Energy Savings over ASHRAE90.1-2010, and

✓ Meets the 25% Energy Savings Target over ASHRAE90.1-2010

2 INTRODUCTION

The Software and Informatics Research Centre (SIRC) building at the University of Ontario Institute of Technology (UOIT) is a new four storey building proposed to be built to house a mix of administrative, classroom, and laboratory space. The building has an ambitious energy target of 25% energy savings over ASHRAE90.1-2010 Appendix G. This report aims to analyze the energy performance of the proposed building with respect to this energy savings target. The first floor contains office and administrative spaces, the second floor contains classroom and laboratory spaces while the third and fourth floors are shelled for future use.

The energy analysis was carried out in IES<VE> 2015, an ANSI/ASHRAE Standard 140 accredited software tool.

3 GENERAL ENERGY MODEL DETAILS

3.1 MASSING & CONFIGURATION

A building energy model was built in IES<VE> 2015 software based on the April 15th floor plans and April 18th elevations. The geometric model can be seen in Figure 1 below. The top two floors were considered as shelled space and were minimally conditioned and lit.

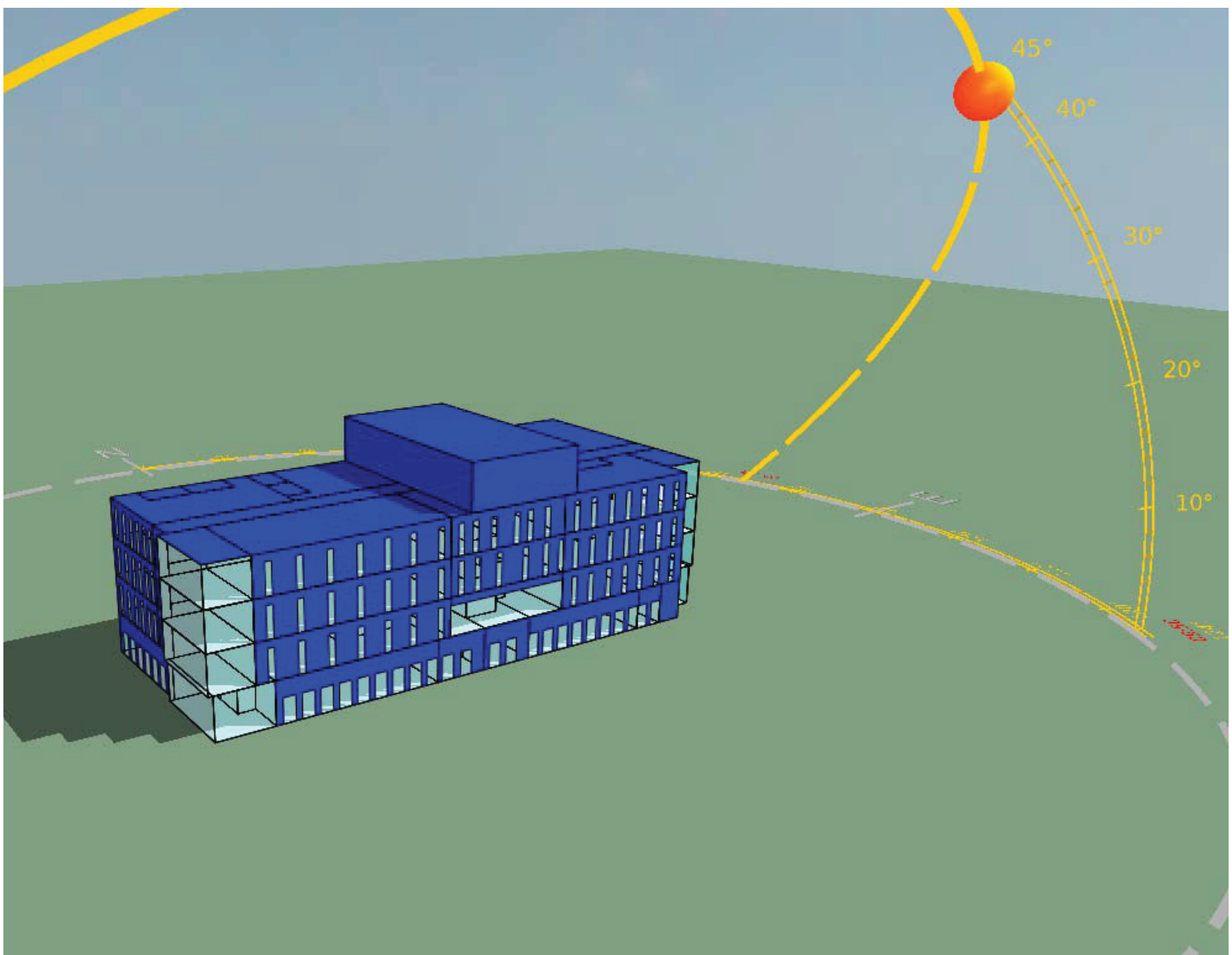

FIGURE 1: UOIT ACADEMIC AND ADMINISTRATIVE BUILDING GEOMETRY

3.2 WEATHER DATA

The Toronto weather file was used as this was the closest, most appropriate hourly CWEC[1] weather file available. Figure 2 shows the hourly outdoor air temperatures from the weather file.

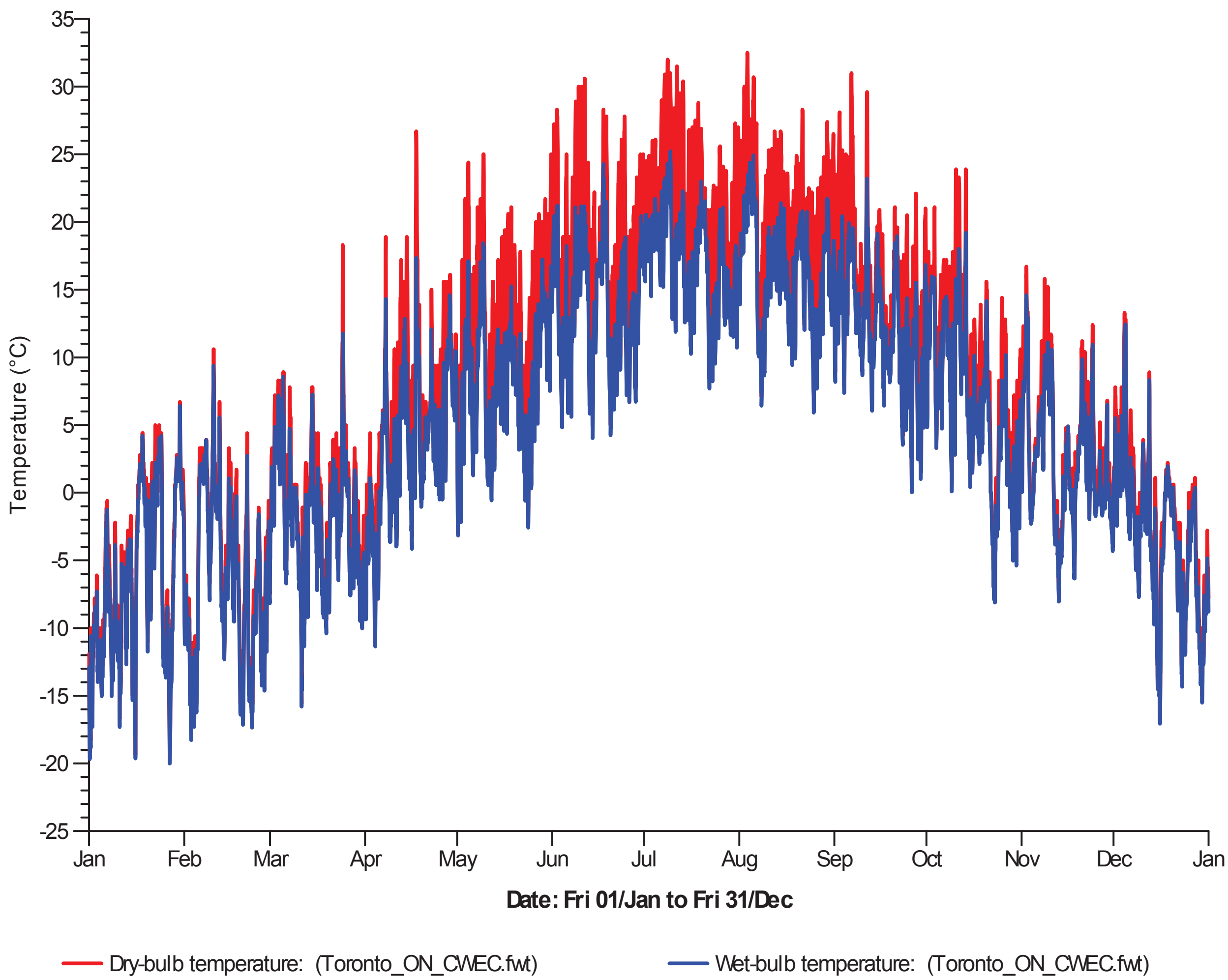

FIGURE 2: PEARSON INTERNATIONAL AIRPORT, FROM CWEC WEATHER FILE

[1] CWEC (Canadian Weather for Energy Calculations) files contain hourly weather observations representing an artificial one-year period specifically designed for building energy calculations. Produced by Numerical Logics in collaboration with Environment Canada and the National Research Council of Canada, CWEC hourly files represent weather conditions that result in approximately average heating and cooling loads in buildings.

3.3 INDOOR CONDITIONS

The temperature and humidity set-points vary according to different space types in the model as shown below in Table 1.

TABLE 1: SUMMARY OF INDOOR CONDITION SET-POINTS

Area	Heating (8am-6pm)/Night	Cooling (8am-6pm)/Night	Humidity
Regularly Occupied Areas	22°C /18°C	24°C /28°C	30%-55%
Mechanical and Electrical Rooms	18°C	None	None
Shelled Space on Floors 3 and 4	10°C	None	None

4 PROPOSED ENERGY MODEL

4.1 BUILDING ENVELOPE

The proposed building envelope was based on performance values provided by Dialog and shown in Table 2. They are typical of a building with good thermal performance.

TABLE 2: SUMMARY OF PROPOSED BUILDING ENVELOPE PERFORMANCE

Envelope Component	Performance
Typical wall overall effective performance	R-20
Roof overall effective performance	R-30
Glazing effective performance including framing	U-0.32, SHGC =0.40
Slab on grade insulation and perimeter footing insulation	R-15 for 24 inches at the perimeter

4.2 INTERNAL GAINS, DOMESTIC HOT WATER AND OUTDOOR AIR

The proposed building lighting power was set at a constant 8.07 W/m^2 (0.75 W/ft^2) in the first two floors and 1 W/m^2 in the shelled space. The miscellaneous equipment gains are the IES defaults for the ASHRAE space types running on the schedule for schools in the ASHRAE90.1-2010 User's Guide. This schedule was modified to allow for 50% occupancy of the second floor spaces during summer. The peak domestic hot water consumption was set at 500 l/h, based on the recommendation of the ASHRAE90.1-2010 User's Guide (based on occupant density and hot water per person) and running on the schedule for schools. The outdoor air requirements are calculated according to ASHRAE62.1.

4.3 HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

The HVAC system in the proposed design is fan coils served by a DOAS unit with heat recovery. Table 3 summarizes the air-side systems in the model while Figure 3 shows the FCU with DOAS in ApacheHVAC.

TABLE 3: SUMMARY OF AIR-SIDE SYSTEMS IN IES <VE> PROPOSED MODEL

System	Area Served	Description
Fan Coils	First and Second Floors	Hot water and chilled water coils
DOAS	First and Second Floors	Hot water and chilled water coils Hot water reheat coils Energy recovery wheel with 70%/65% sensible/latent effectiveness
A/C Units	IT/Comm rooms	Split A/C units for cooling
Unit Heaters	Mechanical penthouse and shelled floors	Hot water unit heaters

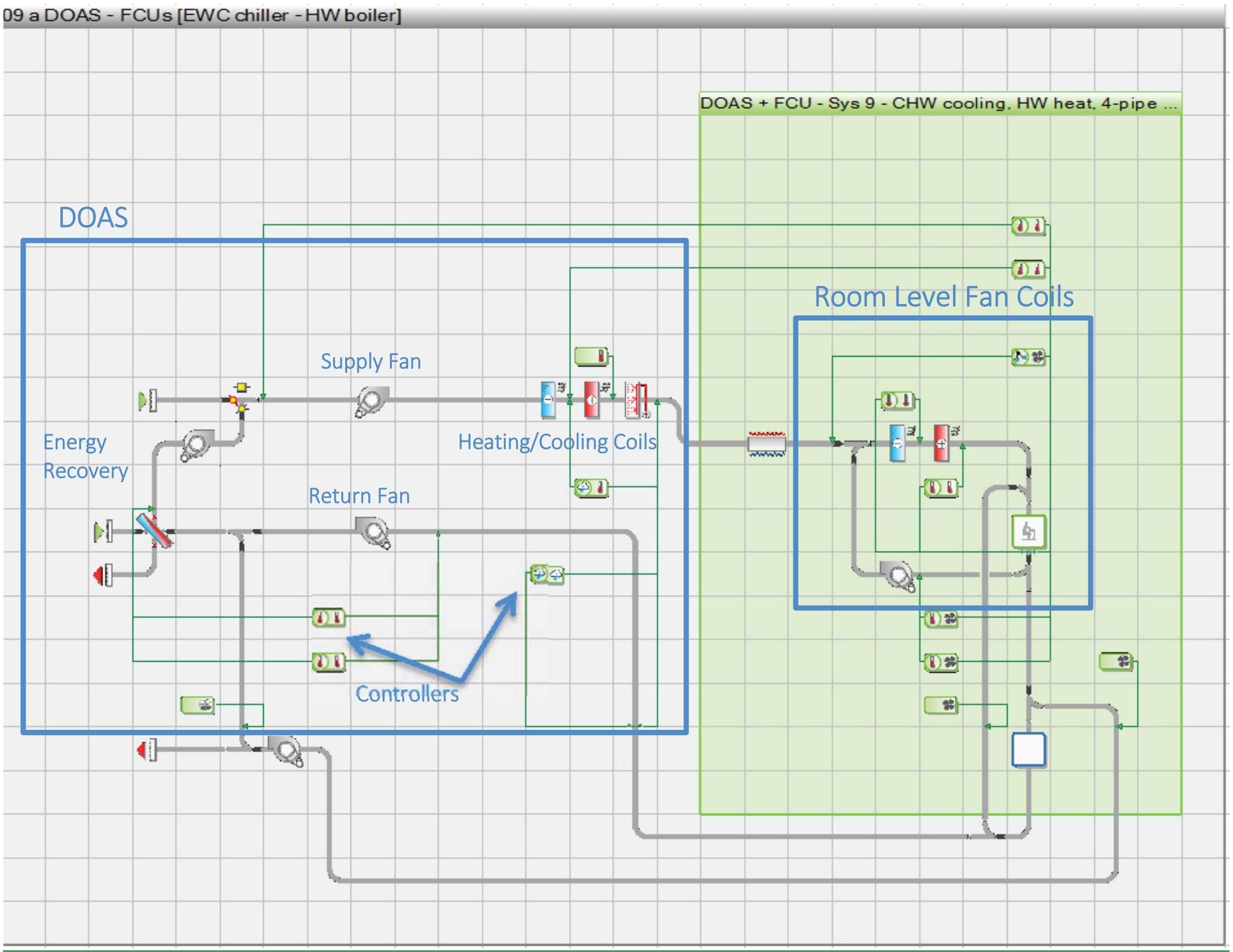

FIGURE 3: FAN COILS WITH DOAS

4.4 WATER SIDE HVAC SYSTEMS

4.4.1 HOT WATER SYSTEM

For all design options the hot water system consists of two condensing boilers serving a primary secondary distribution system with variable speed secondary pumps.

4.4.2 CHILLED WATER SYSTEM

The chilled water system is served by a single air cooled chiller and the distribution system is primary-secondary with variable speed secondary pumps with the chilled water supply temperature reset according to outdoor air temperature.

5 BASELINE ENERGY MODEL

An ASHRAE90.1-2010 Appendix G baseline was created in order to demonstrate the energy target of 25% savings over ASHRAE90.1-2010 by using the appropriate PRM navigator in IES <VE>.

5.1 BUILDING ENVELOPE

The building envelope thermal properties of the baseline model are set according to the ASHRAE90.1 required properties as given in Table 4.

TABLE 4: SUMMARY OF BUILDING ENVELOPE THERMAL PROPERTIES

Component	Effective U-Value (W/m^2-K)
Exterior Walls	Steel-framed non-residential: U-0.36 W/m^2-K
Roof	Insulation entirely above deck: U-0.27 W/m^2-K
Window	Metal framing (all other): U-3.12 W/m^2-K SHGC 0.4

5.2 INTERNAL GAINS, DOMESTIC HOT WATER AND OUTDOOR AIR

The baseline lighting power densities used in the baseline model are given below in Table 5. The domestic hot water and miscellaneous equipment gains are the same as in the proposed model. The outdoor air requirements were calculated according to ASHRAE62.1 according to space type and expected occupancy.

TABLE 5: BASELINE LIGHTING POWER DENSITY

Space Type	ASHRAE90.1-2010 Lighting Power Density (W/m^2)
Classroom	13.3
Conference/Meeting	13.2
Corridor	7.1
Electrical/Mechanical	10.2
Food Preparation	10.7
Lobby	9.7
Labs	13.9
Office – Enclosed	11.9
Office – Open	10.5
Restrooms	10.5
Stairway	7.4
Storage	6.8
Shelled Space	1.0

5.3 HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

The baseline model HVAC system types were selected from ASHRAE 90.1-2010 Appendix G Table G3.1.1B. A summary of the air-side systems in the baseline model is shown in Table 6.

TABLE 6: SUMMARY OF SYSTEMS IN IES <VE> BASELINE MODEL

System	Area Served	Basic Settings
AHU-1 VAV System	First Floor	VAV Hot water coil, DX cooling Hot water reheat coils
AHU-2 VAV system	Second Floor	VAV Hot water coil, DX cooling Hot water reheat coils Energy recovery wheel with 50% sensible effectiveness in ASHRAE90.1-2010 Baseline Only
Unit Heaters	Mechanical penthouse and shelled floors	Hot water unit heaters

5.4 WATER SIDE HVAC SYSTEMS

5.4.1 HOT WATER SYSTEM

The baseline hot water system is served by two hot water boilers with an efficiency of 80%. The hot water supply temperature is reset according to outdoor air temperature between 82°C at -7°C and 66°C at 10°C. The system is a primary only system with variable speed pumping.

6 ENERGY SIMULATION RESULTS

The annual energy by end-use is compared between the proposed design and the ASHRAE90.1-2010 baseline in Figure 4. There are large savings shown in heating energy due to a combination of ventilation heat recovery and efficient condensing boilers. Lighting savings are also present as the design utilizes efficient LED lighting with a lighting power density of 8.07 W/m^2 (0.75 W/ft^2). Fan savings are achieved because there is less air being handled by the central system and more at the zone level. This is counteracted very slightly with an increase in pump energy. Finally, the proposed design uses an air-cooled chiller compared to the baseline which uses DX coils resulting in cooling savings.

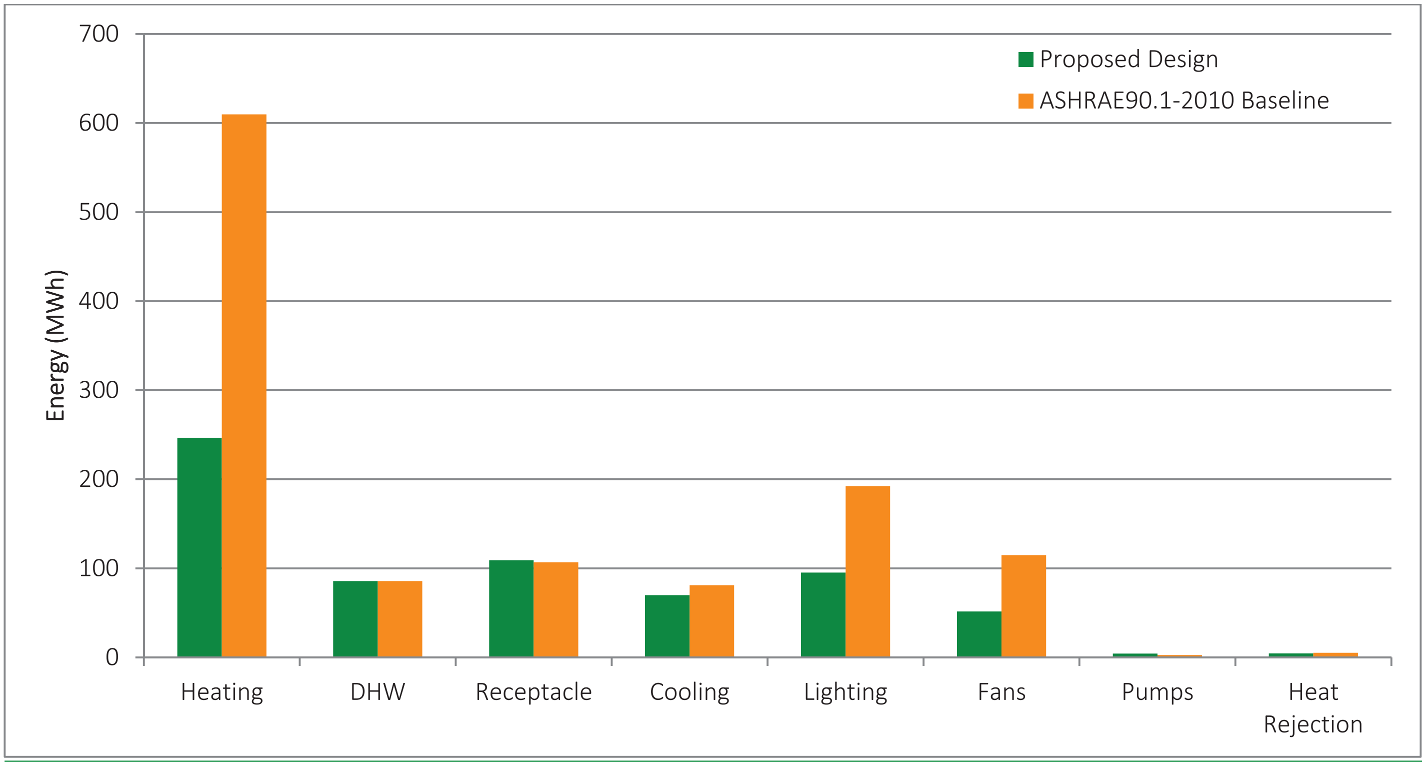

FIGURE 4: ANNUAL ENERGY CONSUMPTION IN EACH DESIGN OPTION AND BASELINE MODEL

The proposed design exceeds the savings target of 25% over the ASHRAE90.1-2010 baseline as shown in Table 7.

TABLE 7: ANNUAL ENERGY SAVINGS COMPARED TO ASHRAE90.1-2010

Option	Energy (eMWh)			Savings over ASHRAE90.1-2010
	Electricity	Gas	Total	
Proposed	337	342	680	**44%**
2010 Baseline	503	695	1,198	-

7 CONCLUSIONS

The proposed design achieves the 25% energy savings over the ASHRAE90.1-2010 baseline target. This is due to a combination of ventilation heat recovery, condensing boilers, efficient LED lighting, use of fan coils with DOAS to reduce fan energy, and an air cooled chiller.

8 ADDITIONAL MODELLING NOTES

8.1 DISCLAIMER

It is important to note that this study is based on the current design and available information, as detailed in this report. **It is not a prediction of actual energy consumption or costs of the proposed design after construction.** Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by the ASHRAE 90.1 standard, changes in energy rates between design of the building and occupancy, and precision of the calculation tool.

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