FINAL

Energy Conservation and Demand Management (ECDM) Plan

1520 Queen Street East
Sault Ste. Marie, Ontario

Prepared for:

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APPENDICES

1.0 INTRODUCTION AND BACKGROUND

Pinchin Ltd. (Pinchin) was retained by Algoma University (Algoma) to assist in the preparation of Algoma's first Energy Conservation and Demand Management (ECDM) Plan. In addition, Pinchin was retained to assist in the calculation of greenhouse gas emissions arising from building energy use, in accordance with Ontario Regulation 397/11 (the Regulation) requirements. This assessment quantifies the greenhouse gas (GHG) emissions from the operation of Algoma's facilities during calendar year 2012.

Ontario Regulation 397/11 made under the Green Energy Act, 2009, states that in order to comply with the Regulation's requirements, Algoma must provide a summary of its annual energy consumption and greenhouse gas emissions, as well as a description of previous, current and proposed measures for conserving and otherwise reducing the amount of energy consumed and the demand for energy created by its operations. This must include a forecast of the expected results of current and proposed measures.

This assessment represents Algoma's first ECDM.

2.0 PRIOR ENERGY CONSERVATION AND SUSTAINABILITY PROJECTS

Recently, the College has embedded sustainability in its strategic plan and demonstrated leadership by pursuing green initiatives to achieve its sustainability goals.

Some recent initiatives specifically related to sustainability and energy reduction include:

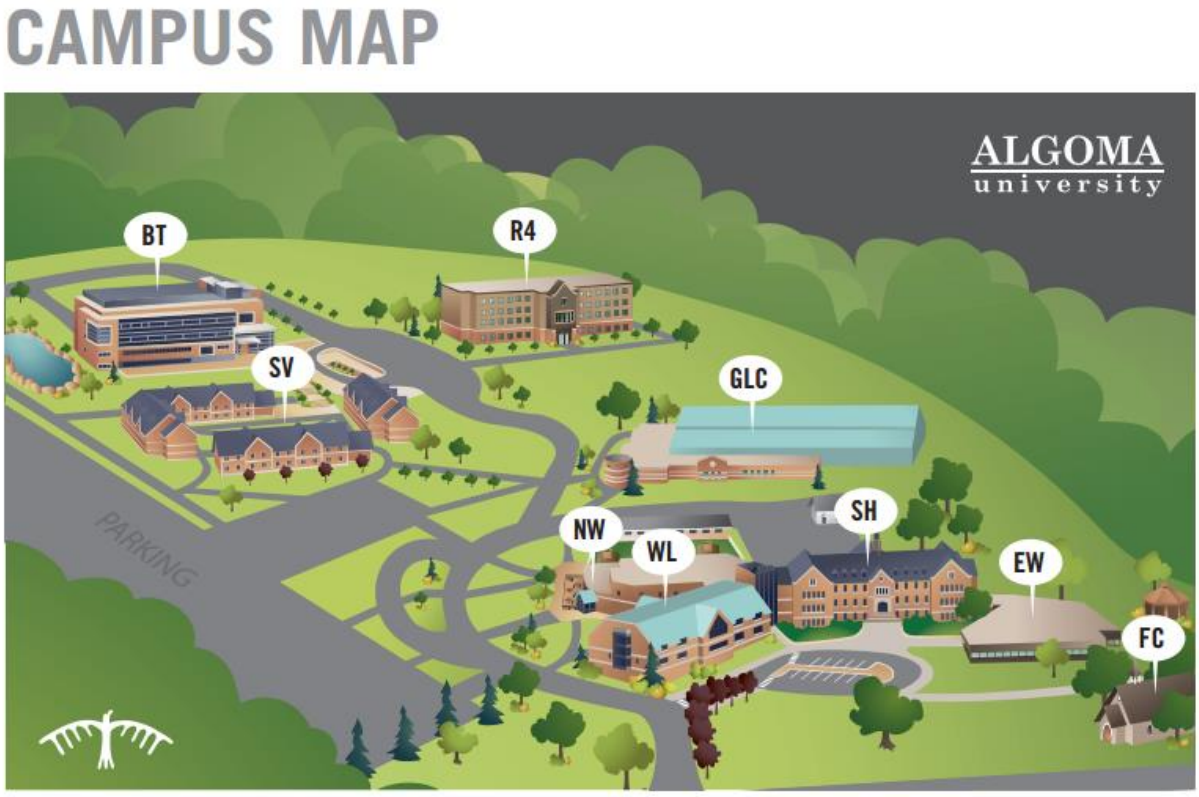
- Algoma was awarded a Union Gas Limited EnerSmart Program rebate in the amount of $9,000 in response to implementing 12 high-efficiency-condensing boilers throughout its campus.
- Continuous energy efficient LED lighting upgrades to eliminate all existing T12 lamps
- Installing occupancy sensors to reduce unnecessary lighting
- Incorporating daylight harvesting technology in new construction
- Total HVAC upgrades to the campus library (21,905 square feet) and athletics facility (38,201 square feet)
- Construction of the LEED Gold-certified *Essar Convergence Centre* (pictured below), ranked the greenest building in Sault Ste. Marie.

Algoma aims to add to these energy conservation initiatives with the measures and objectives identified in this ECDM plan.

3.0 ALGOMA UNIVERSITY ENERGY AND EMISSIONS

3.1 Facility Description

Algoma University's campus, as it pertains to reporting under the Regulation, is comprised of 13 buildings located at 1520 Queen St. E, Sault Ste. Marie, Ontario (P6A 2G4).



SH **Shingwauk Hall**
- Student Recruitment/Reception
- Office of the Registrar
- Financial Aid
- Student Accounts
- Student Services Hallway
- Anishinaabe Initiatives Division
- Anishinaabe Student Life Centre
- Learning Centre

EW **East Wing**
- Shingwauk Residential School Centre

BT **Essar Convergence Centre**
- Health Informatics Institute
- Sault Ste. Marie Innovation Centre
- Algoma Games for Health
- Teaching and Faculty Research Labs
- Student Lounge

NW **North Wing**
- Speak Easy
- GWL Amphitheatre A.K.A. "The Fishbowl"
- IT Helpdesk
- Computer Labs
- Bookstore
- AUSU Office
- T-Bird II Lounge
- Lockers

WL **Wishart Library**
- Reference Desk
- Writing Lab

GLC **George Leach Centre**

SV **Spirit Village Residence**

R4 **Student Residence**

FC **Fauquier Chapel**

The following facility types must be included in the assessment of energy consumption for the purposes of reporting under the Regulation:

1. Administrative offices and related facilities.
2. Classrooms and related facilities.
3. Laboratories.
4. Student residences with > 3 storeys or a building area of more than 600 square metres.
5. Student recreational facilities and athletic facilities.
6. Libraries.
7. Parking garages.

Two facilities (maintenance and storage facilities) are not included in the Regulation as prescribed operation types, however are included in the analysis herein as their energy consumption cannot be separated from the prescribed facilities due to the metering currently in place on campus.

A full list of facilities and their dates of construction is provided below.

Facility Name	Date of Construction	Included Activity Description	Total Area (sq. ft.)	Total Indoor Area Involved in Included Activity (sq.ft.)
East Wing	1970	Classrooms, research space and offices	8,032	8,032
George Leach Centre	1992	Athletics	38,201	38,201
North Wing	2006	Classrooms, research space and offices	42,918	42,918
West Wing/Library	1987	Library, classrooms, research space and offices	29,105	29,105
Shingwauk Hall	1926	Classrooms, administration, auditorium	32,525	32,525
Student Residence Phase I	1987	Student residences > 600 sq. metres.	19,318	19,318
Student Residence Phase II	2001	Student residences > 600 sq. metres.	10,921	10,921
Student Residence Phase III	2003	Student residences > 600 sq. metres.	12,263	12,263
Student Residence Phase IV	2012	Student residences > 600 sq. metres.	32,679	27,494
Essar Convergence Centre	2010	Classrooms, research space, offices, leased space	52,743	46,670
Windsor Park	1930	Student residences > 600 sq. metres.	81,909	81,909
Maintenance Garage	1991	n/a (Maintenance)	2,972	75
Central Storage Building	2004	n/a (Storage)	3,167	75

3.2 Energy Consumption and GHG Emissions

3.2.1 Total Energy Use in 2012

Consistent with many post-secondary institutions in Canada, sub-metering at the individual facility level is not currently available, which precludes the determination of the exact consumption of each building on campus. As such, Algoma's energy consumption in 2012 is provided in total below:

Electricity consumption: 5,195,378 kWh

Natural gas consumption: 374,197 m^3 (3,997,669 ekWh)

In addition, approximately 200 gallons of diesel was consumed in an emergency generator. This energy use was excluded per O.Reg.397/11,s.5 (5).

This energy consumption will act as the baseline for Algoma's energy conservation objectives, outlined in the sections below.

3.2.2 Building Energy Intensity in 2012

Algoma's total building energy consumption for 2012 was 33,095 GJ. This total includes contributions from natural gas and electricity use. This value can be converted to energy intensity figures to be used as benchmarks against other similar facilities, and as a baseline for comparison with Algoma in future years. Total energy intensity at Algoma in 2012 was **25.1 ekWh / ft^2 ,** or **0.97 GJ / m^2.** This figure compares favourably with Natural Resources Canada's benchmark data for educational facilities, found in the Comprehensive Energy Use Database published by the Office of Energy Efficiency. These values were 1.49 GJ / m^2 for Ontario facilities, and 1.41 GJ / m^2 for all such Canadian facilities.

A graphical comparison of Algoma's energy intensity versus the benchmark data is presented in the figure below. The total intensity is also broken down by energy source.

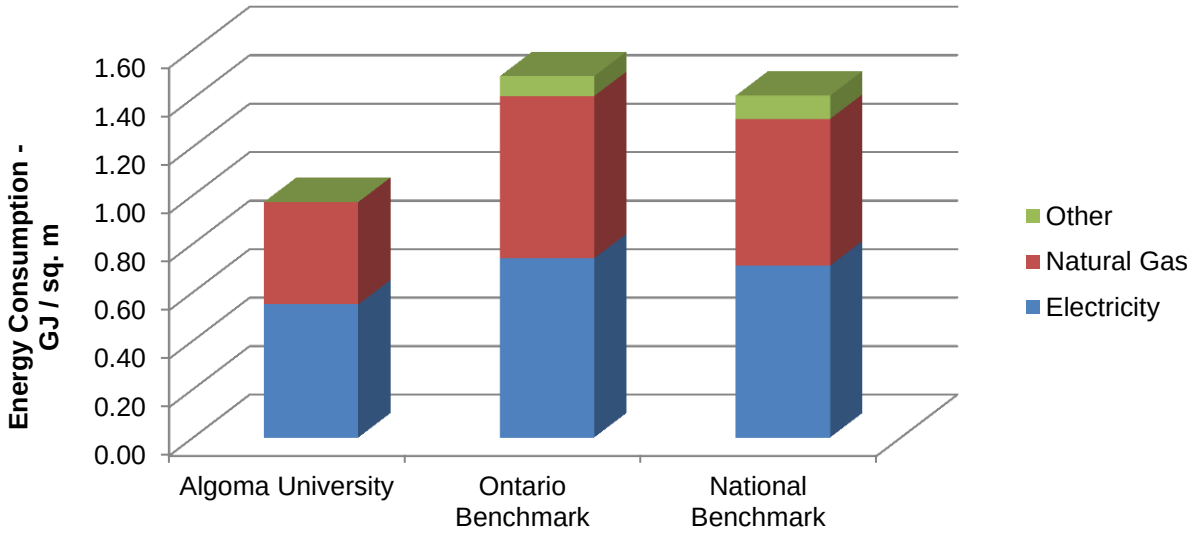


Figure 1: Algoma Building Energy Intensity vs. Benchmark Data

3.2.3 GHG Emissions in 2012

The resultant emissions related to energy consumption arise from electricity consumption and natural gas combustion, totalling **1,206 tonnes of carbon dioxide equivalent (CO_2e).** This total is comprised of contributions from electricity consumption (498.8 tonnes CO_2e) and natural gas combustion (707.5 tCO_2e).

3.3 Sources of Data & Uncertainty

Data was received primarily in the form of utility bills which required manual transcription. As a result, a small potential exists for transcription errors. Pinchin has taken appropriate steps to perform quality assurance and a plausibility assessment on all data used in this report to minimize this risk.

3.3.1 Treatment of Missing Data, Extrapolation

In a small number of cases, electricity data for a given meter was missing for one month of the year. In such cases, the arithmetic average of the prior month and subsequent month was assumed for the missing value.

4.0 ALGOMA UNIVERSITY ENERGY CONSERVATION GOALS AND PROPOSED MEASURES

4.1 Goals and Objectives for Reducing Energy Consumption & Demand

The principal goal of this ECDM plan and its implementation is to improve the long-term sustainability and energy efficiency of Algoma University. With this goal in mind, our primary objectives in the period of 2014-2019 are:

1. To reduce energy consumption for the campus by an average of 1% per year, for a total of 5% over the next 5 years (2014-2019).
2. To perform energy auditing to ensure best practises are being applied across the campus and equipment in use on site is energy-efficient and well-operated.
3. To investigate options for the expansion of renewable energy equipment and proceed where practical.
4. To increase awareness of energy conservation throughout the campus by providing real-time displays as a learning tool, encouraging energy conservation.
5. Increase sub-metering of electricity, natural gas and water where feasible to facilitate building-level data collection, monitoring and progress tracking.

4.2 Proposed Energy Conservation Measures and Energy/Cost Savings Estimates, 2014-2019

Many of Algoma's facilities have recently been upgraded with new and high-efficiency boilers and HVAC units. As such, the energy conservation measures (ECMs) outlined below focus on outreach and non-capital measures. Unless otherwise specified, it is anticipated that the ECMs identified will be in place for the duration of the report period (2014-2019).

Energy Conservation Measure	Description	Estimated Cost
1. Campus-wide energy audits	Energy audits (e.g. ASHRAE Level I or II audits) will identify specific energy efficiency projects which can then be implemented in this reporting period, or potentially the 2019-2024 period.	~ $70,000 depending on the number of buildings audited
2. Renewable energy investigation	Perform consultation, feasibility assessment and detailed costing related to the installation of solar energy, ground source energy, and/or other renewable energy sources on campus.	TBD.
3. Campus energy awareness campaign	To increase awareness of energy issues and energy consumption across the campus, including students, staff and faculty, via messaging and dedicated dashboard/kiosk stations providing energy-related information. Improve energy conservation from computer and monitor use, to water conservation in the dormitories and athletic facilities.	~$30,000
4. Sub-metering	Increase sub-metering of electricity, natural gas and water to provide insight into high-consumption facilities and inform future conservation measures	TBD. Based on the number of meters installed.

Energy Conservation Measure	Description	Estimated Cost
5. Occupancy sensors & timers	Occupancy sensors minimize waste lighting by automatically de-activating during off-peak times and/or when no occupants are present.	~ $250 per sensor
6. Daylight Sensors	To go along with the daylight harvesting already in use in many areas of the campus and in forthcoming new construction, install daylight sensors where appropriate to minimize energy use and drive further demand and total energy reductions.	~ $250 per sensor
7. Air handling unit controls optimization	Aligning the current equipment schedule, sequence of operation and set points with the space use requirements of the buildings to reduce energy consumption and improve occupant comfort.	TBD.
8. Building re-commissioning study	Building recommissioning is a process whereby outdated and inefficient modes of operation currently in use are optimized based on the current building usage and equipment. Energy use and demand reduction is achieved through the optimization of variables such as scheduling, economizer sequences, dampers, controls, and set-points.	~ $20,000 per facility selected
9. Install VFD's	Variable frequency drives allow fan and pump motors to ramp up or ramp down to meet the current flow or pressure demand.	~ $5,000 per VFD
10. Install ERV's	Energy recovery ventilators reduce overall energy use by capturing and recovering existing specific and latent heat energy in air before it is expelled from the facility. Algoma makes use of several HRV's on campus at present.	~ $15,000 per unit, depending on size
11. Chilled water set-point adjustment	Re-examining and optimizing the chilled water set-point can significantly reduce overall energy consumption, especially if this has not been performed recently.	TBD. May be a zero-cost initiative.

Energy Conservation Measure	Description	Estimated Cost
12. Energy and water efficiency in new construction	New construction is the most cost-effective phase of the building lifecycle to incorporate modern energy and water efficient equipment and devices.	TBD.
13. Weather-proofing	Reduce exfiltration and infiltration of outside air by improve the weather-proofing and insulation, especially in older facilities. Infrared thermography may be used to assess where leakage is occurring in the building envelope.	~ $6,000
14. Training for facilities staff	Provide additional training for facilities staff and other Algoma staff members who can drive further energy use reductions via improvements to building operation practises.	~ $5,000
15. Lighting upgrades	Although T12 units have been replaced across the campus, replacement with LED fixtures where feasible will continue to reduce overall energy consumption.	TBD. Dependent on no. and size of fixtures
16. Demand response and peak shaving	Utilizing the building automation systems (BAS) in place on the site, optimize the timing of HVAC fan use and other operational activities to reduce peak demand.	~ $15,000
17. High-efficiency appliance replacements	When appliances are replaced, incorporate Energy Star equipment or similar, where feasible.	TBD, dependent on appliance.
18. Conservation signage	Strategic placement of signage in high-waste areas of energy and water use to increase efficiency through behavioural adjustment.	~ $2,500

Energy Conservation Measure	Description	Estimated Cost
19. Low-E glazing film	Where feasible and cost-effective, install low-e glazing film to increase overall energy efficiency.	~ $7.50 / sq.ft.
20. Install water aerators	Water aerators reduce the total water used and also reduce the heating demands for water use.	~ $500

The combined estimated savings associated with the measures identified above amount to approximately **550,000 ekWh per year,** and **$84,800 per year** in utility cost reductions.

4.3 Description of any Renewable Energy Systems & Amount of Energy Produced Annually

Algoma does not currently generate renewable energy on-site.

4.4 Confirmation of Senior Management ECDM Approval [O.Reg. 397/11, s. 6 (1)(viii)]

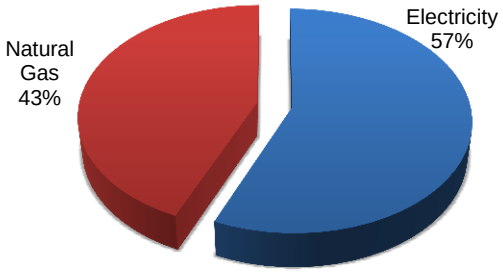
Algoma's Board of Governors, President and Senior Management have approved this ECDM in full.

5.0 SUMMARY

The total energy consumption and greenhouse gas emissions from Algoma's operations in 2012 are shown below:

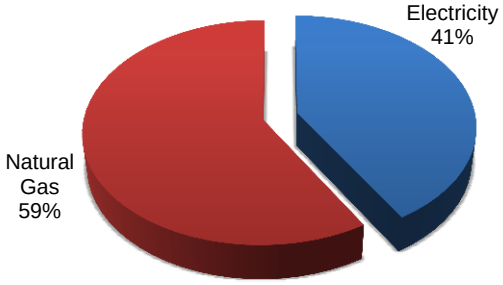
Energy Consumption by Source

Source	Energy Consumption (ekWh)
Electricity	5,195,378
Natural Gas	3,997,669
Total	**9,193,047**



GHG Emissions by Source

Source	Emissions (tCO_2e)
Electricity	498.8
Natural Gas	707.5
Total	**1,206**



The combined estimated savings associated with the measures identified in this plan amount to approximately **550,000 ekWh per year,** and **$84,800 per year** in utility cost reductions.

6.0 LIMITATIONS

It should be noted that Pinchin has attempted to identify any and all of the deficiencies associated with this project. Pinchin does not accept any liability for deficiencies that were not identified within the scope of the investigation.

The assessment is based, in part, on information provided by others. Unless specifically noted, Pinchin has assumed that this information was correct and has relied on it in developing the conclusions.

This report was prepared for the exclusive use of Algoma Ltd, subject to the conditions and limitations contained within the duly authorized work-plan. Pinchin will not be responsible for the use of this report by any third party, or reliance on of any decision to be made based on it without the prior written consent of Pinchin. Pinchin accepts no responsibility for damages, if any, by any third party as a result of decisions or actions based on this report.

Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if Algoma has failed, within a period of two (2) years following the date upon which the claim is discovered within the meaning of the Limitations Act, 2002 (Ontario) to commence legal proceedings against Pinchin to recover such losses or damage.

This report presents an overview, reflecting Pinchin's best judgment using information reasonably available at the time of Pinchin's review and assessment. Pinchin has prepared this report using information understood to be factual and correct and shall not be responsible for conditions arising from information or facts that were concealed or not fully disclosed to Pinchin at the time the work was completed.

7.0 CLOSURE

Pinchin has prepared this report for the exclusive use of Algoma. The Pinchin assessment was conducted in accordance with Pinchin's proposed scope of work and verbal direction provided by the Client, and generally accepted assessment practices. No other warranty, expressed or implied is made.

We trust that the aforementioned report addresses your requirements. Following your review of this submission, we shall be available to address any questions you may have relating to the findings and/or recommendations. Should you require clarification or information regarding this report, please contact Pinchin via the information on page i.

REFERENCES

EC (2014) *Canada's Greenhouse Gas Inventory, 1990-2012.* Greenhouse Gas Division, Environment Canada. May 2012.

IPCC (1996) *IPCC Second Assessment Report.* Developed by the Intergovernmental Panel on Climate Change.

OEE (2015) *Comprehensive Energy Use Database, 1990 to 2012,* Office of Energy Efficiency, Natural Resources Canada, February 2015.

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APPENDIX I

Supplementary Data

1.0 EMISSION FACTOR SUMMARY TABLE

Source	Emission Factor / Conversion Factor	Unit	Reference
Natural Gas	38.46	TJ / GL	EC 2014
Ontario Electricity Grid	96	g CO_2e / kWh	EC 2014
CO_2 – Global Warming Potential, 100-year Horizon	1	n/a	IPCC 1996
CH_4 – Global Warming Potential, 100-year Horizon	21	n/a	IPCC 1996
N_2O – Global Warming Potential, 100-year Horizon	310	n/a	IPCC 1996
Ontario Natural Gas	1,879	g CO_2/m^3	EC 2014
Ontario Natural Gas	0.037	g CH_4/m^3	EC 2014
Ontario Natural Gas	0.035	g N_2O/m^3	EC 2014

Note: additional standard mathematical conversion factors, which do not require a source, were used (e.g. conversions between square feet and square metres).