2025 Energy Conservation & GHG Reduction Plan

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Prepared for:

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Edmonton, Alberta

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Project #: 114760116

Table of Contents

LIST OF TABLES

LIST OF FIGURES

Abbreviations

Abbreviation	Full Name
BAS	Building Automation System
BAU	Business as Usual
BCA	Building Conditions Assessment
CAFE	Corporate Average Fuel Economy
CO_2e	Carbon Dioxide Equivalent
EV	Electric Vehicle
GHG	Greenhouse Gas
GJ	Gigajoule
HDV	Heavy Duty Vehicle
HVAC	Heating, Ventilation and Air Conditioning
ICC	Internal Cost of Carbon
ISI	Institute for Sustainable Infrastructure
LCA	Life Cycle Analysis
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LDT	Light Duty Truck
LDV	Light Duty Vehicle
MDV	Medium Duty Vehicle
NAIT	Northern Alberta Institute of Technology
NRCAN	Natural Resources Canada
PV	Photovoltaic
VFD	Variable Frequency Drive

Executive Summary

The phenomenon of climate change and reducing greenhouse gas (GHG) emissions has long been a priority for Northern Alberta Institute of Technology (NAIT) since 2005 when a staff-led committee established itself to promoting environmental awareness and championing associated initiatives like the development of the NAIT Sustainability Strategy. In 2019, the NAIT's GHG emissions amounted to 41,137 tonnes of carbon dioxide equivalent (tCO_2e), or 0.1 tCO_2e / m^2. These GHG emissions were the direct result of the provision of key services by NAIT, which includes the operation of buildings, fleet and equipment and supporting infrastructure. Compared to the 2009 base year, this is a reduction of nearly 10% on an absolute basis, and a reduction of 62% from on an intensity basis, while the campus has grown 30%.

NAIT's business as usual (BAU) emissions are forecasted to be approximately 44,000 tCO_2e, or 0.09 tCO_2e / m^2 by 2025 while the campus is expected to grow considerably during this time. Through the direct result of energy and GHG reduction actions already underway, NAIT will be able to maintain its current GHG emissions status quo. The implementation of the proposed initiatives in this 2025 Energy Conservation and GHG Reduction Plan (the Plan) in conjunction with the estimated improvement in the Alberta grid emissions intensity are estimated to further reduce NAIT's GHG emissions by up to 40% when compared to 2009 levels. On this basis, NAIT is committing to reducing its GHG emissions by 30% below 2009 levels by 2025.

The objective of this Plan is to move NAIT closer to its GHG emission reduction target by implementing initiatives that build momentum and lay the groundwork for deeper energy and GHG emissions reduction actions to be implemented post-2025. The Plan also meets the requirements of the City of Edmonton Climate Leaders Program.

The Plan covers a five-year horizon from 2020 to 2025. In 2025, this Plan will be updated and a 2035 GHG emission reduction target established. This Plan was based on energy and GHG emissions available for the most current year, 2018, and trends since the 2009 base year as well as anticipated growth to 2025. The identification of initiatives for incorporation into the Plan was done through a combination of staff engagement, formerly completed location-based site visits, a best-in-class review of other educational institutions and input from internal and external subject matter experts.

The proposed initiatives are presented in Table E-1.

Table E.1. Summary of Plan Initiatives

#	Initiative	Energy Reduction Potential	GHG Reduction Potential	Estimated Cost	Timing	Responsibility	Indicators
Buildings & Facilities							
B1	Develop a Green Building Sustainability Policy	Supportive Initiative	Supportive Initiative	• Staff Time	2021	• Facilities	• Policy and technical standards are completed and approved
B2	Implement Energy Audit Recommendations	10-12%	10-12%	• $4.5 to $4.9 Million	Starting in 2020 Ongoing as opportunity / funding arises	• Facilities	Reduction of: • Building Energy Intensity (GJ/m^2) • Building GHG Emissions Intensity (tCO_2e/m^2) • Building Energy Cost Intensity ($/$m^2$)
B3	Implement a Building Commissioning Program	5-12%	5-12%	• Staff Time	2020	• Facilities	Reduction of: • Building Energy Intensity (GJ/m^2) • Building GHG Emissions Intensity (tCO_2e/m^2) • Building Energy Cost Intensity ($/$m^2$)
B4	Implement an Energy Performance Monitoring Program	Supportive Initiative	Supportive Initiative	• Staff Time	2022 and on-going	• Facilities	• Monitoring program is in place • All building operators have access to the monitoring system • Building Energy Intensity (GJ/m^2) • Building GHG Emissions Intensity (tCO_2e/m^2)

#	Initiative	Energy Reduction Potential	GHG Reduction Potential	Estimated Cost	Timing	Responsibility	Indicators
							• Building Energy Cost Intensity ($/m^2)
B5	Building Energy Management Training	Supportive Initiative	Supportive Initiative	• Staff Time & Program Cost	2021	• Facilities	• Training needs identified • Training occurs
B6	Investigate Renewable Energy Sources for Stationary Assets	Supportive Initiative	Supportive Initiative	• Staff Time	Ongoing	• Facilities	• Renewable energy opportunities are identified and assessed • KWh_{ac} produced • % of energy demand from renewable energy
Fleet & Equipment							
F1	Develop a Fleet Management Strategy	Supportive Initiative	Supportive Initiative	• Staff Time	2021	• Facilities	• Strategy is completed and approved
F2	Opportunistically Switch Light Duty Fleet to Electric	5-10%	50-60%	• Assume extra $3,000 per LDV until cost parity is achieved in 2025. LDT premiums will likely range from $8k to $15k for an indeterminable period of time. • Fleet utilization study, including a sample telematics pilot, can range from $75,000 and up. • EV Study: $40,000 - $50,000	2022 for study	• Facilities	• Unit fuel/km • Total L of fuel types used • # of vehicles with greater fuel efficiency, hybrid, EV etc.

#	Initiative	Energy Reduction Potential	GHG Reduction Potential	Estimated Cost	Timing	Responsibility	Indicators
				• Capacity Assessment: $3,000 - $4,000 per facility			
Corporate							
C1	Incorporate Life Cycle Considerations Into Capital Planning and Purchases	Supportive Initiative	Supportive Initiative	• Staff Time	Ongoing	• Facilities • Legal • Procurement	• Policy is completed and approved
C2	Develop An Energy Savings Policy	Supportive Initiative	Supportive Initiative	• Staff Time	2021	• Facilities • Accounting / Finance	• Policy is completed and approved
C3	Develop a Sustainable Policy And Framework	Supportive Initiative	Supportive Initiative	• Staff Time	2021	• Facilities • Legal • Procurement	• Policy is completed and approved

1.0 INTRODUCTION

1.1 CLIMATE CHANGE IS A GLOBAL PRIORITY

Climate change has emerged as the next unprecedented social, economic, and environmental challenge facing our society today. It poses a serious threat to global quality of life, jobs, and physical and natural assets. Many scientists believe that the human-production of greenhouse gas (GHG) emissions since pre-industrial times have already surpassed the Earth's "carrying capacity" of natural systems and pose significant risks of change for mankind to come. The City of Edmonton's 2019 Adaptation Strategy And Action Plan expects that Edmonton will be exposed to more variable extreme weather events, and an overall warmer and drier climate. Without action, these long-term changes can exacerbate existing climate pressures on local economic, social, infrastructure, and environmental systems.[1]

The phenomenon of climate change and reducing energy and GHG emissions has long been a priority for Northern Alberta Institute of Technology (NAIT) since 2005 when a staff-led committee established itself to promoting environmental awareness and championing associated initiatives like the development of the NAIT Sustainability Strategy. Since then, NAIT has guided policies and strategies that have improved its energy and GHG emissions performance while the institution has grown. The result of these actions has been a decline of GHG emissions of more than 10% on an absolute basis, and on an intensity (per m^2) basis of more than 60% below 2009 levels.

In recognition of the importance of climate change, NAIT is committing to undertaking additional efforts to reduce GHG emissions and has set an GHG emissions reduction target of 30% by 2025. This Plan serves numerous purposes in that it provides a 5-year roadmap towards NAIT's 2025 GHG reduction target while meeting the requirements of the City of Edmonton's Corporate Climate Leaders Program. In 2025, NAIT commits to updating this Energy Conservation & GHG Reduction Plan (the Plan) and setting a new 2035 GHG emissions target.

1.2 CITY OF EDMONTON CLIMATE LEADERS PROGRAM

The City of Edmonton Climate Leaders Program is a City led program, designed to support the growing number of Edmonton businesses and institutions, like NAIT, that are concerned about climate change and want to take action. To be an active member of this program, NAIT has made the following commitments:

- To establish and maintain a corporate GHG inventory in accordance with best reporting practices like the World Resource Institute (WRI) Greenhouse Gas Protocol and the ISO 14064-1 GHG accounting standard.
- To set aggressive but realistic 2025 and 2035 GHG emission reduction targets.

[1] https://www.edmonton.ca/city_government/documents/Climate_Resilient_Edmonton.pdf

- To prepare a plan and a series of energy conservation and GHG reduction measures that can be implemented to meet self-imposed GHG emission reduction targets.
- To prepare an energy and GHG emissions forecast of the expected results of the current and proposed initiatives.
- To share these commitments and progress towards it's GHG reduction target on an annual basis.

The preparation of this Plan provided NAIT staff with the opportunity to re-evaluate the status of its energy and GHG emissions footprint, as well as provide a business-as-usual forecast, with and without planned energy and GHG reduction initiatives. The implementation of this Plan will meet the City of Edmonton's Climate Leaders Programs requirements while placing NAIT on a trajectory towards achieving its 2025 GHG reduction target of 30% below 2009 levels.

1.3 ABOUT NAIT

NAIT is a polytechnic that offers technology-based education, applied research, hands-on teaching, and an industry woven pedagogy. Rooted in lifelong learning, NAIT's vision is to aspire to be the most relevant and responsive post-secondary institution in Canada and one of the world's leading polytechnics.

To continue to provide educational services to Alberta's economy and postsecondary landscape, NAIT operates over $1.3 billion in assets in the form of buildings, facilities, fleet vehicles and equipment as well as all supporting infrastructure. The operation of these assets collectively contributes to GHG emissions and provides opportunities for energy conservation and GHG emissions reductions.

1.4 PLAN DEVELOPMENT

This Plan was based on NAIT's 2019 energy and GHG emissions and trends since the 2009 base year as well as anticipated campus growth to 2025. The identification of initiatives incorporated into the Plan was done through a combination of staff engagement, location-based site visits, a best-in-class review of other educational institutions and input from internal and external subject matter experts.

2.0 SCOPE

This Plan is a corporate-wide plan that focuses exclusively on energy and GHG emissions that are directly controlled by NAIT which are also referred to as Scope 1 and 2 GHG emissions. The Plan does not include GHG emissions from Scope 3 GHG emission sources which include transmission, distribution and line losses, paper consumption, student commuting, waste disposal, third-party contractors, construction activities, and embodied GHG emissions. These Scope 3 GHG emission sources may be included in future plans as data availability and monitoring improves (Figure 1).

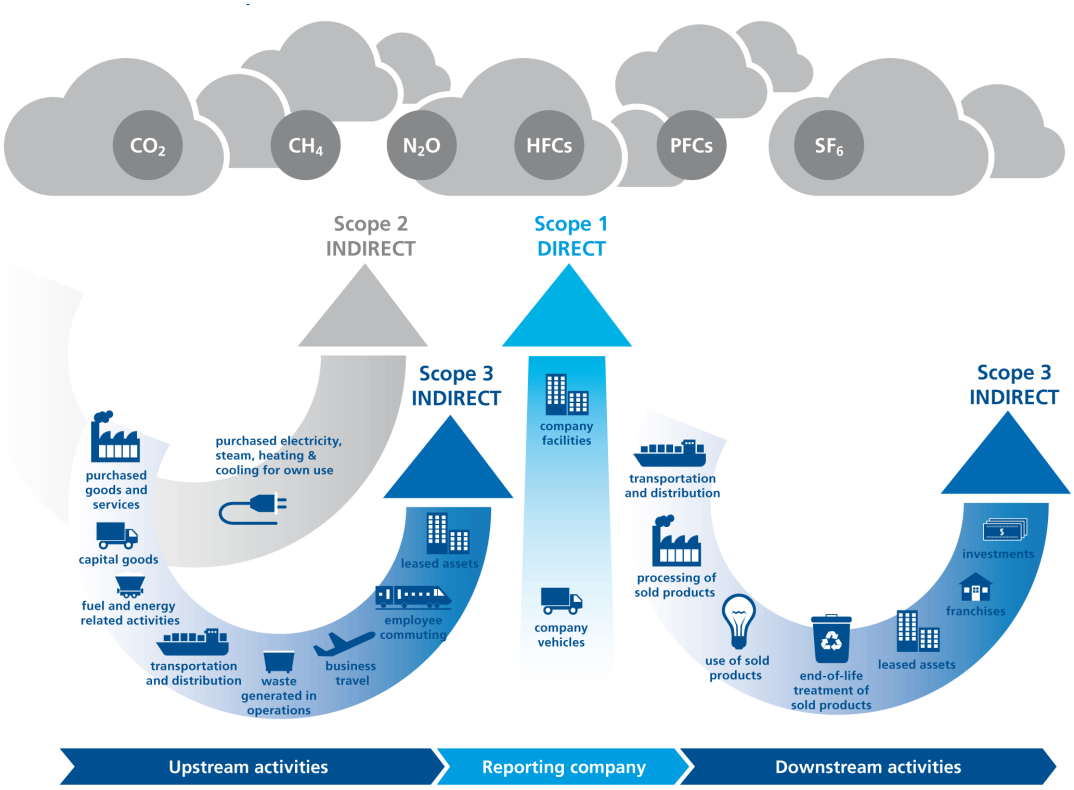

Figure 1. Overview of GHG Emission Sources By Classification[2]

The Plan covers a five-year horizon (2020-2025). The proposed initiatives based on actions identified by NAIT staff using existing and proven technologies. These initiatives are based on best available technology to date but recognize that the business case for selecting specific solutions will need to be identified in the coming years. Potential changes to federal and provincial legislation, available funding opportunities, as well as technological advances over future decades can also help reduce NAIT's GHG emissions over the long-term.

[2] https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

3.0 2018 CORPORATE ENERGY & GHG EMISSIONS

With climate change related GHG emissions at the forefront of public awareness and policy development, organizations are incorporating strategies to both manage the anticipated impacts and reduce their GHG emissions footprint. Many of these efforts have focused on reducing building energy and fleet fuel consumption as these sources are the largest contributors to an organizations' GHG emissions profile.

3.1 CURRENT ENERGY & GHG EMISSIONS

In 2019, the NAIT's GHG emissions amounted to 41,137 tonnes of carbon dioxide equivalent (tCO_2e), or 0.1 tCO_2e / m^2. These GHG emissions were the direct result of the provision of education and support services by NAIT, which can be organized into the following sectors.

- **Buildings & Facilities**: The building and facilities consume electricity and natural gas to heat, cool, ventilate, and illuminate academic and support buildings and facilities.
- **Fleet & Equipment**: NAIT vehicle fleet includes light, medium and heavy-duty vehicles. All vehicles and equipment consume gasoline and diesel.

Table 1 below presents the breakdown of the 2018 energy and GHG emissions by sector.

Table 1. 2018 Corporate Energy and GHG Emissions by Category

Sector	Energy (GJ)		GHG Emissions (tCO_2e)	
Buildings & Facilities	480,406	99.4%	41,103	99.5%
Fleet & Equipment	3,112	0.6%	214	0.5%
Total	**483,518**	**100.0%**	**41,317**	**100.0%**
Intensity (per ft^2)	**1.15**		**0.10**	

Buildings and facilities account for almost for 99% of NAITs' energy usage and GHG emissions with fleet and equipment accounting for less than 1% of energy and GHG emissions. While electricity consumption accounted for only 29% of energy use, it accounted for more than 56% of GHG emissions (Table 2). This is because Alberta's electrical grid produces more GHG emissions than any other province because of its size and its reliance on coal-fired generation.

To achieve the 2025 reduction target, where possible, NAIT will focus on reducing electricity use through conservation measures and by using renewable energy sources, like solar photovoltaics, to displace consumption of grid-based electricity.

Table 2. 2018 Energy and GHG Emissions by Fuel Type

Fuel Type	Energy (GJ)		GHG Emissions (tCO_2e)	
Electricity	140,593	29.08%	23,407	56.65%
Natural Gas	339,813	70.28%	17,697	42.83%
Gasoline	2,331	0.48%	159	0.38%
Diesel	781	0.16%	55	0.13%
Total	**483,518**	**100%**	**41,317**	**100%**

A breakdown by energy use in each sector is presented in Figure 2.

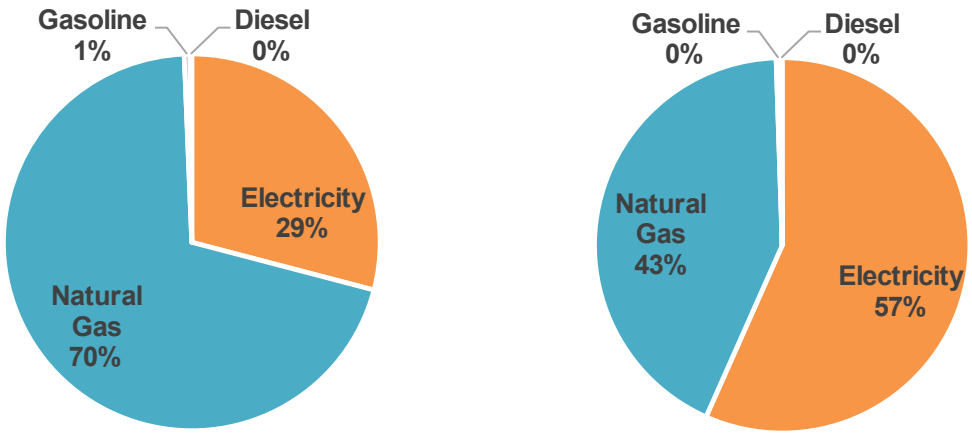

Figure 2. Energy (GJ) (Left) & GHG Emissions (tCO_2e) (Right) By Fuel Type

3.2 HISTORICAL TRENDS

NAIT first began tracking energy consumption and GHG emissions in 2009. Since 2009, energy consumption has decreased by more than 60% on an intensity basis, while the campus has expanded by more than 30% (Figure 3). In terms of GHG emissions, a similar trend has been noted (Figure 4).

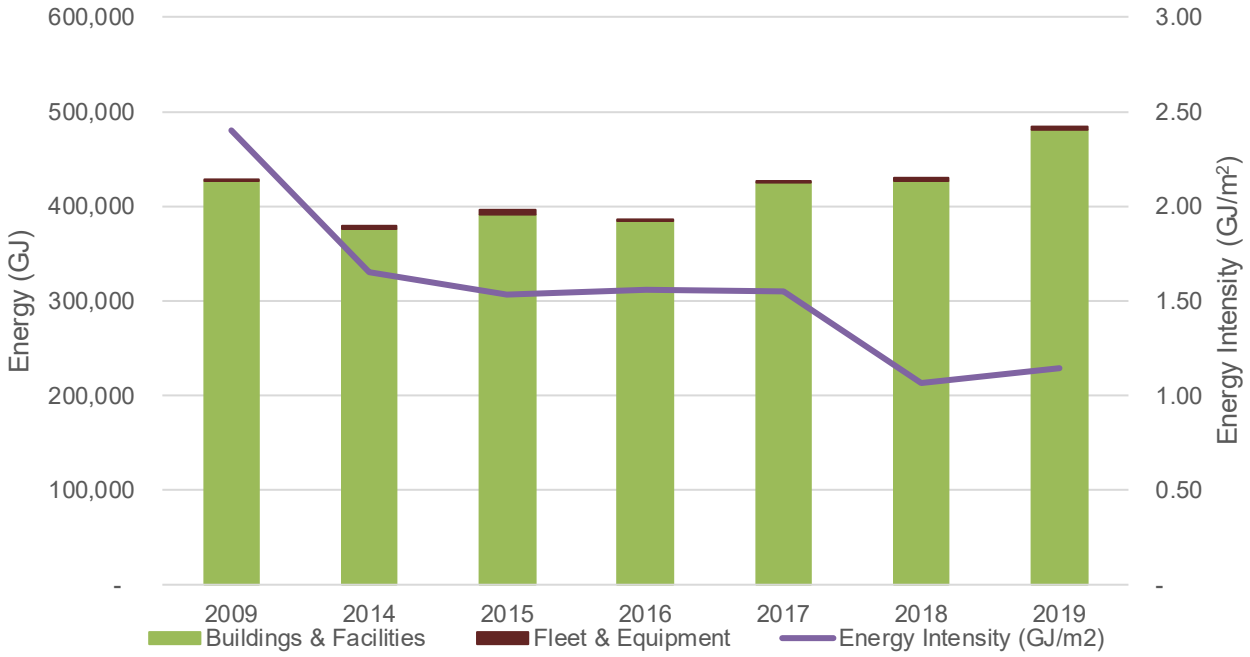

Figure 3. Total Energy Use And Energy Intensity By Year (Not Weatherized)

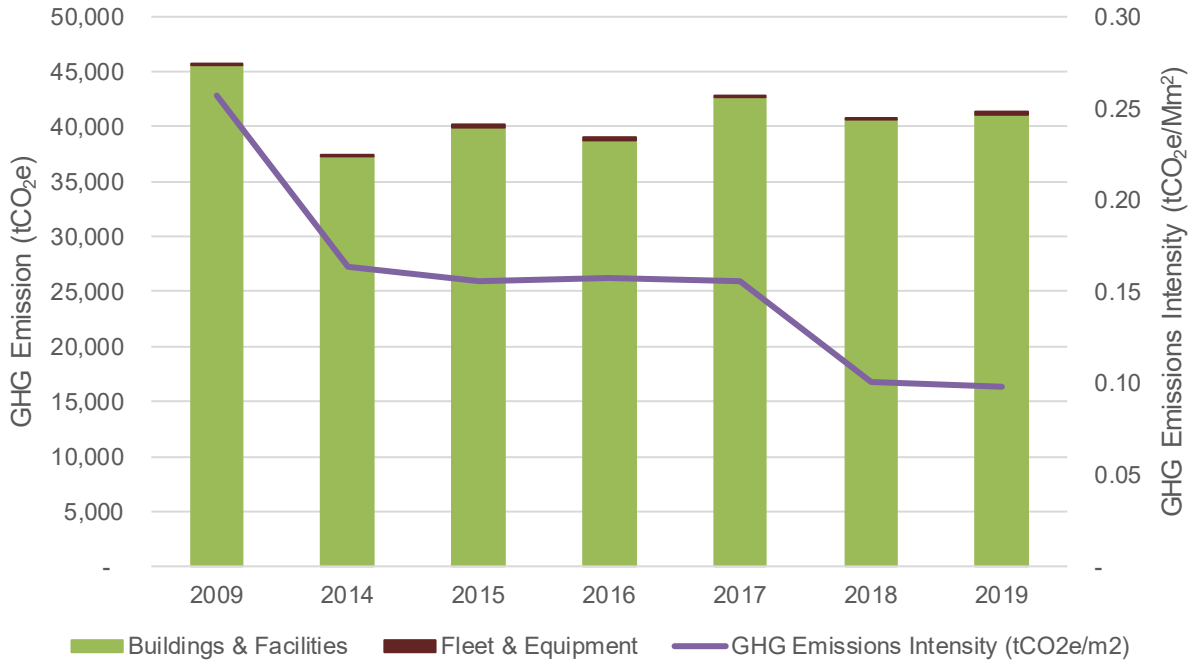

Figure 4. Total Absolute GHG Emissions And GHG Emissions Intensity By Year (Not Weatherized)

3.3 GHG EMISSIONS FORECAST TO 2025

A model of business as usual (BAU) GHG emissions was developed to project future GHG emissions through to 2025 to examine the possible magnitude of GHG reduction opportunities (Figure 5). To estimate the future GHG emissions, NAIT's 2019 energy use was grown proportionally to higher service demand levels as a result of and planned structural changes to the campus, such as the addition of new buildings and removal of others, as well as planned GHG reduction initiatives set by the Provincial and the Federal Governments (e.g. vehicle fuel-economy standards). Based on the analysis, NAIT's BAU emissions are forecasted to be approximately 45,000 tCO_2e in 2025, a decrease of 4% from the 2009 base year which is the direct result of energy and GHG reduction actions already underway at NAIT and activities at the Federal level.

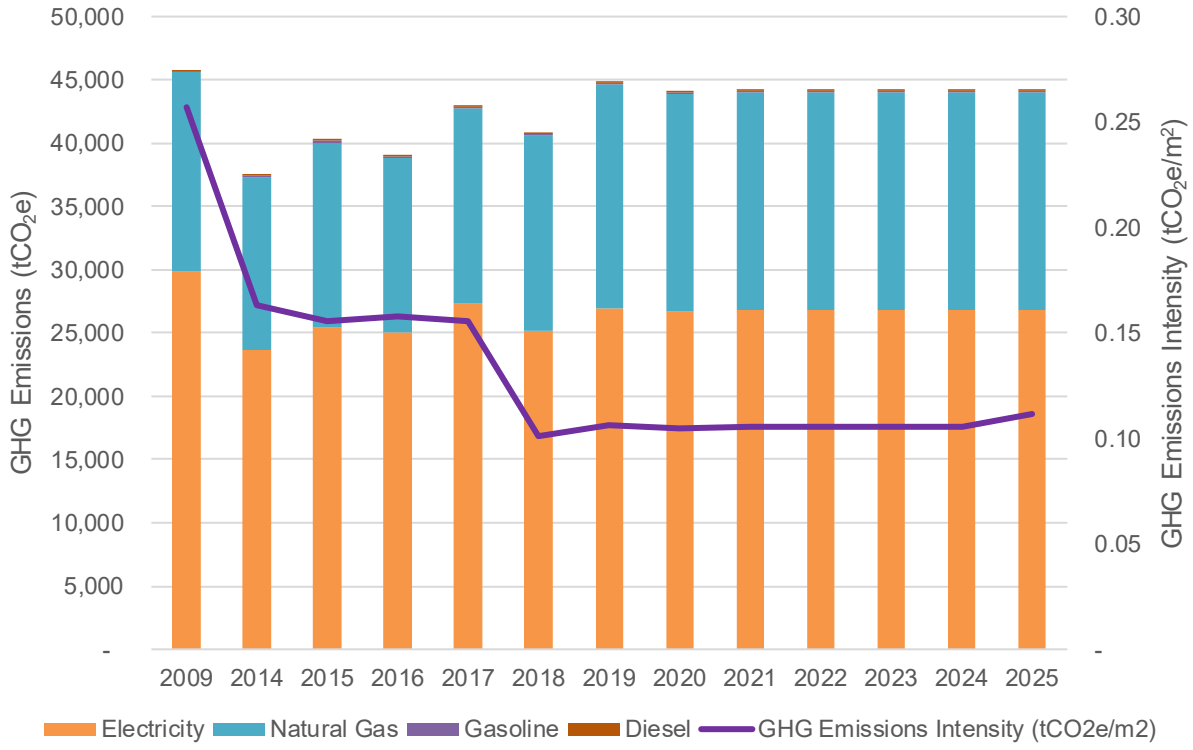

Figure 5. Forecasted GHG Emissions Under a BAU Scenario

The objective of the Plan is to reduce total energy consumption and GHG emissions through the efficient use of energy and resources while continuing to maintain an efficient and effective level of service to students and staff. On this basis, the Plan has established the following objectives:

- To establish key policies that will support and maintain the reduction of energy use and reduce GHG emissions as a result of operations.
- To create a culture of sustainability and conservation.
- To implement renewable energy opportunities where feasible.

- To demonstrate sound operating and maintenance practices that complement the energy efficiencies implemented through the Plan.

The implementation of the proposed initiatives in this Plan in conjunction with the estimated improvement in the Alberta grid emissions intensity are estimated to reduce NAIT's GHG emissions by up to 40% when compared to 2009 levels (Figure 6). On this basis, NAIT is committing to reducing its GHG emissions by 30% below 2009 levels by 2025.

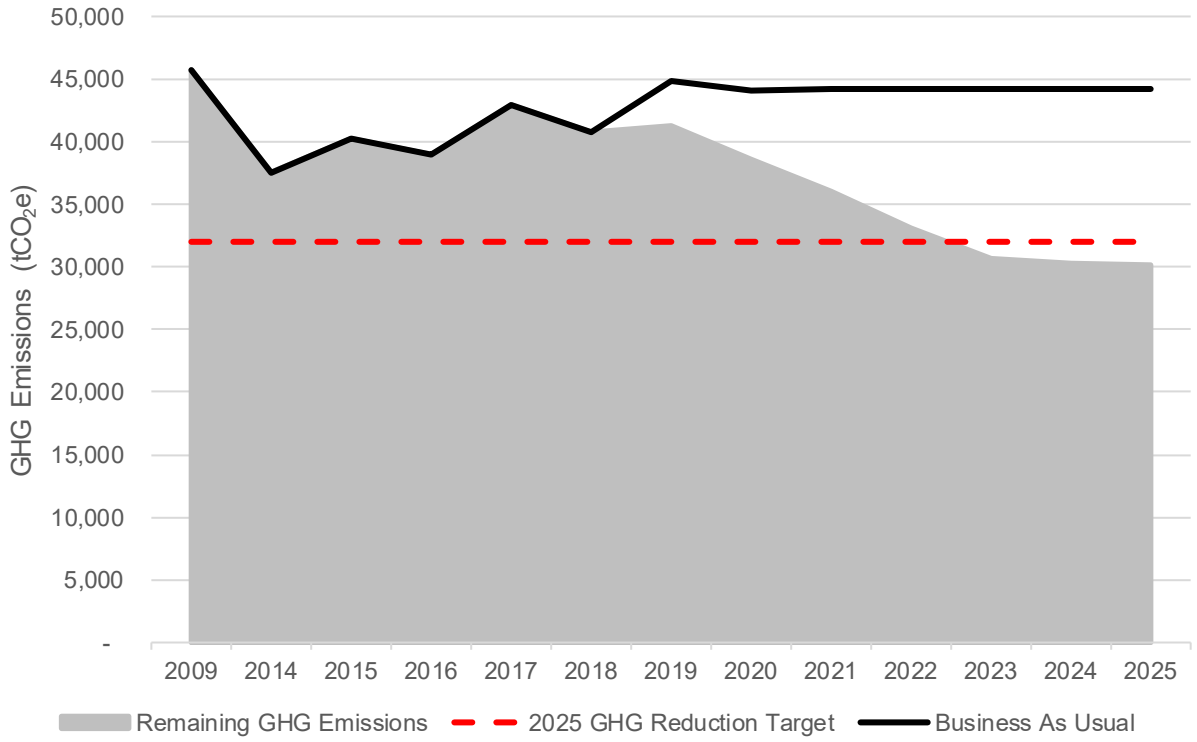

Figure 6. Forecasted GHG Emissions Compared to BAU Scenario

3.4 PROPOSED INITIATIVES

The proposed list of initiatives in Table 3 represents best-practice information collected from similar educational institutions as well as input from staff and experts.

Table 3. Proposed Plan Initiatives

Category	Initiative	Description
Buildings & Facilities	Develop a Green Building Policy	• Develop green building policy and technical standards.

Category	Initiative	Description
Buildings & Facilities	Implement Energy Audit Recommendations	• Complete recommendations from comprehensive energy audits, implement the recommendations, and track the progress of energy audits and projects in the institutions asset management system
Buildings & Facilities	Implement a Building Commissioning Program	• Prepare and implement an ongoing building commissioning & retro commissioning plan.
Buildings & Facilities	Implement an Energy Performance Monitoring Program	• Use a building energy performance monitoring plan to track and report on building energy performance monitoring and provide users with energy and GHG dashboards. • Report on performance for key facilities, and for the Institutions complete asset portfolio to various levels of the organization.
Buildings & Facilities	Seek Additional Training for Operators on Building Energy Management	• Undertake a training needs assessment to address capacity gaps and coordinate general energy management training for employees. • Investigate specific technical training options for targeted staff to bridge identified training gaps (access NRCan's customized Dollars to $ense Energy Management Workshops as a possible option).
Buildings & Facilities	Investigate Renewable Energy Sources for Stationary Assets	• Where opportunities present themselves, assess if there is a business case to incorporate renewable energy technologies to reduce energy costs and GHG emissions.
Fleet & Equipment	Develop a Fleet Management Strategy	• Develop a Fleet Management Strategy to support sustainable service delivery through the life cycle management, operation, and replacement of vehicles, equipment and associated components. The strategy would consider opportunities like procurement standardization, life cycle costing. and vehicle right sizing in order to reduce GHG emissions.
Fleet & Equipment	Opportunistically Switch Light Duty Fleet to Electric	• Opportunistically reduce energy and GHG emissions from its fleet through the purchase and use of electric vehicles. • Over the medium-term (post-2025), complete an EV study to identify where fleet can be converted to EV and what EV infrastructure will need to be planned for.
Corporate	Incorporate Life Cycle Considerations Into Capital Planning and Purchases	• Integrate LCA processes into budget and capital planning, strategic planning, purchasing policies, preventative maintenance plans, environmental management plans, and asset management. • Develop energy efficiency and life cycle costing requirements and add to RFP and purchasing protocols for capital items and projects.
Corporate	Develop an Energy Savings Policy	• Formalize an energy savings policy that recognizes and make available any operational budgets saved, as a result of energy conservation and demand initiatives, to

Category	Initiative	Description
		the sole use and discretion of NAIT department that implemented the initiatives.
Corporate	Develop a Sustainable Procurement Policy And Framework	• Develop and implement a Sustainable Products Ranking Framework and Program that recognizes and prioritizes capital purchases, products and services that are energy efficient and have a low carbon footprint.

4.0 BUILDINGS & FACILITIES

In 2018, NAIT's buildings and facility portfolio accounted for 99% of its energy use GHG emissions. A summary of energy and GHG emissions by facility type is presented in Table 4 which shows that the top energy consuming facilities are the Main Campus, the Center for Applied Technologies (CAT), HP/NCAT, the Production and Innovation Center (PIC) and the Patricia Campus. These buildings account for more than 80% of NAITs GHG emissions. This is presented in Table 4 and graphically in Figure 7.

Table 4. 2018 Energy Consumption And GHG Emissions By Facility

Building / Facility Name	Energy (GJ)	Percent of Total Facility Energy	GHG Emissions (tCO_2e)	Percent of Total Building / Facility GHG Emissions
Parkades	869	0.2%	52	0.1%
Bremner Park	1,355	0.3%	91	0.2%
Center for Applied Technologies	58,670	12.2%	5,176	12.6%
Crane & Hoist-Spruce Grove Campus	2,693	0.6%	219	0.5%
Continuing Education Centre	-	0.0%	-	0.0%
Distribution Centre	9,414	2.0%	633	1.5%
Engineering Technology Annex	23,111	4.8%	2,215	5.4%
HP/NCAT	41,915	8.7%	4,215	10.3%
Main Campus	249,363	51.9%	20,868	50.8%
NBRi Peace River	2,253	0.5%	230	0.6%
ONPA Building	2,369	0.5%	212	0.5%
Patricia Campus	28,827	6.0%	2,279	5.5%
Princess Elizabeth Building	3,093	0.6%	237	0.6%
Souch	18,173	3.8%	1,562	3.8%
Hanger 5 HET	3,146	0.7%	253	0.6%
PIC Building	35,154	7.3%	2,861	7.0%
Total	**480,406**	**100.0%**	**41,103**	**100.0%**

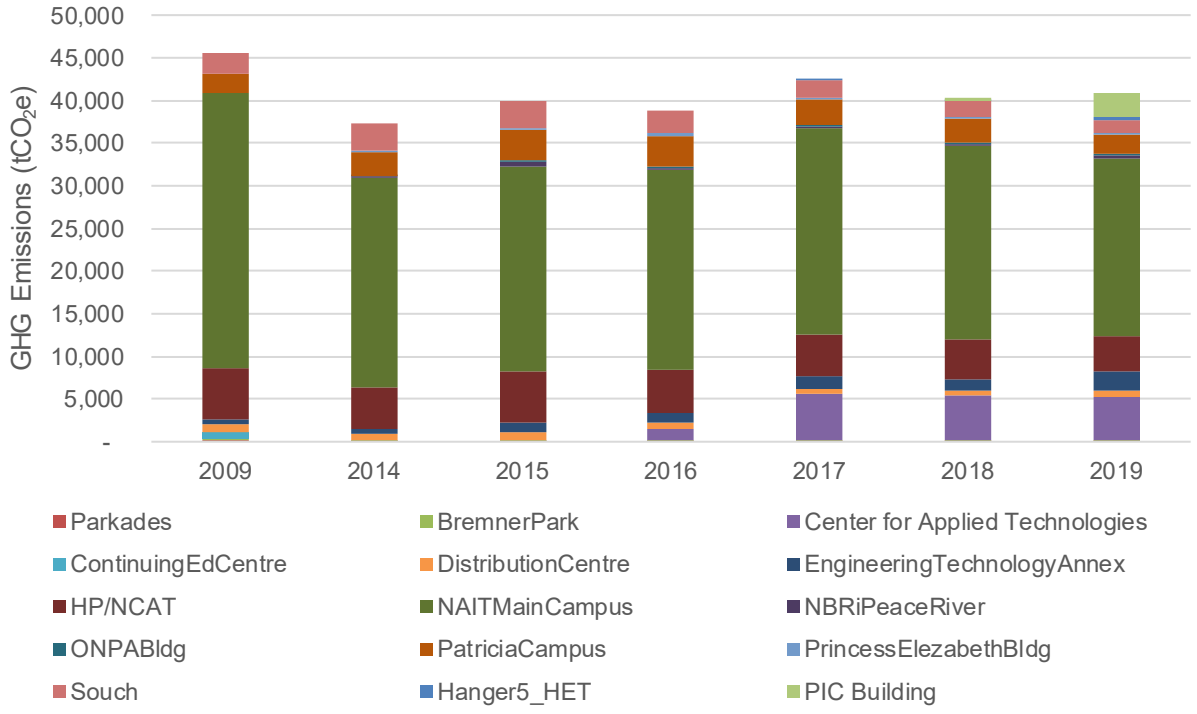

Figure 7. Annual Building GHG Emissions By Facility

Green building certifications are an important first step toward reducing energy consumption and GHG emissions. Existing buildings and facilities will require deep energy retrofits that radically overhaul the building envelope to reduce energy needs or a complete replacement of the building to a higher energy standard. Maintenance and ongoing-commissioning programs - a process of ongoing monitoring, adjustment, and retrofitting with new technologies like building automation systems upgrades, and energy sub-metering will be key to maintaining energy and GHG reductions. Building condition assessments (BCA) and behavioral change programs are also important initiatives that will complement retrofit and building monitoring programs. One of the most cost-effective GHG emissions avoidance measures is to improve existing building utilization rates therefore minimizing the number of new buildings requiring construction in the future. NAIT is currently in the process of updating its Campus Master Plan which is focusing on improving utilization rates and reduced energy usage as the Campus grows over times.

The following is a list of the proposed building and facility initiatives:

- B1: Develop a Green Building Policy
- B2: Implement Energy Audit Recommendations
- B3: Implement a Building Commissioning Program
- B4: Implement Building Management Performance Monitoring Program
- B5: Provide Building Energy Management Training to Staff
- B6: Investigate Renewable Energy Sources for Stationary Assets

B1: Develop a Green Building Policy

The objective of a green building policy would be to provide guidance on green building practices to NAIT staff, consultants, contractors, suppliers, and any others involved in the planning and execution of construction projects at NAIT buildings and facilities. The policy would emphasize the importance of energy efficiency while requiring that users take into consideration the types of energy used and the source of the energy (e.g., renewables). It is recommended that the green building policy apply to NAIT-owned buildings that meet any of the following criteria:

- New buildings with a gross floor area greater than 5,400 ft^2
- Major additions to existing buildings, where the size of the addition is greater than 5,400 ft^2
- Major renovations, retrofits, and rehabilitation of existing buildings, where the construction budget is greater than $100,000.

When drafting the green building policy document, it is recommended that NAIT take into consideration the Canada Green Building Council (CaGBC) Zero Carbon Building Standard.[3]

B2: Implement Energy Audit Recommendations

During the development of the Plan, several building energy scoping audits were completed at the NAIT Main Campus. The scope of the audits included reviewing building thermal performance, load distribution, existing equipment and controls schedules, occupancy patterns, lighting, and efficiency systems to identify energy and emission reduction opportunities. The recommendations ranged from lighting system upgrades, Building Automation Systems (BAS) upgrades, the use of insulation and weather-stripping to installing variable speed motors, and the installation of heat recovery systems. The estimated cost, economic savings, simple payback and estimated GHG emissions reductions opportunities by facility are presented in Table 5.

Table 5. Summary of NAIT Main Campus Energy Scoping Audits

NAIT Main Campus Building	Estimated Cost	Estimated Savings	Simple Payback	GHG Emission Reductions (tCO_2e)
Building F (Medical Wing)	$101,675	$24,458	3.8	122
Building G (Centre for Chemical Studies)	$754,120	$75,293	10.0	707
Building E (Technical Building)	$558,908	$80,563	6.7	426
Building H (Electronics Wing)	$243,484	$25,997	9.0	140
Building J (J-Wing)	$201,715	$32,842	5.7	191
Building T (Administration Building)	$522,189	$47,152	10.7	258

[3] https://www.cagbc.org/cagbcdocs/zerocarbon/CaGBC_Zero_Carbon_Building_Standard_EN.pdf

NAIT Main Campus Building	Estimated Cost	Estimated Savings	Simple Payback	GHG Emission Reductions (tCO_2e)
Building O (Central Building)	$361,390	$58,367	5.1	411
Building U (Learning Resources Centre)	$197,100	$67,682	2.5	350
Building B (Shell Manufacturing Centre)	$86,763	$10,612	1.6	53
Building N (Centre of Machinist Technology)	$27,240	$16,761	1.6	84
Building S (Activities Centre)	$641,750	$82,006	6.4	668
Building A (Industrial Building)	$328,320	$89,065	3.0	591
Building C (Centre of Power Engineering)	$208,680	$49,848	3.6	275
Building D (Services Building)	$51,820	$17,103	2.8	91
Building V (Industrial Technologies)	$94,580	$46,430	2.0	232
Building X (South Learning Centre)	$102,550	$35	2.8	173
Total	**$4,482,284**	**$724,214**	**6.2**	**4,772**

The implementation of the energy scoping audit recommendations are estimated to result in both energy cost savings with reasonable payback periods. It is recommended the NAIT prioritize the efforts to be undertaken based on the expected energy and cost savings, the payback for the individual measure to be employed, and the availability of NAIT resources to affect the improvement. It is recommended that NAIT continue to seek out funding opportunities and incentives to improve the business case for high GHG reduction actions that have a longer or lower financial return on investment.

B3: Implement a Building Commissioning Program

Commissioning verifies that a building has been constructed to its proper specifications. The best time to commission a building is during design and construction, with special attention being paid to the building envelope. Post-construction, continuous commissioning of a building's entire systems over a specified period of time (typically every 1-2 years) is recommended to maintain continuous peak performance over its useful life. Ongoing-commissioning and re-commissioning are important because they reduce operating costs, reduce the risk of failures, and inform retrofit opportunities and deep energy retrofit plans long before they are due. Various pre- and post-implementation commissioning case studies have shown efficiency improvements on the order of 5% to 30% because of improved operations and maintenance. The studies also show that the resulting simple payback periods are typically less than 2 years[4]. Typical commissioning activities include:

[4] Office of Energy Efficiency and Renewable Energy, 2010. *Operations & Maintenance Best Practices: A Guide to Achieving Operational Efficiency,* https://www.energy.gov/sites/prod/files/2013/10/f3/omguide_complete.pdf August 3, 2018.

- Adjusting reset and set-back temperatures and temperature settings.
- Staging / sequencing of boilers, chillers, and air handling units.
- Adjusting and repairing dampers and economizers.
- Modifying control strategies for standard hours of operation.
- Eliminating simultaneous heating and cooling.
- Air and water distribution balancing and adjustments.
- Verifying controls and control sequencing, including enabling and re-enabling automatic controls for set points, weekends, and holidays.

It is recommended that this initiative be added to the Strategic Facilities Plan immediately as the commissioning of buildings would occur on a five-year cycle or when the function of a building or facility changes.

B4: Implement Building Management Performance Monitoring Program

Low-energy intensive buildings do not always operate as they were designed resulting in poor energy performance. Annual energy performance reporting, whether through ENERGY STAR Portfolio Manager or a third-party energy management system, can close the gap between predicted and actual energy use and provide support to an ongoing building commissioning program (Initiative B3). Providing building operators with energy management dashboards will enable them to benchmark their energy performance against prior year data and buildings in the portfolio that are of similar typology to identify underperformers and the need for improvements. Over times, energy performance monitoring can also result in the identification of opportunistic business changes like adjusting how facilities are programmed and managed (e.g., establishing temperature and environment policies for staff and patrons, closing facilities, etc.).

It is recommended that NAIT utilize a no-cost energy monitoring and benchmarking programs ENERGY STAR Portfolio Manager to track and assess energy and water consumption. Although there are no associated costs with the use of ENERGY STAR Portfolio Manager, NAIT will need staff resources to orientate, upload building and facility data, and track and report on performance over time.

B5: Provide Building Energy Management Training to Staff

Building managers and supervisors are responsible for day-to-day maintenance and operation of buildings and facilities with complex heating, mechanical and electrical systems and requirements. Proper understanding and training in the systems is key to achieving and maintaining energy savings and GHG reductions. Training building managers and supervisors on energy management practices and concepts builds competencies that they can use to operate their facilities and carry out operations more effectively and efficiently. It is recommended that NAIT seek a building training program that:

- Examines best-practices, approaches, case studies and the role of technology
- Examines in detail the investigation process
- Identifies how to assess and implement measures
- Provides details on the requirements for ongoing maintenance, monitoring and reporting
- Incorporates hands-on activities that allows for onsite assessment of equipment and systems

- Provides case studies and approaches to dealing with staff and tenants

Additional information on a best practice approach for training can be found in ASHRAE Guideline 0, The Commissioning Process, and Guideline 1.3P, Building Operation and Maintenance Training for the HVAC Commissioning Process.

B6: Investigate Renewable Energy Sources for Stationary Assets

There exits an opportunity to implement renewable energy systems – such as solar photovoltaic, wind, solar water/air heating, passive heating and cooling technologies, ground source heat pumps, biomass - on some of NAIT's stationary assets like buildings. Renewable generation lowers the stresses on the distribution grid, carries significant environmental benefits, and further positions the municipality as a leader in sustainability. Opportunities for renewable generation can also result in additional long-term revenue streams to NAIT. It is recommended that NAIT explore such opportunities as they arise (e.g., new buildings or major retrofits).

Summary of Proposed Initiatives

A summary of the proposed initiatives is presented in the following table.

Table 6. Summary of Buildings & Facilities Initiatives

#	Initiative	Energy Reduction Potential	GHG Reduction Potential	Estimated Cost	Timing	Responsibility	Indicators
B1	Develop a Green Building Policy	Supportive Initiative	Supportive Initiative	• Staff Time	2021	• Facilities	• Policy and technical standards are completed and approved
B2	Implement Energy Audit Recommendations	10-12%	10-12%	• $4.5 to $4.9 Million	Starting in 2020 Ongoing as opportunity / funding arises	• Facilities	Reduction of: • Building Energy Intensity (GJ/m^2) • Building GHG Emissions Intensity (tCO_2e/m^2) • Building Energy Cost Intensity ($/$m^2$)
B3	Implement a Building Commissioning Program	5-12%	5-12%	• Staff Time	2020	• Facilities	Reduction of: • Building Energy Intensity (GJ/m^2) • Building GHG Emissions Intensity (tCO_2e/m^2) • Building Energy Cost Intensity ($/$m^2$)
B4	Implement an Energy Performance Monitoring Program	Supportive Initiative	Supportive Initiative	• Staff Time	2022 and on-going	• Facilities	• Monitoring program is in place • All building operators have access to the monitoring system • Building Energy Intensity (GJ/m^2) • Building GHG Emissions Intensity (tCO_2e/m^2) • Building Energy Cost Intensity ($/$m^2$)

#	Initiative	Energy Reduction Potential	GHG Reduction Potential	Estimated Cost	Timing	Responsibility	Indicators
B5	Building Energy Management Training	Supportive Initiative	Supportive Initiative	• Staff Time & Program Cost	2021	• Facilities	• Training needs identified • Training occurs
B6	Investigate Renewable Energy Sources for Stationary Assets	Supportive Initiative	Supportive Initiative	• Staff Time	Ongoing	• Facilities	• Renewable energy opportunities are identified and assessed • KWh_{ac} produced • % of energy demand from renewable energy

5.0 FLEET & EQUIPMENT

NAIT owns and operates a variety of vehicles to perform daily operations. These include road insured vehicles such as light duty trucks and off-road equipment which utilize either gasoline or diesel fuel. Fleet fuel consumption is influenced by the size of the vehicle fleet, the vehicle operators and the efficiency of the individual vehicles. In 2018, fleet and equipment accounted for less than 1% of NAIT's GHG emissions. Of these GHG emissions, light duty trucks accounted for half of the fleet's GHG emissions with heavy duty vehicles accounting for one fifth of fleet GHG emissions (Table 7).

Table 7. Fleet GHG Emissions by Classification

Classification	GHG Emissions (tCO_2e)	Percent
Light Duty Vehicle (LDV)	33.1	15.9%
Light Duty Truck (LDT)	109.8	52.8%
Heavy Duty Vehicle (HDV)	19.5	9.4%
Off-Road Equipment (ORE)	45.6	21.9%
Total	**208.1**	**100.0%**

Fleet and equipment BAU GHG emissions are expected to decline post 2030 as a result of the expected changes to the Federal corporate average fuel economy (CAFE) standards and tailpipe GHG emissions standards for light duty and heavy-duty vehicles starting in 2027. Currently, there are very limited options in reducing GHG emissions from HDVs. There are some low- or no-emission heavy duty vehicle and equipment options available, but many do not meet occupational health and safety requirements. As the market matures and more options for low- or no-carbon HDVs and equipment become available for purchase, it is recommended that NAIT consider pilot testing of hybrid or fully electric heavy equipment and off-road vehicles prior to purchasing.

Fleet and equipment GHG emissions are the direct result of a wide and varied range of services delivered to campus staff and students. As no single measure can eliminate fleet and equipment GHG emissions, a suite of strategies is required which include:

- F1: Develop a Fleet Management Strategy
- F2: Opportunistically Switch Light Duty Fleet to Electric

F1: Develop a Fleet Management Strategy

The purpose of a Fleet Management Strategy is to reduce the environmental impact of NAIT's vehicle and equipment fleet by reducing associated fuel consumption and GHG emissions, while maintaining or improving service levels. As it relates to energy and GHG emissions management, it is recommended that the strategy focus on:

- **Procurement Standardization**: Procurement standardization aims to minimize fleet and equipment diversity as much as possible which can lead to economic savings, lower maintenance costs, increased operational efficiency and safety, improved vendor relations, and support the migration to renewable fuels. It is recommended that standardization be focused on purchasing fuel vehicles and equipment appropriate for NAIT operations, while accounting for lifecycle costs, and heavily weighting items that are renewably powered or electric. This will require the development of a low-carbon vehicle standard to create a hierarchy of most-preferred to least preferred technologies based on GHG emissions for a range of operational activities.
- **Life Cycle Costing**: Life cycle costing identifies when vehicle and equipment assets should be replaced to minimize the total cost of ownership to NAIT. Lifecyle analysis also provides optimal timing for replacement, based on anticipated use, and can be used to assign actual asset costs, based on actual use, to end users. It is recommended that the vehicle and equipment life cycle replacement and cost assignment program feed into NAIT's asset management and financial systems.
- **Vehicle Right Sizing**: Vehicle right sizing assigns vehicles based on identified need rather than driver preference. It is recommended that the policy afford appropriate NAIT staff with the ability to allocate vehicles for staff based on the functional needs required with the objective of rationalizing fleet assets, reducing fuel consumption and GHG emissions, and increasing fleet efficiencies.

Using life cycle costing while assessing vehicle operational demands and GHG emissions, NAIT will be able to purchase vehicles that provide the same level as operational service and achieve the highest possible GHG emissions reduction. It is estimated that a fleet management strategy and supporting actions such as vehicle rightsizing could achieve a 10-17% reduction of fleet GHG emissions.

F2: Opportunistically Switch Light Duty Fleet to Electric

According to Bloomberg New Energy Finance, by 2040, nearly 55% of vehicle sales will be electric, and are projected to achieve cost parity to their equivalent gasoline powered vehicle by the early 2020s[5] (Figure 8). It is anticipated that by 2025 light duty vehicle (LDV) EVs will reach cost parity with their gasoline and diesel counterparts.

[5] Bloomberg New Energy Finance, 2018, *Electric Vehicle Outlook 2018,* https://about.bnef.com/electric-vehicle-outlook/, accessed August 15, 2018.

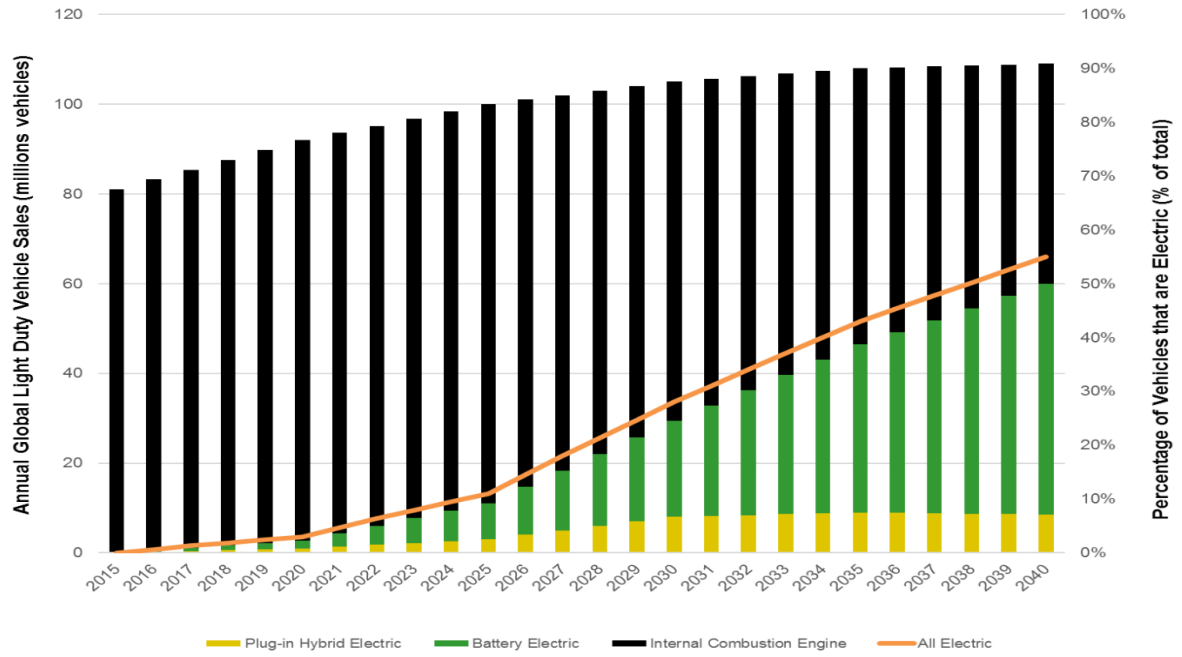

Figure 8. Forecasted Electric Vehicle Global Sales[6]

The variety and types of electric vehicles available for sale are also expected to expand significantly from the current offering of light-duty vehicles to pick-up trucks and SUVs over the next five years. As the battery life, charge time, cost-parity of electric vehicles have improved significantly, it is feasible for NAIT to opportunistically reduce energy and GHG emissions from its light duty vehicle (LDV) fleet by replacing these with leased electric vehicles. This will not only support corporate needs but will encourage the students and staff to make their own investments in electric vehicle technology as well.

To move forward with this initiative, in the short-term, NAIT will need to identify a process that incorporates vehicle right-sizing requirements to identify which vehicles can be replaced with electric vehicles. Over the medium-term, it is recommended that NAIT complete an EV adoption study to identify where fleet can be converted to EV, the costs and benefits to leasing EVs, and what EV infrastructure will need to be planned for.

[6] Bloomberg Finance, 2018. *Electric Vehicle Outlook 2018*, https://about.bnef.com/electric-vehicle-outlook/, accessed on Sept 4, 2018.

Summary of Proposed Initiatives

A summary of the proposed initiatives is presented in the following table.

Table 8. Summary of Fleet & Equipment Initiatives

#	Initiative	Energy Reduction Potential	GHG Reduction Potential	Estimated Cost	Timing	Responsibility	Indicators
F1	Develop a Low Carbon Fleet Management Policy	Supportive Initiative	Supportive Initiative	• Staff Time	2021	• Facilities	• Policy is completed and approved
F2	Opportunistically Switch Light Duty Fleet to Electric	5-10%	50-60%	• Fleet utilization study, including a sample telematics pilot, can range from $75,000 and up. • EV Adoption Study: $40,000 - $50,000 • Capacity Assessment: $3,000 - $4,000 per facility	2022 for study	• Facilities/SCM	• Unit fuel/km • Total L of fuel types used • # of vehicles with greater fuel efficiency, hybrid, EV etc.

6.0 CORPORATE

It is estimated that NAIT can achieve upwards of a 40% GHG emission reduction by 2025 as a result of current and proposed actions identified in the Plan. Achieving this performance will require NAIT to implement conservation first actions like those already identified in this Plan, but also a change in how NAIT internalizes and prioritizes energy consumption, energy savings and GHG emissions. The following initiatives set these important foundations:

- C1: Incorporate Life Cycle Considerations Into Capital Planning and Purchases
- C2: Develop a Sustainable Infrastructure Policy
- C3: Develop a Sustainable Procurement Policy And Framework

C1: Incorporate Life Cycle Considerations Into Capital Planning and Purchases

Like most educational institutions, NAIT is often juggling and prioritizing competing financial priorities, which can result in a procurement culture where the lowest bid is often seen as the most viable and best value. The result, however, is a system that defaults to 'like-for-like' replacements, penalizes higher cost energy and GHG emission reduction technologies and best-practices and does not account for the GHG footprint of the products or services being provided. For example, NRCAN estimates that 20% of Canada's GHG emissions are embodied in the construction sector – which are not accounted for in most global GHG accounting systems.[7]

It is recommended that NAIT continue to integrate life cycle analysis (LCA) processes into budget and capital planning, strategic planning, purchasing policies, preventative maintenance plans, and environmental management plans. It is also recommended life cycle energy and GHG emissions reduction measures be incorporated as part of the rationale for budget requests, that these measures feed into the annual budgeting process, and that projects be examined in consideration to the total life cycle of the asset or project. Success means that these measures are incorporated into the initial stages operational and capital project planning, and that options for energy efficiency and conservation are considered, evaluated and quantified in terms of life cycle, which includes cost, maintenance and energy and GHG reductions. In addition to costs, consideration should be given to available energy services, energy quality and reliability, and supplier performance. The NAIT should consider energy efficient criteria when evaluating, comparing, selecting, or purchasing materials and equipment.

C2: Develop An Energy Savings Policy

When actual utility savings occur from energy reductions projects, future operational budgets are often reduced to reflect this change. However, in many cases the operational costs to maintain the energy reductions are higher than what has been historically required, and the reduction of budget reduces a departments resource capacity to maintain the energy reductions. The proposed initiative would assign

[7] https://www.nrcan.gc.ca/energy-and-greenhouse-gas-emissions-ghgs/20063

the remaining budget to a special projects account (e.g. realized utility savings from an LED retrofit program would be assigned to a financial account for use in the future) for the discretionary use of the department that implemented the energy savings project.

C3: Develop a Sustainable Procurement Policy And Framework

The interest in green procurement reflects growing market preference for environmentally superior goods and capital assets referencing environmental, sustainability and corporate social responsibility standards. However, identifying and verifying the relative environmental benefits of products and establishing which products are actually “green” or “greener” is challenging. There is a general lack of industry standards and accepted criteria for valuation. Many factors throughout the entire life cycle of the product and packaging supply chain, use, and disposal can be included and if so, weighted in analysis. Environmental aspects include items such as recycled content, renewable versus non-renewable resource inputs, GHG emissions and embodied energy, other contaminant emissions, energy efficiency, and waste production and reduction. Economic, social and cultural aspects of procurement include ethical and fair-trade practices such as economic and employee equity, worker health and safety, child labor, and community economic development.

To reduce energy and GHG emissions from products and services, it is recommended that NAIT develop a Sustainable Products Ranking Framework and associated program with the objective to shift spending away from goods and capital assets that have a greater energy, GHG emissions, water, waste footprint towards those that have a smaller footprint over the goods or services lifespan. A Sustainable Products Ranking Framework would enable NAIT to clearly assess the degree to which environmental and social considerations have been addressed over the life cycle of a good or capital asset. Such a framework is designed to compare, rank and weight purchases based on set Regional requirements (e.g., cost, efficiency, etc.) as well as the degree to which the environmental and social impacts of concern have been reduced or eliminated. Each purchase would be assessed against a base case product or service for which no identifiable efforts have been made to reduce the environmental or social impacts. The Framework, its requirements, criteria and processes would need to be documented and reside in an Environmental Procurement Program Guide. In the case of capital goods, like buildings, the Framework would incorporate green performance requirements / objectives and performance metrics such as Energy Use Intensity (EUI) and/or Thermal Energy Demand Intensity and/or GHG Intensity and would undergo an energy and GHG emissions LCA (Initiative C1) to quantify the energy and GHG impact that would be incurred over the life of the asset. These performance targets would then be carried through into contractual requirements, along with associated penalties for non-compliance. To track and monitor contracted services, it is recommended that NAIT include energy and GHG emissions reporting requirements in all new and renewed contracts post 2020.

Summary of Proposed Initiatives

A summary of the proposed initiatives is presented in the following table.

Table 9. Corporate Initiatives

#	Initiative	Energy Reduction Potential	GHG Reduction Potential	Estimated Cost	Timing	Responsibility	Indicators
C1	Incorporate Life Cycle Considerations Into Capital Planning and Purchases	Supportive Initiative	Supportive Initiative	• Staff Time	Ongoing	• Facilities • Legal • Procurement	• Policy is completed and approved
C2	Develop An Energy Savings Policy	Supportive Initiative	Supportive Initiative	• Staff Time	2021	• Facilities • Accounting / Finance	• Policy is completed and approved
C3	Develop a Sustainable Procurement Policy And Framework	Supportive Initiative	Supportive Initiative	• Staff Time	2022	• Facilities • Legal • Procurement	• Policy is completed and approved

7.0 PLAN IMPLEMENTATION

7.1 GOVERNANCE AND COLLABORATION

The NAIT's Sustainability Task Force will hold the responsibility of leading the implementation of the Plan. This responsibility includes:

- Serving as a primary point of contact for all Plan initiatives and related matters.
- Generating and distributing reports to staff and management.
- Monitoring and verification of energy and GHG emissions performance.
- Promotion of energy and GHG emissions education and awareness.
- Acting as a resource in the planning, development and implementing of energy efficiency and GHG reduction projects.

The Sustainability Task Force will evaluate the potential energy saving opportunities for each specific policy, project or program initiatives and will prioritize each based on the expected energy and cost savings, the payback, and the availability of NAIT resource to implement. Individual departments will be responsible for the project management for the implementation of the specific policy and program initiatives, with support from the Sustainability Task Force. Projects will be implemented on a case-by-case basis and brought forth for consideration and approval by management as necessary.

7.2 MONITORING EXISTING & EVALUATING NEW INITIATIVES

The Plan contains a list of recommended initiatives to be completed over the next five years. Implementing the initiatives requires dedicated resources and systems in place to ensure that the policies, programs, and projects recommended are implemented and tracked so that NAIT reduces energy consumption and GHG emissions. The intention of the Plan is to dovetail energy conservation, energy demand management, and GHG emissions as part of NAIT normal course of business for asset retrofits, renewals and life cycle replacement projects. Success in this endeavor requires incorporating conservation and demand management options at the initial design stages. In so doing, this ensures that options for improving energy efficiency are considered, evaluated, and quantified in terms of life cycle costing analysis, including cost, maintenance, GHG reductions and other co-benefits that may accrue to NAIT. When evaluating future initiatives, a NAIT checklist should include the following:

- Project base case
- Energy efficient options
- Project costs (base case vs. energy efficient case)
- Project savings (in terms of energy, maintenance, avoided GHG emissions)
- Maintenance savings
- Financial benefits
- Environmental benefits
- Co-benefits

- Incentives/funding available
- Overall benefits
- Life cycle analysis recommendations

The Plan spans 5-years to which at that point, the initiatives will be evaluated in consultation with the various NAIT departments, as part of the departmental strategic operations planning process. This will be an opportunity to review and prioritize potential strategies and set the 2035 GHG reduction target based on resources, forecasted changes at the campus, and emerging technological opportunities.

7.2.1 FUNDING

Wherever possible, NAIT should take advantage of funds to speed up the implementation of project initiatives. For example, NAIT could submit an application to Infrastructure Canada for federal funding to support the energy projects under the basis that the retrofits would reduce GHG emissions and increase resilience to the effects of climate change.

As external funding programs are subject to political and other unforeseen circumstances, NAIT should proactively plan and incorporate capital and operating costs of the proposed initiatives into future budgets. This will enable NAIT to take advantage of external funding opportunities when they are available, but not have to rely on these external sources to move forward on initiatives.

7.3 REPORTING & COMMUNICATION

7.3.1 Monitoring & Reporting

An ongoing feedback loop, known as the Deming Cycle facilitates continuous improvement, can be used to facilitate the continuous improvement of the Plan, and ensure that it remains as a living document. The four components of the Deming Cycle, shown below in Figure 9, are “plan, do, check and act.” A run through the plan-do-check-act cycle must occur on an annual basis and should coincide with NAIT’s annual budget cycle for planning each year’s capital and operating budgets.

Plan Implementation

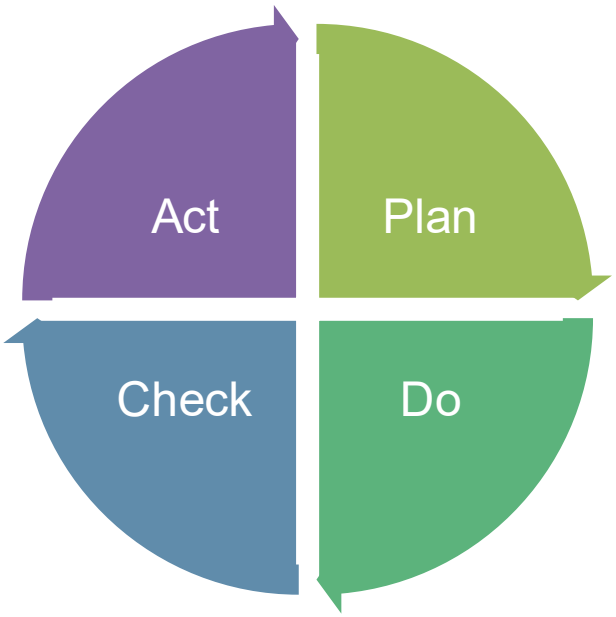

Figure 9. The Deming Cycle (Plan-Do-Check-Act)

A monitoring framework provides NAIT with a task list of items to track that will help re-assess the effectiveness of Plan initiatives, GHG emissions, and other activities contained within the Plan over time (the "check" components of the cycle). Monitoring includes two components. The first is the monitoring of the Plan initiatives - what is being done, who is doing it, is the activity funded, etc. The second component is the compilation of the energy and GHG emissions inventory to monitor the success of the Plan initiatives. Tracking, measuring, and sharing progress towards the initiatives identified in the Plan is essential to maintaining momentum for change. The success of the Plan will be measured by the results achieved relative to prior reporting years.

On an annual basis, the Sustainability Task Force will prepare an Energy and GHG Emissions Report, which at a minimum, will include:

- Current energy and GHG emissions profile in aggregate and broken down by asset
- Change in energy and GHG emissions from the prior year and the baseline
- Follow up actions from the prior year's report.
- A description of the work that has been completed.
- Extent to which GHG emission reduction have been met.
- Identification of any issues or challenges faced in advancing each initiative
- An indication of progress toward achieving each initiative, using the following scale:
    - Not Started – The initiative has not been implemented.
    - On Track – The initiative has been implemented. For various initiatives, progress will be measured through quantitative and qualitative primary indicators (Table 10) and secondary indicators (as identified in the initiatives tables).

  - Outstanding – An issue, barrier and/or challenge is prohibiting the initiative from being implemented.
  - Delayed – The initiative has been delayed or placed on hold.
  - Completed – The initiative has been completed.
- List of new initiatives to address issues, barriers and challenges.
- Timing and assigned responsibilities of the initiatives.

Table 10. Plan Key Performance Indicators

Key Performance Indicator (KPI)	Measurement
Building Energy Intensity	Energy use per unit area
Building Emissions Intensity	Greenhouse gas emissions per unit area
Building Energy Cost Intensity	$ per unit area
Renewable Energy Generated	KWh_{ac} produced % of energy demand from renewable energy
Fleet Fuel Efficiency	Fuel quantity per kilometer
Fleet Total Fuel Used	Fuel quantity
Fleet Number of Vehicles in Different Classes	Number of vehicles with greater fuel efficiency, hybrid, electric vehicle etc.
Policy Recommendation	Completion of recommended policy

The implementation of the Plan (the “Plan and Do” components of the cycle) will require the formulation of an annual work plan to define what actions are undertaken annually. To aid in successful implementation, the annual work plan should tie into departmental business plans and budgets to ensure responsibilities and resources are allocated accordingly. Progress will be reported to the following stakeholders as noted below.