Empowering Sustainable Futures:

Energy Innovation for Akoma's Community Development

Akoma Land Holdings, 1018 Main Street, Preston Township, Halifax Regional Municipality

September 18, 2024

nscc Applied Research

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Veronica Marsman
Akoma Holdings Property Manager
1018 Main Street
Dartmouth, Nova Scotia B2W 4X9

Dear Veronica,

We are writing to submit this report entitled "Empowering Sustainable Futures: Energy Innovation for Akoma's Community Development". This document represents the results of the study conducted in collaboration between Akoma Holdings Inc., and the NSCC Applied Energy Research Lab, aiming to develop a sustainable energy strategic plan for the future developments of Akoma.

The report delves into various facets of energy sustainability, including current energy consumption assessments, future scenario projections, renewable energy potential, stakeholder engagements, and strategic recommendations. Through data analysis, scenario planning, and stakeholder consultations, we have endeavoured to provide a holistic perspective on energy sustainability within Akoma's development framework.

Our findings underscore the critical importance of prioritizing energy efficiency, adopting stringent building standards, and harnessing renewable energy sources to foster sustainable development. By integrating these principles into your projects, Akoma has the opportunity to not only reduce its environmental impact but also optimize resource utilization and enhance community resilience.

It is our hope that this report serves as a valuable resource to inform your decision-making processes and shape the trajectory of Akoma's future endeavours. Should you have any questions, require additional information, or wish to discuss any aspect of the report in further detail, please do not hesitate to reach out.

Sincerely,

Wayne Groszko
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Executive Summary

The "Empowering Sustainable Futures: Energy Innovation for Akoma's Community Development" project, spearheaded by the Nova Scotia Community College Applied Energy Research Lab in collaboration with Akoma Holdings Inc. and Hope Blooms, presents a strategic blueprint for achieving energy efficiency and net-zero carbon emissions in Akoma's future developments. This report includes assessments of current energy consumption, future scenario projections, renewable energy potential, electric vehicle considerations, and strategic recommendations. Our analysis aims to provide actionable insights and evidence-based recommendations to support sustainable development at Akoma.

The primary objective of this project is to develop strategies that emphasize environmental stewardship, optimize resource utilization, and enhance community resilience. Key findings from our analysis include that Akoma's current energy consumption is approximately 310 MWh per year. This demand can be more than offset by integrating a 1 MW solar array, projected to generate 1200 MWh annually. Additionally, transitioning to the Net Zero Energy Ready (NZER) building standard for all new construction could result in an 80% reduction in energy consumption compared to the baseline scenario, requiring an additional 14.5 MW of solar capacity to fully offset energy usage from future planned developments on your property. The feasibility of leveraging on-site renewable energy generation, particularly solar arrays, has been highlighted, with the implementation of solar canopies and rooftop solar panels significantly reducing the land required for solar farms.

To achieve the outlined goals, we recommend that Akoma prioritize energy sustainability by emphasizing stringent building standards, renewable energy sources, and innovative technologies in all development projects. Proactively building to higher energy-efficient standards will save significant amounts of energy and associated costs over the long term. Collaborative efforts with stakeholders, including government entities, industry partners, lenders, and community members, will be essential in overcoming challenges and realizing the vision of a sustainable and resilient future. Strategically planning and implementing renewable energy solutions will help meet a substantial portion of electricity needs, contributing to both environmental sustainability and long-term operational cost savings. By integrating these principles into its development strategy, Akoma can lead by example, demonstrating the feasibility and benefits of environmentally conscious practices in affordable housing and community-focused economic development initiatives.

1.0 Project Introduction

In response to the imperative to address climate change and promote sustainable development, the "Empowering Sustainable Futures: Energy Innovation for Akoma's Community Development" project was initiated to examine energy efficiency strategies and renewable energy solutions for Akoma Holdings future development plans. This report presents the findings and recommendations resulting from an in-depth analysis of current energy usage, future scenario projections, stakeholder consultations, and feasibility assessments.

1.1 Project Goals

The goal of the project is to develop comprehensive strategies that prioritize environmental stewardship, optimize resource utilization, and enhance community resilience. By analyzing existing energy consumption patterns, projecting future energy usage scenarios, and exploring renewable energy potential, the project aims to inform the development of actionable insights and evidence-based recommendations for energy sustainability at Akoma. The project deliverables are as follows:

1) Comprehensive Study of Akoma's Land Base and Development Plans to understand needs and opportunities for emission reductions and sustainable energy.
2) Stakeholder Engagement Meetings and Report to gather stakeholder goals and align with energy sustainability opportunities.
3) Assessment of Energy Efficiency, Renewables, and Energy Storage to evaluate potential for energy efficiency and renewable energy on Akoma lands.
4) Assessment of Transportation Electrification to evaluate electric vehicle infrastructure and shared EV systems opportunities.
5) Development of Strategic Energy Plan to formulate a comprehensive report outlining energy opportunities and required investments.
6) Final Reporting to Akoma, as well as to the Low Carbon Communities Fund, to present final project outcomes and recommendations.

1.2 Project Description

Akoma, a non-profit organization, is dedicated to the stewardship of 320 acres of land surrounding Kinney Place, formerly the Old Home Orphanage, in Westphal, Nova Scotia. The organization's mission is to maintain and develop these lands for the benefit of the African Nova Scotian community and society at large. The project's audience comprises current and future community members who will utilize the spaces and services provided. Presently, operations include affordable housing, community gardens, offices, commercial spaces, meeting rooms, and an early childhood education center. Planned future developments encompass additional affordable housing units and community facilities. Enhanced energy sustainability and stability in energy costs will benefit all community members utilizing these services and engaging with the land.

The 320 acres of land, primarily consisting of vacant or untouched areas designated as an Urban Reserve, hold significant cultural and historical value for the surrounding African Nova Scotian community. In 2021, at Akoma's request, the Halifax Regional Municipality (HRM) rezoned a portion of the land to permit the reuse of the former Old Home building and pursue a mix of economic and social opportunities (Halifax Regional Council, 2021). Future developments will prioritize energy sustainability and aim for reduced greenhouse gas emissions, aligning with a net-zero energy future.

The built environment currently contributes to 13% of Canada's greenhouse gas emissions (Efficiency Canada, 2023a). When considering electricity usage for cooling, lighting, and appliances, this figure rises to 18%, and even further to approximately 30% when accounting for impacts from manufacturing, production, and construction (Canada Green Building Council, 2022). Incorporating sustainable energy techniques and services into projects will not only mitigate environmental impact but also enhance energy sovereignty and community resilience in the transition to a low-carbon future.

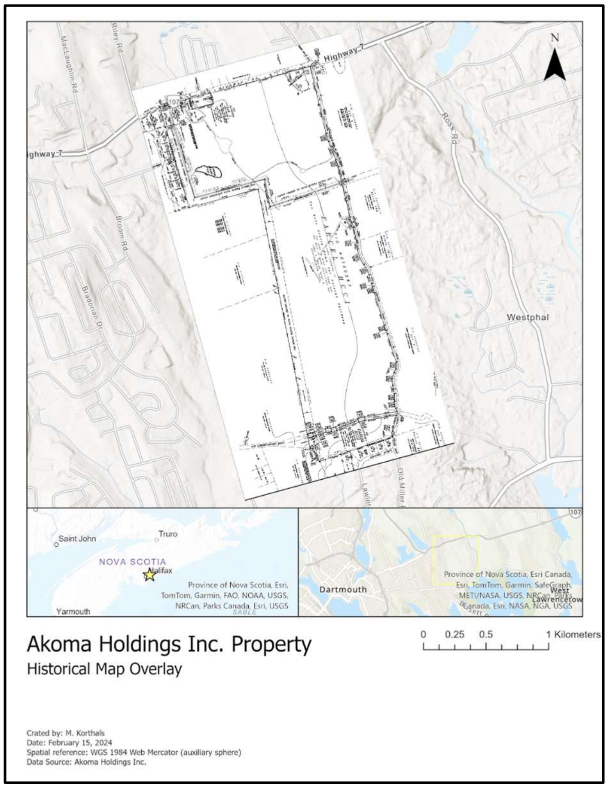
1.3 Future Plans

Table 1: Concept Plan for future construction at Akoma

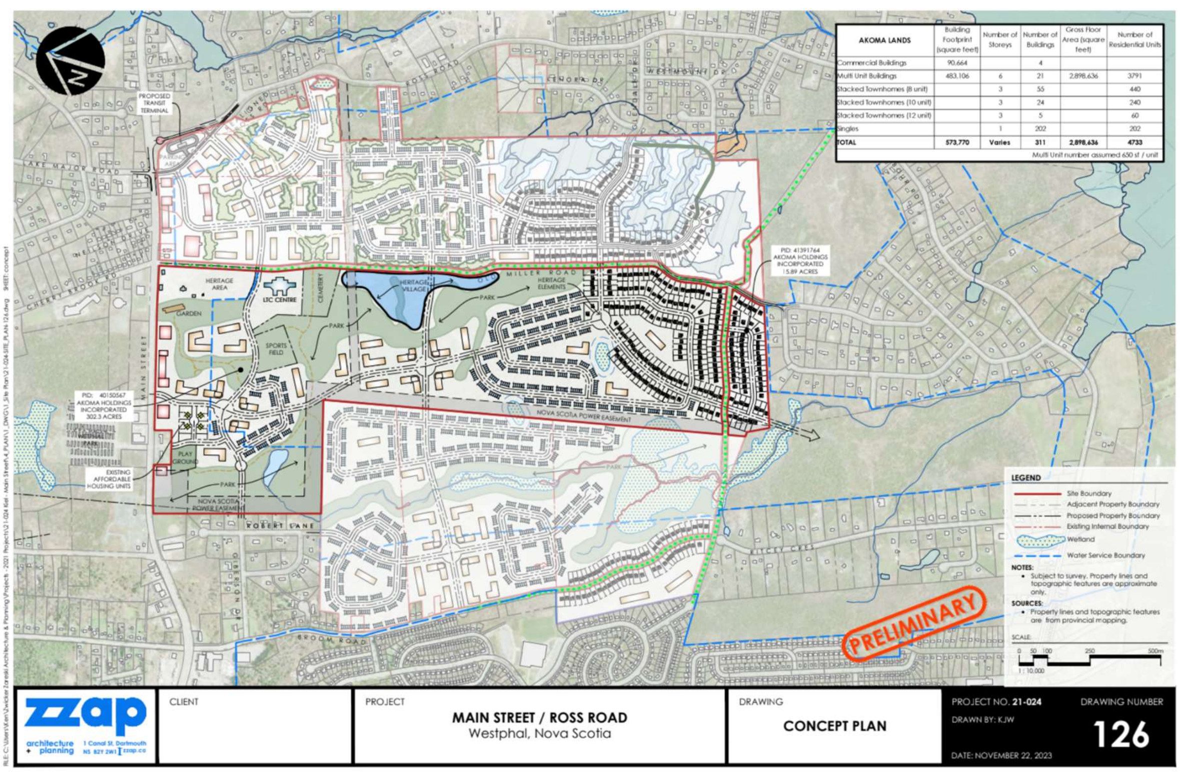
Akoma Lands	Building footprint (sq feet)	Number of stories	Number of buildings	Gross floor area (sq feet)	Number of Residential Units
Commercial buildings	90,664		4		0
Multi-Unit Buildings	483,106	6	21	2,898,636	3,791
Stacked Townhomes (8 unit)		3	55		440
Stacked Townhomes (10 unit)		3	24		240
Stacked Townhomes (12 unit)		3	5		60
Singles		1	202		202
Total	**573,770**	**Varies**	**311**	**2,898,636**	**4,733**

Based on the concept plan provided by Akoma, a clear understanding of the project's scope has been established. As outlined in Table 1, the plan includes constructing a mix of residential and commercial buildings. This includes apartment buildings, stacked townhomes, and single-family homes, aiming to add 4,733 residential units over the next 30 years.

Energy Innovation for Akoma's Community Development



Figures 1-3. Akoma Property Maps. Created by M. Korthals & zzap Archictecture & Planning



AKOMA LANDS	Building Footprint (square feet)	Number of Storeys	Number of Buildings	Gross Floor Area (square feet)	Number of Residential Units
Commercial Buildings	90,664		4		
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Stacked Townhomes (12 unit)		3	5		60
Singles		1	202		202
TOTAL	573,770	Varies	311	2,898,636	4733
					Multi Unit number assumed 650 sf / unit

2.0 Background

To effectively understand Akoma's goals and provide informed recommendations for future developments, it is essential to analyze the current energy landscape at both national and provincial levels. This involves a thorough examination of existing energy policies, initiatives, and trends to identify opportunities for sustainable energy solutions and resource management practices. By understanding the broader context of energy consumption, production, and conservation, we can make informed decisions regarding Akoma's energy needs and potential renewable energy projects. Additionally, it is crucial to consider the evolving regulatory frameworks and technological advancements in the energy sector to ensure that Akoma's energy strategies and future developments align with emerging regulations and best practices.

2.1 Net-Zero Targets in Canada

The federal government of Canada has committed to achieving a net-zero economy by 2050, as articulated in the Canadian Net-Zero Emissions Accountability Act (S.C. 2021, c. 22). This significant legislative measure establishes a legally binding framework to achieve net-zero greenhouse gas emissions, setting five-year national emissions reduction targets and developing credible, science-based plans. The Act emphasizes transparency and accountability, mandating regular progress reports and public participation in the planning process.

A key component of this framework is the 2030 Emissions Reduction Plan, aimed at reducing Canada's greenhouse gas emissions by 40-45% below 2005 levels by 2030. This plan outlines sector-specific strategies across various industries, including transportation, electricity, oil and gas, buildings, and agriculture. It integrates input from over 30,000 Canadians, including provinces, territories, Indigenous Peoples, and industry stakeholders. The Plan also sets interim targets, such as a 20% reduction in emissions by 2026, and is monitored through periodic reports. The first progress report, released in December 2023, indicates that Canada is on track to meet its 2030 targets if current and proposed policies are effectively implemented.

In recent years, energy efficiency initiatives and policies have gained significant traction, reflecting a growing awareness of environmental sustainability and the need to mitigate climate change. The government has promoted energy efficiency across various sectors through programs and policies such as incentives for energy-efficient upgrades and regulations mandating higher efficiency standards. Achieving net-zero by 2050 is an ambitious goal, requiring commitment and action from all levels of government and citizens.

2.2 Net-zero Targets in Nova Scotia

At the provincial level, Nova Scotia is committed to achieving net-zero emissions by 2050, as outlined in the Environmental Goals and Climate Change Reduction Act (2021, c. 20, s. 1). This commitment is further reinforced by the actions detailed in the 2022 "Our Climate, Our Future: Nova Scotia's Climate Change Plan for Clean Growth" report by the Department of Environment and Climate Change.

Nova Scotia's net-zero targets are anchored by the EGCCRA and the "Our Climate, Our Future" report. The EGCCRA, enacted in October 2021, outlines 28 specific goals aimed at building a sustainable future. These goals include reducing greenhouse gas emissions to at least 53% below 2005 levels by 2030 and achieving net-zero emissions by 2050. The Act emphasizes developing a green and circular economy, improving environmental health, and transitioning to clean and renewable energy. It also mandates annual progress reports from the Minister of Environment and Climate Change to the House of Assembly, ensuring transparency and accountability.

Released in December 2022, "Our Climate, Our Future" details 68 actions to address climate change and promote clean growth. This comprehensive plan was informed by a provincial climate change risk assessment, extensive consultations with Nova Scotians, and emerging opportunities for sustainable practices. Key initiatives include generating 80% of electricity from renewable sources by 2030, procuring 372 MW of new wind power, developing 5 GW of offshore wind capacity, and investing in hydrogen and solar projects across the province.

In keeping with the provincial targets and action plan, the government of Nova Scotia has established a variety of programs to support and incentivize the necessary actions, including incentives for building to higher energy efficiency standards as well as rebates for insulation, heat pumps, electric vehicles, and solar energy generation systems. One particularly relevant program established by the Province is the Community Solar Program, which sets in place a framework for organizations to finance, build, and operate solar power plants between 0.5 MW and 10 MW in size, based on a subscription model for selling the electricity to associated customers through an agreement with Nova Scotia Power that is facilitated by the Province. This represents a potential opportunity for Akoma to generate significant solar power through the Community Solar Program. More information is available at the provincial government website (Province of Nova Scotia, 2024).

2.3 Nova Scotia's Energy Profile

Analyzing Nova Scotia's energy profile reveals a considerable reliance on non-renewable sources, with coal, natural gas, and petroleum constituting 76% of the province's energy mix as of 2019 (Canada Energy Regulator, 2024). Furthermore, 88% of greenhouse gas (GHG) emissions in 2020 originated from fossil fuel usage for electricity generation, transportation, and heating buildings (Nova Scotia Government, 2022). These statistics underscore the urgent need for Nova Scotia to transition to sustainable and renewable energy sources to mitigate its carbon footprint and align with global climate goals.

Currently, Nova Scotia relies heavily on coal for electricity generation, accounting for approximately half of its electricity production. The province is committed to phasing out coal by 2030 and aims to increase the share of renewable energy in its power mix to 80% by the same year. Key initiatives to achieve these targets include substantial investments in wind and solar energy, with plans to add up to 1,500 megawatts of wind energy to the existing 600 megawatts. Additionally, Nova Scotia is exploring battery storage solutions to address the variable nature of wind and solar energy and ensure a reliable power supply. The province is also considering the future use of hydrogen and fast-acting natural gas generation to support this transition.

Moreover, structural changes in the energy sector are underway, such as the creation of a new energy regulator and system operator to enhance competition and facilitate the transition to low-cost, reliable renewable energy sources. These reforms are designed to ensure that the transition to a greener energy future is both equitable and economically viable for Nova Scotia's residents.

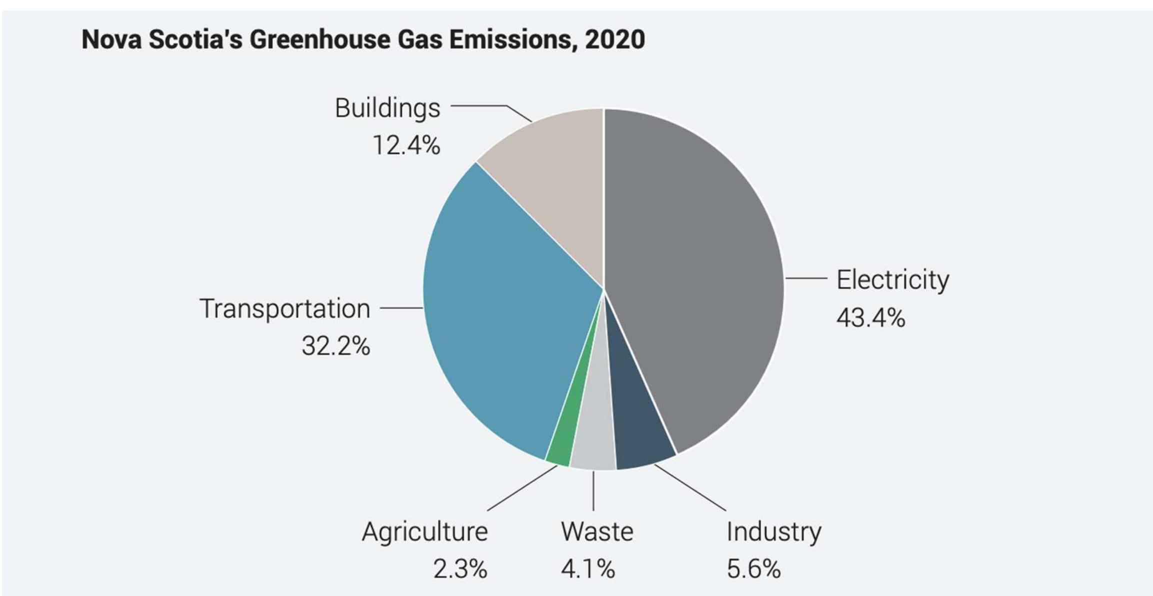

Figure 4: Nova Scotia's Greenhouse Gas Emissions by sector for 2020. Source: Nova Scotia Government (2022)

2.3 Climate-Resilient Buildings in Nova Scotia

Transitioning to a net-zero emission and energy future by 2050 necessitates the immediate construction of sustainable and efficient buildings. To achieve this target, the building sector must adopt new regulations and standards for climate-resilient structures. According to the 2022 "Our Climate, Our Future" report, the Nova Scotia government has committed to the following initiatives:

1) Prohibiting the installation of oil-fired heating equipment in new buildings by 2025.
2) Implementing the 2020 National Energy Code for Buildings and the 2020 National Building Code.
3) Promoting the construction and renovation of net-zero homes and multi-unit residential buildings, including net-zero affordable housing.
4) Assisting commercial and institutional building owners in understanding their energy performance and planning for energy efficiency upgrades through voluntary energy-use monitoring.
5) Mandating that all new government buildings and major retrofits entering the planning phase after 2022 be net-zero energy ready and climate resilient, with a priority on leasing buildings committed to net-zero energy standards and climate resiliency starting in 2030.
6) Introducing the Green Choice Program in 2023, which will enable government and other large customers to purchase 100 percent renewable electricity for their operations as it becomes available.

3.0 Building Standards & Certifications

Building standards are pivotal in enhancing the energy efficiency and sustainability of the built environment. Adhering to elevated efficiency standards can significantly reduce energy consumption costs, alleviate peak demand pressures, and improve occupant comfort (Government of Canada, 2023). In recent years, there has been a marked trend towards more rigorous standards designed to curtail energy usage and greenhouse gas (GHG) emissions. Figure 5 delineates the current scope and potential advancements in the life cycle carbon footprint of buildings. This section delves into prominent future-oriented building standards that are gaining traction in Nova Scotia, reflecting the province's commitment to sustainable development and climate resilience.

Beyond the adoption of building standards, building certifications such as LEED (Leadership in Energy and Environmental Design) play a crucial role in advancing sustainability goals. LEED for Neighborhood Development (LEED-ND) integrates the principles of smart growth, urbanism, and green building into a system for neighborhood design. This certification goes beyond individual buildings to address the broader context of neighborhood development, promoting sustainable practices in site selection, design, and construction. LEED-ND certification encourages the development of communities that are environmentally responsible, economically productive, and conducive to a high quality of life, thereby complementing building standards and fostering a holistic approach to sustainable development.

While building standards set the minimum requirements for energy efficiency and sustainability, certifications like LEED-ND provide a comprehensive framework for creating sustainable and resilient communities. Together, these initiatives are instrumental in reducing the environmental impact of the built environment and advancing Nova Scotia's climate goals.

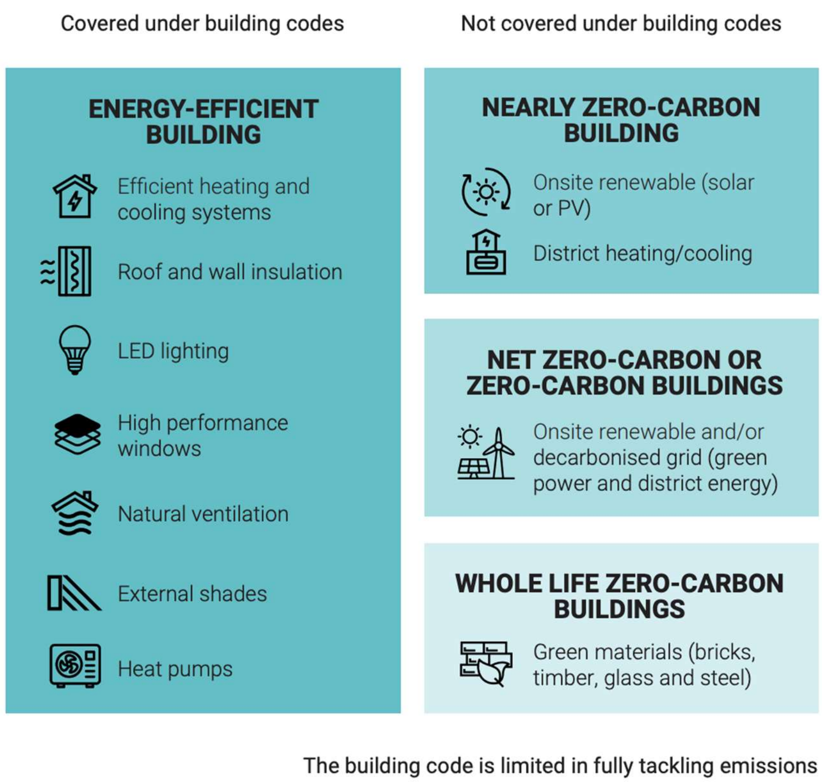

Figure 5: Building Standard Regulations. Source: IEA (2021)

3.1 NECB 2020

The National Energy Code of Canada for Buildings (NECB) specifies the technical requirements for designing and constructing energy-efficient buildings. The 2020 edition represents a significant milestone towards achieving net-zero buildings. Key updates in this edition include setting stringent limits for the thermal transmittance (U-values) of building envelopes and windows to enhance insulation, implementing mandatory airtightness testing protocols to ensure buildings meet specified air leakage performance standards, enhancing lighting efficiency standards to reduce energy consumption and improve overall building performance, and establishing rigorous performance criteria for heating, ventilation, and air conditioning (HVAC) systems to optimize energy efficiency (Government of Canada, 2023). Additionally, the NECB 2020 introduces a tiered adoption approach, allowing provinces and territories to progressively improve their building standards within a unified code framework. This tiered system facilitates incremental enhancements, enabling regions to tailor their adoption strategies based on local requirements and capacities, ensuring a flexible yet systematic path toward higher energy efficiency standards (Government of Canada, 2023).

3.2 Net-Zero Energy Ready (NZER)

Net-zero energy standards represent a progressive approach designed to ensure buildings generate as much energy as they consume on an annual basis. In the National Energy Code of Canada for Buildings (NECB) 2020, Tier 5 corresponds to the Net-Zero Energy Ready (NZER) standard. This designation requires constructing buildings to the highest energy efficiency standards specified in the NECB, enabling them to meet their energy needs through the integration of on-site renewable energy or off-site clean energy sources (Efficiency Canada, 2023b). Nova Scotia has committed to adopting the NZER code for new construction by 2030 (Ecology Action Center, 2023). Achieving Tier 5 of the code is feasible and would result in an 80% improvement in energy efficiency over the baseline standard (Ecology Action Center, 2023). This advancement would significantly accelerate Nova Scotia's progress towards its climate objectives, ensuring a sustainable and secure energy future for the province.

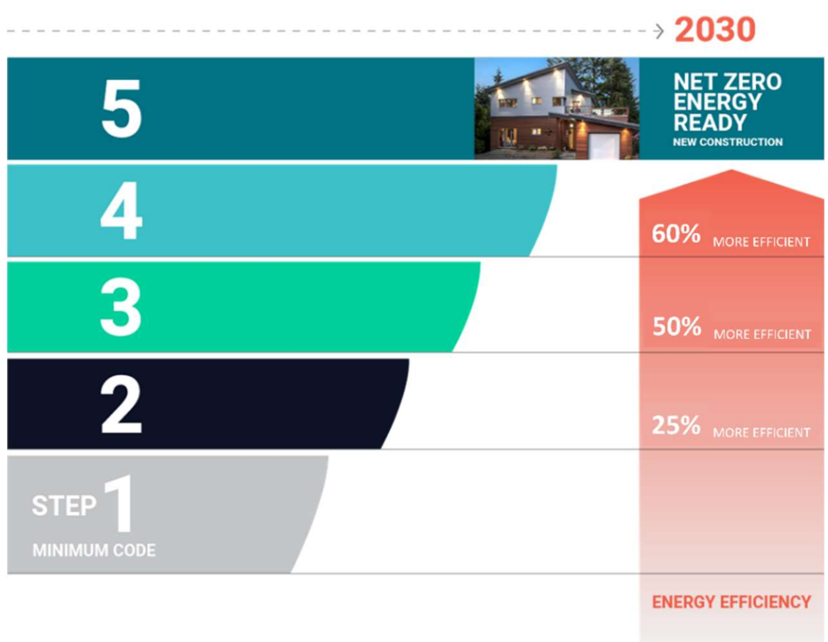

Figure 6: Canada's National Energy Code for Buildings 2020 – tiered approach. Adapted from: Efficiency Canada (2023b)

3.3 Embodied Emissions

Constructing buildings to energy-efficient standards alone does not fully address all environmental concerns; embodied emissions are also an important consideration for sustainability. Embodied emissions encompass the total greenhouse gas (GHG) emissions produced throughout the lifecycle of the materials used to construct the building, including manufacturing, transportation, construction, operations, and eventual decommissioning. Major contributors to embodied emissions include materials such as concrete, insulation, steel, glass, and aluminum (Efficiency Canada, 2023a). Utilizing low-carbon alternatives to these materials, such as hempcrete, cellulose, recycled steel/aluminum, wood, and cross-laminated timber (CLT) can substantially reduce the embodied carbon in buildings. Assessing embodied emissions is critical for evaluating the overall environmental impact of construction projects and formulating strategies to mitigate the carbon footprint associated with the built environment.

3.4 LEED for Neighborhood Development (LEED-ND)

The LEED v4 for Neighborhood Development (ND) rating system focuses on sustainable design and building practices for entire neighborhoods, encompassing aspects like smart location, community connectivity, energy efficiency, green infrastructure, and sustainable building practices. The document outlines various credits and prerequisites developers must meet to achieve different levels of certification. These credits are grouped into four main categories each with their own individual prerequisites, promoting a holistic approach to sustainable urban development. Key elements include:

1. **Smart Location and Linkage (SLL):** Encourages development within existing urban areas to reduce sprawl, vehicle use, and promote healthier lifestyles.
2. **Neighborhood Pattern and Design (NPD):** Focuses on creating walkable streets, diverse housing options, and accessible public spaces to foster community interaction and reduce environmental impacts.
3. **Green Infrastructure and Buildings (GIB):** Emphasizes energy-efficient building designs, renewable energy use, and sustainable water management practices.
4. **Innovation and Design Process (IN) and Regional Priority (RP):** Recognizes innovative practices and addresses region-specific environmental priorities.

Achieving LEED ND certification offers substantial financial, environmental, and social benefits. LEED-certified developments save on energy and water costs, reducing utility bills with significant energy reductions, up to 60% for LEED Platinum homes. These projects undergo rigorous third-party inspections, ensuring superior performance. They also offer higher resale values, faster sales, and eligibility for financial incentives. Environmentally, LEED ND promotes sustainable communities, reducing greenhouse gas emissions and conserving resources, while fostering walkable, healthy neighborhoods and supporting diverse, equitable housing options. Additionally, LEED ND helps developers comply with regulations and ensures resilience to climate impacts, positioning projects at the forefront of the green building movement.

3.5 Passive House

Passive House Certification is a rigorous voluntary standard for energy efficiency in buildings, which significantly reduces the building's ecological footprint. It results in ultra-low energy buildings that require little energy for space heating or cooling. Developed by the Passive House Institute (PHI) in Germany, the certification focuses on meticulous design and construction standards to achieve maximum energy efficiency and indoor comfort. Key Principles include:

- **Thermal Insulation:** High levels of continuous insulation to minimize heat loss.
- **Airtightness:** Buildings must achieve very low levels of air leakage, preventing energy loss and improving indoor air quality.
- **Thermal Bridge-Free Construction:** Designing and constructing buildings to eliminate thermal bridges that can cause heat loss.
- **High-Performance Windows:** Utilizing triple-pane windows and advanced glazing techniques to enhance insulation.
- **Heat Recovery Ventilation (HRV):** Implementing mechanical ventilation with heat recovery to provide fresh air while retaining heat.

Passive House certification offers numerous benefits, including significantly reduced energy consumption, with Passive Houses using up to 80% less heating and cooling energy compared to conventional buildings, thus substantially lowering energy bills. This reduction in energy use also leads to a lower carbon footprint, decreasing greenhouse gas emissions and contributing to environmental sustainability, resource conservation, and climate change mitigation. Additionally, the superior insulation and airtightness of Passive Houses, combined with heat recovery ventilation systems, ensure consistent and comfortable indoor temperatures and a continuous supply of fresh air, thereby enhancing indoor air quality and occupant health. Furthermore, Passive House certification ensures compliance with future, stricter energy codes and may qualify for various financial incentives, rebates, and tax credits aimed at promoting energy efficiency. There are multiple builders in Nova Scotia with experience building to the Passive House standard who can provide guidance on how to build to this standard, including your current contractor partner, Dora Construction. Even if official certification is not applied for, following the Passive House standard has significant long-term benefits in terms of operational savings.

4.0 Methods

The National Energy Code of Canada for Buildings (NECB) 2020 introduces a comprehensive tiered approach to improve building energy performance, culminating in Tier 5, which corresponds to the Net-Zero Energy Ready (NZER) standard. This tiered system allows for progressive enhancements in energy efficiency, providing a clear framework for provinces and territories to incrementally adopt more stringent standards.

The NECB outlines five energy performance tiers, each representing a higher level of energy efficiency:

- **Tier 1:** Baseline standard to meet the least stringent requirements for energy efficiency.
- **Tier 2:** 25% reduction in energy consumption compared with the baseline.
- **Tier 3:** 50% reduction in energy consumption compared with the baseline.
- **Tier 4:** 60% reduction in energy consumption compared with the baseline.
- **Tier 5 (Net Zero Energy Ready):** The goal is that the building is energy efficient enough that its annual energy consumption could be completely covered by renewable energy generated on-site, such as with solar panels on the roof, and is ready to take that step, whether the solar panels are installed during initial construction or later.

4.1 Building Scenarios

The remainder of the report will analyze three distinct energy future scenarios for development projects at Akoma to facilitate comparative analysis of energy usage. These scenarios encompass the Baseline/Business-as-Usual or Tier 1 scenario, the Tier 3 scenario, and the NZER or Tier 5 scenario.

4.1.1 Scenario 1: NECB 2020 Tier 1 (Baseline)

The business-as-usual scenario reflects the current building and energy landscape of the province. Residential unit estimates were generated using baseline data from Statistics Canada on household energy consumption by dwelling type for Canada and the provinces (Statistics Canada, 2024). Given the limited data specific to dwelling types in Nova Scotia, a conversion factor of 0.64 was derived from comparing energy usage for single-family dwellings in Nova Scotia to that of the rest of Canada. This factor aims to more accurately represent energy usage in Nova Scotia, accounting for regional climatic factors and existing building standards. The estimates for various dwelling types were subsequently converted to megawatt hours (MWh) for consistency and precision in energy usage analysis.

For the commercial building analysis, we acquired precise data by reviewing existing power bills from Akoma. These bills provided detailed consumption records for three buildings over a two-year period. The buildings included in the survey were located at 49 Wilfred Jackson Way, 35 Wilfred Jackson Way (the Bauld Center), and 1018 Main Street (the Akoma Family Center). By tabulating the monthly energy usage, we calculated the daily and annual energy consumption averages for each building over the two-year period, expressed in megawatt hours (MWh).

4.1.2 Scenario 2: NECB Tier 3

Scenario 2 was evaluated using the NECB 2020 Tier 3 standards. Implementing these standards for new construction from now until 2028, rather than adhering to the existing provincial building standards, is optimal as it aligns with the anticipated trajectory of the industry. The province has committed to adopting Tier 3 standards by 2028, as outlined in the proposed amendments to the Nova Scotia Building Code Regulations (Ecology Action Center, 2023). Under Tier 3, buildings are expected to achieve a 50% improvement in energy efficiency compared to the baseline standard (Ecology Action Center, 2023). Utilizing this projected 50% increase in efficiency, we estimated the energy reduction from the baseline data established in Scenario 1.

4.1.3 Scenario 3: NECB 2020 Teir 5 (NZER)

Scenario 3 was evaluated using the NECB 2020 Tier 5 standards, also known as the Net Zero Energy Ready (NZER) standard. This scenario was selected in alignment with the province's commitment to achieving this industry standard by 2030 (Ecology Action Center, 2023). Under the NZER standard, buildings are expected to be 80% more efficient than those constructed to current standards (Efficiency Canada, 2023a). Based on this projected 80% increase in efficiency, we calculated the anticipated energy reduction from the baseline data established in Scenario 1.

4.2 Current Energy Consumption

To comprehensively assess energy consumption at Akoma, data on current energy usage was analyzed. Utilizing power bills provided by Akoma for the commercial buildings, as detailed in section 4.1.1, we estimated the average annual energy consumption per building in megawatt hours (MWh). For the newly constructed Fairfax Homes, which lacked reference power bills, we employed the Efficiency Nova Scotia Energy Use Calculator. To derive accurate energy use estimates for the duplexes, we classified them as single-family homes, thereby doubling the occupancy numbers and appliance usage. With four duplexes totaling eight two-bedroom units, each averaging approximately 1,138 square feet and an anticipated occupancy of three individuals per unit (Eastgate, n.d.), we incorporated these parameters into the calculator. Additionally, our discussions with DORA Construction confirmed that the buildings adhere to the current building code. This approach enabled us to estimate the energy usage for each duplex building as accurately as possible without having real power bill data.

4.3 Long-Term Care Facility

To estimate the energy consumption of the planned LTC facility at Akoma, a case study analysis of the Windsor Elms Village LTC facility in Windsor, Nova Scotia was conducted. This facility serves as an excellent reference point due to its similar floor plan and footprint size. Windsor Elms Village, which accommodates 108 beds and provides long-term care services, underwent a significant energy retrofit in 2019, costing $948,000, to enhance its energy efficiency. Using data from the organization's presentation via the Ecology Action Center and Equilibrium Engineering (n.d), the annual energy expenditure was determined. We specifically considered the demand charge, calculated based on the facility's monthly peak load and priced at $10.554 per kW according to Nova Scotia Power (2023). Assuming that energy usage is charged at a base rate of $0.13248/kWh and accounting for a 55% reduction in energy usage post-retrofit, we estimated the facility's energy consumption both before and after the retrofit. This analysis offers valuable insights into the potential energy savings achievable through similar actions for Akoma's planned facility.

Figure 7: Windsor Elm Village Aerial Photo. Source: Equilibrium Engineering (n.d)

4.4 Electric Vehicles & Infrastructure

In addition to calculating the energy usage of the various buildings, the energy consumption associated with the introduction of electric vehicles (EVs) was estimated. Assuming an average of one vehicle per household, a projected total of 4,741 EVs by the end of construction was determined. Utilizing data from the Electric Vehicle Database, it was determined that the average EV consumes approximately 0.18 kWh per kilometer. Furthermore, based on data from a 2018 study conducted by DalTRAC, it was found that the average person in the Halifax Regional Municipality (HRM) travels 23.3 km per day in their vehicles. Using these figures, the additional energy consumption each vehicle would contribute to the overall projected energy usage for each scenario was calculated.

4.5 Solar Potential

The study aimed to determine the amount of solar energy required for Akoma to meet its energy demands. The PVWatts calculator, developed by the National Renewable Energy Laboratory (NREL), was utilized for this purpose. The calculation involved 1 MW units of fixed solar arrays that would be oriented south (180 degrees) with a 20-degree tilt angle, positioned on the Akoma lands (coordinates: 44.69, -63.46). This setup accounted for weather and climatic factors influencing the overall energy output of the array.

It is worth noting that 1 MW of ground mounted solar requires approximately 6 acres of land. If the entirety of the future development's electricity use was to be offset using this method, at minimum, 90 acres of land would need to be utilized for solar arrays. In order to preserve Akoma's most valuable resource, its land, other methods of implementing solar were also considered, including rooftop solar and solar canopies to offset the electricity use of future buildings and EVs.

Solar canopies are elevated structures installed above parking lots, walkways, or other open spaces, equipped with solar panels to generate electricity. These canopies provide shade and protection from the elements while capturing solar energy, which can be used on-site or fed back into the grid.

As an example of the potential of rooftop solar to offset the electricity use and contribute to Net-Zero goals within the current and future development, the 3 buildings for which utility information was provided were analyzed to determine an estimate of the amount of solar needed to offset electricity use completely. In addition, PVWatts was again utilized to determine how much solar the roofs of these structures could practically accommodate.

5.0 Results

5.1 Current Energy Usage at Akoma

The three buildings for which utility info was provided were as follows, 49 Wilfred Jackson Way, 35 Wilfred Jackson Way (Henry G. Bauld Centre), and 1018 Main Street (Akoma Early Childhood Education). These buildings support a variety of community-related uses, including meeting spaces, offices, education, events, and a closed-environment farm that produces greens for the community. The estimate includes the building at 18 Wilfred Jackson Way, which includes the Opus Café as well as other community businesses, offices and meeting spaces. In addition, four duplex residential buildings on Paris Lane that are newly constructed have been included as estimates.

Table 2: Current Energy Use at Akoma

Current Buildings at Akoma	Number of buildings	Number of units	Energy usage (MWh/year)
Commercial buildings	5	5	256.3
Duplexes	4	8	57.4
Total			**313.7**

Based on the calculations summarized in Table 2, Akoma currently uses about 314 MWh of energy per year with existing buildings and infrastructure. Knowing this information is critical to making informed decisions about energy efficiency upgrades and infrastructure updates.

5.2 Energy Use Scenarios

Table 3: Projected Energy Use by Scenario

Projected Energy Usage	Projected Number of New builds	Number of units	Scenario 1 (MWh/year)	Scenario 2 (MWh/year)	Scenario 3 (MWh/year)
Commercial buildings	4	4	205	102	41
Multi-Unit Buildings	21	3,791	31,474	15,737	6,295
Stacked Townhomes (8 unit)	55	440	6,195	3,098	1,239
Stacked Townhomes (10 unit)	24	240	3,379	1,690	676
Stacked Townhomes (12 unit)	5	60	845	422	169
Singles	202	202	39,288	19,644	785
Total			**46,026**	**23,013**	**9,205**

Table 3 summarizes the results from the future scenario analysis in which buildings are constructed to varying levels of efficiency standards. Scenario 1 represents the current industry baseline standard, indicating that if Akoma adheres to this standard, the total energy usage of all buildings at full build-out of the development plans will be approximately 46,000 MWh/year.

Scenario 2 represents compliance with the NECB 2020 Tier 3 standard, entailing a 50% efficiency improvement, resulting in a total energy consumption of approximately 23,000 MWh/year. Scenario 3 exemplifies adherence to the NZER standard, entailing an 80% efficiency increase, resulting in a total energy consumption of 9,200 MWh/year. Examining the differences between the projected annual energy use totals demonstrates the significant impact of adopting different efficiency standards in reducing energy consumption. Scenario analysis facilitates the comparison of potential energy savings achieved by implementing various standards and informs decision-making regarding building design, construction practices, and energy efficiency standards.

5.3 LTC Facility Results

Table 4: Windsor Elm Village Case Study

Windsor Elm Village LTC	Before Retrofit (MWh/year)	After Retrofit (MWh/year)
	1,155	520

Table 4 presents the results of the case study on energy consumption for the Windsor Elm Village LTC facility. Calculations estimate that the facility used 1,155 MWh/year before the retrofit and reduced consumption to 520 MWh/year post-retrofit, achieving an efficiency increase of approximately 55%. This case study provides valuable insights into the potential energy savings achievable through retrofitting existing buildings, particularly in the long-term care (LTC) sector. The post-retrofit annual energy consumption serves as an important benchmark for estimating the energy usage of the LTC facility at Akoma, assuming similar efficiency standards are met.

5.4 EV Projections

Table 5: Annual EV Energy Consumption

EVs	Average Energy Efficiency (kWh/km)	Average distance travelled in the HRM (km/vehicle)	Energy usage (kWh/year/vehicle)	Projected Number of vehicles	Total energy usage (kWh/year)
	0.18	23.3	1,530	4,741	**7,253,730**

Table 5 summarizes the findings for the annual energy requirement that would be added if each household had one EV, which is a likely future scenario given current adoption trends. Rebate programs such as Electrify Nova Scotia and the iZEV Program from the Government of Canada are making the switch to EVs more accessible. Given the average efficiency of an electric vehicle is 0.18 kWh/km, and each vehicle travels approximately 23.3 km/day, the average energy used annually by each household is estimated to be 1,530 kWh/year. With the addition of 4,741 residential units on the Akoma land by the end of construction, this will require an additional 7,300,000 kWh or 7,300 MWh of energy per year.

5.5 Solar Potential Results

Utilizing the PVWatts calculator from the US National Renewable Energy Laboratory, with data specific to the location of the Akoma lands, it is estimated that implementing a 1 MW fixed solar array would enable Akoma to generate approximately 1,200 MWh/year of energy. This metric is useful for estimating the number of solar arrays required to effectively offset the organization's energy consumption.

Expanding on this, Akoma can strategically plan its renewable energy initiatives by considering factors such as available space, budget constraints, and regulatory requirements associated with new builds. As mentioned, a 1 MW solar array typically requires approximately 6 acres of space, whether on parkland, agricultural land, parking areas or buildings. With this information, the organization can engage with stakeholders to devise the most effective strategy moving forward.

RESULTS

1,195,866 kWh/Year*

Month	Solar Radiation ($kWh / m^2 / day$)	AC Energy (kWh)
January	2.33	62,330
February	3.17	75,792
March	4.60	119,001
April	4.70	114,172
May	5.15	126,542
June	5.36	124,071
July	5.56	131,304
August	5.63	133,570
September	4.74	111,266
October	3.51	87,797
November	2.27	56,762
December	1.98	53,258
Annual	4.08	1,195,865

Figure 8: Energy Production (kWh/year) for a 1MW array at Akoma. Source: NREL

Using the size of average parking space, 162 ft^2, and amount of parking spaces needed to accommodate the 4741 proposed EVs it is estimated that solar canopies for EV parking could allow for an additional 2.9 MW of solar.

5.6 Energy Use Scenario Comparison

Table 6: Total Energy Use per Scenario

Categories	Scenario 1 Energy (MWh/year)	Scenario 2 Energy (MWh/year)	Scenario 3 Energy (MWh/year)
Existing buildings	314	314	314
New builds	46,026	23,013	9,205
LTC	520	520	520
EVs	7,254	7,254	7,254
Total Energy Usage	**54,113**	**31,100**	**17,292**
# of 1 MW Solar Arrays needed	**45.09**	**25.9**	**14.4**

Table 6 provides a comprehensive overview of total energy usage across different categories for each scenario considered in the Akoma development project. Based on the findings for energy use in each category, the size of the solar array needed to achieve net-zero can be determined for each scenario. Scenario 1 would require a 45 MW array, necessitating approximately 270 acres of area for solar panels, whether on land or on structures. Scenario 2 would require a 26 MW array, needing 156 acres of area, and Scenario 3 would need a 14.5 MW array, requiring 87 acres of area. These calculations highlight the potential for significant land and energy savings by implementing more efficient building standards. Prioritizing energy efficiency measures and incorporating renewable energy solutions like solar arrays allows Akoma to reduce its environmental footprint, optimize land use, and enhance the overall sustainability of the development.

Of note, the Community Solar Program invites applications for the development of solar power plants of up to 10 MW in capacity per project. This, coupled with the results for Scenario 3, suggests that over the course of the future development, electricity production from a solar plant of the maximum (10 MW) capacity under the program can be absorbed on an annual basis.

6.0 Scaling

6.1 Stakeholder Engagement

Starting in January, stakeholder meetings were initiated to understand the project's requirements and the community's aspirations. These engagements involved key individuals such as Veronica Marsman, the property manager at Akoma; Trianda, the administrative assistant; Andrew Trench from New Source Energy; and Tony Lajo from DORA Construction.

6.1.1 Akoma Staff

Since the beginning of the project, several meetings have been held with Veronica and Trianda from Akoma Holdings, primarily to understand the future vision for the Akoma lands and business operations. These discussions revealed several key concerns and priorities regarding land management and operations. It was noted that nearly the entire property is designated as an Urban Reserve, indicating that development cannot proceed until rezoning is completed in accordance with HRM land use by-laws (HRM, 2014). However, the northern section of the property adjacent to Highway 7/Main Street has been reclassified as Mixed Opportunity Districts (MODs), allowing for development in that area (Figure 8). All developmental endeavors at Akoma depend on the land designation.

Veronica and Trianda emphasized that future developments will be executed through leasing land parcels, retaining the 320-acre property under the stewardship of the organization and the broader community. According to the concept plan map, forthcoming developments will include multi-unit buildings, single homes, and stacked townhomes, totaling 4733 residential units. Additionally, plans for commercial structures, sports facilities, parks, and a long-term care facility (LTC) are underway, with the LTC project in the planning stages in collaboration with Harvey Architects and Northwood.

Moreover, Akoma had initially partnered with New Source Energy to establish a solar farm that will supply power to both existing and future developments. Currently, Akoma's power generation strategy involves leasing the land to other companies and subsequently procuring the generated power.

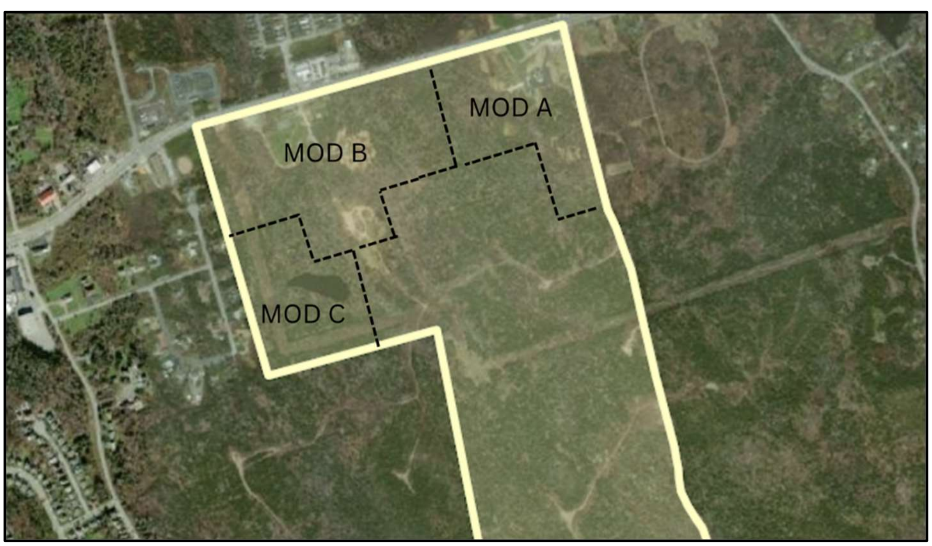

Figure 9: Mixed Opportunity Districts (MODs) at Akoma. Created by M. Korthals

6.1.2 New Source Energy

Based on meetings and email exchanges with Andrew Trench from New Source Energy (NSE), several insights have emerged regarding the scope of the energy creation proposal with Akoma Holdings. Andrew indicated awareness that Akoma is considering various additions to its developments, including a stadium, a housing project, and an LTC facility.

NSE proposed constructing an initial 1-MW solar power plant, with subsequent builds based on demand, aiming to swiftly expand its capacity to provide electricity for both Akoma's current needs and future projects. The location of the build in one of the MODs on the Akoma land has impacts on its feasibility due to proximity to the grid, road access, and the long timeframe associated with rezoning other areas; hence, NSE has proposed MOD C (see Figure 9) as the most suitable area from its perspective. However, in a subsequent meeting with Akoma staff, we understood that the area in MOD C is envisioned to have lower-intensity development and parkland, and therefore may not be the first choice as an area for a ground-mounted solar power plant.

Additionally, NSE is exploring other clean energy systems, including hydrogen fuel cell energy. Andrew highlighted hydrogen's versatility, noting its potential for various transportation modes and building heating/cooling systems. Developing innovative solar + hydrogen energy projects may be attractive for federal funding programs in clean energy, including Natural Resources Canada's Renewable Energy Demonstrations program.

6.1.3 Rooftop & Canopy Solar Potential

As mentioned, 1 MW of ground mounted solar requires approximately 6 acres of area. If the entirety of the future development's electricity use was to be offset using land-based solar arrays, at minimum, 90 acres of land would need to be utilized. In order to preserve Akoma's most valuable resource, its land, other spaces to implement solar were also considered, including solar canopies for charging the proposed fleet of EVs and rooftop solar to offset the electricity use of the buildings and residential units.

Solar canopies are elevated structures installed above parking lots, walkways, or other open spaces, equipped with solar panels to generate electricity. These canopies provide shade and protection from the elements while generating solar electricity, which can be used on-site or fed back into the grid. Using the size of average parking space, 162 ft^2, and amount of parking spaces needed to accommodate the 4741 proposed EVs, it is estimated that solar canopies could allow for an additional 2.9 MW of solar.

As an example of the potential of rooftop solar to offset the electricity use and contribute to net-zero goals within the current and future development, the buildings for which utility information was provided were analyzed to determine an estimate of the amount of solar needed to offset electricity use completely. In addition, PVWatts was again utilized to determine how much solar the roofs of these structures could practically accommodate.

Table 7: Rooftop Solar Potential of Akoma Buildings

Address	Size of Net-Zero Array (kW)	PVWatts Roof Array Estimate (kW)	% Solar
49 Wilfred Jackson Way	54	17.7	32.8%
35 Wilfred Jackson Way	40	15.9	39.7%
1018 Main Street	29	24.5	84.5%

As Table 7 indicates, for each existing building, between 32% and 85% of the electricity used within the building could potentially be offset with solar generated on the roof area of that building. This suggests that a significant portion of future electricity needs can be met with rooftop solar by enacting a policy to have all future buildings on the Akoma Lands include solar power generation integrated into the design. One advantage of this approach is that it allows for gradual growth in solar power generation along with the construction of new buildings. Another advantage is that this approach makes use of the same electricity distribution wires that will be connected to each building, thus increasing the efficiency of resource use in terms of capital expenditures.

To illustrate the impact of this approach, if every new building constructed at Akoma was built with an appropriately sized and oriented solar power system on the building and on solar carports used for parking an electric car, by an approximate estimate, up to 7.4 MW of solar electricity generation capacity could be installed on rooftops over time as the development proceeds. This could cover a significant portion of close to half of future electricity consumption on the Akoma lands, without using more of your valuable land.

6.1.4 DORA Construction

A telephone meeting with Tony Lajo of Dora Construction provided insights into the construction methods and energy efficiency standards of the first four duplexes recently built on the land. These duplexes are constructed to a basic level of energy efficiency, featuring R20 walls, R40 roofs, double-glazed low-e Argon windows, reasonable airtightness, and heat recovery ventilation. They comply with the current building code, offering better performance than older houses built to previous codes, although they do not meet the upcoming enhanced standards or net-zero or Passive House levels. Dora Construction indicated that they also construct homes to meet higher standards, such as net-zero or Passive House, if there is client demand. This presents an excellent opportunity to collaborate with a builder experienced in net-zero construction.

7.0 Summary & Discussion

The findings presented in this report underscore the valuable role that solar energy and energy efficiency can play in future development at Akoma. By conducting a thorough analysis of current energy consumption, future scenario projections, and renewable energy potential, we have identified opportunities and challenges in achieving a net-zero future.

Our analysis indicates that Akoma's current energy consumption is approximately 314 MWh per year. This demand can be more than completely offset by integrating a 1 MW solar array, projected to generate 1200 MWh annually. A 1 MW solar array would require about six acres of space, whether on land, buildings, or parking areas, and could be developed in the near-term through the Province's Community Solar Program. Over time, the developments on the lands will eventually use all the output of a 1 MW solar array and more.

Scenario analysis demonstrated the significant impact of adopting higher efficiency standards on energy consumption. Adopting the Net Zero Energy Ready (NZER) standard could result in an 80% reduction in energy consumption compared to the baseline scenario, which would keep the required amount of additional future solar power down to 14.5 MW instead of the 45.1 MW it would otherwise take to reach a net zero target.

While every MW of solar capacity requires surface area for the solar panels, installing on rooftops and solar carpark canopies could substantially improve the effectiveness of land utilization. We estimate that up to 7.4 MW of solar capacity, which is a large portion of the required total, could be installed gradually on the buildings and car parking areas as development proceeds. Adopting a policy of installing solar on the available surfaces of all new construction projects, including buildings and parking areas, will help meet your energy sustainability goals while saving land space.

Another innovation that has not been explored in this study but that could be helpful is agrivoltaics, which is the practice of installing solar panels together with agriculture. Basically, the solar panels are installed high enough above the ground to be able to garden and farm beneath them for food production under partial shading. This growing field of research is showing good results for simultaneous production of food and electricity on the same land.

The value of constructing to more energy-efficient standards is evident through this analysis. Energy efficiency and sustainable design are crucial for policymakers and decision-makers as we transition to a low-carbon future. By proactively opting to build to higher standards, Akoma can avoid costly retrofits and save time and money in the long run. The Windsor Elm Village case study illustrates that enhancing energy efficiency represents a significant investment but yields substantial benefits: reduced energy consumption allows resources to be reallocated to improve the well-being, quality of life, and services provided to both community members and staff.

Our assessment of renewable energy potential, particularly solar arrays, highlights the feasibility of leveraging on-site renewable energy generation to offset total energy consumption. With careful planning and strategic implementation, Akoma can harness solar energy to meet a substantial portion of its electricity needs, contributing to environmental sustainability and cost savings.

8.0 Recommendations

Moving forward, we recommend that Akoma strategically plan and implement energy-efficient building practices, integrated solar energy, and electric vehicle charging infrastructure.

Specifically, we recommend the following based on this work:

(1) To adopt LEED for Neighbourhood Development (LEED-ND) as a guiding set of principles for the design of future developments at Akoma.

(2) To adopt the Net Zero Energy Ready (NZER) standard for all new construction on the Akoma Lands. This will lead to much lower energy consumption and make the transition to renewable energy supply more feasible.

(3) To enact a policy of installing solar panels on all new construction as it is built, including buildings and parking areas. This will lead to a gradual increase in the percentage of solar energy on-site while making efficient use of your land and infrastructure.

(4) To explore the creation of a 1-MW solar farm on the Akoma property, either in concert with agriculture (agrivoltaics) or parkland, so that it blends well with other community uses of the land.

(5) To include wiring for Level 2 EV charging for resident and visitor use with all new construction. The focus here is on future residents who will be looking to charge their electric vehicles overnight at home. The infrastructure to make that possible is much easier to include during construction than to add afterwards. Public and Level 3 charging can be included where desired, at a lower priority than home charging.

9.0 Conclusion

In conclusion, the Strategic Planning for Energy Sustainability at Akoma project has established a robust foundation for informed decision-making and strategic planning aimed at achieving energy efficiency and net-zero carbon emissions in future developments. Through a comprehensive analysis of current energy usage, exploration of future scenarios, and assessment of renewable energy potential, we have identified clear pathways to reduce energy consumption, mitigate environmental impacts, and enhance community resilience.

Moving forward, it is imperative for Akoma to prioritize energy sustainability in its development projects by leveraging stringent building standards, renewable energy sources, and innovative technologies. By adopting higher energy-efficient standards today, Akoma can realize significant energy savings and associated cost reductions over the long term. Implementing advanced building standards, such as the NZER standard, can result in substantial reductions in energy consumption compared to baseline scenarios. These savings not only translate into lower utility bills but also yield environmental benefits through reduced GHG emissions and decreased reliance on non-renewable energy sources.

Collaborative efforts with stakeholders, including government entities, industry partners, and community members, will be essential in overcoming challenges and realizing the vision of a sustainable and resilient future for Akoma and the surrounding community. By integrating energy sustainability principles into its development strategy, Akoma has the opportunity to lead by example, demonstrating the feasibility and benefits of environmentally conscious practices in affordable housing and community-focused economic development initiatives.

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