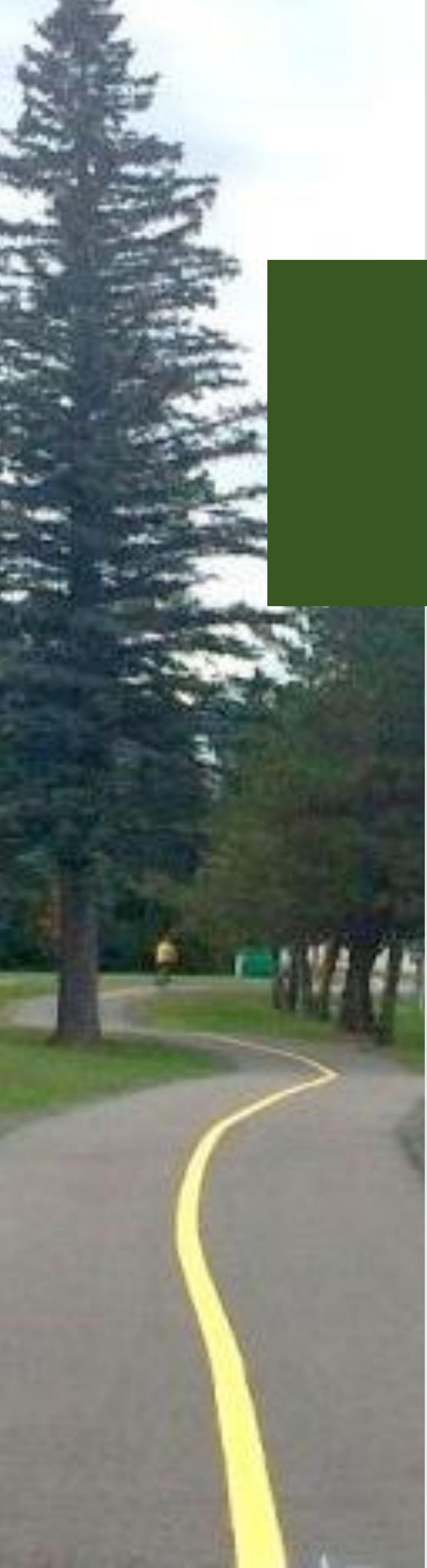

Feasibility Analysis of Proposed Climate Actions – North Grenville

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1. PURPOSE AND SCOPE

The Municipality of North Grenville is advancing its climate planning under the Partners for Climate Protection (PCP) framework (Federation of Canadian Municipalities, 2024). The PCP framework requires accounting for emissions at the community inventory, covering all greenhouse gas (GHG) emitting activity within the municipal boundary, and the corporate inventory that covers emissions from municipal operations and assets. Progress from inventory to action planning requires an assessment of what reductions the proposed measures are capable of delivering at the scale the targets require. The purpose of this report is to provide North Grenville with an assessment of their proposed measures based on verified community and corporate GHG inventories.

The 2024 inventories are considered the baseline year, and the business-as-usual (BAU) forecasts are developed from them based on expected population and sector growth. The inventories were prepared using utility data obtained directly from Enbridge Gas and Hydro One, municipal fleet and facility records, and estimation methods for sectors where local data is not yet available. The baselines establish the reference points against which all future reductions will be measured, and helps determine the feasibility of the targets that follow and the actions assessed against them.

With the baseline established, proposed actions identified through the municipal planning process were screened to determine which can be quantified within the inventory structure. On the community side, a longer list of proposed actions was consolidated into a set of measurable initiatives linked directly to inventory sectors. On the corporate side, facility, fleet, and waste-related actions were examined in relation to their share of municipal emissions, and the estimated effect of each is compared to the BAU forecasts to show how far the full action set moves North Grenville toward its 2030 and 2050 goals.

The analysis gives Council and staff a comparative frame to refine targets and prepare for the next stage of climate planning. Estimates of potential reductions, set against the scale of what the targets require, make visible both where the greatest opportunities lie and where gaps are likely to remain. Grounding target-setting in the inventory structure ensures that the commitments North Grenville makes are defensible and supported by evidence, and can help in future planning sessions.

2. COMMUNITY INVENTORY & BAU FORECASTS

North Grenville's community-wide GHG inventory and forecasts build from the 2024 baseline, prepared using utility data obtained directly from Enbridge Gas and Hydro One, provincial fuel sales data scaled to the municipal level, and estimation methods for sectors where local data is not yet available. The analysis includes a 2024–2050 BAU trajectory, quantified impacts of draft community actions for 2030 and 2050, and a comparison to the municipality's targets to identify remaining gaps.

2.1 Community BAU Assumptions

North Grenville's BAU scenario applies a fixed growth rate to each emissions sector based on anticipated population and economic development between 2024 and 2050. The current BAU is based on the assumptions summarized in Table 2, which outlines their rationale and implications. The projection offers a reference point for feasibility testing, but it is important to periodically review the assumptions as data and policy conditions change. Key assumptions underpinning the projections include:

- Residential, ICI, transportation, solid waste, and wastewater sectors are each projected to grow in proportion to population, consistent with the Official Plan Medium Growth Scenario.
- The growth rate is drawn directly from the Municipality's draft Official Plan (Municipality of North Grenville, 2024), which projects population growth of approximately 10% per five-year period under the Medium Growth Scenario.
- Agriculture emissions are held constant at 8,646 tCO_2e per year, reflecting that livestock and manure management emissions are not driven by municipal population growth. Herd sizes are updated periodically as part of the Agricultural census.
- Some potential future mitigation policies such as electrification shifts, fuel switching, or efficiency gains may help reduce emissions. Ther are also future changes that may increase emissions, such as higher-than-expected population growth, increases in emissions from the provincial electricity grid, land clearing, or supply chain challenges. The assumption for this early feasibility study is that many of those future nuances are likely to cancel each other out, and that the focus should be on the factors that North Grenville and its community have more control over.
- All forecasts assume a fixed emissions factor regime; changes in electricity grid carbon intensity or waste diversion rates are not incorporated.

Table 2. BAU Assumptions for Community Emissions Projections

Assumption	Description	Implications
One-to-One Growth	10% growth rate applied per five-year period across all sectors, consistent with the Municipality's draft Official Plan Medium Growth Scenario, assuming emissions rise directly with population.	No improvements in fuel mix, efficiency, diversion, or electrification are included. May overstate emissions in sectors where standards or turnover reduce per capita impacts.
Static Electricity Factor	Electricity grid and landfill methane capture factors are held constant through 2050.	Likely underestimates emissions — IESO projects Ontario's grid carbon intensity to double by 2043.
Transportation Stability	Transportation emissions assumed to grow with population.	Likely overstates, since EV adoption and federal efficiency standards will reduce emissions without local action.
Solid Waste Linear Growth	Waste assumed to grow in a straight line with population.	May overstate, as future diversion improvements and regulations could reduce landfill methane.
No Background Mitigation	Excludes improvements from building codes, appliance standards, or provincial fuel mix changes.	Conservative assumption may overstate emissions in several sectors.
Agriculture Constant	Agriculture emissions held flat through 2050.	Herd sizes and manure management practices are not expected to shift materially with population growth, and reductions in this sector depend on farm-level decisions outside municipal control.
Wastewater and Solid Waste Process Emissions	Wastewater and active landfill share emissions grow with population at the same rate as other sectors.	Small baseline shares; incremental growth is modest in absolute terms.

2.2 Community BAU Forecast

North Grenville's community-wide BAU projection builds from the 2024 baseline, applying population-based growth rates drawn directly from the Municipality's draft Official Plan Medium Growth Scenario (10% growth over five years). BAU in this context refers to the continuation of existing energy use, service demand, and operating practices without new climate measures, and provides the benchmark against which the scale of reductions is assessed. The baseline forms the foundation for projecting future emissions under a continuation of current practices, showing the path the community would follow in the absence of new mitigation actions.

Applied to the 2024 baseline of 447,799 tCO_2e, the BAU approach projects an emissions increase of approximately 10% by 2030 and 61% by 2050. Table 1 shows the 2024 baseline alongside BAU projections for 2031, 2036, and 2050 across the major community emissions sectors. Transportation dominates North Grenville's community emissions profile, accounting for around 90% of the 2024 baseline. Residential and ICI buildings together contribute 7.1%, while agriculture, solid waste, and wastewater make up the remainder.

Table 1. Community Baseline and BAU GHG Projections (tCO_2e)

Sector	2024 Baseline	2031 BAU	2036 BAU	2050 BAU
Residential	19,693	23,435	25,867	33,085
ICI	12,109	14,410	15,899	20,343
Transportation	405,216	482,207	532,049	680,763
Solid Waste	1,912	2,275	2,511	3,212
Wastewater	223	265	293	375
Agriculture	8,646	8,646	8,646	8,646
Total	**447,799**	**531,238**	**585,265**	**746,424**

North Grenville's BAU projections show that, without new mitigation measures, community emissions will rise well above the levels needed to meet the municipality's targets for 2031, 2036, and 2050. From a 2024 baseline of 447,799 tCO_2e, emissions are projected to rise to 531,238 tCO_2e by 2031, 585,265 tCO_2e by 2036, and 746,424 tCO_2e by 2050. That represents growth of approximately 19% by 2031, 31% by 2036, and 67% by 2050. The scale of projected growth reflects North Grenville's sustained population expansion as an Ottawa commuter municipality, and it underscores the degree to which inaction compounds the challenge over time.

Transportation dominates the community emissions profile at 90.5% of the 2024 baseline. Residential and ICI buildings together contribute 7.1%, while agriculture, solid waste, and wastewater make up the remainder. Nearly all of the baseline emissions — and effectively all of the projected growth — trace directly to fossil fuel combustion in personal vehicles. The concentration of emissions in a single sector shapes every aspect of the feasibility analysis that follows, and it makes clear that meaningful progress toward any reduction target depends on what happens in transportation. Even ambitious action in buildings, waste, or natural heritage will not materially alter the overall trajectory without corresponding progress on how and where residents travel. By pointing directly to where the overwhelming majority of emissions originate, the BAU forecast guides attention to the areas where action will matter most and where reductions are most likely to close the gap toward the municipality's 2031, 2036, and 2050 goals.

The BAU projection is deliberately simplified, but it provides a consistent point of comparison. Actual outcomes may diverge because of factors outside the municipality's control. For example, if the carbon intensity of the provincial electricity grid increases, building-related emissions could rise, while new federal fuel efficiency standards or shifts in vehicle adoption could reduce transportation emissions even without local action. The BAU scenario is best understood as a stable reference case against which the impact of local actions can be measured, rather than a detailed prediction of future conditions.

2.3 Community Action Impact Analysis

Following BAU pathways, the next step is to estimate how far the municipality's proposed climate actions could bend the BAU curve. Translating the draft action list into quantifiable reductions requires linking each measure directly to the emissions sectors it affects. The full list of actions identified by municipal staff was reviewed, and a structured screening process was consolidated into measurable initiatives tied directly to inventory sectors. Each action was grouped into transportation, buildings, waste, or natural heritage and assigned reduction estimates scaled to realistic local uptake assumptions.

For each action, three uptake scenarios were developed — low, midpoint, and high — representing the range of plausible outcomes for 2031, 2036, and 2050. The uptake fractions reflect realistic assumptions about how many households might complete energy retrofits, what share of vehicle trips could shift to active or transit modes, and how much organic waste could be diverted from landfill over each time horizon. The results, summarized in Table 3, provide high-level estimates of reductions achievable by

2031, 2036, and 2050 if actions are implemented at moderate ambition levels and begin scaling in the near term.

The reductions amount to approximately 2% below the 2031 BAU level, 5% below the 2036 BAU level, and 16% below the 2050 BAU level. Transportation dominates the modeled reductions at every milestone year, contributing 80% of the 2031 total and 87% of the 2050 total, consistent with its overwhelming share of the baseline. Buildings provide a meaningful secondary contribution, while waste and natural heritage remain modest in absolute terms but add incremental progress and important co-benefits.

The full set of fraction multipliers, baseline linkages, and scenario ranges is documented in the Appendix of this report, which is designed to function as a working tool — municipal staff or external reviewers can adjust individual assumptions to test how sensitive the results are to changes in uptake or timing. The sections that follow walk through each action grouping in turn: transportation (T1–T3), buildings and development (B1, B2, B3, B4), waste management (W1, W2), and natural heritage management (N1, E4). For each grouping, the discussion covers the sector's share of the baseline, the rationale behind the uptake assumptions, and the scale of potential reductions against the BAU trajectory.

Table 3. Estimated Community-Wide GHG Reductions from Draft Climate Actions

Sector	Draft Plan Actions	Reduction by 2031 (tCO_2e)	Reduction by 2036 (tCO_2e)	Reduction by 2050 (tCO_2e)
Transportation	Flexible transit, active transportation infrastructure, mixed-use and transit-oriented development	7,294	25,366	101,304
Buildings & Development	Green building standards, residential and ICI retrofit incentives, residential renewables, soft densification	1,677	4,610	14,184
Waste Management	Waste audit, green bin expansion, food waste reduction	52	91	201
Natural Heritage	Tree canopy expansion, urban forest management	96	324	1,125
Total		**9,119**	**30,391**	**116,814**

The emissions distribution underscores why resources for implementation must be concentrated in transportation above all else. Buildings, waste, and natural heritage measures remain important for their own contributions and co-benefits, but their role is complementary. Progress in those sectors, however ambitious, will not move the overall inventory in the way that transportation measures can. With more than 90% of baseline emissions tied to fossil fuel combustion in personal vehicles, the trajectory of North Grenville's emissions will be determined by how successfully the municipality and its residents shift away from car dependency over the coming decades.

While the modeled reductions help narrow the gap between BAU emissions and long-term targets, they are not sufficient to reverse the growth trajectory. Achieving deeper cuts will require scaling actions more aggressively, particularly in the 2025 to 2036 period, and aligning them with external drivers such as accelerating EV adoption, federal efficiency standards, and provincial infrastructure investment. Without that coordination, the current action set will moderate growth but will not bend the curve enough to place North Grenville on track for its 2036 and 2050 goals.

2.3.1 Transportation (T1–T4)

Transportation is the defining feature of North Grenville's community emissions profile, accounting for 90.5% of the 2024 baseline at 405,216 tCO_2e. Virtually all of these emissions come from gasoline and diesel use in personal vehicles, reflecting the municipality's near-total dependence on car travel, its dispersed rural settlement pattern, and the large share of residents commuting to Ottawa daily. Because the sector is so dominant, even modest changes in mode share, fuel use, or technology adoption create measurable shifts in overall totals — and conversely, inaction in transportation effectively determines the trajectory of the entire community inventory.

The three modeled transportation actions (T1, T2, T3) were each tied to the baseline share of fossil fuel use in on-road transportation. Reduction estimates were scaled using uptake fractions that represent the share of trips, vehicles, or kilometres affected under low, midpoint, and high scenarios for 2031, 2036, and 2050 (see Appendix 1 for multipliers). Table 5 summarizes the assumptions and modeled reductions for each measure, expressed as a percentage of the BAU projection for each milestone year, as well as their combined effect across milestone years.

The results show that long-term reductions in transportation depend on a combination of mode shift and land use change compounding over time rather than on any single dominant measure. Unlike Smiths Falls where EV adoption drives the majority of projected reductions, North Grenville's action set concentrates on mode shift and development patterns, reflecting the municipality's semi-rural character and the limited near-term potential for transit-based solutions at scale. Reductions build gradually at first, then accelerate as infrastructure investments, behavioural change, and land use patterns compound through the 2030s and 2040s. At 0.8–1.9% of the 2031 BAU projection, 2.6–6.0% by 2036, and 9.2–17.9% by 2050, even the full transportation action set at high uptake leaves a substantial gap against the targets. Piloting flexible transit routes, advancing active transportation infrastructure, and embedding transit-oriented development standards in the near term are the foundations on which deeper reductions through the 2030s and 2040s will depend.

Table 5. Modeled Reductions from Transportation Actions (T1–T3)

Action	Uptake Assumption	2031 Reduction (tCO_2e)	2036 Reduction (tCO_2e)	2050 Reduction (tCO_2e)	Share of BAU Emissions
T1. Flexible transit / dial-a-ride	0.5–1% of trips near-term, 5–10% long-term	2,026–4,052 (0.4–0.8%)	7,051–14,101 (1.2–2.4%)	20,261–40,522 (2.7–5.4%)	Moderate
T2. Active transportation (cycling, walking)	0.5–1% of trips near-term, 10–15% long-term	2,026–4,052 (0.4–0.8%)	7,051–14,101 (1.2–2.4%)	40,522–60,782 (5.4–8.1%)	Moderate to High
T3. Mixed-use / transit-oriented development	0.1–0.5% near-term, 2–8% long-term	405–2,026 (0.1–0.4%)	1,410–7,051 (0.2–1.2%)	8,104–32,417 (1.1–4.3%)	Low to Moderate
Combined (T1–T3)	—	**4,457–10,130 (0.8–1.9%)**	**15,512–35,253 (2.6–6.0%)**	**68,887–133,721 (9.2–17.9%)**	—

2.3.2 Buildings & Development (B1–B6)

Buildings and development account for 7.1% of North Grenville's 2024 community baseline at 31,802 tCO_2e, a share substantially smaller than in most Ontario municipalities and a direct reflection of transportation's overwhelming dominance of the inventory. Natural gas is the primary emission source across both residential and ICI buildings, reflecting the prevalence of gas-heated housing in Kemptville and the reliance on propane and heating oil in rural areas outside the gas distribution network. Because stationary energy represents a meaningful and directly addressable portion of the inventory, even incremental efficiency improvements or renewable substitutions translate into measurable reductions.

The modeled actions in this category (B1, B2_res, B2_ici, B3, B4) were tied to the stationary energy subsectors of the inventory. Reduction estimates were scaled using uptake fractions representing the share of homes or facilities completing retrofits, the share of new developments built to higher standards, or the proportion of residential properties adopting on-site renewables, under low, midpoint, and high adoption scenarios for 2031, 2036, and 2050 (see Appendix 2 for multipliers). Table 6 summarizes the assumptions and modeled reductions for each measure, expressed as a percentage of the BAU projection for each milestone year, as well as their combined effect across milestone years.

Combined, these measures reduce approximately 995–2,357 tCO_2e by 2031 (0.2–0.4% of BAU), 3,461–8,198 tCO_2e by 2036 (0.6–1.4% of BAU), and 8,058–20,310 tCO_2e by 2050 (1.1–2.7% of BAU). The trajectory is dominated by residential retrofits in the near term, with green building standards and soft densification growing in importance as the building stock turns over through the 2030s and 2040s. Near-term reductions depend on scaling retrofit programs and residential renewable installations quickly, while long-term alignment with community targets requires sustained investment, program design, and policy support. The core GHG outcomes in this category hinge on retrofit uptake across both residential and ICI buildings, and without deliberate financing mechanisms and workforce capacity, modeled reductions will be difficult to achieve

Table 6. *Estimated* GHG Reductions from Building and Development Actions

Action	Description	Reductions by 2031 (tCO_2e)	Reductions by 2036 (tCO_2e)	Reductions by 2050 (tCO_2e)	Notes
B1: Green building standards	Applied to new residential and ICI construction	32–80 (<0.1%)	111–278 (<0.1%)	1,590–6,360 (0.2–0.9%)	Long lead time; impact scales with new construction volume
B2: Residential retrofits	Grants and incentives for existing housing stock	492–985 (0.1–0.2%)	1,712–3,426 (0.3–0.6%)	3,939–7,877 (0.5–1.1%)	Dominant near-term contributor; scales with program uptake
B2: ICI retrofits	Grants and incentives for commercial and institutional buildings	242–606 (<0.1%)	842–2,108 (0.1–0.4%)	908–1,211 (0.1–0.2%)	Fewer sites but higher energy intensity per facility
B3: Residential renewables	Solar panels and distributed energy storage	197–591 (<0.1%)	685–2,056 (0.1–0.4%)	985–2,954 (0.1–0.4%)	Steady contributor; scales with installation rates
B4: Soft densification	Sustainable standards for new housing development	32–95 (<0.1%)	111–330 (<0.1%)	636–1,908 (0.1–0.3%)	Long lead time; modest near-term impact
Combined	**All building and development measures**	**995–2,357 (0.2–0.4%)**	**3,461–8,198 (0.6–1.4%)**	**8,058–20,310 (1.1–2.7%)**	**Dominated by residential retrofits**

2.3.3 Waste Management (W1–W2)

Waste-related emissions in North Grenville account for a small portion of the 2024 community baseline at 1,912 tCO_2e, or 0.4% of the total. These emissions reflect North Grenville's share of active landfill emissions at GFL Environmental's Eastern Ontario Waste Handling Facility, driven by methane generation from organic material decomposing in the landfill. Targeted diversion measures can reduce the volume of organics reaching the landfill and yield incremental climate benefits, even if the absolute scale of reductions in this sector will remain modest relative to transportation and buildings.

The modeled actions in this category (W1, W2) were tied directly to the solid waste subsector of the 2024 inventory. Reduction estimates were scaled using uptake fractions representing household participation in diversion programs and food waste reduction initiatives under low, midpoint, and high adoption scenarios for 2031, 2036, and 2050 (see Appendix 3 for multipliers). Table 7 summarizes the assumptions and modeled reductions for each measure, expressed as a percentage of the BAU projection for each milestone year, as well as their combined effect across milestone years.

Taken together, waste-related actions reduce between 29–76 tCO_2e by 2031, 101–264 tCO_2e by 2036, and 153–248 tCO_2e by 2050, each representing less than 0.1% of the BAU projection at every milestone year. While the absolute contributions remain small compared to transportation or buildings, these measures provide incremental progress and meaningful co-benefits including public engagement, resource recovery, and reduced pressure on landfill capacity. Meaningful progress in this sector depends on embedding organics diversion within a broader strategy that keeps attention on the major emissions sources, while recognizing waste measures as complementary contributors.

Table 7. *Estimated* GHG Reductions from Waste Management Actions

Action	Description	Estimated Reductions by 2031 (tCO_2e)	Estimated Reductions by 2036 (tCO_2e)	Estimated Reductions by 2050 (tCO_2e)	Notes
W1: Waste audit and green bin expansion	Organics diversion through expanded municipal programs	19–57 (<0.1%)	66–198 (<0.1%)	134–191 (<0.1%)	Primary near-term opportunity in this sector
W2: Food waste reduction	Household participation in diversion apps and programs	10–19 (<0.1%)	35–66 (<0.1%)	19–57 (<0.1%)	Educational and behaviour change role
Combined	**All waste measures**	**29–76 (<0.1%)**	**101–264 (<0.1%)**	**153–248 (<0.1%)**	**Small absolute impact; useful incremental reductions**

2.3.4 Natural Heritage Management (N1, E4)

Natural heritage measures occupy a distinct position in the emissions framework. Carbon sequestration from managed forests is not included in the PCP community inventory totals, but it represents one of the few pathways available for generating negative emissions within the municipal boundary. North Grenville holds a meaningful existing asset in its share of Limerick Forest, estimated at 947 hectares (Arbex Forest Resource Consultants Ltd., 2007), which sequesters approximately 6,425 tCO_2e per year under current management (Puric-Mladenovic et al., 2016; OMNRF, 2015). The modeled actions in this category focus on recognizing, protecting, and incrementally expanding that sink rather than building canopy from a near-zero base.

The two modeled actions, N1 (urban tree canopy expansion, tree preservation policy, and Limerick Forest protection) and E4 (Funding for an Urban Forest Management Plan to expand managed forest cover), were linked directly to the forest sequestration line item in the inventory. Reduction estimates were applied as percentage increases in annual sequestration relative to the existing sink, reflecting the biological growth cycle of trees and the long lag time before newly planted or expanded canopy contributes materially to annual carbon uptake. Table 8 summarizes the assumptions and modeled reductions for each action, expressed as a percentage of the BAU projection for each milestone year, as well as their combined effect across milestone years. Appendix 4 records the multipliers applied for this category.

Near-term contributions from both actions are modest at less than 0.1% of the BAU projection at every milestone year. Canopy expansion and forest management should be understood as long-term buffers rather than near-term solutions. Beyond their carbon role, both actions deliver important co-benefits including biodiversity habitat, stormwater retention, and cooling, all of which strengthen community resilience in ways that the GHG inventory cannot fully capture.

Table 8. Estimated GHG Reductions from Natural Heritage Actions

Action	Description	Estimated Reductions by 2031 (tCO_2e)	Estimated Reductions by 2036 (tCO_2e)	Estimated Reductions by 2050 (tCO_2e)	Notes
N1: Tree canopy and Limerick Forest	Urban canopy expansion, tree preservation policy, Limerick Forest protection	32–64 (<0.1%)	111–223 (<0.1%)	321–643 (<0.1%)	Builds slowly; protection of existing sink is the near-term priority
E4: Urban Forest Management Plan	FCM-funded expansion of managed forest cover	32–64 (<0.1%)	111–223 (<0.1%)	321–964 (<0.1%)	Longer-term potential contingent on funding and plan adoption
Combined	**All natural heritage measures**	**64–128 (<0.1%)**	**223–445 (<0.1%)**	**642–1,607 (<0.1%)**	**Long-term buffer; valuable co-benefits beyond carbon**

2.4 Gap Analysis, and Alignment with BAU

The sector-level estimates outlined in the preceding sections illustrate how much of North Grenville's 2031, 2036, and 2050 gaps could plausibly be narrowed under varying uptake scenarios. To understand their significance, the estimates need to be compared against the BAU trajectory and assessed in terms of where the municipality holds leverage, where external alignment is required, and which measures are ready to implement now versus over the longer term.

Table 9 summarizes the estimated sectoral reductions compared to the BAU forecast, showing both the scale of departure and notes on alignment with external trends. The results confirm that waste and natural heritage contributions, while valuable, remain marginal in absolute terms at every milestone year. Transportation is the only sector capable of moving the overall inventory in a meaningful way, and even under high-uptake scenarios its modeled reductions fall well short of what the targets require. Buildings provide a secondary contribution that grows steadily over time but remains a fraction of the transportation challenge.

To complement the numerical estimates, Table 10 provides a qualitative framing of sector-level feasibility, sequencing, and dependence. The framing moves beyond percentages to consider where the municipality holds the greatest leverage, how ready each sector is for implementation, and which areas need to be prioritized first. It also identifies where external coordination is unavoidable and where local programs can advance without waiting for provincial or federal alignment.

Transportation emerges as the highest priority at every time horizon, with mode shift, active transportation infrastructure, and transit-oriented development representing the largest available reductions and the clearest sequencing logic. Even under high-uptake scenarios, the full action set delivers only a fraction of the reductions required. North Grenville's emissions profile makes this challenge more acute than in most municipalities — with transportation accounting for more than 90% of the baseline, no combination of buildings, waste, and natural heritage measures can compensate for insufficient progress in how and where residents travel. Achieving real reductions will depend on external systemic change in vehicle technology, fuel supply, and regional transportation investment that goes beyond direct municipal authority. The local role is to maximize uptake where leverage is highest, establish the infrastructure and policy foundations early, and position the municipality to benefit as those external systems evolve.

Table 9. Estimated Sectoral Reductions Compared to the BAU as how much it departs from the BAU projection.

Sector	2031	2036	2050	Departure	Notes on BAU Alignment
Transportation (T1–T3)	0.8–1.9%	2.6–6.0%	9.2–17.9%	Moderate to High	Mode shift and land use change drive long-term reductions; compounding effect builds through the 2030s and 2040s.
Buildings & Development (B1–B4)	0.2–0.4%	0.6–1.4%	1.1–2.7%	Low to Moderate	Residential retrofits lead near-term gains; green building standards and densification grow in importance over time.
Waste Management (W1, W2)	<0.1%	<0.1%	<0.1%	Low	Green bin expansion and food waste reduction provide incremental marginal progress
Natural Heritage (N1, E4)	<0.1%	<0.1%	<0.1%	Low to Moderate	Sequestration builds slowly as canopy and managed forest area expand over decades.

Table 10. Summary of Sector-Level Constraints, Dependencies, and Sequencing Considerations

Sector	Local Leverage	Implementation Readiness	Sequencing Priority	External Dependence
Transportation	High	Moderate	High	High
Residential	Moderate	Moderate	Medium	Moderate
ICI	Low to Moderate	Low to Moderate	Medium	High
Solid Waste	Moderate	High	Low to Medium	Low
Natural Heritage	High	Moderate	Medium	Low

2.5 Recommended Targets

North Grenville's climate targets are built from a 2024 baseline, which is a later starting point than the reference years used in most federal and international climate frameworks. Canada's federal targets are measured against a 2005 baseline, while IPCC pathways for limiting warming to 1.5°C are typically anchored to 1990 levels. A municipality completing its first inventory in 2024 cannot retroactively establish earlier baselines with the same rigour, and aligning interim milestones precisely with federal or IPCC percentage thresholds is therefore not straightforward. A 20% reduction from 2024 by 2031 does not represent the same absolute effort as a 20% reduction from 2005, and the 2031 and 2036 milestones recommended here should be understood in that context rather than read as direct equivalents to federal interim targets.

Net-zero by 2050 is the shared destination across federal, provincial, and IPCC frameworks regardless of baseline year. Interim milestones of a 20% reduction below 2024 levels by 2031 and a 45% reduction by 2036 are recommended here, with a target of reaching net-zero by 2050. The interim milestones of 20% by 2031 and 45% by 2036 are recommended as internally consistent waypoints that keep the municipality on a credible path toward that endpoint, with reductions accelerating over time as external systems — particularly in vehicle technology, energy supply, and regional transportation — align with the direction of travel.

The 45% milestone was selected over a more moderate 40% target in part because of how the reduction pathway unfolds over time. At 45%, the required annual pace of reduction is roughly consistent on both sides of 2036 — approximately 16,800 tCO_2e per year through 2036 and 17,600 tCO_2e per year from 2036 to 2050. A 40% target would require a slower near-term pace but a steeper acceleration after 2036, placing greater pressure on the period when the most difficult structural changes must occur. The 45% trajectory is more demanding in the near term but tells a more coherent story of steady, sustained progress toward net zero. These benchmarks provide the reference points against which local climate actions must be assessed and compared to the community's projected emissions under the BAU trajectory. Table 4 presents this comparison, showing both the recommended targets and the reductions required in each milestone year relative to both the BAU trajectory and the 2024 baseline.

Table 4. Community Targets Compared to BAU Projections

Year	BAU Projection (tCO_2e)	Target Level (tCO_2e)	Reductions Needed vs BAU	Reductions Needed vs 2024 Baseline
2024	447,799 (baseline)	—	—	—
2031	531,238	358,239 (20% below 2024)	172,999	89,560
2036	585,265	246,289 (45% below 2024)	338,976	201,510
2050	746,424	0 (net zero)	746,424	447,799

Figure 1 illustrates these trajectories, comparing the BAU forecast to the municipality's adopted targets. The widening gap between the BAU projection and the target lines highlights the scale of reductions required to realign the community trajectory. By 2031, the gap between BAU and the target level exceeds 170,000 tCO_2e, and by 2050 it approaches the full forecast total, underscoring the need for structural changes in transportation and building energy use at a scale that goes beyond incremental measures. Recognizing this timing challenge now allows North Grenville to shape its interventions, secure external funding, and align with broader policy drivers rather than fall behind the curve.

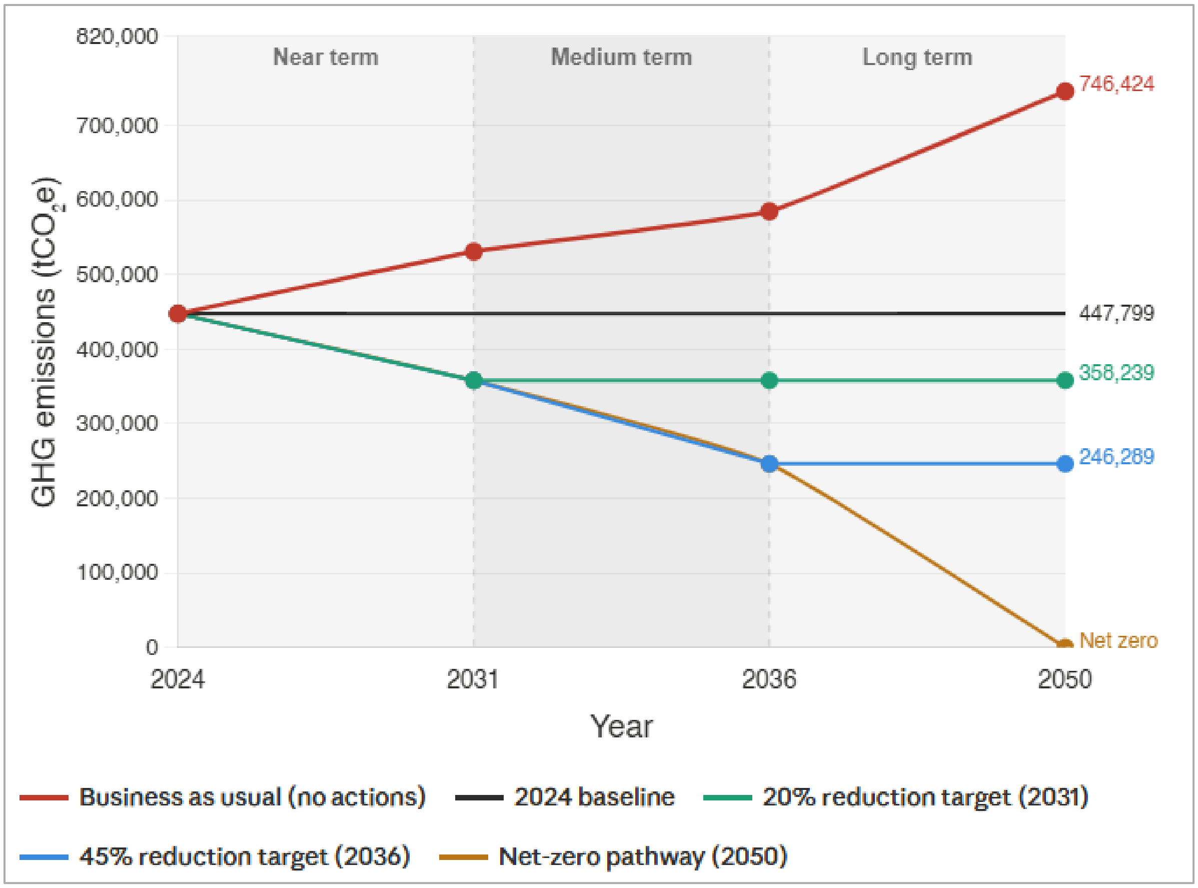

Figure 1. Community BAU and Target Trajectories (tCO_2e)

3. CORPORATE INVENTORY & FORECASTS

North Grenville's corporate greenhouse gas (GHG) inventory and forecasts build from the 2024 baseline, prepared using utility data obtained directly from Enbridge Gas and Hydro One, municipal fleet and facility records, and the IPCC First-Order Decay model for emissions from four closed municipal landfill sites. The analysis includes a 2024–2050 business-as-usual (BAU) trajectory, estimated impacts of draft corporate actions for 2031, 2036, and 2050, and a comparison to the municipality's recommended corporate targets to identify remaining gaps.

3.1 Corporate BAU Assumptions

North Grenville's corporate BAU scenario applies fixed or gently rising trajectories to each municipal sector, reflecting the continuation of existing practices without new mitigation measures. This approach maintains consistency with PCP protocols while providing a clear reference point for testing proposed climate actions. Applied to the 2024 baseline of 2,385 tCO_2e, the result is a projected net decline in total corporate emissions through 2050, driven by the passive decay of closed landfill emissions rather than by any deliberate action. While appropriate for comparative analysis, the underlying assumptions need to be made explicit:

a) Incremental Service Growth: Energy use and emissions in facilities, fleet, water, and wastewater are assumed to grow modestly with incremental service demands, such as longer facility hours, modest vehicle turnover, or slight increases in treatment volumes. Growth rates of approximately 2% by 2031, 3.5% by 2036, and 6% by 2050 are applied to energy-consuming sectors, consistent with the approach used in Smiths Falls and reflecting that municipal operations do not scale proportionally with population.

b) Static Electricity Emissions Factor: All electricity-related emissions are held constant through 2050. Ontario's grid carbon intensity is projected to rise in the 2030–2040 window, which could push facilities, water, wastewater, and streetlighting emissions higher than projected.

c) No Background Efficiency Gains: Facility retrofits, appliance upgrades, or fleet replacements that reduce emissions without formal climate policy are not included. LED conversions in municipal buildings and streetlighting may continue regardless of policy, but are excluded here.

d) Water and Wastewater Facility Stability: Water and wastewater emissions are assumed to grow only with incremental service demand. Potential regulatory changes or technology upgrades that might occur independently of local policy are not included.

e) Active Landfill Share: North Grenville's share of active landfill emissions at GFL Environmental's Eastern Ontario Waste Handling Facility is assumed to grow modestly with service demand, consistent with the approach applied to other corporate sectors.

f) Closed Landfill Decay: Emissions from North Grenville's four closed municipal landfill sites (South Gower, Oxford Mills, Burritts Rapids, and Kemptville) are projected forward using the IPCC First-Order Decay model applied to each site individually (IPCC, 2006). Unlike all other corporate sectors, these emissions decline automatically over time and are not subject to mitigation through operational decisions.

g) Closed Landfill Residual Emissions: The four closed municipal landfill sites will continue to generate methane through 2050 and beyond, with emissions declining gradually under the IPCC First-Order Decay model but never reaching zero within the planning horizon. By 2050, residual closed landfill emissions are projected at approximately 242 tCO_2e, declining to roughly 73 tCO_2e by 2074. Achieving net zero in the corporate inventory by 2050 will therefore require carbon sequestration, verified offsets, or other net-negative measures to neutralize this residual, as operational measures alone cannot eliminate it.

These assumptions together create a reference case designed to maximize transparency and comparability. The BAU may understate risks in electricity-related sectors by not accounting for rising grid intensity, and may overstate emissions in fleet and buildings by not crediting likely efficiency gains. The closed landfill decay is the one component of the corporate BAU that moves with certainty in a known direction. On balance, the BAU provides a stable benchmark against which to measure the effect of corporate climate actions, without embedding external changes that fall outside municipal control.

3.2 Corporate BAU Forecast

North Grenville's corporate business-as-usual (BAU) projection builds from the 2024 baseline for municipal operations. The 2024 baseline reflects energy consumption and emissions across six sectors: facilities, fleet, street lights, water, wastewater, and waste from four closed municipal landfill sites plus the municipality's active landfill share. Together these sources produced 2,385 tCO_2e in 2024, representing approximately 0.5% of the community-wide inventory.

Unlike the community BAU, which is shaped by population and economic growth, the corporate BAU is driven by infrastructure lifecycles, facility energy demand, and service delivery requirements. Energy-consuming sectors — facilities, fleet, street lights, water, and wastewater — are projected to grow modestly, reflecting incremental increases in service demand and facility use rather than proportional population growth. Municipal operations do not scale directly with population; a growing community requires incrementally more service capacity, but not proportionally more buildings, vehicles, or infrastructure. Waste emissions are treated differently across the two components: the active landfill share grows modestly with service demand, while emissions from the four closed municipal landfill sites decline over time following the IPCC First-Order Decay model, reflecting the ongoing but diminishing decomposition of organic material deposited before closure. No mitigation measures are included in the reference case. Table 11 summarizes the 2024 baseline and BAU projections for 2031, 2036, and 2050 across the major corporate sectors.

Table 11. Corporate Baseline and BAU GHG Projections (tCO_2e)

Sector	2024 Baseline	2031 BAU	2036 BAU	2050 BAU
Municipal Facilities	707	721	732	749
Municipal Fleet	389	397	403	412
Street Lights	4	4	4	4
Water	187	191	194	198
Wastewater	211	215	218	224
Waste — Closed Landfills	824	625	487	242
Waste — Active Share	64	65	66	68
Total	**2,385**	**2,218**	**2,104**	**1,897**

The corporate BAU forecast shows a declining total over time, driven almost entirely by the decay of closed landfill emissions rather than by any mitigation action. Closed landfill emissions fall from 824 tCO_2e in 2024 to 625 by 2031, 487 by 2036, and 242 by 2050 as organic decomposition runs its course at all four sites. Energy-consuming sectors grow modestly across the same period, with facilities remaining the largest source throughout. By 2050, as landfill emissions approach their long-term floor, the energy-consuming sectors — facilities, fleet, water, and wastewater — account for the overwhelming share of the remaining corporate total. Street lights are a small but fully measurable load drawing entirely on grid electricity.

The declining corporate BAU total should not be mistaken for progress toward climate targets. The reduction is passive and automatic, driven by physics rather than policy. The energy-consuming sectors, which represent the portion of the corporate footprint most directly within municipal control, continue to grow modestly throughout the projection period and will remain the focus of corporate climate action. The BAU scenario is deliberately simplified but provides the reference point against which corporate actions can be assessed. Actual outcomes may diverge depending on changes in electricity grid intensity, infrastructure upgrades, or external procurement requirements, but the BAU remains an appropriate benchmark for feasibility analysis.

3.3 Corporate Action Impact Analysis

To assess what portion of the corporate emissions gap could realistically be addressed through local measures, the draft corporate actions were translated into quantifiable estimates of avoided emissions. Each action was linked directly to the 2024 corporate inventory, ensuring that results align with the same sector structure used for the baseline and BAU projections.

Estimates were generated using uptake fractions that represent plausible low, midpoint, and high scenarios for 2031, 2036, and 2050. These fractions capture the degree to which fleet vehicles might shift to zero-emission models, the scale of retrofits and renewable energy installations implemented across municipal facilities, or the extent of waste diversion improvements in corporate operations. The fractions form the bridge between baseline emissions and modeled reductions, turning conceptual actions into numerical trajectories. All corporate action impacts are reported relative to the BAU pathway shown in Table 11 for 2031, 2036, and 2050.

The detailed fractions, baseline linkages, and resulting scenario ranges are documented in the accompanying spreadsheet delivered with this report. That file provides the authoritative reference for sector-level results and can also be used as a sensitivity-testing tool: municipal staff or external reviewers may adjust the assumptions directly to test alternative outcomes. An appendix to this report reproduces the fraction multipliers applied, ensuring transparency in the assumptions underlying each estimate.

3.3.1 Fleet and Equipment (F1–F2)

Fleet emissions account for 16.3% of North Grenville's 2024 corporate baseline at 389 tCO_2e, drawn from gasoline and diesel use across light-duty vehicles, heavy-duty trucks, heavy-duty equipment, and a propane-powered zamboni. Although smaller in absolute terms than facilities, fleet emissions are among the most visible sources under direct municipal control, and changes in this category can signal leadership and provide early demonstrations of climate action. The draft actions in this category focus on two areas: developing a zero-emission vehicle policy and conducting a fleet audit to transition municipal vehicles to zero emissions by 2035 (F1), and installing publicly accessible EV charging stations at municipal locations to support fleet electrification (F2). F2 is a supporting action with no independent reduction multiplier; its role is to enable and accelerate the fleet transition under F1.

The assumptions behind F1 reflect the pace at which vehicle turnover translates into emissions reductions. In the early years, policy groundwork, fleet audits, and charging infrastructure investments take time before they produce vehicle purchases. By 2050, the high-end scenario assumes the corporate fleet is nearly fully electrified, making this measure decisive in long-term planning. Reduction estimates were scaled using uptake fractions representing the share of fleet vehicles transitioned to zero-emission models under low, midpoint, and high scenarios for 2031, 2036, and 2050, expressed as a percentage of the fleet BAU projection for each milestone year (see Appendix 5 for multipliers).

The modeling shows that reductions remain modest by 2031 and 2036, on the order of tens of tonnes, as the early years are dominated by policy development and infrastructure deployment rather than vehicle replacement. By 2050, however, a nearly electrified fleet avoids 311–389 tCO_2e depending on the scenario, representing 75–94% of the fleet BAU projection for that year. The sequencing logic is central for decision-making: near-term investment in policy, audits, and charging infrastructure lays the foundation for the compounding reductions that materialize as vehicles reach end of life through the 2030s and 2040s. Delaying that foundation pushes the bulk of reductions further into the future and makes the 2050 target harder to reach.

3.3.2 Buildings and Facilities (M1–M4)

Facilities account for 29.6% of North Grenville's 2024 corporate baseline at 707 tCO_2e, driven largely by natural gas for space heating and electricity for operations across the municipal building portfolio. Because these are stationary systems with predictable demand, improvements in efficiency and fuel switching can translate directly into measurable reductions over time. The draft actions in this category include four measures: building retrofits including insulation, LED lighting, and smart energy management systems (M1), on-site solar at municipal buildings (M2), energy benchmarking across all municipal facilities (M3), and geothermal heating for municipal facilities (M4). M3 is a supporting action with no independent reduction multiplier; its role is to identify opportunities and support the delivery of M1 and M2.

The assumptions for these measures reflect both technical constraints and realistic timelines for deployment. Retrofits (M1) provide the earliest and most reliable reductions. Upgrades to insulation, lighting, and smart energy management systems can be implemented within near-term budget cycles, with results scaling steadily as more facilities are addressed. On-site solar (M2) is modeled as a modest contributor in the near term, expanding significantly over the long term as installations are scaled across the corporate building stock. Geothermal (M4) is treated as a longer-lead option reflecting the feasibility assessment, permitting, and capital investment required before any installations can proceed. By 2050 the high-end scenario assumes geothermal is deployed at meaningful scale across eligible facilities, contributing a visible share of the overall reductions.

Considered together, these measures show reductions of 78–212 tCO_2e by 2031 (10.8–29.4% of the facilities BAU projection), growing to 156–416 tCO_2e by 2036 (21.3–56.8%), and 389–742 tCO_2e by 2050 (51.9–99.1%). Retrofits drive the near-term results, with solar and geothermal growing in importance through the 2030s and 2040s. For staff or reviewers adjusting the multipliers in Appendix 6, the sequencing of capital investments and the municipality's budgetary capacity to sustain investment across multiple measures simultaneously are the key practical constraints. Near-term effects are driven by retrofits and register as meaningful departures from BAU; larger divergence by 2050 depends on sustained investment in renewables and the successful deployment of geothermal at municipal facilities.

3.4. Gap Analysis, and Alignment with BAU

The sector-level estimates outlined in the preceding sections illustrate how much of North Grenville's 2031, 2036, and 2050 corporate gaps could plausibly be narrowed under varying uptake scenarios. To understand their significance, the estimates need to be compared against the BAU trajectory and assessed in terms of where the municipality holds leverage, where external alignment is required, and which measures are ready to implement now versus over the longer term.

Table 14 summarizes the estimated sectoral reductions compared to the BAU forecast, showing both the scale of departure and notes on alignment with existing operational practices. The results confirm that waste, water, wastewater, and streetlighting each provide only marginal absolute reductions relative to the corporate total. Buildings and fleet are the practical points of intervention, with retrofits, solar, and geothermal carrying most of the facilities contribution and fleet electrification driving later-period gains.

To complement the numerical estimates, Table 15 provides a qualitative framing of sector-level feasibility, sequencing, and dependence. Fleet shows high municipal leverage with immediate opportunities through procurement policy, though progress depends on funding cycles and charging infrastructure. Buildings and facilities offer moderate to high leverage, with near-term opportunities through retrofits and a longer-term pathway through solar and geothermal. Water and wastewater remain low to moderate levers locally. Streetlighting is a low-barrier, high-readiness sector, though its overall contribution is marginal. Closed landfill emissions fall entirely outside the scope of operational intervention and will require sequestration or offsets to address the residual.

When assessed against the recommended targets of a 20% reduction by 2031, 45% by 2036, and net zero by 2050, the modeled corporate reductions fall short at every milestone. Even with ambitious uptake of fleet electrification and building retrofits, combined reductions reach only a fraction of what the targets require by 2031 and 2036. By 2050, modeled actions in buildings and fleet could address a meaningful share of the energy-consuming sector emissions, but the closed landfill residual remains beyond the reach of operational measures. Full alignment with the net-zero target will depend on pairing those operational actions with sequestration or offsets for the landfill residual, and on external funding and regulatory support for the harder-to-reach sources.

Table 14. Estimated Corporate Reductions Compared to BAU Trajectory

Sector	2031 Reduction	2036 Reduction	2050 Reduction	Departure from BAU	Notes on BAU Alignment
Fleet (F1, F2)	0.9–3.5%	1.8–7.3%	16.4–20.5%	Low to Moderate	Near-term gains require policy groundwork and charging infrastructure; long-term impact depends on ZEV turnover pace.
Buildings & Facilities (M1–M4)	3.5–9.6%	7.4–19.8%	20.5–39.1%	Moderate to High	Near-term reductions led by retrofits; long-term gains depend on scaling solar and geothermal. M3 benchmarking supports but does not independently reduce emissions.
Water Facilities	<0.1%	<0.1%	<0.1%	Low	No quantified actions; incremental efficiency possible through capital upgrades.
Wastewater Facilities	<0.1%	<0.1%	<0.1%	Low	No quantified actions; deeper reductions require regulatory or capital interventions.
Streetlighting	<0.1%	<0.1%	<0.1%	BAU-Aligned	Ongoing LED conversions proceed regardless of climate policy.
Corporate Waste (W1)	<0.1%	<0.1%	<0.1%	Low	Waste audit and green bin expansion provide incremental diversion; absolute reductions marginal.
Closed Landfills	Passive decay	Passive decay	Passive decay	BAU-Aligned	Emissions decline automatically under FOD model; not subject to operational mitigation. Residual of ~242 tCO_2e by 2050 requires offsets or sequestration.

Table 15. Summary of Sector-Level Constraints, Dependencies, and Sequencing Considerations

Sector	Local Leverage	Implementation Readiness	Sequencing Priority	External Dependence
Fleet	High	Moderate	High	Moderate
Buildings & Facilities	Moderate to High	Moderate	High	High (capital, grid context)
Water Facilities	Low to Moderate	Moderate	Low to Medium	High (funding, technology)
Wastewater Facilities	Low to Moderate	Low	Low to Medium	High (regulatory, funding)
Streetlighting	High	High	Low	Low
Corporate Waste	High	Moderate	Low	Low to Moderate
Closed Landfills	None	N/A	N/A	N/A

3.5 Recommended Targets

The corporate targets recommended here are anchored to the same 2024 baseline as the community inventory and carry the same caveat. The interim milestones are best understood as waypoints on a path to net zero rather than precise equivalents to federal or IPCC percentage thresholds. What matters most is the direction and pace of the trajectory and whether the reductions achieved in each period keep the municipality on course for the 2050 endpoint that all frameworks share.

Interim milestones of a 20% reduction below 2024 levels by 2031 and a 45% reduction by 2036 are recommended, with net zero by 2050 as the long-term target. The same reasoning that supports 45% over 40% at the community level applies here: at 45%, the required annual pace of reduction is broadly consistent across both sides of 2036, avoiding a scenario where the easier near-term reductions are banked while the harder structural changes are deferred to the back half of the planning horizon. Based on the 2024 corporate baseline of 2,385 tCO_2e, the 2031 target equals 1,908 tCO_2e, the 2036 target equals 1,312 tCO_2e, and the 2050 target is net zero. Table 13 presents this comparison, showing the reductions required in each milestone year relative to both the BAU trajectory and the 2024 baseline.

Figure 2 illustrates these trajectories. Unlike the community chart, the corporate BAU line declines over time due to passive landfill decay, which can give a misleading impression of progress. The gap between the BAU projection and the target pathway nonetheless widens through the planning horizon, because the passive decline in landfill emissions does not translate into reductions in the energy-consuming sectors where deliberate action is required. Recognizing this distinction now allows North Grenville to direct corporate investment toward the sectors where it can make a measurable difference rather than rely on a declining BAU total as a substitute for progress.

Table 13. Corporate Targets Compared to BAU Projections

Year	BAU Projection (tCO_2e)	Target Level (tCO_2e)	Reductions Required vs BAU	Reductions Required vs 2024 Baseline
2024	2,385 (baseline)	—	—	—
2031	2,218	1,908 (20% below 2024)	310	477
2036	2,104	1,312 (45% below 2024)	792	1,073
2050	1,897	0 (net zero)	1,897	2,385

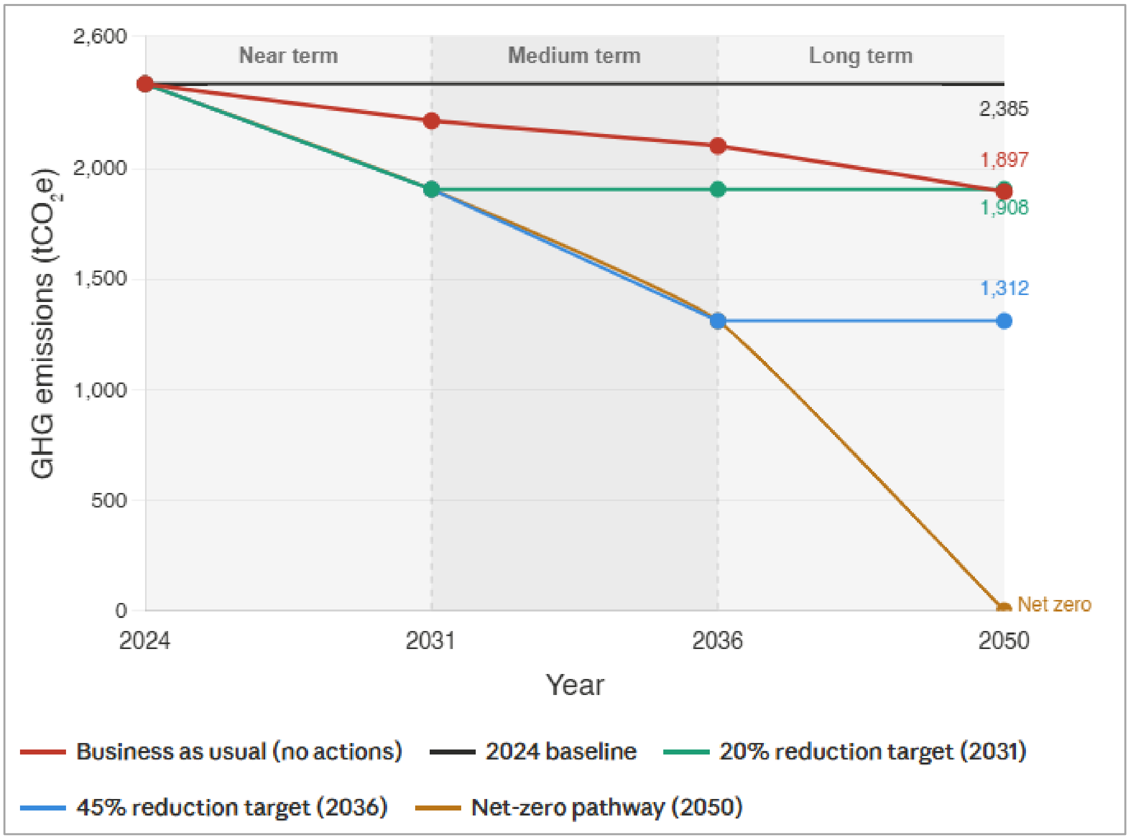

Figure 2. Corporate BAU and Target Trajectories (tCO_2e)

4. INTEGRATED DISCUSSION OF COMMUNITY AND CORPORATE RESULTS

The community and corporate inventories together provide a full picture of North Grenville's emissions profile and the reductions required to align with climate targets. In 2024, community emissions totalled 447,799 tCO_2e, compared to 2,385 tCO_2e from municipal operations. Corporate emissions represent approximately 0.5% of the total, a small share in absolute terms but one that falls entirely under municipal authority. Community-wide reductions will ultimately determine whether the municipality's targets are met, while corporate operations provide a platform to implement direct measures, pilot new approaches, and signal leadership to the wider community.

The sectoral distributions reflect North Grenville's distinctive emissions profile. At the community level, transportation accounts for 90.5% of emissions, with residential and ICI buildings contributing 7.1% and agriculture, waste, and wastewater making up the remainder. At the corporate level, closed landfill waste dominates the 2024 baseline at 34.5%, followed by facilities at 29.6% and fleet at 16.3%, with water, wastewater, street lights, and the active landfill share making up the balance. The community and corporate profiles diverge more sharply in North Grenville than in most municipalities, because transportation's overwhelming dominance of the community inventory has no parallel in the corporate portfolio. Across both scales, however, fossil fuel combustion remains the primary driver of emissions that operational and policy measures can address.

Figure 3 provides a consolidated view of the 2024 profile, illustrating the proportional scale of each community sector alongside the combined corporate inventory. Transportation alone accounts for nearly 90% of the combined total, leaving all other sectors — residential, ICI, agriculture, waste, wastewater, and the entire corporate portfolio — to share the remaining 10%. This reinforces the interpretation that corporate measures, while important for their immediacy and demonstrative value, cannot materially shift the overall trajectory. Community-wide transformation in transportation will ultimately determine whether North Grenville's 2031, 2036, and 2050 commitments are within reach.

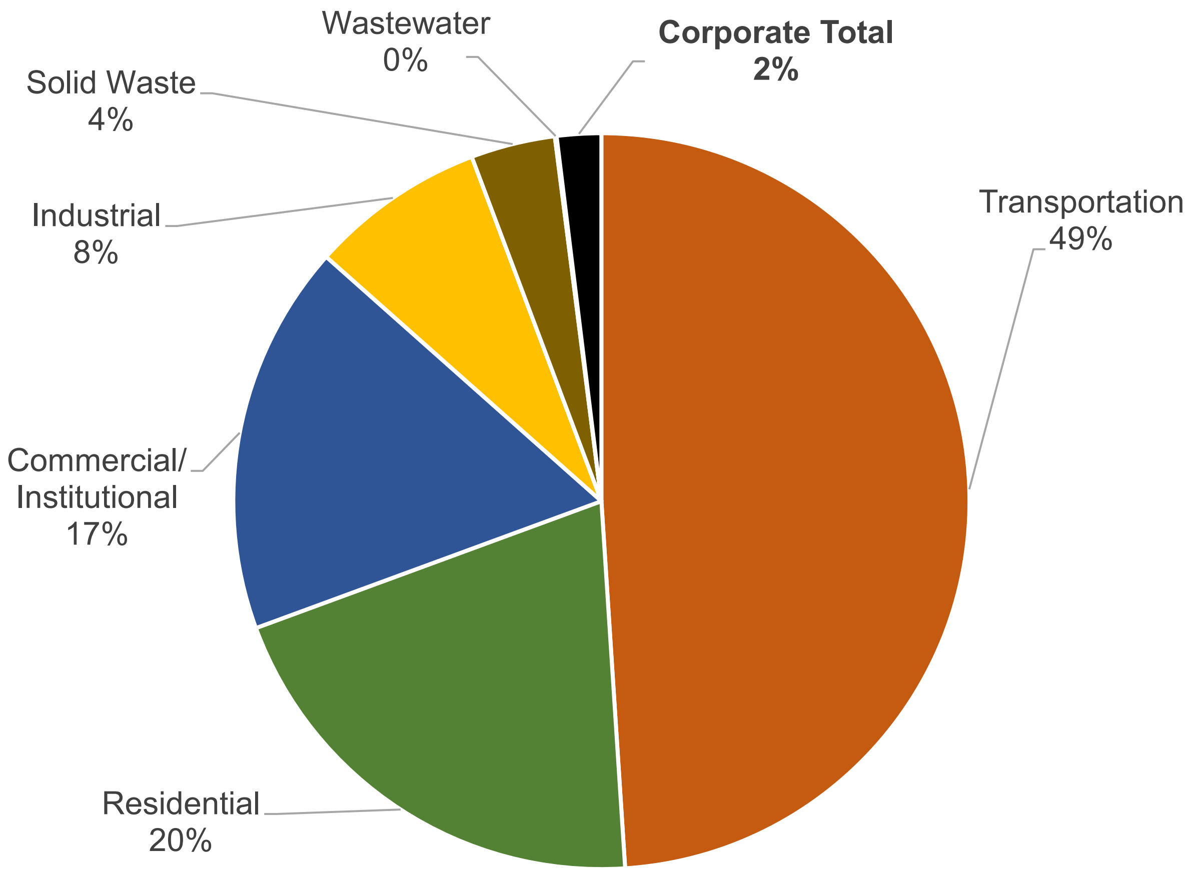

Figure 3. 2024 Community Emissions by Sector (% of total), including Corporate Emissions as a 'sector' to illustrate relative impact of each inventory portfolio.

Meeting the 2031 community target requires cutting approximately 89,560 tCO_2e from the 2024 baseline, yet modeled actions deliver only approximately 9,119 tCO_2e at midpoint. At the corporate level, the 2031 target requires reducing approximately 477 tCO_2e from the 2024 baseline, against a BAU shortfall of 310 tCO_2e. By 2050, both scales face the requirement of net zero: eliminating or offsetting 447,799 tCO_2e community-wide and 2,385 tCO_2e in municipal operations, with the corporate total complicated further by the closed landfill residual that operational measures cannot reach.

Table 16 compares estimated reductions against BAU trajectories for both community and corporate sectors, set against the recommended targets of a 20% reduction by 2031, 45% by 2036, and net zero by 2050. The table highlights the relative contribution of each sector to 2031 and 2050 outcomes, as well as the degree of alignment with BAU or reliance on external policy and investment conditions.

The results in Table 16 confirm several cross-cutting themes. At both scales, near-term progress depends on low-barrier measures within municipal control — procurement decisions, building retrofits, and diversion programs — while deeper reductions hinge on longer-term structural shifts in transportation, renewable energy deployment, and grid stability. Sequencing is critical: fleet procurement and building retrofits provide visible early gains, while larger interventions such as widespread mode shift, transit-oriented development, and full fleet electrification require longer timelines but ultimately deliver the largest reductions.

The 2031 milestone functions as the first decisive test. It directs attention to measures within municipal control — fleet procurement, building retrofits, and waste diversion — while also signaling the scale of investment and program delivery that must grow steadily to remain on course for the 2036 and 2050 commitments. North Grenville's emissions profile makes this challenge more acute than in most municipalities. With transportation accounting for more than 90% of community emissions, progress toward any target is effectively synonymous with progress on how residents travel, and that is a challenge no municipality can resolve through local action alone.

Table 16. *Estimated* Reductions Compared to BAU Trajectories (Community and Corporate)

Scale / Sector	2031 Reduction	2050 Reduction	Departure from BAU	Notes on BAU Alignment
Community — Transportation (T1–T3)	0.8–1.9%	9.2–17.9%	Moderate to High	Mode shift and land use change drive long-term reductions; compounding effect builds through the 2030s and 2040s.
Community — Buildings & Development (B1–B4)	0.2–0.4%	1.1–2.7%	Low to Moderate	Residential retrofits lead near-term gains; green building standards and densification grow over time.
Community — Waste Management (W1, W2)	<0.1%	<0.1%	Low	Green bin expansion and food waste reduction provide incremental progress; absolute reductions marginal.
Community — Natural Heritage (N1, E4)	<0.1%	<0.1%	Low (non-BAU)	Sequestration additive to baseline; builds slowly as canopy and managed forest area expand.
Community — Grid Decarbonization	—	—	BAU-Aligned	Provincial system assumed to remain low-carbon; changes in grid intensity fall outside municipal control.
Corporate — Fleet (F1, F2)	0.9–3.5%	16.4–20.5%	Low to Moderate	Near-term gains require policy groundwork; long-term impact depends on ZEV turnover pace.
Corporate — Buildings & Facilities (M1–M4)	3.5–9.6%	20.5–39.1%	Moderate to High	Retrofits lead near-term; solar and geothermal grow in importance over time.
Corporate — Water Facilities	<0.1%	<0.1%	Low	No quantified actions; incremental efficiency possible through capital upgrades.

Scale / Sector	2031 Reduction	2050 Reduction	Departure from BAU	Notes on BAU Alignment
Corporate — Wastewater Facilities	<0.1%	<0.1%	Low	No quantified actions; deeper reductions require regulatory or capital interventions.
Corporate — Streetlighting	<0.1%	<0.1%	BAU-Aligned	Ongoing LED conversions proceed regardless of climate policy.
Corporate — Waste (W1)	<0.1%	<0.1%	Low	Waste audit and green bin expansion provide incremental diversion; marginal absolute reductions.
Corporate — Closed Landfills	Passive decay	Passive decay	BAU-Aligned	Emissions decline automatically under FOD model; residual of ~242 tCO_2e by 2050 requires offsets or sequestration.

4.1 Expanding the Transportation Action Set

The three transportation actions modeled in this report establish a foundation, but the gap between what they deliver and what the recommended targets require is substantial at every milestone year. Closing that gap will depend on North Grenville developing a more comprehensive and layered approach to transportation emissions over the coming years. The municipality's commuter profile — 93.8% of residents travelling by car, with an average one-way distance of 23.5 kilometres to Ottawa — defines both the scale of the challenge and the nature of the solutions most likely to move the inventory. The following areas represent the most promising directions for expanding the transportation action set beyond what has been modeled here.

4.1.1 Regional Transit Advocacy, Coordination, and Commuter Programs

The single largest opportunity in North Grenville's emissions profile is reducing the number of single-occupancy vehicle trips made by residents in their daily commute, and pursuing that opportunity requires action at two levels simultaneously. At the local level, ride-share programs, vanpools, and employer-coordinated commuter partnerships could reduce the number of vehicles making that daily trip without requiring new infrastructure or provincial support. Park-and-ride facilities at strategic locations along key commuter corridors would lower the barrier to participation and provide a physical anchor for future transit connections.

At the regional level, North Grenville cannot reduce car dependency at the scale the targets require without sustained transit investment, and securing that investment requires active engagement with OC Transpo, Metrolinx, and the Province of Ontario. Express bus service on commuter corridors, GO Transit extensions, or demand-responsive rural transit pilots each represent opportunities the municipality should actively pursue rather than wait on. North Grenville's emissions data makes a compelling case for that investment, and Council should use it actively in its advocacy, positioning the municipality as a willing and prepared partner in any regional expansion.

4.1.2 Hybrid Vehicle Uptake as a Near-Term Bridge

Full electrification of the personal vehicle fleet is a long-term transition that depends on charging infrastructure, vehicle availability, and household economics that will take years to align. Hybrid vehicles represent a near-term bridge that is available now, requires no new infrastructure, and reduces fuel consumption by 40 to 60% on average (Natural Resources Canada, 2023). A municipal program that actively promotes hybrid vehicle adoption — through awareness campaigns, incentive advocacy at the provincial and federal level, and partnerships with local dealerships — could produce measurable reductions in gasoline consumption within the current planning cycle. Given that transportation fuel sales are the primary data input for the community inventory, any sustained reduction in consumption registers directly in future inventory updates. In a community where car dependency is near-universal and commute distances are long, even a modest shift in the composition of the personal vehicle fleet toward hybrid technology represents one of the most accessible near-term pathways available.

4.1.3 Electric Vehicle Adoption as a Long-Term Structural Shift

Electric vehicles carry a substantially lower emissions profile than gasoline or diesel equivalents, and their long-term contribution to North Grenville's reduction trajectory is significant. The barrier to adoption in a rural commuter community is not primarily awareness — it is range confidence and access to charging. Deploying publicly accessible EV charging at municipal facilities, major employers, and key commercial nodes in Kemptville reduces that barrier and signals to residents that the infrastructure is in place to support the transition. The near-term role of the municipality is to build the charging network ahead of demand rather than in response to it, ensuring that when vehicle turnover accelerates through the late 2020s and 2030s, North Grenville residents have the infrastructure they need to make the switch.

4.2. Residential Retrofits — Fuel Switching in Older Rural Homes

Many older rural homes in North Grenville rely on heating oil and propane for space heating — fuels with higher carbon intensity and higher operating costs than alternatives. Switching these homes to cold-climate air source heat pumps does not require extending natural gas infrastructure, and modern units perform effectively in Eastern Ontario winters. The emissions reduction per participating household can be substantial, and the co-benefits of lower energy costs and improved comfort make the case to homeowners without framing the conversation primarily around climate.

Nearby municipalities have demonstrated that structured retrofit programs can deliver meaningful results at the community scale. Kingston and Lanark County have both run programs that combined financing, coaching, and contractor training to support households through the process, achieving average emissions reductions well above their targets (Federation of Canadian Municipalities, 2024; Lanark County, 2024). North Grenville has the residential profile to support a similar approach, and several provincial and federal funding pathways exist to help municipalities establish and deliver programs of this kind. Developing a retrofit strategy targeted at fuel oil and propane households would produce reductions that register directly in the community inventory and would complement the transportation-focused actions that dominate the plan.

4.3. Expanding the Natural Heritage Action Set

North Grenville's 947-hectare share of Limerick Forest is already one of the more significant contributors to the near-term emissions gap in this plan. The existing managed forest sink sequesters approximately 6,425 tCO_2e annually — equivalent to 7.2% of the reductions required to meet the 2031 target and 3.2% of the 2036 gap. No single community action in the plan, outside of transportation, approaches that contribution on its own.

The fractions modeled for N1 and E4 are deliberately conservative in the near and medium term. Bringing new managed forest area into the inventory takes time, and the 2031 and 2036 estimates reflect that sequencing honestly. What the model does not fully capture is what happens as new stands mature. Forest sequestration compounds over time — stands brought under management today sequester modestly in the early years but accelerate through the 2030s and 2040s as biomass accumulates. By 2050 the upper end of the modeled range understates the likely contribution because it applies a static rate to stands that will be meaningfully more productive by that point.

To illustrate the potential, consider what modest expansions in managed forest cover could contribute by 2050. A 10% increase in managed area beyond the current 947 hectares adds approximately 95 hectares and contributes an additional 644 tCO_2e/yr at the conservative static rate, with actual contributions rising as those stands mature. At 20% and 30% cover increases, additional sequestration reaches 1,282 and 1,926 tCO_2e/yr respectively at the same static floor. Combined with the existing sink, a 30% expansion scenario could contribute over 8,350 tCO_2e/yr toward the net-zero gap by 2050 at the low end of the range — and meaningfully more as new stands reach productive maturity.

Equally important is what this report has not yet counted. The modeling here is based entirely on Limerick Forest because it is the one managed forest asset with a documented management plan and a defined municipal boundary. North Grenville has not yet conducted a full natural asset inventory, and additional managed woodlots, riparian corridors, wetlands, and reforestation opportunities likely exist within the municipal boundary that could contribute measurable sequestration if brought into a formal management and accounting framework. A broader natural asset inventory would give the municipality the data needed to quantify those contributions and incorporate them into future inventory updates. The forest story told in this report is a starting point, not a ceiling.

5. CONCLUSIONS & TAKEAWAYS

The combined analysis of community and corporate emissions shows both the scale of reductions required in North Grenville and the different degrees of influence the municipality can exercise across sectors. The baseline and BAU forecasts confirm that without intervention, community emissions will grow substantially through 2050, driven by population growth in a municipality already among the most transportation-dependent in Ontario. Corporate emissions decline passively over the same period due to closed landfill decay, but the energy-consuming sectors that municipal operations can actually influence continue to grow. The modeled actions demonstrate that reductions are possible, but their feasibility depends on a balance of municipal control, external alignment, and careful sequencing.

Table 16 summarizes the estimated reductions compared to BAU trajectories across both scales. At the community level, transportation measures have by far the largest potential, with buildings providing a meaningful secondary contribution. At the corporate level, facilities and fleet offer the clearest points of influence, while waste, water, wastewater, and streetlighting remain marginal in absolute terms. Together, the table makes visible the divergence between where reductions are technically possible and where the municipality holds direct authority, underscoring the need to align municipal action with external policy and funding support.

Some sectors — municipal fleet, buildings, solid waste, and streetlighting — are under direct municipal control, allowing North Grenville to act through procurement, facility upgrades, and operational programs. Although the reductions from these areas are modest in absolute terms, they are visible, verifiable, and supported by co-benefits such as operational savings, improved services, and community engagement. Other sectors — particularly community-wide transportation, residential and ICI buildings, and the closed landfill residual — account for much larger totals but depend heavily on external funding, regulatory frameworks, and systemic change that goes beyond municipal authority.

This distinction clarifies where North Grenville can take immediate action, where groundwork must be laid for future reductions, and where outcomes will ultimately be determined by provincial or federal policy. Aligning local efforts with these external dynamics ensures that municipal action remains both pragmatic and strategically positioned.

Takeaway 1: Long-distance commuting dominates North Grenville's emissions and must be the central focus of climate action

North Grenville's emissions profile is defined by geography and commuting patterns that have developed over decades. Transportation accounts for 90.5% of community emissions not because of any single policy failure, but because residents commute long distances to Ottawa by car and there is no realistic alternative. The pattern is deeply embedded in the land use and infrastructure decisions of the past, and no climate action plan can undo it in a single planning cycle.

At the community level, actions that change how residents travel — shifting trips to active modes, reducing car dependency through land use, and accelerating the transition to electric vehicles — carry disproportionate weight relative to everything else in the inventory combined. At the corporate level, fleet electrification represents the most visible and directly controllable near-term opportunity. Measures outside transportation, including efficiency improvements in buildings, waste diversion, and natural heritage actions, provide meaningful co-benefits and incremental progress, but their combined contribution cannot compensate for insufficient progress in how residents travel. Screening future proposals through this lens — asking whether they materially reduce fuel consumption or vehicle kilometres travelled in the dominant sector — ensures that effort is aligned with actions capable of moving the inventory.

Complementary actions retain value by supporting stewardship, education, and resilience, but their role is distinct from the core measures that directly reduce GHG emissions. They can support engagement, build readiness, and provide co-benefits, but they cannot substitute for the structural changes required in transportation and building energy systems. The concentration of emissions in a single sector is both the defining challenge and the clearest guide to where investment and program delivery must be focused.

Takeaway 2: Screen actions for their direct effect on measurable GHG emissions

North Grenville's draft plan includes many proposals with value for stewardship, adaptation, or community engagement. These initiatives have a role to play, but the climate plan's credibility depends on distinguishing them from actions that directly move the emissions inventory. Screening each proposed measure against the community and corporate inventories ensures that limited municipal effort and resources are concentrated where they can produce measurable results. In practice, this means asking three basic questions of every proposed action:

1. Does it change how much energy is used? For example, retrofits that lower heating demand or equipment upgrades that reduce fuel consumption.
2. Does it change the type of energy or fuel? For example, switching from natural gas to electricity or adopting zero-emission vehicles.
3. Does it change the quantity of waste generated or managed? For example, reducing organic waste going to landfill or capturing methane that would otherwise be emitted.

Actions that can answer yes to at least one of these questions have a traceable path to the inventory and should be prioritized accordingly. Actions that cannot still have value for engagement, resilience, and long-term readiness, but their role is complementary rather than foundational to meeting the reduction targets.

Takeaway 3: Corporate operations are where North Grenville can act now and demonstrate progress

The gap between what the full action set can deliver and what the recommended targets require is real, and most of it lies in sectors the municipality cannot control directly. Corporate operations are the exception. Fleet procurement, facility retrofits, and on-site solar fall within existing budget and capital planning cycles, and progress in these areas can be initiated without waiting for external alignment or provincial support.

The absolute reductions from corporate actions are modest relative to the community total, but that is not the right measure of their value. Delivering on corporate commitments builds the institutional muscle — in procurement, project management, and performance tracking — that larger community-wide programs will eventually require. It also gives Council and staff something concrete to report, which matters for maintaining public confidence and for making the case to funders and partners that North Grenville is serious about implementation. The 2031 milestone is the first test of that credibility, and corporate actions are where the municipality has the clearest path to passing it.

Takeaway 4: Managed forests represent a compounding long-term asset that the current model understates

North Grenville's 947-hectare share of Limerick Forest already sequesters approximately 6,425 tCO_2e annually — equivalent to 7.2% of the reductions required to meet the 2031 target. No single community action in the plan, outside of transportation, approaches that contribution on its own. The fractions modeled for N1 and E4 are deliberately conservative, reflecting the time required to bring new managed area into the inventory. What the model does not capture is the compounding effect of maturing stands, which means the 2050 contribution will exceed what the static rate suggests. A 30% expansion in managed forest cover could contribute over 8,350 tCO_2e/yr by 2050 at the conservative floor of the range. Beyond Limerick Forest, a full natural asset inventory could identify additional sequestration opportunities across the municipality that have not yet been counted. The full analysis is presented in section 4.3.

Takeaway 5: Transportation commuter programs, residential fuel switching, and managed forest expansion represent the most significant unmodeled reduction opportunities available to North Grenville

The actions modeled in this report are grounded in what the current action set can credibly deliver. Sections 4.1, 4.2, and 4.3 identify where meaningful additional reductions are available that have not yet been captured in the model. On transportation, the modeled actions address mode shift and land use at a high level, but the commuter pattern driving 90.5% of community emissions calls for a more targeted response. Ride-share and vanpool programs, park-and-ride infrastructure, and active regional transit advocacy each address the daily commute directly. Hybrid vehicle uptake offers a near-term reduction pathway that requires no new infrastructure and registers immediately in fuel sales data. EV charging infrastructure, built ahead of demand, positions the municipality for the structural fleet transition that will define the medium and long-term trajectory.

On residential buildings, many older rural homes in North Grenville heat with fuel oil and propane — the highest carbon intensity fuels in the residential sector. Switching these households to cold-climate air source heat pumps does not require natural gas infrastructure and can produce per-home emissions reductions of 60% or more. Nearby municipalities have demonstrated that structured retrofit programs with financing and coaching support can deliver results well above their targets. North Grenville has the residential profile to support a similar approach.

On natural heritage, the existing Limerick Forest sink already contributes more to the near-term gap than any modeled community action outside of transportation. Expanding managed forest cover and completing a full natural asset inventory would quantify sequestration opportunities that this report has not yet counted, and the compounding effect of maturing stands means the long-term contribution grows beyond what a static rate captures.

5.1. Final Reflection

The targets recommended in this report are science-based, but science does not implement them — municipalities do, within real constraints of jurisdiction, budget, and time. North Grenville has done the foundational work: a credible baseline, a transparent BAU, and an honest assessment of what the draft actions can and cannot deliver. The gap between what the actions produce and what the targets require is not a failure of the plan — it is an accurate picture of where local authority ends and external systems begin.

Revisiting the targets regularly matters because those external systems will change. Vehicle technology, provincial grid intensity, federal funding programs, and regional transportation investment will all evolve over the planning horizon, and each shift creates new opportunities to close the gap. A target that looks out of reach in 2025 may look achievable by 2030 if the right external conditions materialize. Keeping the milestones in place gives the municipality a fixed reference point from which to measure that progress and make the case for the investments and partnerships as needed.

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7. APPENDICES

Appendix 1. Fraction Multipliers Applied in Transportation Modeling

Action	2031 Low	2031 High	2050 Low	2050 High
T1: Flexible transit / dial-a-ride / shared-taxi for semi-rural settings	0.005	0.01	0.05	0.1
T2: Active Transportation Plan update; cycling and pedestrian infrastructure	0.005	0.01	0.1	0.15
T3: Mixed-use and transit-oriented development to reduce car dependency	0.001	0.005	0.02	0.08

Appendix 2. Fraction Multipliers Applied in Buildings & Development Modeling

Action	2031 Low	2031 High	2050 Low	2050 High
B1: Green building standards (LEED, Passive House) for new builds	0.001	0.0025	0.05	0.2
B2_res: Residential retrofit grants and incentives	0.025	0.05	0.2	0.4
B2_ici: ICI retrofit grants and incentives	0.02	0.05	0.075	0.1
B3: Residential renewable energy (solar, distributed storage)	0.01	0.03	0.05	0.15
B4: Soft densification and sustainable housing standards	0.001	0.003	0.02	0.06

Appendix 3. Fraction Multipliers Applied in Waste Management Modeling

Action	2031 Low	2031 High	2050 Low	2050 High
W1: Waste audit and green bin expansion	0.01	0.03	0.07	0.1
W2: Food waste reduction and diversion programs	0.005	0.01	0.01	0.03

Appendix 4. Fraction Multipliers Applied in Natural Heritage Modeling

Action	2031 Low	2031 High	2050 Low	2050 High
N1: Urban tree canopy expansion, tree preservation, Limerick Forest	0.005	0.01	0.05	0.1
E4: FCM Urban Forest Management Plan	0.005	0.01	0.05	0.15

Appendix 5. Fraction Multipliers Applied in Fleet Modeling

Action	2031 Low	2031 High	2050 Low	2050 High
F1: ZEV policy and fleet transition	0.05	0.2	0.8	1.0

Appendix 6. Fraction Multipliers Applied in Buildings and Facilities Modeling

Action	2031 Low	2031 High	2050 Low	2050 High
M1: Building retrofits (insulation, LED lighting, smart energy management)	0.05	0.15	0.3	0.5
M2: On-site solar at municipal buildings	0.05	0.1	0.15	0.3
M4: Geothermal for municipal facilities	0.01	0.05	0.1	0.25

Appendix 7. IPCC First-Order Decay Model — Closed Landfill Site Projections (tCO_2e)

Site	2024	2031	2036	2050
South Gower	112	79	61	31
Oxford Mills	255	180	140	69
Burritts Rapids	210	148	115	57
Kemptville	311	219	171	85
Total	888	625	487	242