Figure 1 Ford eTransit operated by Frees Trees in Dawson

Medium and Heavy Duty Electric Vehicle Pilot Analysis and Report

2020 to 2024

Figure 2 Ford eTransit operated by Duncans in Whitehorse

Figure 3 Mercedes eSprinter operated by Nomad in Whitehorse

Background

In the Yukon, on-road transportation contributes 46.2 per cent of non-mining GHG emissions. Electric vehicles can substantially lower GHG emissions of transportation. Electric cars, SUVs and light trucks are already well proven in the Yukon, but medium and heavy duty (MHD) electric vehicles were less well known in the Yukon before this pilot. MHD vehicles for commercial and institutional applications include vehicles with a Gross Vehicle Weight Rating (GVWR) of 3856kg or more. Their weight and commercial purpose sets them apart from personal light duty vehicles (LDVs) such as cars, SUVs, minivans, small cargo vans, and most pick-up trucks.

This report covers the Medium and Heavy Duty Zero Emission Vehicle pilot (known as 'MaHDZEV' pilot) which began in 2020 and is expected to be complete in 2027. Our Clean Future identified a mandate for this pilot as follows:

Action T15: Begin a pilot project in 2021 to test the use of short-haul medium and heavy-duty electric vehicles for commercial and institutional applications within Yukon.

The aims of this pilot project are to test and demonstrate the use of medium and heavy duty zero emission vehicles in the Yukon and ultimately encourage greater uptake of these vehicles in cases where they can be beneficial. Vehicle purchases by businesses were supported with Government of Yukon funds in order to test and demonstrate their suitability, strengths and limitations in our climate and location.

Table 1. Medium- and Heavy Duty Vehicle Class Definitions.

Vehicle Type	Gross Vehicle Weight Rating	Vehicle Examples
Class 8	14,970+ kg	Semi, Dump, cement, heavy conventional, sleeper, coach bus
Class 7	11,794 – 14,969kg	Furniture, medium conventional
Class 6	8,846 – 11,793kg	Beverage, single-axle vans, rack
Class 5	7,258 – 8,845 kg	Large walk-in, city delivery, bucket
Class 4	6,351 – 7,257 kg	Large walk-in, conventional vans, city delivery
Class 3	4,537 – 6,350 kg	Walk-in, conventional vans, city delivery
Class 2B	3,856 – 4,536 kg	Utility vans, full-size pick-ups, step vans

Vehicle supply and choice

Over the decade preceding these pilots, the supply of MaHDZEVs in the Yukon and North America has generally developed more slowly than the supply of light-duty electric vehicles. There have been substantial improvements since 2020 in the Yukon and globally. However, considerable variation in the pace of improvement has emerged within the MHD sector between vehicle types and market segments.

The cargo van segment has seen rapid improvements in availability, diversity, and capability since 2022 across North America. Announced cargo van offerings and upgrades indicate that these improvements will continue. A high ratio of operating cost to capital cost generally corelates with substantial economic benefits of electrification. The return on investment for electric cargo vans in medium-to-high-km per year applications may be among the fastest of all ZEVs.

Availability of electric transit buses has grown steadily over the past decade; sales are now about equal to that of internal combustion engine transit buses in Europe, China, and South America. They are projected to reach 60 per cent globally in 2030 [2].

Shuttle bus availability is also improving rapidly, but their high cost and range concerns present continued challenges. Medium duty Class 3 to 6 trucks are electrifying rapidly in China and Europe but less so in North America.

Heavy duty class 6, 7, and 8 (such as semis or large straight trucks) are seeing a slowly improving supply, and the price difference between heavy-duty electric and internal combustion engine (ICE) vehicles remain high.

iMHZEV

The Government of Canada launched their incentive for Medium and Heavy Duty Zero Emission Vehicles (iMHZEV) in July of 2022. The federal program offers rebates to commercial vehicles of class 2B to class 8 with fixed rebate amounts for each vehicle class, ranging from $10,000 for class 2B to $150,000 for long range class 8 vehicles. The program defines an eligible “commercial vehicle” as having either capacity for 9 or more passengers or a full width interior cargo area length of 185 cm or more, which is notable as this criteria effectively excludes pick up trucks.

In Q2 2024, a new category was introduced to allow pickup trucks to access the program under the classification of medium duty passenger vehicles at a reduced funding amount of $5,000. As of March 2024, 100% of all medium duty passenger vehicle rebates issued have been for pickup trucks.

Timeline

The MaHDZEV Pilot included two project intake phases. Phase 1 began with outreach to Yukon businesses, First Nations, Municipalities and other organisations in summer 2021. Applications were received in September 2021. Approvals, vehicle deliveries, and payments occurred from October 2021 to July 2024.

Phase 2 of the pilot was launched in November 2022 with extensive outreach directly to eligible organisations as well as through mass marketing on social media, radio and newspaper. The deadline for proposals for Phase 2 was January 31st, 2023. Proposals were evaluated in February, with successful applicants being informed in March 2023. Vehicle deliveries and payments occurred from April 2023 to March 2024.

All recipients agreed to participate in quantitative and qualitative data collection for a period of three years, starting on the date of signing the transfer payment agreement.

The Energy Branch installed data loggers on a subset of 10 vehicles. Performance data was collected through December 2024.

All successful applicants were also consulted via surveys to gauge qualitative performance information.

Uptake and Incentive Awards

Phase 1

When Phase 1 was launched in 2021 there was a low level of awareness of larger electric vehicles, the list of available vehicles was short, and the ability of manufacturers to deliver in reasonable time frame was uncertain. These challenges coupled with an extremely high price difference between ICE and EV offerings justified a high percentage rebate. The rebate for successful applicants was set at 80 per cent of project costs.

A total of 25 submissions were received in Phase 1, of which 22 were received in the initial opening of the pilot in September 2021 and three were received when the pilot was reopened for submissions in late 2022.

Of the 22 submissions received in September 2021, two were initially chosen for funding: a class 7 water delivery truck and a class 4 shuttle bus. The shuttle bus was purchased by a Whitehorse-based hotel operator. The water delivery truck project ultimately did not proceed due to difficulties in arranging for local service and maintenance of the vehicle. In order to reassign the funds initially allocated for the water delivery truck, the program was reopened to new applicants in late 2022 and the list of previous applications was revisited. This resulted in providing funding for the purchase of three cargo vans, an agricultural tractor and a forklift. A class 7 truck was also set to be purchased by a local construction materials supply business during this later intake, but also did not proceed as the supplier cancelled the contract just weeks before scheduled delivery citing an inability to provide local service and maintenance.

Phase 2

As Phase 2 commenced in 2023, conditions had improved: general awareness of larger EVs was better, the list of available vehicles was growing fast, lead times for vehicle orders were becoming generally more predictable, a similar federal program had just been initiated, and information on both supply and demand sides of the local market had been gathered from Phase 1.

Anticipating a greater number of high-quality applications for a limited pool of funding, Phase 2 was redesigned to allow for up to 70 per cent funding including the portion covered by the federal iMHZEV program. Phase 2 was restricted to Yukon businesses, non-profit organizations, municipalities and Yukon First Nation governments and development corporations. Pick-up trucks were excluded from eligibility for this intake as MDH vehicles dedicated to commercial purposes were primarily targeted with this funding.

Two notable applications within this intake round for class 7 trucks were eventually excluded after the supplier withdrew the quote based on not being ready to support the service of these vehicles locally.

In total, 48 eligible applications and five ineligible applications were received. Applications were reviewed by a panel of three Energy Branch staff and scored based on a table of weighted criteria.

Table 2. Application Selection Rubric

Criteria	Description	Weight
Visibility	How visible will this vehicle be in this use case? not visible = 0, highly visible in one community = 2.5, Highly visible to much of Yukon's population = 7, highly visible in many communities = 10	25
Cost Effectiveness	What is the cost per tonne of greenhouse gas emissions avoided of the "EV Premium" of this vehicle? Calculated as cost difference between EV and ICE versions divided by cumulative GHGs avoided until 2030. Score = (100% - Percentile among all applications) / 10	15
Distance Travelled Annually (kw / year)	<10,000km = 0, 10,001 - 15,000 = 3, 15,001 - 20,000 = 7, >20,000 = 10 (Note: Applicants' km estimate will be used, but may be adjusted by the Energy Branch if warranted)	5
Feasibility of Monitoring	If it is feasible to monitor vehicle using a and readily implementable system then the score is 10, otherwise it is 0. No intermediate score.	5
Potential for Replication / Expansion	How likely is there to be large uptake of this type or use of vehicle? How common are the ICE alternatives in use in Yukon? How often is this type of vehicle replaced (more frequent is preferred)? No potential = 0, high potential = 10	50

After points had been allocated, the proposals were ranked accordingly. The panel then selected successful applicants from the ordered list, taking into consideration: ranking, number of similar proposals, anticipated delivery date, the applicant's plan for charging and operating the vehicle, a desire for an equitable distribution of vehicles and financial support amongst communities and economic sectors, and the selection panel's perspective as to how well the vehicle and its proposed use fit with the objectives and purpose of the pilot project.

Successful applicants were offered between 25 and 70 per cent of the cost of the vehicle total in rebates, including the federal iMHZEV rebate.

Over the course of this phase, 18 vehicle purchases were completed, of which 14 were cargo vans, two were chassis cab trucks and two were pieces of industrial equipment; a forklift and a drilling rig. These figures do not include nine projects which were approved for funding but were cancelled by the proponent. Reasons for cancellation included: lack of organisational capacity to complete the project, difficulty securing adequate service arrangements, and lack of funds.

List of projects supported in both phases

Table 3. Complete List of Vehicles Supported (Phase 1 and 2).

Type	Model	Status	Class	Quantity	Business type(s)	Phase
Cargo Van	Ford eTransit	In operation	2B	16	Electrician, food production, printing, plumbing, healthcare, dog walking, mining services, furniture & electronics, bike shop, property management, general construction, waste management	2 in Phase 1 14 in Phase 2
Chassis Cab Truck	Ford eTransit	In operation	2B	2	Mechanical contractor, wood fuel delivery	Phase 2
Cargo Van	Mercedes eSprinter	In operation	2B	1	Electrician	Phase 2
Shuttle Bus	17-seater Micro Bird G5	In operation (partial)	4	1	Hotel	Phase 1
Industrial Equipment	Various	In operation	NA	4	Mining logistics, fabrication, farming, drilling	2 in Phase 1 2 in Phase 2

Operations and data collection

The following factors were identified for data collection during the testing and demonstration of these vehicles: cold weather performance, vehicle range, reliability, energy consumption, charging requirements, and greenhouse gas emissions. Each participant agreed to operate the vehicle and provide information through surveys as well as allowing Yukon government-owned data loggers to be connected to the vehicles. Ultimately, nine cargo vans were tracked using data loggers allowing quantitative data to be collected over the period September 2022 through December 2024. A diversity of vehicles was prioritised in the pilot processes, including outreach and evaluation. Unfortunately, many of the other vehicle types which were approved did not proceed to purchases. The cargo vans were ultimately monitored as they were delivered on the expected schedule and were compatible with available monitoring systems.

Cargo vans: results and discussion

Range

Quantitative results

Concerns about range were raised frequently by prospective commercial operators. Two particular questions came up repeatedly:

- Whether the range quoted by manufacturer can be trusted sufficiently to plan business operations around? and;
- What is the impact of winter weather on the vehicle's range?

In order to assist with these considerations for future medium- and heavy-duty ZEV commercial operators, the charging and usage data recorded by participating cargo vans was used to calculate actual range achieved in each month of the year. The method used to calculate the range is outlined in Appendix A. Range achieved is reported as a percentage of manufacturers quoted range. Since there are various configuration of cargo vans in the program with varying quoted ranges, the percentage of quoted range is more illustrative of actual performance and more useful for prospective purchasers of a wider variety of vehicles. The overall annual average performance was about 98% of manufacturer claimed range but varies by vehicle and greatly by temperature.

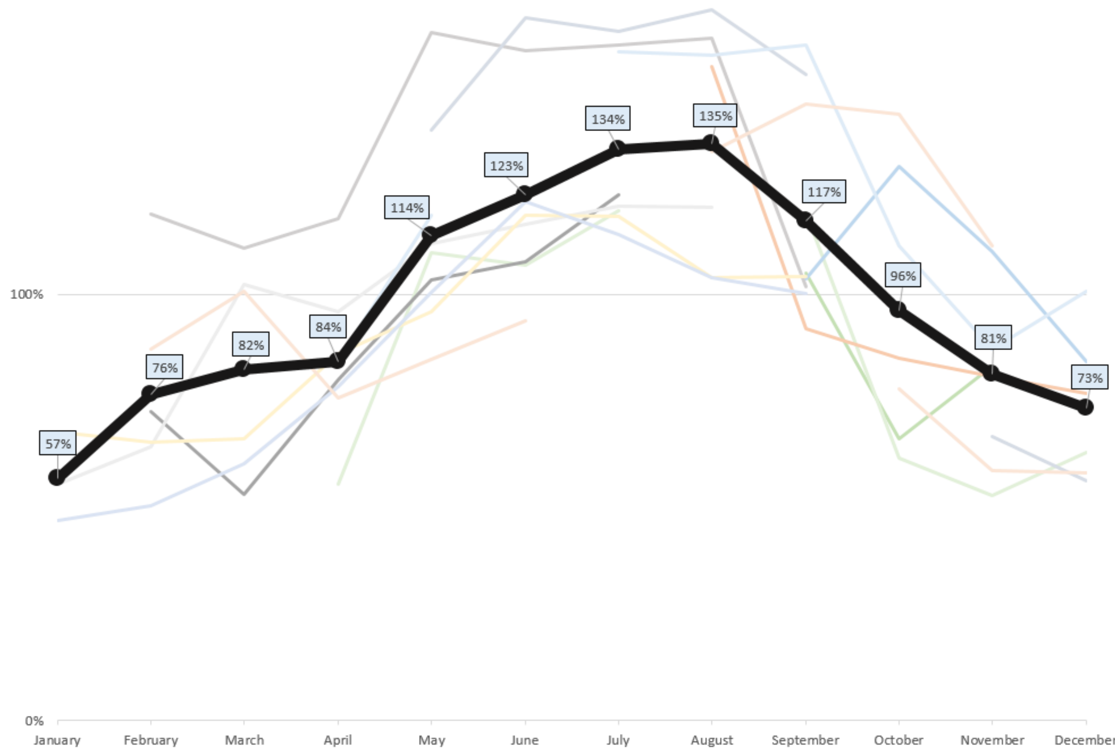

Figure 44. Real Range of Cargo Vans vs. Manufacturer-Stated Range (Monthly).

In figure 4, the range achieved is plotted as a percentage of the manufacturer's quoted range, with the month of the year shown on the X-axis. Each participating vehicle is represented by a thin coloured line. The average of all vehicles is shown by the thick black line. On average, the real range is greater than manufacturer quoted range for 5 months of the year and below for 7 months, peaking at 135 per cent in August and declining to 57 per cent in January.

Cabin heating load is known as a main cause of range loss in winter. In a cargo van the cabin and cargo compartment may form a single space or they may be separated by a bulkhead. When examining real ranges of vehicles with bulkheads distinctly from those without bulkheads, there is a clear trend demonstrating increased ranges of vehicles with bulkheads, likely due to a reduced heating and cooling load (Figure 5 5).

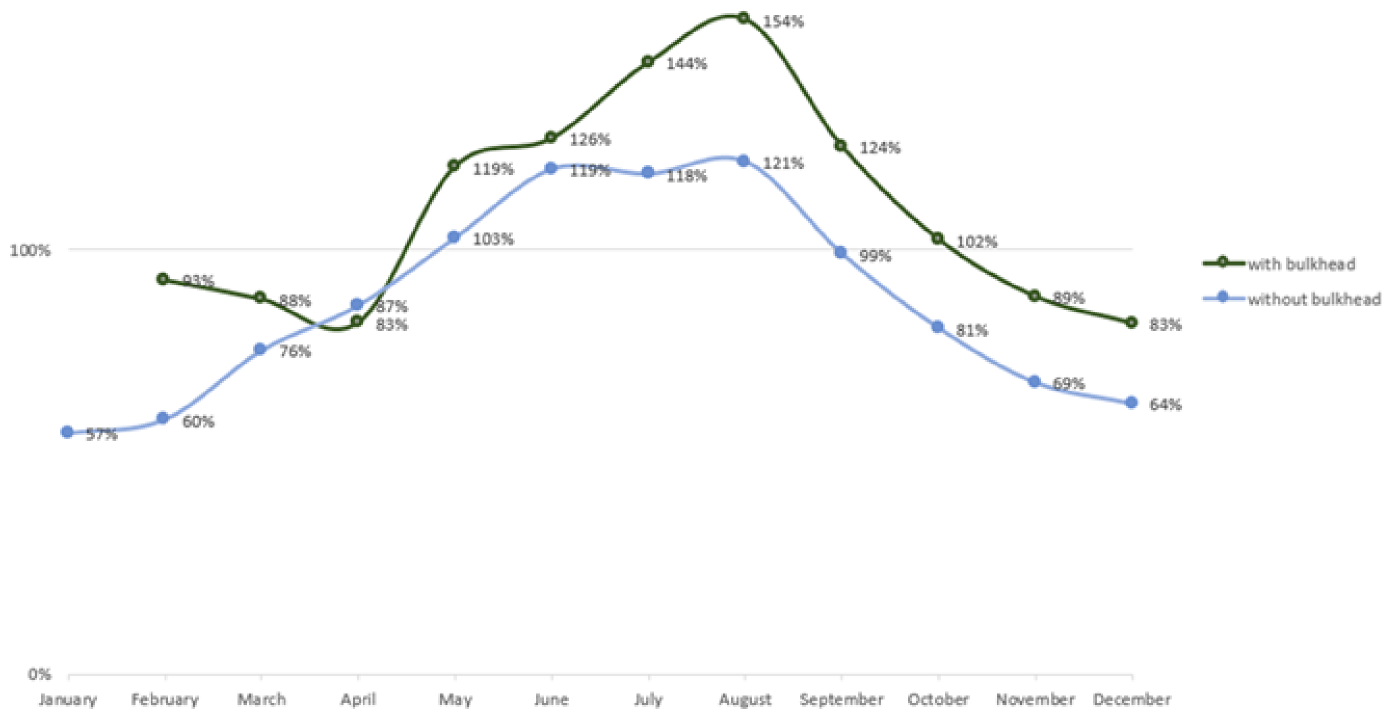

Figure 5 5. Range of Cargo Vans With & Without Bulkheads (Monthly).

Survey Results

When participants were asked if a general estimated range reduction in extreme cold to about 60 per cent of manufacturer's quoted range was consistent with their observations, 45 per cent did not know, 40 per cent said it was about right, 10 per cent said their range was less, and 5 per cent said their respective vehicle's range was better than 60 per cent.

Charger types used

Quantitative results

For the project's cargo vans, Level 2 chargers were used for more than 75 per cent of charging, Level 1 chargers were used for a small but notable portion, and public DC fast chargers were only used for a very small portion of total charging needs. This is detailed in Table 4, which shows the portion of the energy delivered to vehicles through charging over the monitoring period by charger type.

Table 4. Distribution of Charging by Charger Type.

Charger Type	% of Charging
AC Level 1 Chargers	13%
AC Level 2Chargers	78%
AC Chargers, Overall	**91%**
DC Chargers	9%

Survey Results

When asking participants about charging habits, 95% of respondents indicated that most charging was done on AC chargers while 5% said they used both AC and DC equally.

Energy cost savings and greenhouse gas reductions

Reducing both greenhouse gas emissions and energy costs were primary motivators for implementing these pilots and for each participant. On average, cargo vans with data loggers attached used 39.4 kWh for every 100km driven. This is averaged across the full year and includes winter; it should be noted energy use is higher than average during winter while being lower than average during summer. Since no equivalent fossil fuel cargo vans were tracked as part of this program, the electric vans were compared with a nominal EPA fuel efficiency rating for a gasoline powered Transit Cargo Van of 16MPG (14.8L/100km) [3].

All participating vehicles were charged on the Yukon Integrated System, with an estimated carbon intensity of 67.5g/kWh [4]. the emissions intensity just for the grid in 2020 was used for this report; the intensity for the Yukon Integrated System in 2021 and 2022 are slightly lower with both years being around ~44g/kWh. The 2020 intensity was consistently used to provide conservative results as recent trends suggest the intensity of the Yukon Integrated System will increase in future years.

On average greenhouse gas emissions per km for the participating cargo vans were 92 per cent lower than that of an equivalent gasoline powered van. The electric vans were responsible for 26g/km, whereas the nominal gasoline vans were 13 times higher at 341g/km.

As of March 2025, energy cost was 60 per cent lower for electric vans when compared with the nominal ICE van, at $0.09/km vs $0.24 respectively [5]. During the course of the pilot, the saving was closer to 70 per cent due to higher fuel prices.

The operator of an electric cargo van which covers 20,000 km per year could expect to save about $2,900 per year in energy costs. The cost of fuel for the ICE van would be approximately $4,800, whereas the cost of electricity for the electric van would be about $1900.

Survey results

Program participants were asked:

"Some vehicles in this pilot were fitted with data loggers. Data collected over the past 12 months shows that electricity costs were 70% less than the cost of diesel for an equivalent vehicle. Does this align with your experience?"

50% of respondents said 70% savings were about right, 45% did not know, and 5% said they saved even more than 70%.

Payback period and profitability

EVs typically cost more to purchase than their ICE equivalent but have lower operating costs. Potential customers are interested in how long it will take for the operating cost savings to pay back the initial investment and how the operating cost savings will stack up over the years. These questions were examined using the data logged from cargo vans (specifically the e-Transit) included in this pilot. The base price of an e-Transit is $14,100 more than an equivalent trim ICE. This is more than offset by total rebates of $20,000 on offer to businesses purchasing an electric e-Transit $10,000 from the federal government and $10,000 from the Government of Yukon.

Table 5 illustrates the savings a business could expect. For the values in this table, no discount rate is applied and March 2025 prices are used for electricity and gasoline. These calculations do not take into account the reduced maintenance costs of electric vehicles. A detailed explanation of calculations is available in Appendix A.

Table 5. Cargo Van Cost Savings & Payback Period.

Distance driven (km/yr)	Annual Savings ($/yr)	Payback Period (no rebate, years)	10-Year Cost Savings (no rebate, $)	15-Year Cost Savings (no rebate, $)	10-Year Cost Savings (full rebate, $)	15-Year Cost Savings (full rebate, $)
15,000	$2,173	6.49	$7,625	$18,488	$27,625	$38,488
20,000	$2,897	4.87	$14,867	$29,350	$34,867	$49,350
25,000	$3,621	3.89	$22,109	$40,213	$42,109	$60,213

Greenhouse gas emissions

The potential greenhouse gas savings of electrification of transportation are particularly strong in the Yukon due to the very high percentage of low carbon generation on the Yukon Integrated System. Table 66 shows the amount of greenhouse gas emissions that can be avoided based on the distance driven per year, averaging approximately 5 to 8 tonnes of CO2e annually. To put this into context, the average GHG emission per Yukoner is 16.7 tonnes [6], an electric cargo van could displace this much in 2 – 3 years.

The impact of battery production is taken into account and is paid back in roughly less than 1 year in all scenarios examined.

Please refer to Appendix A for a detailed explanation of the associated calculations.

Table 6. GHG Emission Comparison (Electric Cargo Vans).

kms per year	GHG from ICE vehicle (t CO2e/yr)	GHG from EV (t CO2e/yr)	GHG reductions (t CO2e/yr)	Carbon debt of battery production (t CO2e)	GHG reductions over 10 years (tCO2e)	GHG reductions over 15 years (t CO2e)
15,000	5.12	0.388	4.73	7.48	39.8	63.5
20,000	6.83	0.518	6.31	7.48	55.6	87.2
25,000	8.54	0.647	7.89	7.48	71.4	111

Shuttle Bus: Results & Discussion

A lesson in emerging technologies, hybrid design and local support arrangements

The operation of a single shuttle bus was monitored through surveys. The bus is a Micro Bird G5 17 seater shuttle bus, which was built by Giradin on a Ford E450 chassis with electrification provided Ecotune. The vehicle was sold to a hotel operator in Whitehorse by BC-based Dynamic Bus Sales and Service.

The operator reports being dissatisfied with the vehicle for reasons mainly stemming from low quality build and lack of local service options. Since going into service in October 2022, there have been multiple technical problems requiring service. Lack of local service arrangements exacerbated the impact of these problems by causing long periods in which the vehicle was unavailable for use. The operator expressed extreme dissatisfaction, stating that the difficulty in shipping parts and scheduling timely repairs were impractical for their operational needs.

The negative experiences of the bus owner/operator highlight the different considerations for purchasing vehicles that are not mass produced and are not supported by a local supplier.

Businesses considering purchasing any vehicle from an out of territory supplier should first consider the experiences of the operator of this bus.

Robust and reliable service arrangements and warranty are recommended and should include provision of locally available expertise capable of working on the vehicle when needed.

Pilot outcomes

Information gathered over the course of the MaHDZEV pilots demonstrated that there is considerable interest from businesses and institutions in electrifying their commercial vehicles. Developments on both the supply and demand side have been unevenly distributed among vehicle types:

- **Cargo Vans** - Variety, performance, availability and price for cargo vans is approaching that of light duty vehicles and continues to improve. Thanks to early adopters and these pilots, the public is beginning to become aware of the benefits and availability of these vehicles.
- **Larger Class 6, 7 and 8 Trucks** – These vehicles are not yet locally available. Suppliers have been focusing on the large commercial centres first. Operators of these class of vehicles are generally open to opportunities to reduce operating costs through switching to electric vehicles. The concentration of businesses and population within 50 km of downtown Whitehorse results in a large number of use cases that are well suited for the first wave of electrification.
- **Transit Buses, Shuttle Buses, Box Trucks and Other Similar Vehicles** – Choices are growing and becoming more competitive, but suitable local service for such vehicles remains a consideration.

The division into these three categories observed in the Yukon aligns with the published national program statistics for the federal iMHZEV program. As stated previously, the federal iMHZEV program provides rebate amounts which are varied according to vehicle class. Incentives range from $10,000 for class 2B commercial vehicles to $150,000 for long range class 8 trucks. During the period from 2024-04-01 to 2025-01-31, cargo vans made up 87 per cent of federally rebated commercial vehicles. Of those, 60 per cent were e-Transits and eSprinters, while 27 per cent were larger vehicles such as Brightdrop, Lightning E Motors, and Greenpower. Class 6, 7, and 8 made up a much smaller portion of total vehicles; together they represented 11% (with Class 6 at 3%, Class 7 at 1%, and Class 8 at 7%). However, the number and diversity of rebated models in these classes have increased since the program began, reflecting improved vehicle availability.

Developing on the opportunities identified in the MaHDZEV pilots, the Energy Branch launched a rebate dedicated to class 2B and higher commercial ZEVs in 2024. The rebate provides $10,000 for each vehicle, which can be stacked with the rebates available from the federal iMHZEV program. As the Yukon rebate is a fixed amount regardless of vehicle class or price, it is most relevant to Class 2B, 3, and 4 vehicles. For businesses considering operating these classes of vehicle and considering switching to electric, the stacked rebates effectively support the upfront investment needed to access long term reductions in operational cost and GHG emissions. To date, there have been four rebates paid out through the medium and heavy-duty rebate, all of which are Class 2B cargo vans. For the more expensive vehicles in higher classes, such as Class 7 or 8 trucks that typically cost in excess of $400,000, currently available rebates are limited in their capability to strongly incentivize purchasing decisions.

Next steps

The MaHDZEV pilots were successful in testing and demonstrating a subset of electric commercial vehicles, primarily with cargo vans. Unfortunately, the pilot was unable to test and demonstrate any heavy-duty vehicles. Any subsequent pilot project should target the testing and demonstration of larger vehicles, such as the Class 7 and 8 trucks, shuttle buses, transit style buses, and box trucks. Testing these vehicles will require ensuring local service arrangements are available as this has been demonstrated to be a key measure to long term success.

It is recommended that any future pilot testing of MHD vehicles should focus on Class 7 and 8 electric trucks as suppliers have indicated they are now able to supply and support these vehicles, along with local participants indicating interest in these vehicles.

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Appendix A – Calculations

Method used to Calculate range

GeoTab data loggers connected to vehicles in the study were used to record vehicle trip details, charging events, and battery state of charge (SOC). The distance driven between each charging event divided by the drop in battery SOC indicates the implied range. For example, a distance of 120km with a SOC drop of 75% would indicate an implied range achieved of 160km (120/0.75 = 160km). The total distance driven in each month was divided by the total SOC drop in that month, resulting in monthly implied range achieved.

The results confirmed that the range achieved is strongly correlated with seasonal temperatures. For this reason it is more informative to report the range in each month than over an annual average.

Energy Cost Savings and GHG reductions calculations

Cost Savings

Annual GHG emissions from operation for an ICE cargo van was calculated by multiplying the gasoline used in litres by the carbon intensity of burning gasoline (2.3 kg CO2e / L).

Annual GHG emissions from operation of the electric vans on the YIS was calculated by multiplying the energy used by the carbon intensity of electricity on the YIS (0.0675 kg CO2e / kWhr) [4].

Cost of fuel to operate the ICE van was calculated using the price of gasoline in Whitehorse ($1.613 / L) [5] multiplied by fuel use as estimated by EPA (14.8L/100km) [3].

Cost of electricity to charge the battery of the electric vans was estimated at $0.25 / kWhr, which is in line with the effective marginal rate paid by many commercial and residential customers on rate schedule 2160 or 1160.

GHG Reductions

GHG intensity of gasoline = 2.3 kg CO2e / L

GHG intensity of electricity on the YIS = 0.0675 kg CO2e / kWhr

GHG emissions due to operation of the reference ICE van in t CO2e/yr = (Distance driven) X (Fuel consumption per km) X (GHG intensity of gasoline)

GHG emissions due to the operation of the electric van in t CO2e/yr = (Distance driven) X (Energy consumption per km) X (GHG intensity electricity on the YIS)

GHG reduction due to EV use = (GHG emissions due to operation of the reference ICE van) - (GHG emissions due to the operation of the electric van)

The manufacturer specified battery capacity of the electric cargo vans included in this study is 68kWhr. Carbon debt due to battery production has been estimated according to an average value of 0.11 t CO2e / kWhr reported in a wide ranging review of the literature [7].

68 X 0.11 = 7.48 t CO2e