Road to Net Zero: Optimus Prime's Case Analysis

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Introduction

In this presentation, we will be working towards Optimus Prime's pledge to achieve net-zero emissions by 2050, underscoring the dedication to sustainability and environmental stewardship.

Our detailed plan, encompassing Company Analysis, Current Carbon Baseline, Phased Decarbonisation Implementation Strategies and Forward-Looking Innovations, is poised to steer Optimus Prime towards a cleaner, greener future.

Company Analysis

- Current Fleet Size
- Districts Distribution
- Business Units
- Types of Vehicles

Carbon Baseline

- Finding estimated emission levels from historical data
- Comparing carbon footprint between ICE and EVs.

Decarbonisation Route Map

- Installation of Telematics
- Transition to EVs
- Scaling and Optimisation
- Net Zero Goal

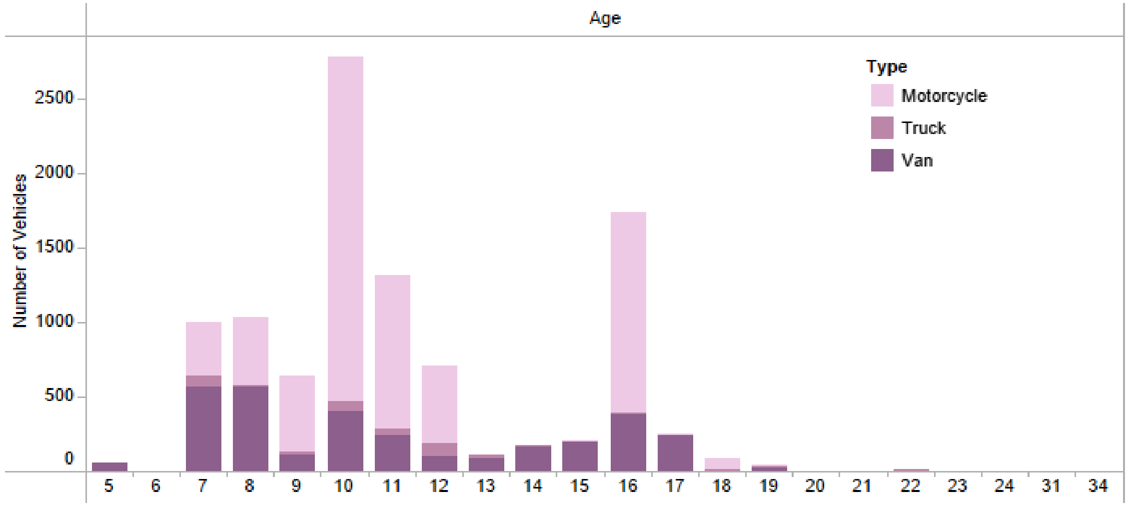
District
(All)

Vehicle Type
(All)

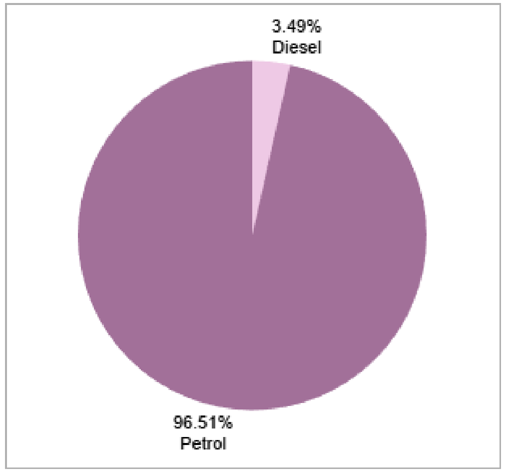
Optimus Prime’s Vehicle Fleet Analysis

by Team Triple L

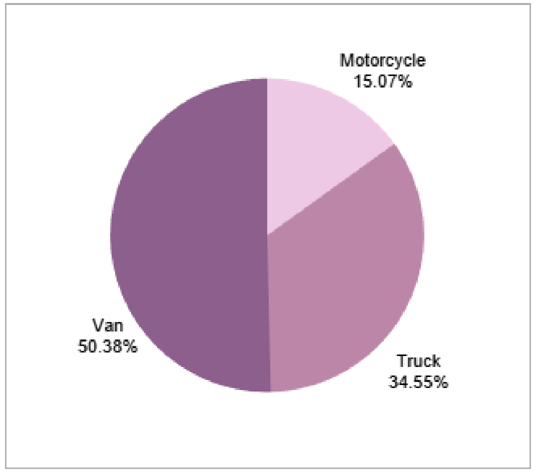
Age of Vehicles



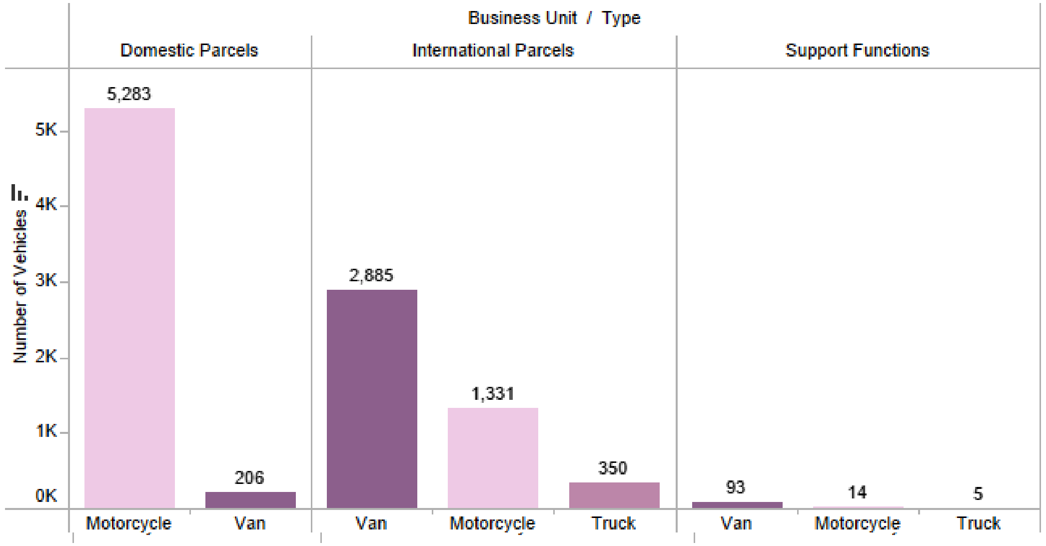
Fleet's Fuel Type



Fleet's CO2 Emissions



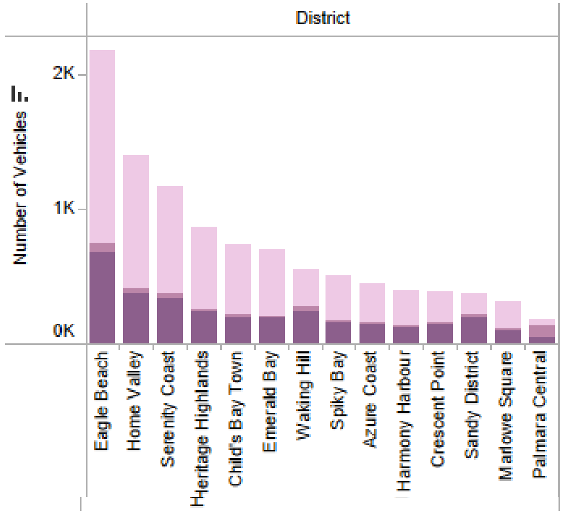
Number of Vehicles by Business Units



Current Fleet Size

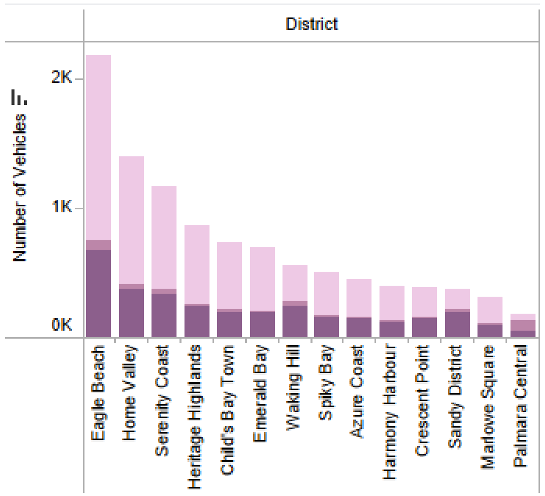
	Type / Category		
	Motorcycle	Truck	
District	Motorcycle	3-tonne truck	8-tonne truck
Azure Coast	293	9	
Child's Bay T..	521	21	
Crescent Point	222	7	
Eagle Beach	1,430	74	
Emerald Bay	485	15	
Harmony Har..	264	10	
Heritage High..	607	12	
Home Valley	991	26	
Marlowe Squ..	205	7	
Palmara Cent..	48	76	
Sandy District	153	15	
Serenity Coast	795	28	

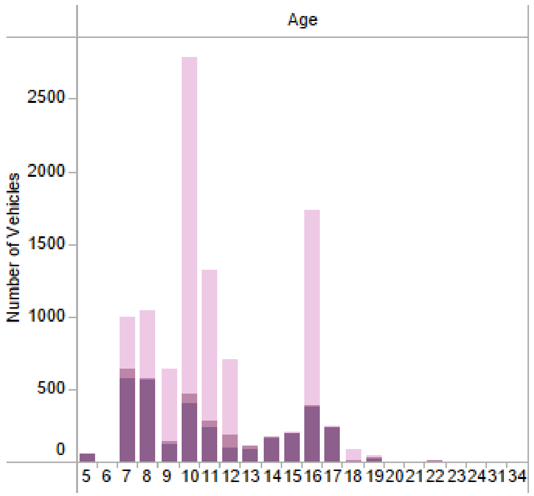
Number of Vehicles by District

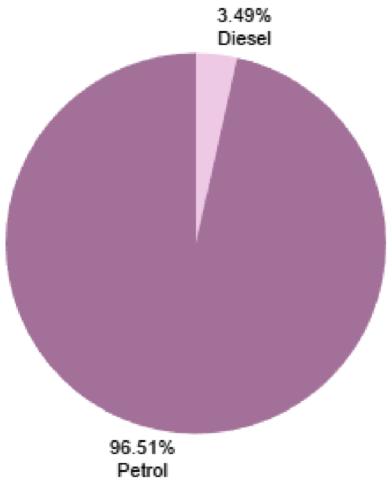


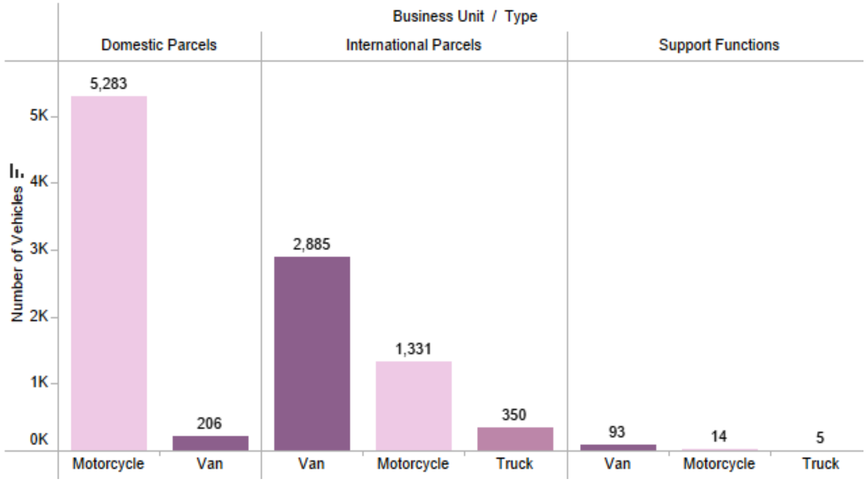
Kindly refer to our submitted Tableau file for the interactive dashboard!

Company Analysis: Current Status









Top 3 Districts with highest Number of Vehicles are: **Eagle Beach, Home Valley and Serenity Coast**

These are the districts we will **prioritise** when **scaling & optimising** charging infrastructures

Majority of Optimus Prime's vehicles aged **16 years and below**.

Visualising the age distribution allows the company to **forecast future replacement cycles** and plan budget accordingly.

Entire fleet currently relies fully on traditional **Internal combustion engines (ICE)** vehicles.

Petrol vehicles: **96.51%**
Diesel vehicles: **3.49%**

Domestic Parcels **relies heavily on Motorcycles** to make their deliveries. Motorcycles are well-suited for navigating through urban environments, efficient for densely populated areas.

International Parcels employs **all the vehicle types** but relies mainly on Vans.

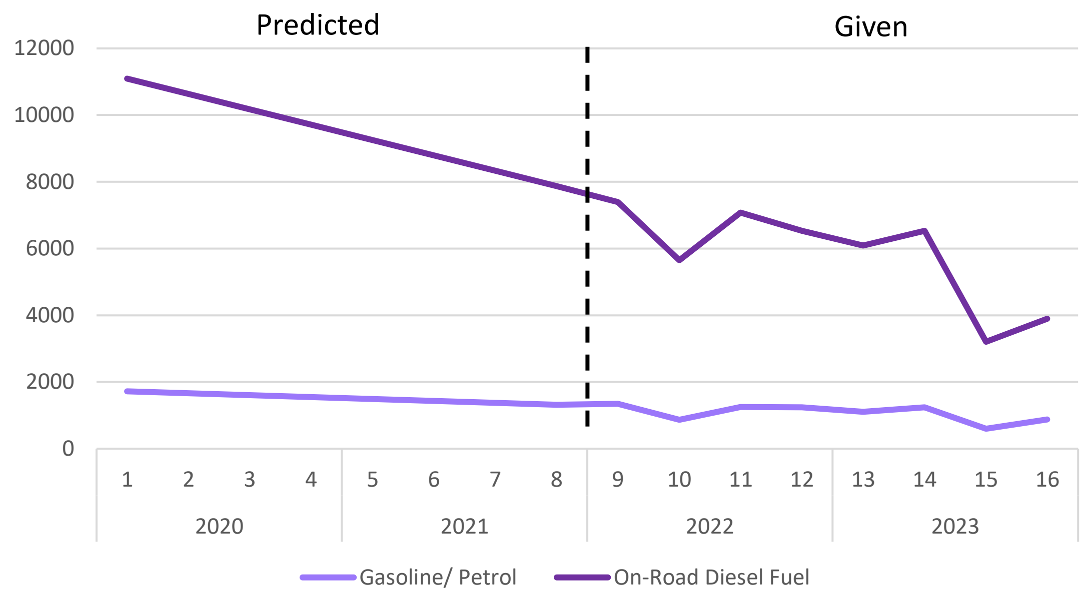
Fleet Carbon Baseline

Assumption:
Emission factors for different ICE vehicles were not given. Emissions per vehicle type had to be estimated by assuming diesel produced 16% more CO2 compared to petrol on average (Source: Michelin, 2022).

- Fleet log data was from 2020 & 2021 while emissions data was from 2022 & 2023. Thus, prediction of 2020 & 2021 emissions from future 2022 & 2023 data was required to find the baseline emissions adjusted for distance travelled.
- Average emissions per year were calculated as total emissions per unit distance travelled.

Emissions Baseline: 202.83 kgCO2 /1000km

Predicting Past Emissions



Emission Rates for 2021 (kgCO2/1000km)

Vehicle Type	ICE	EV
Motorcycle	74.13	49.5
Vans	404.96	143
Trucks	1163.95	825

*The detailed calculations can be found in the excel workbook attached.

Projected Emissions Savings of Full EV Replacement

Year	ICE	EV	Reductions
2020	48,145	37,668	36.96%
2021	39,867	35,550	36.79%

*EVs do not have tailpipe emissions, but 0.55tCO2/MWh is generated from electricity providers.

EVs offer significant reductions in carbon footprint compared to the current fleet of ICEs.

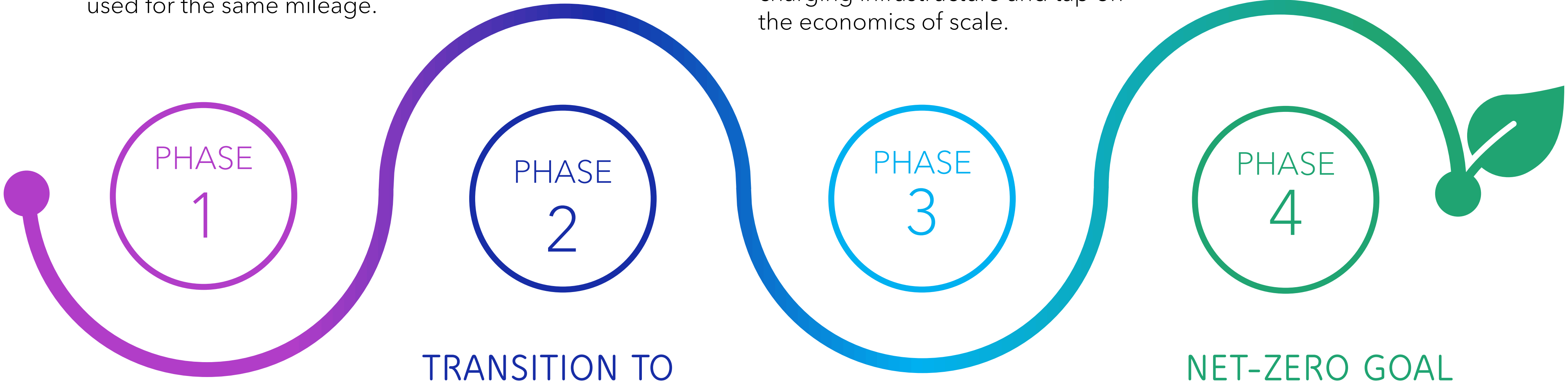
DECARBONISATION ROADMAP

OPTIMIZE CURRENT OPERATIONS

Installing fleet telematics can result in 15 -20% less fuel used for the same mileage.

SCALE AND OPTIMISE

When a proportion of vehicle fleet has converted to EV, it would be more cost efficient to install private charging infrastructure and tap on the economics of scale.



TRANSITION TO ELECTRIFICATION

Progressively phase out the older ICE vehicles and replace them with EV counterparts

NET-ZERO GOAL

By 2050, Optimus Prime's fleet is slated to be fully electric, with an efficient charging and scheduling system.

Decarbonization Roadmap: 1. Optimize Current Operations

- In our project to transition ICE Vehicles to EVs, we've adopted a phased approach, alongside integrating telematics technology to optimize costs efficiently.

Installing Telematics provides us with 15% and 20% fuel savings for ICE and EVs respectively. We calculated the estimated Fuel Cost Savings for each Vehicle Category per year.

Category	Average Fuel Price	Fuel Consumption Savings per 1000 Km	Average Travel Distance (Km)	Fuel Cost Savings
Panel Van	$ 1.95	$ 11.52	49819434.00	$ 1,117,173.59
3-tonne Truck	$ 2.05	$ 25.91	14750403.00	$ 784,646.41
Motorcycle	$ 1.85	$ 1.64	124063672.00	$ 377,681.67
Pick-up truck	$ 1.93	$ 7.14	12960361.50	$ 179,094.78
Window Van	$ 1.97	$ 10.36	1699607.50	$ 34,690.85
7-seater Van	$ 1.87	$ 14.16	708474.50	$ 18,787.64
Patrol Vans	$ 1.98	$ 11.57	661600.00	$ 15,181.48
8-tonne Truck	$ 1.97	$ 26.40	52286.00	$ 2,717.15

- To ensure efficient utilization of resources, we decided to install telematics in vehicles based on their lifespan. This means that telematics will be installed on vehicles not slated for imminent phase-out.

Vehicle Type	Fleet Size	Savings Per Unit
Motorcycles	6,628	$56.98
Vans	3,184	$2,217.93
Trucks	355	$428.68

Optimal No. of Years		
Motorcycles	Vans	Trucks
3.51 Years	0.70 Years	0.23 Years

- **Carbon Tax**

2023	2023 with Telematics
$ 824,425.00	$ 700,761.25

Savings: $123, 663.75

For motorcycles with at least 3.5 years of remaining lifespan, the cost of installing telematics can be **offset by the benefits** such as cost savings and operational efficiency. For Vans and trucks, the threshold is notably lower. Even with relatively short lifespan, the benefits can be realized within a much shorter timeframe.

* The detailed calculations can be found in the excel workbook attached.

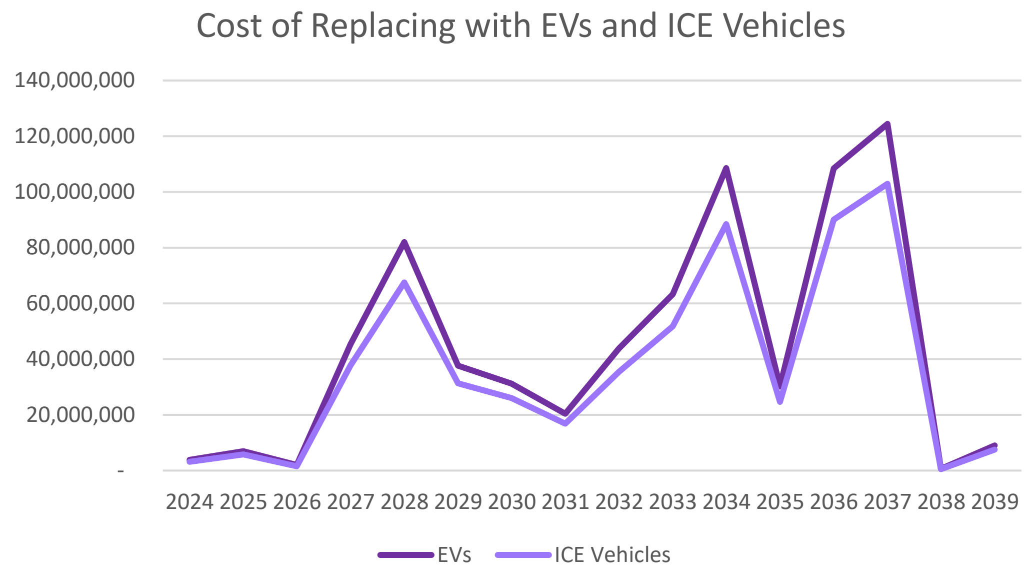
Decarbonization Roadmap: 2. Transition to Electrification

Assumption:
Lifespan of commercial vehicle: 20 years. This is based on Singapore's policy regarding goods vehicles lifespan. (Source: LTA)

Implementation:
When vehicles reach the end of their lifespan, instead of replacing with new ICE vehicles, Optimus Prime to replace with EVs (or ICE vehicles). Telematics will be installed on new vehicles immediately to maximise savings.

Considerations:

1. Cost of Vehicles
2. Sufficient charging infrastructure to support significant increase in EVs



Increase in total cost: **21%**

Phase 2a: Pilot

2024 – 2026: Replace all old vehicles with EVs and monitor carbon emissions and costs relating to transition.

Phase 2b: Optimising Transition

2027 - 2030: Taking into account considerations and outcomes of 2a. , optimise the proportions of ICE vehicles and EVs as new vehicles.

2031 onwards: To meet the aim of having a fully electric fleet by 2050, all new vehicles bought to replace old vehicles should be EVs.

Decarbonization Roadmap: 3. Scale and Optimise

For the initial years, districts can tap on the local public infrastructure to power the electric vehicles. As the EV fleet increases, there are cost savings that can be realised, by installing private charging infrastructures.

Implementation

When a district implements charging infrastructure, it is recommended for chargers to be installed as a set, of 20 chargers with varied charging speed.

Charging infrastructure	Quantity	Total Cost
120 kW DC ($P/unit)	2	$440,000
60 kW DC ($P/unit)	6	$600,000
22 kW DC ($P/unit)	12	$96,000

$1,136,000

Cost Comparison Public vs Private Charging

Calculating the cost of charging shows that:

Vehicle Type	Year's Cost Savings from Private Infrastructure / Vehicle
Motorcycle	$941.90
Van	$14,951.69
Truck	$39,199.49

The detailed calculations can be found in the excel workbook attached.

Case Study on Eagle Beach

Noting that Eagle Beach has a larger fleet of vehicles amongst all districts, we will use it as a case study on scaling and optimising operations.

Number of vehicles to phase out

Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Motorcycle	0	2	38	0	223	1	0	0	119	149
Van	1	15	0	69	67	27	11	22	18	51
Truck	4	1	1	0	0	0	1	3	20	8
Potential Cost Savings	$178,814	$234,749	$84,865	$878,356	$1,107,259	$344,845	$181,549	$404,618	$1,195,292	$1,151,343

$2,467,589 **$2,559,363** **$2,549,175**

Considering the **potential cost savings per year** as the vehicles are implemented, it would be recommended for a charging station to be installed, when **the running total** of the potential cost savings **exceeds the cost of building** the charging infrastructure. For Eagle Beach, that is: at **t=4, t=6 and t=9.**

This can be replicated to the other districts, deferring the financial investments of charging infrastructure until the cost savings that can be realised, exceeds the cost of implementation.

Decarbonization Roadmap: 4. Net Zero Goal

Phase 1

With telematics, distance travelled per litre of fuel is increased, reducing emissions associated with ICE vehicles in current fleet.

Potential Reduction of Carbon Baseline → 15%

Phase 2

Transitioning to EVs would result in higher upfront costs. However, in the long run, savings would outweigh increased cost. Transitioning to EVs would also reduce emissions significantly.

Potential Reduction of Carbon Baseline → Progressively towards 100%

Net Zero Goal

By 2050, Optimus Prime is poised to have a full EV fleet, contributing to the net-zero goal.

Phase 3

To utilise public charging infrastructure for initial phase, and leverage on economies of scale by establishing private charging Infrastructure, when the cost savings outweighs the implementation costs.

Lower Initial Implementation Cost, Deferred Investment Expenses

Future Opportunities

- Optimise charging schedule through **AI-driven solutions**, that trains on daily fleet usage patterns specific to vehicles and districts.
- Explore solar energy panels on vehicles. Inspired by Singapore's successful trials with solar panels on buses, which generates up to 1kW per vehicle.
- Explore using renewable energy sources for electric supply to charge vehicles..

THANK YOU.

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