# Project Microcar

# Discussion Paper

**6th May 2013**

**Toa Greening**

**0274393163**

www.projectmicrocar.co.nz

feedback@projectmicrocar.co.nz

**Tango T600 Ultra-narrow electric vehicle**

## 1. Introduction

**Overview**

The main objective of Project Microcar is to solve Auckland's peak time motorway congestion in the least amount of time and cost.

Auckland's traffic congestion problems are not because of the number of single occupied vehicles on the motorway at peak traffic times. It is because of the **width** of single occupied vehicles on the motorway at peak traffic times.

The risks of continuing with conventional transport planning methodologies of building more motorways, roads, train tracks, bus lanes, cycle lanes, tunnels and bridges is that it will not solve traffic congestion. It will instead cause a major financial crisis in the very near future.

The solution is to replace a specified amount of the existing single occupied vehicles with a leased fleet of narrow electric Microcars that can travel side by side in a single lane to relieve peak time congestion.

The significant economic, social and environmental benefits will turn Auckland into the most liveable City in the World.

The challenge is for an authority to implement such a revolutionary transportation scheme.

*"If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions." - Albert Einstein*

**A Snapshot of the future**

The below short story is a six year future snapshot of Microcar transportation in Auckland City

*The time is 8:33am; I have exactly 27 minutes to get to the office in the CBD from my home in Mt Wellington. I plant a quick kiss on the baby and wife and then dash to the electric vehicle or EV parked in the garage. I remove the charging cable from the main socket, quickly enter the EV and place my briefcase into the back passenger seat.*

*A flick of the start switch tells me that the charge is now complete and an estimated 130km is available between the next charge cycles. A check of the navigation system shows me that all lanes are currently free flowing on the motorway, although the weather reports are advising heavy rain. I indicate onto the main street shared lanes and coast in behind a gas-guzzler, another EV enters the same lane beside me and we both proceed to the motorway onramp. Why anyone would still be driving a gas-guzzler at peak traffic is beyond me but I guess some people simply refuse to change their ways.*

*Thinking back six years ago the Auckland Council in a revolutionary move to reduce motorway congestion decided to introduce a fleet of leased EV's. It was dubbed the congestion buster and marketed as the ultimate convenient public transport scheme. Everyone was initially cautious over the narrowness of the 2 person vehicles and safety aspect of them operating side by side in a normal lane. The vehicle manufacturers quickly built a small fleet of prototypes which were approved by the transport authority and made available for public to test drive.*

*Caution very quickly disappeared as the EVs were constructed just like a racing car with a roll cage, reinforced structures and a surprising amount of acceleration. The vehicles had excellent visibility and were actually fun to drive. The very low weekly lease rate, maintenance costs and subsequent total transportation costs were the same as taking the train or bus. However this was to ensure that there was a strong initial demand. I went into the ballo and was one of the lucky first to be offered one of these vehicles for lease. Amazingly within two years of the full fleet of EVs entering the motorway network all peak time congestion had disappeared. The problem now is that the EV manufacturing plant cannot keep up with market demand.*

*At the onramp the gas-guzzler ambles into the dedicated left lane, the other EV and I both move side by side into the right lane. On the green we both zip ahead of the gas-guzzler and enter the near free flowing traffic. I make my way across to the fast lane and coast just to the side of another EV. I spot the latest billboard on the side of the motorway "I will never give up my V8". At $4 litre you have to be crazy to still be driving one.*

*It is now 8:38am and there is plenty of time to get into the CBD.*

*Starting from next year a new model EV which is fitted with an autopilot cruise control will be released. What this means is that once you are on the motorway your EV can be put into autopilot and it will essentially drive you to your off-ramp destination. I am not too sure about this technology but understand that it is needed to further optimise the capacity of motorway network, as Auckland's growth is now phenomenal. The success of the EV fleet lead to an explosion of new international investment into Auckland as it was looked upon as a progressive and innovative City to do business in. With the new businesses came more people wanting to reside in the most liveable City in the world. Well who would have thought that a small electric vehicle would have made such a difference to our City?*

*It is now 8:52am and I am parking the EV with enough time to get a coffee before heading into the office. The sun is out. I wonder what happened to that rain forecast.*

**Background**

Over the next 30 years Auckland's population is expected to double with 70% of new residential dwellings being built within the existing City limits and 30% into new Greenfield areas. With most of our transportation networks already at capacity $60 billion in 2013 dollar terms will need to be spent in Auckland on transport infrastructure over the next 30 years.

By using traditional transportation models Auckland needs to build more motorways, highways, arterial routes, train tracks, bus lanes, cycle lanes, bridges and tunnels to accommodate the 30 year population growth. Currently Central Government and Auckland City Council are locked in a debate whether enough is being done to plan and fund Auckland transport over the next 30 years.

Auckland Council has identified $12 billion in additional funding to complete the identified transportation projects for the next 30 years.

This equates to $30,000 per ratepayer, which may be funded by the following:

- Increased Taxes - IRD, GST, Rates, Petrol, Land, Capital Gains
- Increased User Charges - Tolling, Road User Charges, Parking, Fines
- Asset Sales - Ports of Auckland, WaterCare Ltd, Airport Shares, Public Land and Facilities
- Increased Debt – which must be paid for by the previous three sources

Project Microcar takes a fresh look at the funding challenges facing Auckland's transportation networks and provides a revolutionary solution to the impending funding and transportation crisis.

**The Problem**

Our motorways are at capacity because there are too many cars on the road at peak hour. Our buses and trains are full at peak times because too many people are trying to use them due to the congested motorways.

- There are not enough roads and motorways to accommodate the current number of vehicles at peak times
    - Building more roads and motorways requires a huge investment into the road network

- The bus and train networks are at capacity because of historical under investment into public transport
    - Moving people out of cars onto public transport requires a huge investment into public transport

Both scenarios require significant investment in the transportation networks.

**The Risks**

The identified $60B transportation network costs are only for identified projects and will require increased taxes, user charges, asset sales and debt to fund. This estimated funding does not address what may be required for the congestion of our residential streets from intensification and new motorways/streets required for the new urban Greenfield areas.

- Funding sources are finite and insufficient to cover future transportation costs
- As funding becomes scarce, the resulting debt crisis is passed onto the tax/rate payers

**The Solution**

To get to the most obvious solution we need to analyse the existing problem. The problem is not the number of single occupancy vehicles on the motorways at peak traffic times. It is the width of the single occupancy vehicles on the motorway at peak traffic times.

The solution is to optimise the capacity of the motorway by initially rolling out a fleet of narrow 1-2 person Microcars. These will be driven two to a lane and will be future proofed to use an intelligent motorway network and navigation/cruise control systems.

This can be implemented in the following four stages:

- Stage 1 – Introduce a city fleet of narrow 1-2 seated Microcars which can travel two to a lane to increase the capacity of the existing road network and solve the current peak time congestion
    - To solve existing congestion 25% of private vehicles at peak traffic areas will be upgraded to Microcars
    - Up to a 300% increase in total motorway capacity can be achieved as more Microcars are introduced into peak time traffic
    - Significant transportation and maintenance cost reductions to Microcar customers
    - Estimated years 2 to 4

- Stage 2 - Upgrade the motorway network with intelligent monitoring technology that informs users of real time traffic conditions and opens the motorway shoulder to improve traffic throughput
    - Up to a 33% increase in motorway capacity
    - Estimated years 4 to 6

- Stage 3 - Introduce smart navigation and cruise control systems to maximise the efficiency of the existing motorways
    - Up to a 273% increase in motorway capacity due to closer travelling distances, smart breaking and cruise control systems
    - Estimated years 7 onwards

- Stage 4 - A range of fully automated vehicles becomes available from various vehicle manufacturers
    - Up to a 500% increase in motorway capacity due to closer travelling distances and smart travel planning systems
    - Estimated years 15 onwards

It is anticipated that the success of stage 1 creates market demand for the new Microcar industry to be expanded throughout New Zealand, Australia and Asia.

- Stage 1a – Mass expansion of the city fleet to encourage the maximum number of vehicle commuters into Microcars
    - Maximises the motorway capacity by 300% and improves capacity of residential streets
    - Improved bus networks due to overall improvement of the road networks
    - New revenue available from expansion of the market
    - Estimated year 4 to 6

- Stage 1b – Export of Microcars to Australia and Asia
    - New revenue available from the international expansion of the market
    - Estimated year 6 onwards

**The Challenge**

The really exciting news is that the technology exists today and is currently available. I have gathered information on this so that you can decide whether this is a good project to develop.

# 2. Traffic Congestion

**Overview**

The following report was produced by consulting company Sinclair Mertz for Auckland Council and provides the future traffic scenarios if the Inner City Rail Loop did not go ahead.

> *"By 2021, most bus networks near and in the city centre will be at capacity or overloaded in terms of what can be provided on existing roads, the report says. Private motor vehicle speeds will have halved from 16km/h in the morning peak to 8km/h. The rail network will have reached the maximum number of services possible. And by 2041, the bus network will be "significantly over capacity" and the average morning peak car speed in the city centre will be 5km/h. Car journey times to the city centre from the west and south will increase by 30 to 50 per cent, adding an extra 30 minutes each way from the South Auckland growth area."*

There are various reports demonstrating the amount of congestion if the Inner City Rail Loop was not built.

**Aucklanders want Govt cash for rail - 19/11/12**

*http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10848414*

**Enough reports - get on with rail - 23/11/12**

*http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10849341*

**Auckland's looming go-slow - 23/11/12**

http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10849358

There are various reports demonstrating the limitations of the Inner City Rail Loop and motorway Projects.

**Case for Auckland CBD Rail Link not yet made**

http://www.beehive.govt.nz/release/case-auckland-cbd-rail-link-not-yet-made

**Holiday highway colossal waste of $1.69b**

http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10635391

**New Lane Five Years off**

http://www.stuff.co.nz/auckland/local-news/manukau-courier/6542538/New-lane-five-years-off

The truth is probably halfway in between with the costs being more and benefits being less than is estimated. Auckland Transport has provided a 30year plan, which is primarily based upon the Auckland Plan and follows NZTA schedule of work but adds the ICRL and a second harbour crossing to the list of critical projects. The combined costs from both AT and NZTA is $60B. However the looming transport issues of intensification and new urban Greenfield areas are ignored.

NZTA will continue with the schedule of motorway works however the Ministry also ignores the looming transport issues of intensification and new urban Greenfield areas planned for the Auckland region.

http://en.wikipedia.org/wiki/Auckland_CBD
13% of Aucklanders work in the CBD
87% of Aucklanders work in other parts of Auckland

**Inner City Rail Loop**

Auckland Council makes three huge assumptions on the ICRL:

- The ICRL will move large numbers of commuters during peak traffic
- Market demand for intensification will occur along the rail corridor
- Large numbers of commuters will migrate to rail

The 2010 ICRL business case is very light on the details on how the Inner City Rail Loop will go from 21 to 60 train movements per hour and how some major lines like the Southern line will need to increase from 10 to 40 trains per hour at peak times. Unfortunately Auckland Transport has not provided the technical modelling information to prove its case.

To get 60 trains moving in both directions on the ICRL will require 40 trains per hour heading North through the Puhinui, Papatoetoe, Middlemore, Otahuhu stations. This means 15 split to the Eastern line, taking it to 25, 5 are added from the Onehunga line taking it to back to 30, this then splits at New Market with 15 heading West (requires major work at Newmarket) and 15 to Britomart, which is then merged with 15 from the Eastern line taking this to back to 30 trains/hour heading towards Britomart. The current peak AM departures at the station in Manurewa are 7:20, 7:28, 7:33 and 7:40. The 7:28 and 7:33 trains are never within the 5-minute window as often it can take 1-2 minutes for people to get on/off the train. Therefore 40 trains per hour (1 train/90 sec) through Puhinui, Papatoetoe, Middlemore and Otahuhu is physically impossible.

The key issue with the Southern line is that it is a shared line and not a dedicated line like the Sky Train network in Vancouver. Therefore the Southern line is shared with the main North Island trunk line and intersects with the Manukau, Onehunga, Eastern and Western lines. It is unlikely that this line will ever move more than 12 trains per hour and would therefore require a new and very costly dedicated line to improve the performance to the 40 trains per hour required for the ICRL. This dedicated line is not included in the ICRL so it is likely that services from the South will not improve and ICRL will not achieve the 60 trains per hour. However the majority of Greenfield expansion will occur in the South.

The most efficient way to increase throughput of the Britomart station is to expand the two track bottleneck into the station to four tracks and build another 2 platforms so that more trains can be held for the AM and PM peaks. This is how terminus train stations are designed in major cities throughout the world.

The issue is that the ICRL is very Central Business District focused and makes some large assumptions with little evidence. It totally ignores the looming issues around increased congestion of our residential streets from intensification and the new motorways/streets required for the new urban Greenfield areas that have been identified in the Rural Urban Boundary.

**Puhoi to Wellsford "Holiday Highway"**

The designation of this as a highway of national significance has always been controversial. Apart from accidents the only time this part of SH1 is congested is during holiday periods. The stretch does require safety improvements in some areas but at an estimated $1.69B it is one of the most wasteful transport projects to have ever been proposed. It is a massive Auckland transport project yet does nothing to ease daily peak time traffic congestion.

**SH20-SH1 Extension**

This project merged the SH20 South Western motorway with the main SH1 Southern motorway. This project started in 2006, was completed in 2011 and cost over $100M. After five years of disruptive road works at the SH20-SH1 over pass the new extension was opened. Following the opening of the SH20-SH1 extension a subsequent third lane on the Southern link of SH1 was programmed to start 2011. Unfortunately the third lane was rescheduled to start in another five years in 2016.

The new SH20-SH1 extension added three new lanes (1 from Redoubt road and 2 from SH20) to the existing three lanes on SH1. Over 1 km all six lanes were merged into two lanes. Within weeks of the new SH20-SH1 opening the SH1 section became congested over a 4-6km stretch at the PM peak. The newly congestion section went from 3-5minutes prior to opening to up to 30 minutes.

Retrospective remedial works were performed over the following six months, which resulted in traffic lights being installed on the SH20 lanes. Now the SH1 time delay has been reduced to 8-12 minutes, with SH20 now being backed up for kilometres at the PM peak.

**Conclusion**

The SH20-SH1 extension demonstrates that NZTA clearly has prioritisation issues with its projects. The NZTA spends significant sums of taxpayer's money but has no accountability when projects fail to deliver.

Both the Inner City Rail Loop and Puhoi to Wellsford Holiday Highway demonstrate how vast sums of money can be allocated to transportation projects with very light business cases and highly questionable transportation benefits.

There must be a better way to plan transport than continuing to make the same expensive mistakes over and over again.

**Tango T600 on the freeway**

# 3. The Looming Financial Crisis

**Auckland Council Debt**

Prior to the 2010 Auckland Council amalgamation the total debt for the regions five cities was approximately $2.4 billion. Three years on and the Auckland Council treasury department expects to increase debt from $5 billion to $14 billion over the next decade for asset renewals and capital expenditure.

http://www.interest.co.nz/bonds/62519/how-and-why-auckland-council-plans-borrow-nz14-bln-behalf-its ratepayers-over-next-decad

$14 billion equates to:

- $1,166 per ratepayer per year for the next 30 years if fully funded by rates or $35,000 per ratepayer
- $2,799 per ratepayer per year for the next 30 years if fully funded by debt (amortised at 7% over 30yrs) or $83,970 per ratepayer

The reason why rates have not rapidly increased to date is because Auckland Council uses its CCO organisations to fund (via debt) the interest payments on the existing debts.

**Transport**

Auckland Council has identified a shortfall of $12 billion dollars to progress its Transportation projects over the next 30 years

$12 billion equates to:

- $1,000 per ratepayer per year for the next 30 years if fully funded by rates or $30,000 per ratepayer
- $2,400 per ratepayer per year for the next 30 years if fully funded by debt (amortised at 7% over 30yrs) or $72,000 per ratepayer
- $1,000-$2,400 per ratepayer per year for the next 30 years if funded by Rates, User Pays, Fees, Taxes, Debt and Asset Sales

Under all scenarios the ratepayer will be primary source of revenue to fund the asset renewals and transportation projects. Without other funding sources the projects will be majority debt funded so the amortised total cost of $155,970 ($83,970 + $72,000) is the basis for the looming financial crisis.

**Lessons to be learnt from the Kaipara District Council**

In 2012 the Kaipara District Council were replaced with commissioners due to an $80 million budget blow out on a new sewerage plant at Mangawhai. The debt amounts to $26,153 debt per ratepayer and the council's debt servicing payments are now nearly double its income.

As a result the average rates have almost doubled since 2009 so that the Kaipara Council can meet the interest repayments. The worst outcome from this is that people are now being forced out of their homes, as some simply cannot afford to pay the huge rates increases. More significant rises are planned so that Council can start to pay off the $80M debt. Kaipara now face decades of high rates to get out of debt.

Auckland Council will be in the same situation in the near future as it plans $65,000 ($35K asset renewals + $30K transport) cost per ratepayer or $155,970 amortised over the next 30 years.

**The Future Funding Crisis**

Although a number of transport funding options are being proposed by Auckland Council the time to implement the various options will mean that borrowing will be the main mechanism in the short term for asset renewals and some of the initial stages of the transport projects.

At some point in time Auckland Council will reach a fiscal limit where it can no longer borrow from institutions. The fiscal limit may be imposed by overseas credit rating limits making it difficult for Council to borrow more, increases in interest rates or by Central Government intervention. This means that the borrowing to fund interest on existing debt is ended and new revenue must be quickly generated from the Auckland ratepayers.

The final stage will occur quite rapidly as was the case with Kaipara District Councils inability to pay its $80M debt for the new Sewage infrastructure. Auckland Council will have to introduce huge increases in rates, user pays fees, road tolls, local taxes and the sale of Council assets. The sale of Council assets like the Airport shares, Ports of Auckland and WaterCare will further shrink the revenue base which means rate payers will need to provide more revenue.

Ratepayers will revolt over the huge increases in rates and user pays fees and Government will be forced to step in and replace the elected members with Commissioners. The Commissioners will merely enforce the increases in rates and fees to pay the debts, sell off assets, and reduce services and in some cases force residents out of their homes to pay the debts. This is what is occurring in the Kaipara district.

This will be a terrible down spiralling situation for New Zealand's economic powerhouse to be in. The end result is that the City becomes more expensive to live in and less attractive for people and businesses to move to.

The requirement to come up with innovative ways in which Council can solve its funding and transportation requirements must be explored.

**Tango T600 side by side on the freeway**

# 4. Microcars

**Overview**

A Microcar is the smallest automobile classification, usually applied to very small cars (smaller than city cars).
http://en.wikipedia.org/wiki/Microcar


**2 x Tango T600 sharing a motorway lane**

**Congestion reduction studies**

The following study on motorcycles and traffic congestion determined the following:

- *" If 10% of car drivers would give up their car for a motorcycle or a scooter, traffic congestion would be reduced by 40%, according to a study performed in one of Belgium's most congested routes, typical of Europe's densest urban areas."*
- *"A 25 percent modal shift from cars to motorcycles was found to eliminate congestion entirely."*

http://www.acem.eu/index.php/media-corner/press-releases/80-more-powered-two-wheelers-would-ease-congestion

Therefore we can conclude that to resolve congestion on the busiest parts of the motorway 25% of private vehicles, which are congested over the time period of 2-3hrs, will need to be replaced with a Microcar that is the same width as a motorcycle.

**Road Capacity Studies**

Transport planners and various motorway studies have concluded that the maximum capacity of the motorway lane is 2000 cars per hour per lane.

http://www.internationaltransportforum.org/IntOrg/ecmt/southeast/TIRS/TIRSann05.pdf
http://www.ejtir.tbm.tudelft.nl/issues/2001_01/pdf/2001_01_04.pdf

The below table on traffic volumes was extracted from NZTA
http://nzta.govt.nz/resources/state-highway-traffic-volumes/shtv-2008-2012-by-region.xls

| Description | Direction | Equipment | AADT (2008) | AADT (2009) | AADT (2010) | AADT (2011) | AADT (2012) |
|---|---|---|---|---|---|---|---|
| SH1 Khyber Pass On Ramp to Gillies Ave Off Ramp SB - Virtual | Inc | Virtual | 101629 | 101189 | 98520 | 100593 | 103826 |
| SH1 Khyber Pass Off Ramp to Gillies Ave On Ramp NB - Virtual | Dec | Virtual | 98677 | 99521 | 96559 | 95647 | 97151 |
| TOTAL | | | 11134019 | 11331259 | 11353328 | 12343408 | 12549867 |

The busiest section on the Auckland motorway network is Kyberpass at approximately 100,000 in each direction for all three lanes per day.

- Of interest is that the above SH1 Kyber Pass road does not show any significant increases in daily car usage (0.3% increase for SB and NB totalled).
- However Total Daily Traffic movements increased by 12.6%
- Theoretically based upon a population growth rate of 3.33% traffic should have increased 17% over the 5 year period.

We know that congestion starts at >2000 vehicles/hour so the key point is the total time of congestion. At present congestion can occur over a 2-3 hour period at the AM and PM peaks.

**Calculating the number of Microcars to relieve congestion**

The busiest part of the Auckland Motorway network is the central junction. The following assumptions are made to calculate the number of Microcars required to relieve congestion. Each total lane count is the average lane count for the congested sections of the motorway.

**Total Lanes**

- Northern Motorway 3 lanes
- Western Motorway 3 lanes
- Southern Motorway 3 lanes
- Total of 9 congested lanes

**Calculation**

- Assume that the majority of vehicles in the AM and PM peaks are the same vehicles which are commuting to and from their place of work
- Assume that congestion at AM and PM peaks is a worst case of 3 hours per peak
- 9 congested lanes = 9 x 2000 cars per hour capacity = 18000 x 3 hours = 54000 congested cars
- 25% of peak congested traffic = 0.25 x 54000 = 13,500 Microcars required to relieve congestion

Therefore to relieve congestion a minimum of 13,500 private vehicles at the central junction peak times will need to be upgraded to Microcars.

**Tango T600 0-100km/hr in 4 seconds – 600KW Electric Engine**

# 5. Microcar Case Study

**Overview**

I investigated a number of Microcars for the case study. Many were too wide, too slow, limited range or one off conceptual vehicles that were not market ready for mass production. The Tango T600 by Commuter Cars satisfied the criteria and was subsequently contacted for this case study.

**The Tango T600**

**Commuter Cars**

Commuter Cars manufactures a two passenger narrow electric Microcar called the Tango. Essentially two Tango vehicles can fit in a standard motorway lane side by side. It was first prototyped in 2003, has had limited production in the US and UK and planning mass production in the near future.

The specifications of the vehicle are revolutionary in that the top T600 model has been built like a like a racing car with roll cage and side impact reinforcement. The T600 has an electric engine that delivers 600KW at the wheel and can accelerate from 0 to 100km/hr within 4 seconds. A standard Ford XR6 or Holden SS V6 has a 220-250KW engine. While the T600 appears tall and tippy the location and weight of the battery means it has a low centre of gravity and therefore very stable and manoeuvrable. The mass produced models will be similarly constructed but with lower output of 200KW and 100KW electric engines.

For more information refer to the companies marketing website www.commutercars.com.

The following information has been gratefully received from the Commuter Cars founder Rick Woodbury to assist with estimating the costs to build an Auckland Council lease fleet.

### Build Investment

*"Design, tool and build for production of 15,000 per year. This is still considered very low volume production. It would require $115-million, but would reduce the price to $29k to return the same 50% ROI over 4 years."*

*"Typically, a 100,000 per year production requires design and tooling in the amount of $1- to 2-billion USD. That could be amortized to as little as $10k per vehicle." NB: Excludes Battery*

**10 Year Warranty**

*"For this reason we can give a ten year unlimited mileage warranty, comfortable that the cost to Commuter Cars will be infinitesimal in comparison with the value to the customer. Ten year warranties are now commonplace for cars that have much more to fail than a Tango. This will ensure the best word of mouth reputation and comfort necessary to penetrate a new market. It is unlikely that a battery-powered commuter car will amass enough miles, in 10 years, to be a factor."*

**Running Costs**

*"The only component on a Tango that is subject to substantial, recurring cost is the battery. Although the electricity to charge an EV is only one or two cents per mile, battery replacement cost is ranging from five to fifteen cents per mile" NB: Electricity charging costs of 1-2 cents per mile*

**Auckland Council Microcar Fleet**

The following three scenarios explore how Auckland motorway congestion can be solved with the introduction of an Auckland Council fleet of leased Microcars over a 10-year operational period. It also explores the economic development of an Auckland based Microcar manufacturing industry that exports leased Microcars to Australia and Asia.

Commuter Cars have surveyed lease options and respondents were prepared to pay on average $100/wk and to additionally be charged for mileage. The first scenario A uses a very low weekly lease rate of $55/wk for an average weekly distance of 250km over a 1-3 year lease period. The intention of the initial low lease rate is to create market demand so that there is a high initial uptake by customers. The high initial update will ensure that 15,000 vehicles are leased. Higher and more profitable lease options are used in B and C after the removal of motorway congestion.

**A. 15,000 Vehicles to relieve Motorway Congestion**

The following scenario builds an Auckland Council fleet of 15,000 Tango, which are targeted at removing the congestion on the busiest central junction. As identified in the previous section a total of 13,500 or 25% of vehicles at the central motorway junction will be upgraded to the Tango to remove congestion on this part of the motorway. The economics of this model means a cost of $231M over the 10 year lease period, an asset value of $43.5M and solves the major motorway congestion on the central junction within four years time. After 10 years the fleet could be sold, or refurbished for extended operations. It is expected that in 10 years time the cost of batteries will reduce considerably and the range increase.

- Cost $29,000 x 15,000 = $435M
- Amortised debt of $435M at 7% over 10 years = $66M/yr = $660M
- Leased at $55/week = $2860/yr x 10 years = $28,600 x 15,000 = $429M
- Total cost = $660M – $429M = $231M
- Depreciated asset value at year 10 (using 0.6yr1, 0.8yrX) = 0.1 x $435M = $43.5M
- Battery costs for 130km range is included in the lease
- Electricity charging costs are 1-2 cents per km

**B. 100,000 Vehicles to fully expand the New Zealand market**

The following scenario builds a mass produced Auckland Council fleet aimed at getting large numbers of peak time commuters into the Microcar. The manufacturing efficiencies of mass production lower the costs per Microcar. The economics of this model provides a gross profit of $1.12B over ten years, an asset value of $200M, solves motorway congestion, residential congestion and adds significant capacity to both the motorway and residential road networks. Another benefit is a vastly improved bus network due to the reduction of peak time congestion across Auckland. After 10 years the fleet could be sold, or refurbished for extended operations. It is expected that in 10 years time the cost of batteries will reduce considerably and the range increase.

- Cost $20,000 x 100,000 = $2B
- Amortised debt of $2B at 7% over 10 years = $278M/yr = $2.78B
- Leased at $75/week = $3900/yr x 10 years = $39,000 x 100,000 = $3.9B
- Gross Profit $3.9B-$2.78B=$1.12B
- Depreciated asset value at year 10 (using 0.6yr1, 0.8yrX) = 0.1 x $2B = $200M
- Battery costs for 130km range is included in the lease

- Electricity charging costs are 1-2 cents per km

**C. 1,000,000 Vehicles exported to overseas markets**

The following scenario builds a mass produced vehicle, which would involve the export of vehicles into Australia and Asia. The economics of this model provides a gross profit of $24.4B over ten years, an asset value of $2B. After 10 years the fleet could be sold, or refurbished for extended operations. It is expected that in 10 years time the cost of batteries will reduce considerably and the range increase.

- Cost $20,000 x 1,000,000 = $20B
- Amortised debt of $20B at 7% over 10 years = $2.76B/yr = $27.6B
- Leased at $100/week = $5200/yr x 10 years = $52,000 x 1,000,000 = $52B
- Gross Profit $52B-$27.6B=$24.4B
- Depreciated asset value at year 10 (using 0.6yr1, 0.8yrX) = 0.1 x $20B = $2B
- Battery costs for 130km range is included in the lease
- Electricity charging costs are 1-2 cents per km

**Cost Analysis**

Below is a cost benefit analysis of a standard Car, Train and Microcar options from for a 50km CBD return trip. You will note that there is little cost difference between travelling by Microcar and Train, although travel by Train still requires a car for part of the trip and this therefore incurs maintenance costs.

**Average Car = $5980/year**

Return travel 50km to the CBD is $12/day in petrol
Maintenance/replacement costs will be variable depending upon age and distance travelled
Parking is $14/day
Total cost is $26/day x 230 business days = $5980/year (excludes maintenance/replacement vehicle costs)

**Train = $3864/year**

Return travel by car to the train station $3/day in petrol
Maintenance/replacement costs will be variable depending upon age and distance travelled
A five stage return fare to the CBD is $13.8/day
Total cost is $16.8/day x 230 business days = $3864/year (excludes maintenance/replacement vehicle costs)

**Microcar = $3910/year**

Full maintenance lease based upon an average peak time return trip of 50km = $55/week = $11/day
Electricity charging costs 2c/km x an average 50km/day = $1/day
Parking based upon motorcycle rates is $5/day
Total cost is $17/day x 230 business days = $3910/year

The Microcar will remove all peak motorway congestion so the travel time will be half that of the Train and more convenient. The Bus network and standard vehicles will improve as a result of removing all peak time motorway congestion**.**

**Electrification of Auckland Rail**

The electrification of Auckland's rail will have questionable benefits to rail commuters, does not solve motorway congestion and will have a total amortised cost of $3.48B which will be paid by taxes and rates over the next 30 years. The railway is subsidised $20-$25M per year with the below articles outlining the costs and benefits by the electrification of Auckland railway.

http://www.stuff.co.nz/waikato-times/business/8547075/Secrecy-hides-transport-flaws-from-scrutiny
http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10857062

*"But council transport chairman and veteran electrification campaigner Mike Lee believes the new trains will not be enough to boost flagging patronage unless they are supported by general service improvements, notably far better punctuality and extended weekend timetables, without prohibitive fare rises."*

On the way

- 57 three-car trains arriving between September this year and mid-2015.
- Tracks, signals, and other works such as raising bridges over 85km of lines from Britomart to Papakura and to Swanson - $500 million cost (Government funded).
- Trains and depot (including 12-year maintenance contract) - $640 million (cost shared between Government and Auckland Council).
- Total $1.14B

**Project Costs**

The electrification of lines, new trains and workshop = $1.14B
If the total cost of $1,14B is amortised at 7% over 30yrs = $91M/yr = $2.73B over 30 years
Annual rail subsidy = $25M/yr x 30 = $750M
Total cost is $3.48B over 30 years

**Vancouver Sky Train**

Due to rapid population growth over the past decade Vancouver decided to invest heavily in the expansion of the Sky Train network. Sky Train is an automated rapid transit system that moves 400,000 commuters each day and is often referred to as the ideal model for city transport planning. Vancouver does not and has not invested in a fully connected central motorway like Auckland. Vancouver rates second to LA in terms of the most congested Cities in North America. Vancouver demonstrates that there is a lesson to be learnt from investing heavily in only one mode of transport.

## Conclusion

The amortised cost of Auckland's rail electrification is $3.486B over 30 years, which is being paid by taxes, rates, user pays and asset sales. Rail electrification will not solve motorway congestion, however it will add to the looming financial crisis.

The fleet of 100,000 leased Microcars will generate $1.12B profit over 10 years. It solves motorway congestion, residential congestion and adds significant capacity to both the motorway and residential road networks. It will also vastly improve the bus network due to the reduction of peak time congestion across Auckland.

The stark comparison of the $3.48B cost for the fleet of electric trains versus a $1.12B profit for a fleet of leased electric Microcars proves that conventional transport planning methodologies are financially unsustainable and do not solve the problem of traffic congestion.

# 6. Intelligent Motorways

**Overview**

The below collection of websites provide an overview into the development of Intelligent Motorways. The key point from this is that this technology can open up the shoulder of the motorway at certain times, which can lead to a 33% increase in capacity. The intelligent motorway technology is a prerequisite to the introduction of Smart Cars, or cars that can autonomously operate on the motorway.

http://en.wikipedia.org/wiki/Managed_motorways_in_the_United_Kingdom

Managed motorway in the United Kingdom (also Controlled Motorways) are motorways that use Active traffic management to improve peak traffic flows by introducing reduced road speed limit and hard shoulder running at busy times. First used in 2005, it is currently in operation on sections of the M1, M6, M25 and M42 with proposals to extend it to sections of the M4, M5, M60 and M62. Other benefits include a reduction of road traffic collisions, more reliable journey times, improved traffic flows, and reduced noise and harmful vehicle emissions.[1] [2].

http://en.wikipedia.org/wiki/Active_traffic_management

Active traffic management (also managed lanes, smart lanes, managed motorways) is method of increasing peak capacity and smoothing traffic flows on busy major highways. Techniques include variable speed limits, hard-shoulder running and ramp-metering controlled by overhead variable message signs. It has been implemented in several countries, including Germany, the United Kingdom, and the United States.

# 7. Smart Cars

**Overview**

The below collection of websites provide an overview into the development of Smart Car technologies. The key point from this is that once motorway travel is fully automated this can lead to a capacity increase of 500%.

http://en.wikipedia.org/wiki/Vehicular_automation

As a method of automating cars without extensively modifying the cars as much as a robotic car, Automated highway systems (AHS) aims to construct lanes on highways that would be equipped with, for example, magnets to guide the vehicles. Highway computers would manage the traffic and direct the cars to avoid crashes.

http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/intelligent-cars-could-boost-highway-capacity-by-273

You're a terrible driver. Yes, you. Terrible. At least, you're terrible compared to a robot, which is smarter, faster, and more experienced. In fact, if we all just give up driving on highways and let robots take over for us, we could effectively end highway congestion as we know it by boosting the capacity of our existing roads by a staggering 273%.

On a highway filled to capacity by human drivers (which is about 2,200 vehicles per hour per lane), about five percent of the available road space is taken up by cars. Five percent. This is because humans are so bad at driving that we need lanes that are twice the size of our cars, and at highway speeds, we have to keep between 40 and 50 meters away from the car in front of us.

Every time we talk about robot cars we have to mention two things. Thing One is that all of the technology to do this stuff already exists. And not just in Google's fully autonomous cars: there are cars that you can buy today that have adaptive cruise control that can sense the cars in front of them, blind spot sensors that can see cars to the side, and lane sensors that can track lane markings. Vehicle to vehicle communication is nearly a reality too, and the technology has been successfully demonstrated in Europe in the form of road trains.

http://spectrum.ieee.org/automaton/robotics/industrial-robots/sartre-autonomous-car-platoons

The European project SARTRE focuses on an alternative to single, completely autonomous vehicles such as those developed at Google by Sebastian Thrun or those of the autonomous taxi developed by the AutoNOMOS Project or by the MadeInGermany project, both by Raúl Rojas. Instead, SARTRE develops road trains - convoys of vehicles that autonomously follow a lead vehicle driven by a professional driver.

Such vehicle platoons function much like an improved version of adaptive cruise control, matching a car's movements to the distance, speed, and the direction of the car in front. Once in a platoon, this allows drivers to relax and do other things like reading or even taking a nap while the platoon drives toward its long distance destination.

The project participants hope that platooning will not only improve road safety, but also drastically reduce fuel consumption, cutting it by up to 20%, with a similar cut in emissions. In addition, platooning is expected to reduce traffic congestion, because it will allow cars to travel at highway speeds with only a few meters between them.

http://thenextweb.com/insider/2012/08/06/connected-cars-intelligent-vehicles-hit-german-roads-in-4-year-trial-to-improve-road-safety/

The fleet of 120 cars in the research project will test the latest car-to-car and car-to-infrastructure communications, and there are hopes that roads will become safer as a result of removing human error from the equation. So what's being tested? Well, for example:

- Electronic brake lights: This delivers a message from the lead vehicle to a following vehicle if an emergency braking procedure is carried out, even if the incident occurs out-of-sight, for example around a bend in the road
- Public traffic management: Providing exact traffic prognosis based on available information, thus easing congestion
- Obstacle warning system: Enabling vehicles to inform other road users of the presence, position and type of potentially hazardous obstacles on the road
- Traffic sign assistant: This remains in continuous contact with traffic management centres to access up-to-date information on variable speed limits, temporary restrictions and diversions; as well as providing details of current and approaching permanent regulations, such as fixed speed limits and right of way

http://www.kpmg.com/us/en/issuesandinsights/articlespublications/pages/self-driving-cars-next-revolution.aspx

For 125 years the automotive industry has been a force for innovation and economic growth. Now, in the early decades of the 21st century, the pace of innovation is speeding up and the industry is on the brink of a new technological revolution: "self-driving" vehicles.

The new technology could provide solutions to some of our most intractable social problems—the high cost of traffic crashes and transportation infrastructure, the millions of hours wasted in traffic jams, and the wasted urban space given over to parking lots, just to name a few. But if self-driving vehicles become a reality, the implications would also be profoundly disruptive for almost every stakeholder in the automotive ecosystem. As one industry executive put it, "Everything, from how we move goods to how we move ourselves around, is ripe for change."

KPMG LLP and the Centre for Automotive Research (CAR) collaborated on this report, interviewing leading technologists, automotive industry leaders, academicians, and regulators to develop hypotheses on how self-driving vehicle technology could unfold and its potential impacts. It is clear from our research that any company remaining complacent in the face of such potentially disruptive change may find itself left behind, irrelevant.

An essential implication for an autonomous vehicle infrastructure is that, because efficiency will improve so dramatically, traffic capacity will increase exponentially without building additional lanes or roadways. Research indicates that platooning of vehicles could increase highway lane capacity by up to 500 percent. It may even be possible to convert existing vehicle infrastructure to bicycle or pedestrian uses. Autonomous transportation infrastructure could bring an end to the congested streets and extra-wide highways of large urban areas. It could also bring the end to battles over the need for (and cost of) high-speed trains. Self-driving vehicles with the ability to "platoon"—perhaps in special express lanes—might provide a more flexible and less costly alternative.

# 8. Conclusion

Referring to the Commuter Cars case study, a mass-produced fleet of 100,000 plus electric narrow Microcars will provide the following benefits:

- Solve motorway congestion within 4 years time
- Solve residential street congestion within 6 years time
- Add significant capacity to both the motorway and residential road networks
- Improve the bus network due to the reduction of peak time congestion across Auckland
- Provide a gross profit of $1.12B over ten years from the fleet of leased vehicles
- Provide an asset ready for sale or refurbishment of $200M at year 10

There are other significant benefits that will follow the creation of a Microcar manufacturing industry.
Below is a brief list:

- Reduced motorway network investment required
    - A second Harbour bridge at a cost of $5B may not be required until next century
    - Other significant AT and NZTA projects in the $60B plans may not be required until next century
    - Motorway and residential congestion in Wellington would also be solved therefore deferring major transportation projects until next century
- Reduced public transport investment and subsidies required
    - The ICRL at a cost of $3B may not be required until next century
    - The current $100M AT and NZTA per year transportation subsidy may be reduced due to a more efficient and profitable public transport network
- Reduced road maintenance due to the Microcar using different surface areas of the road
    - $1B per year or half of Auckland's rates is currently spent on local roads. This could potentially be halved due to Microcars providing an even wear of the roads
- Improved bus transportation network
    - Due to residential and motorway networks no longer being congested
- Dedicated single occupied vehicle lanes
    - Improved overall traffic flow of vehicles in the dedicated lanes
    - May also result in more conversions to private motorbikes
- Completion of cycleway networks as a result of new available funding
- Training and employment opportunities provided by the Microcar industry
- New innovative businesses around Intelligent Motorway and Smart car technologies
    - Opportunity to create other high-tech industries and export businesses
- Economic improvement due to removal of motorway congestion costs
- Economic improvement due to new revenue from the Council operated Microcar fleet
- New business and investment due to removal of motorway congestion costs
- Increased immigration by skilled professionals who want to live in an uncongested city
- Reduced greenhouse gas emissions as people upgrade to Microcars
- Increased international coverage of Auckland as the most liveable City in the World
    - This could result in increased tourism, investment, migration and innovation as above

The alternative is to continue making the same transport mistakes over an over again which eventually will lead to a major financial crisis and a huge downwards spiral of Auckland's economy.

The significant benefits and opportunities speak for themselves therefore I encourage you to send all comments and support to feedback@projectmicrocar.co.nz so that we can contact you in the future on the development of this revolutionary project.