Introduction to Cable Cars (Part A): A Case for Urban Cable Cars in New Zealand

Executive Summary

The use of cable cars in New Zealand for public transport, as opposed to tourism, purposes is a new concept. While they are already in use extensively around the world in many locations including Portland (Oregon, USA), Mexico City (Mexico), La Paz (Bolivia), London (UK), Toulouse (France), Luxembourg, and Haifa (Israel), they are a new travel mode for New Zealand. With the increasing pressure on our urban transport networks, particularly for limited road space, finding smarter ways to use our transport network is essential for the ongoing prosperity and functioning of our cities.

This report provides an introduction to what is meant when aerial cable cars are discussed as a public transport option, how they work and the opportunities for their implementation across New Zealand.

Cable cars can address several of the key transport challenges facing New Zealand cities, including congestion, air and noise emissions as well as severance between our communities and the places we work, live and enjoy. The report also identifies several opportunities for cable cars in major New Zealand urban areas, Auckland, Hamilton, Tauranga, Wellington, Christchurch and Queenstown.

Fundamentally, the aerial cable car offers a reliable, efficient, and low emission transport mode, addressing regional and urban congestion and enhancing connections between communities. They are not just an isolated solution, but fit as part of a fully integrated, multimodal transport concept that meets the demand of the people.

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1. Introduction

As our cities are growing, the pressure on our transport network is increasing. Over the last 10 years, the number of vehicles on our roads has grown significantly, including a 50% increase in vehicles in Auckland alone. It is not feasible to keep expanding our road network as there is neither the space nor the money to deliver it. We cannot road build our way out of congestion.

To respond to these challenges, we need to change our thinking about how we move about our cities. For the last 50 years, the private car has met our needs, whether that was for commuting, business, or recreational purposes. It was able to fit seamlessly onto a road network that also catered for our freight needs carrying foodstuffs to supermarkets or materials to building sites; the needs of our tradespeople, taking the plumber, the builder or the electrician to their jobs; and our public transport system, among many other uses. However, with our networks at capacity, we need to find a better way to use road space effectively and efficiently.

This new approach is reflected in Government and local policies which are seeking to increase the uptake of walking, cycling and public transport while reducing congestion and emissions as we look to adapt to better forms of mobility.

To date however, our thinking has been primarily focused on better use of the existing roadways. This has seen the proliferation of transit lanes (bus only or T2/T3), the removal of on-street parking to provide additional lane capacity and the widening of footpaths and cycle lanes. While these are all extremely beneficial approaches, they have two key limitations:

- we are running out of road space to reallocate, and,
- they are generally dependent on the existing network of streets and roads.

We need to rethink our approach.

One innovative approach, for New Zealand at least, but which has been operating successfully overseas for decades, is the aerial cable car, ropeway, or gondola. While we may be familiar with these for tourist purposes, such as in Rotorua, Queenstown, or Christchurch, or in relation to ski field operations, there is significant potential to consider them as part of the public transport system.

This is Part A of a three-part analysis which considers how cable cars may be suitable as public transport service offering. Part B provides more detailed commentary on the policy, consenting and installation considerations for cable cars and Part C looks at specific opportunities where they may be appropriate.

2. How Can Cable Cars Support Public Transport?

At its most basic, public transport is about moving people from one area to another in an efficient and affordable manner. Fundamentally it involves meeting the customer's needs, and successful public/urban transport systems demonstrate this by becoming a traveler's *mode of choice*. This requires consideration of the following characteristics:

- ✓ **Connecting people where they want to go**. If public transport does not provide connections to and from key destinations, people will not use it.

- ✓ **Service frequency.** When deciding whether to walk, bike, use public transport or drive, the customer is seeking the ability to choose when they want to go. If they have an unacceptable delay to their journey, such as through poor levels of frequency, they will select a different a mode.
- ✓ **Scalable.** Urban cable cars operate at full capacity all the time and have a modular nature. Routes can also be extended easily if required
- ✓ **Reliable journey times.** When travelling, we want to have a travel time that is consistent across the day, week, or year. If travel times vary dramatically, such as due to congestion or poor service levels, the user cannot rely on it and either must allow significant additional time for their journey or must choose a different mode. When public transport patrons are considering mode choice, travel time is a key factor. The aerial nature of urban cable cars, which avoids ground-based travel time issues such as congestion, offers a competitive travel time.

I now leave 45mins earlier than I used to, because congestion varies so much, to ensure I make my appointments on time.
Real Estate Agent - Auckland

- ✓ **Integration into existing public transport networks.** Urban cable cars can be easily integrated as part of a wider strategic multi-modal public transport network. For example, existing ticketing systems can be used for cable cars.
- ✓ **Space saving.** Modern transport solutions do not have to take up large amounts of space or displace people from their communities and homes. Unlike traditional modes of public transport that need to factor in considerations such as extra space for stations, depots, vehicle lanes, stabling and proximity to residential areas (due to noise, pollution etc.), cable cars build upwards and only need minimal space for towers (as little as 4-10m2) and garaging. Stations are also built into existing infrastructure where possible, such as malls and commercial buildings, limiting the need to build outwards.

Cable cars are one of the most effective ways of delivering an attractive public transport mode. One of their greatest benefits is consistency, as cable cars are unaffected by traffic, congestion, or road works. This also means reliable headways for passengers – when travelling on traditional modes such as a bus, it is common to wait for a delayed service and then have more than one of the same bus arrive at one time. Such occurrences in a cable car system are virtually impossible as the cabins move interdependently. Passengers are connected to key locations quickly and easily, with operations of high frequency and capacity allowing all user groups to just turn up and go without needing to plan their journey around or consult timetables.

2.1 Where can Cable Cars be used?

Cable cars can be used in a range of different ways:

- ✓ Bridging gaps: where geographical or other barriers mean that other modes cannot travel e.g., rivers or valleys
- ✓ Connecting two sites: providing a link from point A to point B
- ✓ Network extension: providing links to existing networks such as rail or BRT stations
- ✓ Congestion relief: taking pressure of existing congested road corridors or PT systems
- ✓ Network creation: where dense urban forms or challenging topography mean traditional, road based, transport solutions are not feasible.

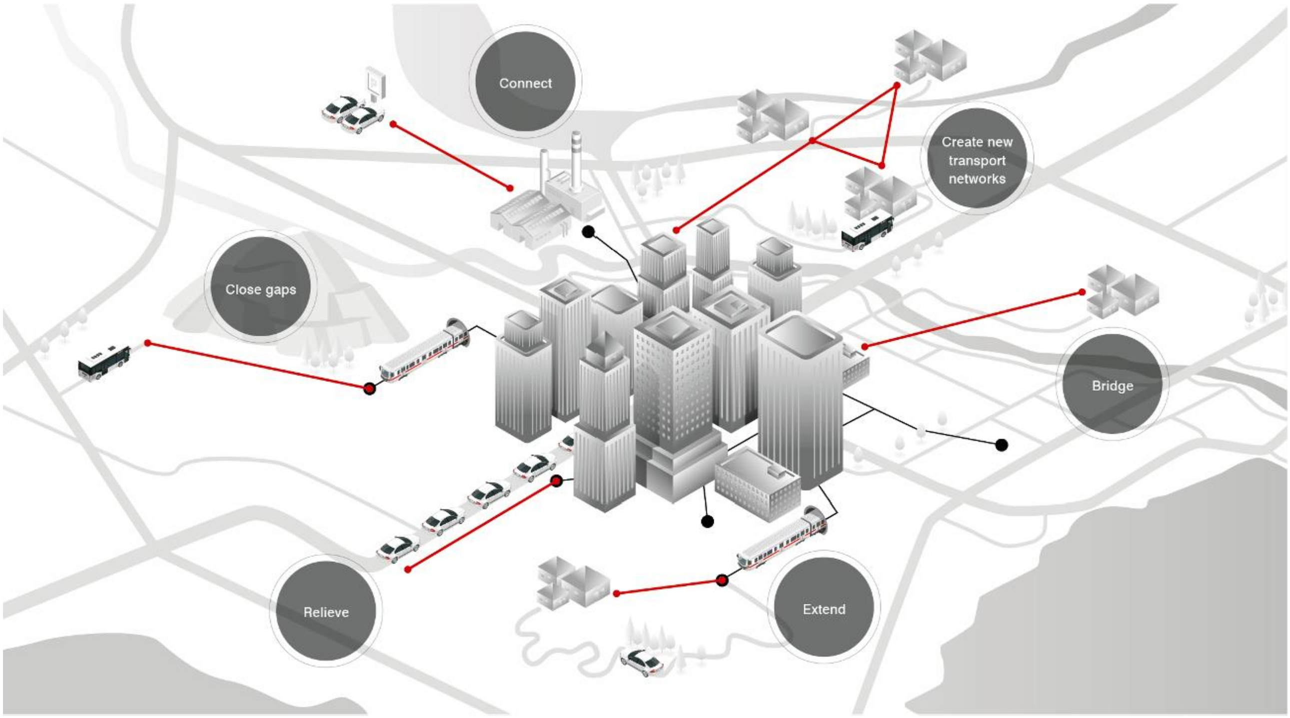


Figure 2-1 Cable Car Uses

Portland, Oregon, USA

Operating since December 2006, the cable car, known as the Portland Aerial Tram, can carry 79 people per cabin, and links the Oregon Health and Science Hospital with the South Waterfront district. It addressed both a relatively steep gradient and a relatively indirect road network, providing a key link into the wider Portland public transport system. With a 5-minute travel time, it is a highly competitive and attractive alternative to the other choices: a 45-minute bus ride, a 27-minute bike ride, a 30-minute walk, or a 12-minute car journey.

2.2 How Efficient are they?

Cable cars can operate in a range of different ways, depending on the requirements needed. With smaller cable cars and lower frequency, they can move a similar number of people to a normal bus. As passenger demand increases, their capacity and frequency can also increase and be comparable to trams, bus rapid or light rail schemes.

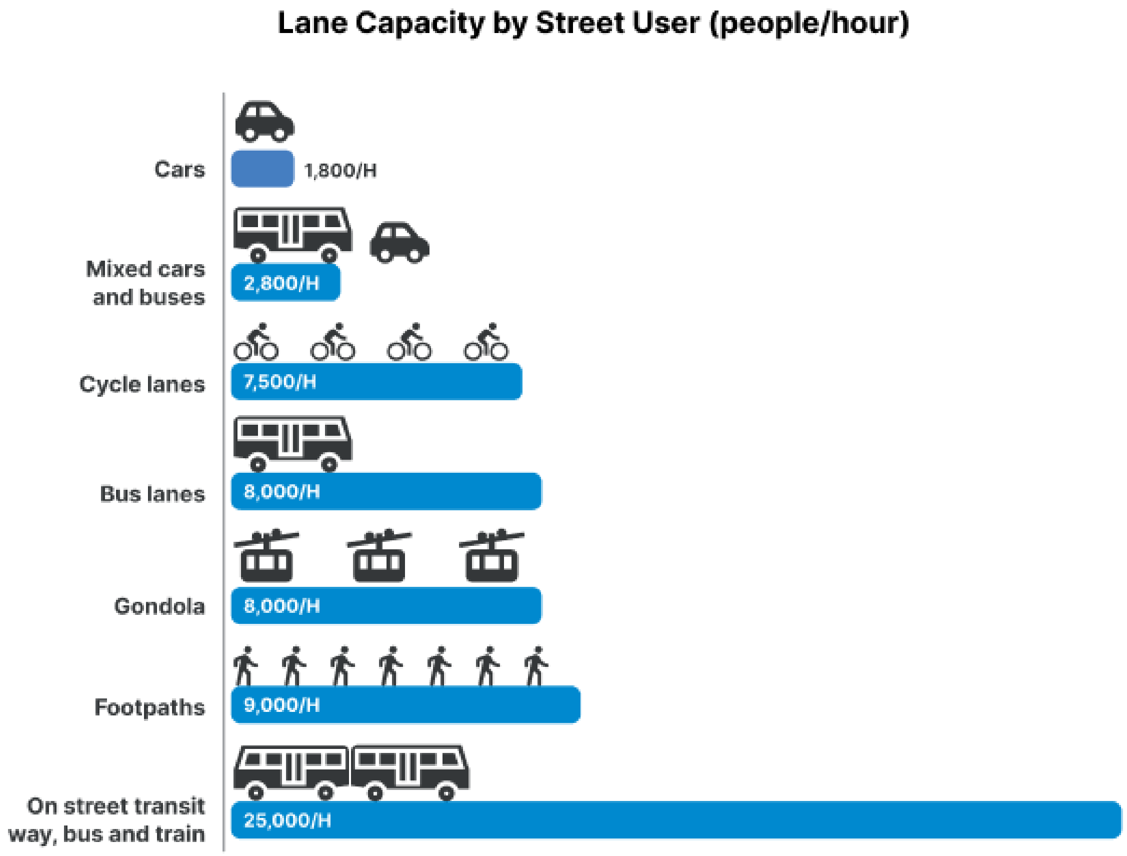


Figure 2-2 Cable Car Passenger Capacity per Hour (Cable car figures are bi-directional)

Figure 2-2 shows the carrying capacity of cable cars compared with other modes, for similar lane widths. Key to note is that while most modes compete for the same road space, such as mixed traffic and bus lanes or tracks, cable cars are completely segregated without compromising the capacity of the existing network – they provide a net addition to network capacity which will also help to reduce travel time. It must also be recognised that the different modes have different spatial requirements as well as operating speeds and these need to be considered as part of the assessment process.

Due to their flexibility, cable cars can also be used over relatively short distances, while other modes such as trams or light rail, generally require greater distances due to offset their higher cost as shown in Figure 2-3

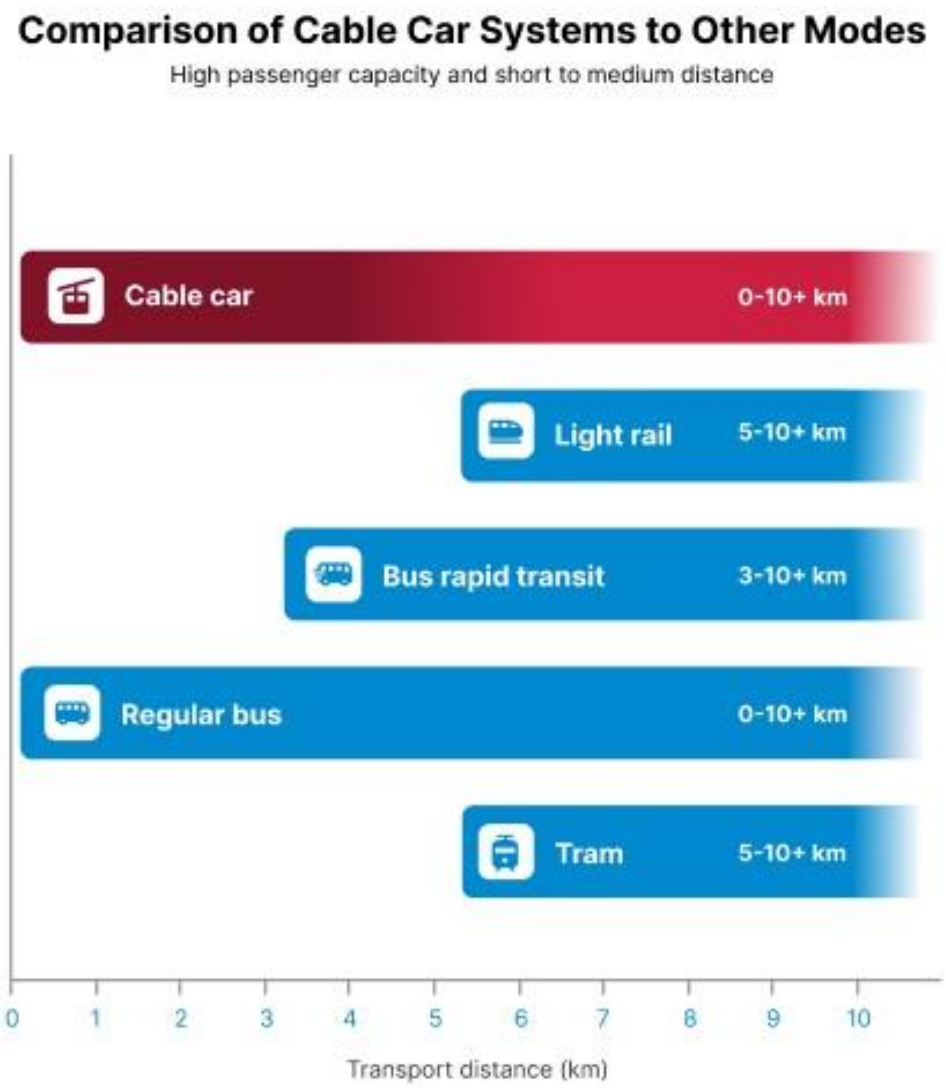


Figure 2-3 Public Transport Operating Distances

3. What do we mean when we say Cable Car?

In simple terms, a cable car is a transport system linking two or more fixed points, with a vehicle that is moved by a rope (cable).

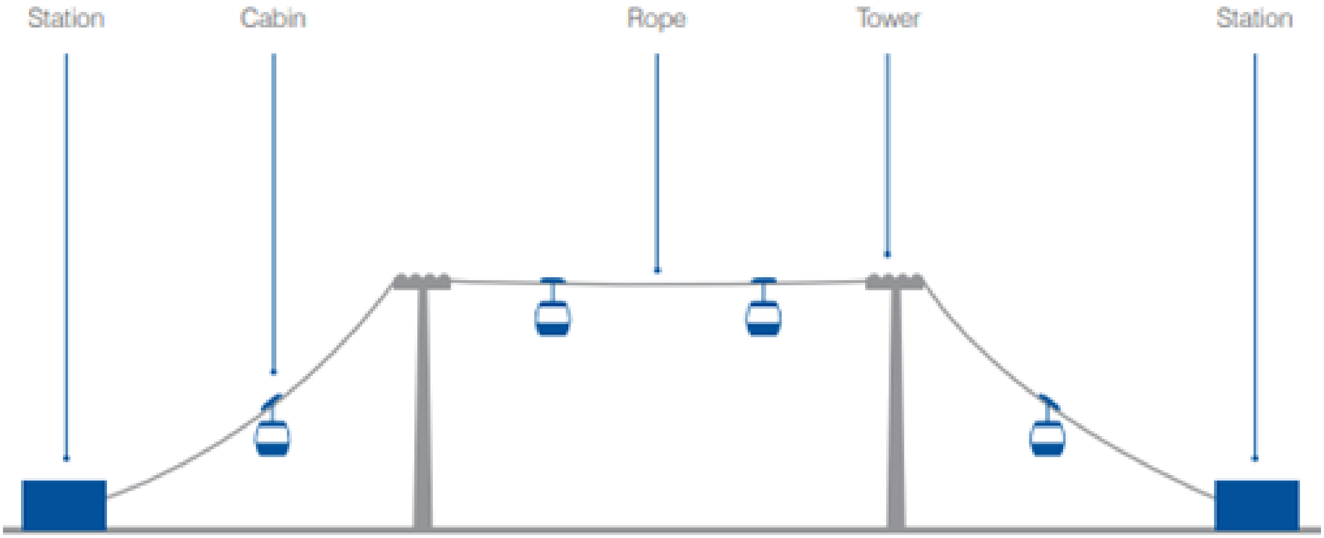


Figure 3.4 Components of a Cable Car

The steel rope, called a haul rope, runs between two end stations, and is powered by an electric drive system which makes the rope move.

Attached to the rope are the cabins for passengers, which generally range in capacity from 8 to 35 passengers, however the largest cabins can carry up to 230 passengers. For comparison, a standard urban bus in Auckland has 45 seats. Cabins, and their access, are completely step free providing universal access.

The majority of cable car systems implemented to date are monocable (one cable) detachable gondola systems. A recent innovation is the development of a tri-cable (three cable) system which enable larger cabins to be operated in more challenging environments e.g., across longer spans (up to 1km) and in stronger wind locations.

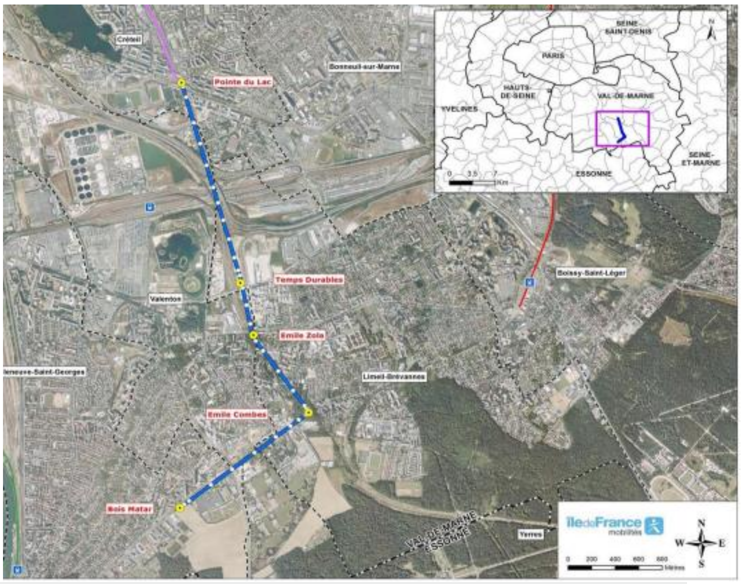
3.1 Cable Car Stations

Stations provide the passenger boarding and alighting facilities and can be standalone structures, incorporated into other buildings, built over roads or even underground.

Figure 3.5 Examples of Standalone structures, Bridge or Incorporated Stations

Paris, France

The C1 cable car in Paris, currently under construction, traverses 4.6km with five stations supported by 30 towers approximately 160m apart. The cabins have a 10-seat capacity and run every 30 seconds during the peak and off-peak, enabling the system to carry up to 2,000 passengers per hour per direction.



The journey time will be approximately 18minutes, compared to 75mins walking, 27mins by bike, and 35mins by bus and about 15mins by car. A key benefit of the cable car is that due to its elevated nature, it is not affected by the road network which enables it to travel directly across major road and rail links without the need for additional bridges or accessways. It also adds another layer of multimodal travel to the network, as the cable car will be connected with bus services and cycle lanes for enhanced last mile connectivity.

The steel rope is suspended between stations by towers. The distance between towers can vary depending on the specific type of system deployed, as well as topography and local wind speeds. While the size of the towers are dependent on the system requirements, they are likely to be a minimum of 4m2 at the base with heights varying depending on the local conditions. In the Paris example, they vary between 14m and 55m in height.

As a fixed cable way system, a cable car route can only follow direct lines between stations, however it can change direction at a station. This straight route approach is a key benefit of the system as it connects stations in the most direct way.

A key benefit of the cable car approach is that it requires no additional infrastructure on the ground – just the passenger stations and intermediate towers.

Environmental impact

Cable cars are one of the most sustainable modes of public transport. e

Based on overseas examples, it has been calculated those modes ranging from trams to buses to minivans, emit the equivalent of 350% to 450% more CO_2 eq compared to a cable car.

Cable cars are also 100% electric, and with New Zealand's high proportion of renewable electricity generation, the usage would emit very little CO_2 e compared to other modes.

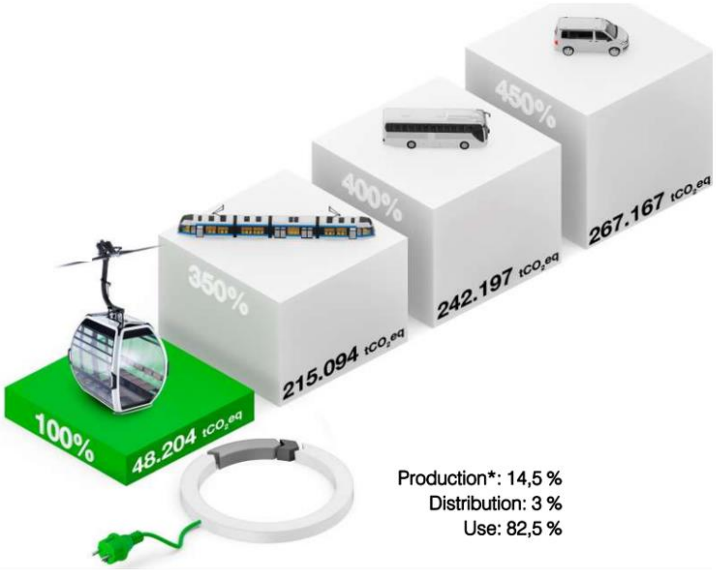
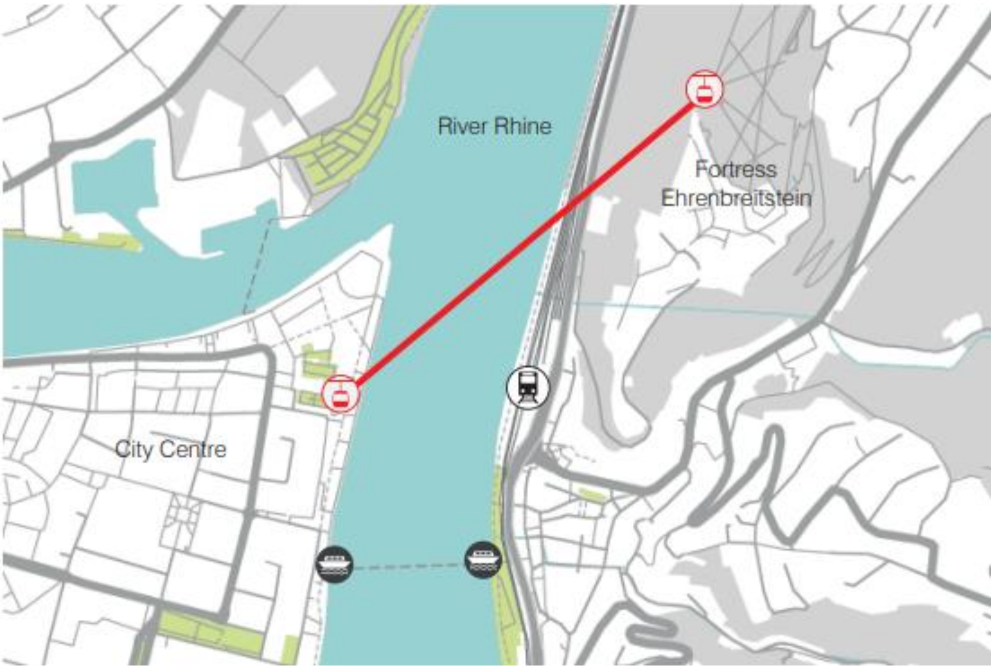


Figure 3.1 Comparison of emissions produced from various PT modes in Bolivia (2019)

Koblenz, Germany

The Koblenz cable car was constructed to transport visitors attending a horticultural show in 2011 from the city centre to the show site at Ehrenbreitstein. Its implementation addressed the issue of crossing the river Rhine to access the site, which previously required a detour via a bridge and then travelling on one narrow and winding street up the hill. With high projected visitor numbers, the city was looking at major traffic congestions on the only access road. The cable car solution reduced the trip time to 4 minutes, a significant improvement from the 25-minute travel time by bus (without congestion). It also avoided bus trips and transported over 5.7 million passengers over 6 months of operation during the show, with a capacity of 3800 pphpd. The Koblenz cable car is a tri-cable system that can withstand wind speed of up to 100 k/h and does not obstruct shipping operations on the river Rhine.



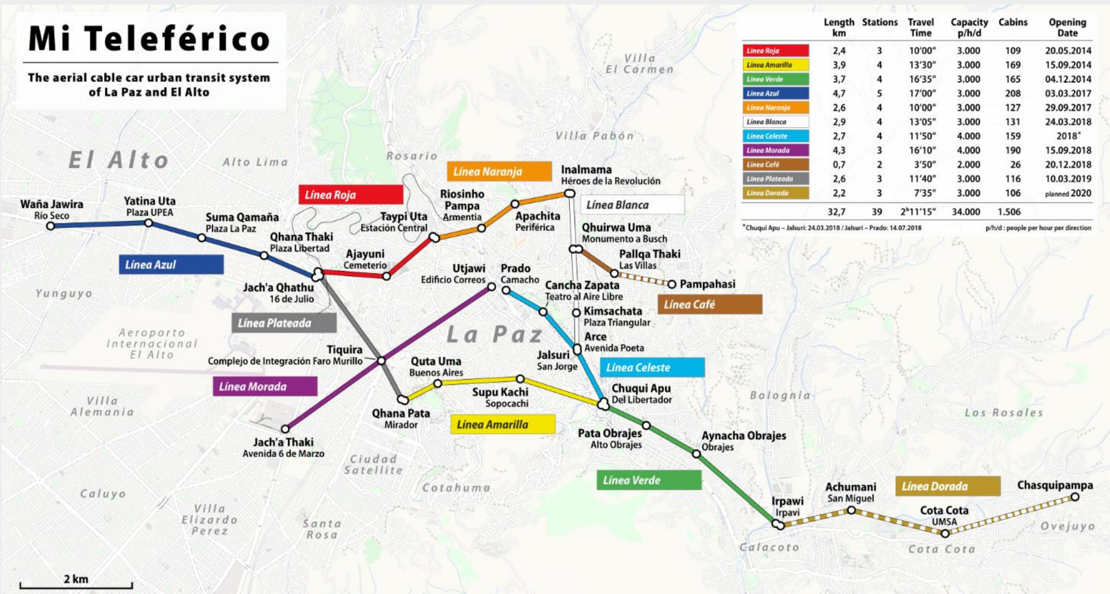
Mexico City, Mexico

In 2021 Mexico City opened Cablebús Línea 1, an almost 10km long urban ropeway connection that directly links the 3.5 million residents of Cuautepec to the city's largest transport hub, Indios Verdes, where passengers can easily transfer to the bus and metro. The cable car has shortened journeys by up to a half and can accommodate 4,000 people per hour in each direction. Construction and operation of the first line of the network has directly created 300 jobs, with the improved mobility gained from the cable car also boosting the economy of the surrounding area.

Through the construction of the cable car, former lady major of Mexico City improved social equity by improving public transport, creating open public spaces, and bringing social services to underserved areas.

La Paz, Bolivia

Commencing with its first line 2014, the La Paz area in Bolivia now has the largest cable car network in the world. Originally it was introduced to address a significant topography challenge as the two initial communities were separated by a 400m vertical drop, linked by only a few congested, winding roads. The stations were also designed to be multi-modal hubs that connect with buses. Combined this has enabled the citizens to have a significantly safer and quicker journey than otherwise, and its success has seen the service extended to a total of 10 lines, varying in length between 700m and 4.7km and carrying over 300,000 people per day.



	Length km	Stations	Travel Time	Capacity p/h/d	Cabins	Opening Date
Línea Roja	2,4	3	10'00"	3.000	109	20.05.2014
Línea Amarilla	3,9	4	13'30"	3.000	169	15.09.2014
Línea Verde	3,7	4	16'35"	3.000	165	04.12.2014
Línea Azul	4,7	5	17'00"	3.000	208	03.03.2017
Línea Naranja	2,6	4	10'00"	3.000	127	29.09.2017
Línea Blanca	2,9	4	13'05"	3.000	131	24.03.2018
Línea Celeste	2,7	4	11'50"	4.000	159	2018*
Línea Morada	4,3	3	16'10"	4.000	190	15.09.2018
Línea Café	0,7	2	3'50"	2.000	26	20.12.2018
Línea Plateada	2,6	3	11'40"	3.000	116	10.03.2019
Línea Dorada	2,2	3	7'35"	3.000	106	planned 2020
	32,7	39	2h11'15"	34.000	1.506	

*Chuqui Apu – Jalsuri: 24.03.2018 / Jalsuri – Prado: 14.07.2018

p/h/d : people per hour per direction

4. Would Cable Cars Work in New Zealand?

Cable cars are not a perfect solution but can provide significant advantages compared to traditional road based transport solutions in the right circumstances such as:

- ✓ A 'first/last mile' connection – connection of two sites, combined with micromobility solutions for the first and last mile
- ✓ Linking separated facilities – a campus, university or commercial centre is disconnected from its immediate surroundings
- ✓ Road connections are constrained – winding or congested road networks that have slow travel times or poor safety outcomes
- ✓ Height differences between key attractions and high demand areas – particularly where road connections may not be appropriate or safe
- ✓ Rivers or valleys separate communities and a bridge is not feasible or appropriate
- ✓ Enhanced public transport capacity is required but road space is also required for freight and other vehicle purposes
- ✓ The delivery of sustainable and emission free travel is required.

The following examples demonstrate how cable cars can provide an efficient and low emissions public transport option suited to New Zealand's unique landscape and needs.

Mount Maunganui, Arataki and Papamoa to Tauranga City Centre

Mount Maunganui is a popular part of Tauranga with a bustling commercial/ retail area with a high residential population that also receives significant numbers of tourists throughout the year.

Due to limited road capacity and bus priority congestion is often significant, creating frustration for residents and visitors which also leads to environmental & financial costs. The introduction of a cable car, see Figure 4-1, connecting the Mount with nearby attractions such as Bayfair Mall or Tauranga city centre, would immediately relieve congestion and reduce travel times with improved reliability.

Figure 4-1 Tauranga route opportunity

At peak times, such as New Year, when the population can increase by over 20,000 visitors, the transport network struggles to cope. With a flexible cable car system, it is easy to increase the capacity from a few hundred per hour, up to 8,000 people per hour. To move a similar number of people by road would require over 2,000 cars with 4 people per car (including parking spaces) or over 200 buses. A fuller analysis of demand is included in Part C of this document.

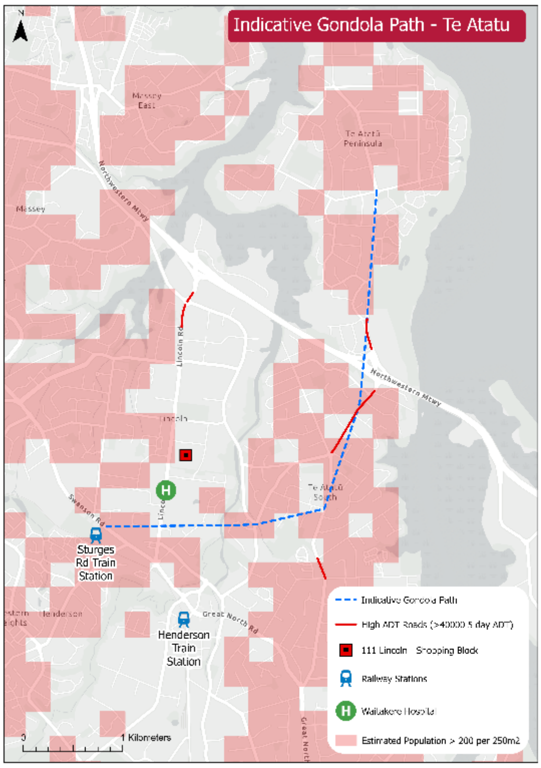


Figure 4-2 Te Atatu route opportunity

Te Atatu Penisula, Auckland

The Te Atatu Peninsula presents an opportunity for cable cars to provide a competitive transport option to move people from the Peninsula to the Henderson.

A point to point analysis shows that a cable car could connect residents to nearby workplaces and amenities, such as the Sturges Road and Henderson train stations and other destinations along the Western Line, Waitakere Hospital, Trusts Arena, food and retail centers, and numerous schools. It could also provide a connection to a future North West MRT line.

Figure 4-2 shows a potential route linking Te Atatu Peninsula to Henderson. Poor public transport connectivity means that the equivalent travel by bus can take up to 28-minutes and with increasing congestion due to limited road networks and a growing population, travel times from the peninsula are deteriorating.

A cable car system would be able to address the bottle neck issue of Te Atatu Penisula as the elevated infrastructure can bypass ground level congestion and densely populated urban areas reducing travel times and traffic congestion. See Part C of this document for further consideration of the Te Atatu demand profile.

Wainuiomata, Lower Hutt

Wainuiomata is a large suburb of Lower Hutt in the Wellington region with a population of approximately 19,000 people. Separated from Lower Hutt central by the hills, direct access is limited to only the Wainuiomata Road. Across the Hutt Valley, there are linkages to the Waterloo train station, Queensgate Shopping centre, and Melling stations which can provide rail access to Petone and Wellington CBD.

With over 13,200 daily trips made in, and between Wainuiomata and Melling/Hutt Valley this is a key link for local residents.

Figure 4-3 Wainuiomata route opportunity

A cable car linking Wainuiomata and Melling, across the valley, would ease congestion and provide a pathway over the steep topography of the regional park. Additionally, if a stop was provided at the top of the hill, additional benefit could be provided for tourists wishing to take in the views as shown in Figure 4-3

Figure 4-4 Riccarton to Papanui route opportunity

Riccarton to CBD to Papanui, Christchurch

Greater Christchurch is the second largest metropolitan area in New Zealand and is projected to have a population of over 700,000 people in the next 25 years.

Increasing congestion on routes into the central city[1], particularly along the Riccarton and Papanui Road corridors are increasing travel times, localised emissions and impacting local communities. Shifting to an aerial cable car operation can provide an opportunity for efficient travel times, without impacting road capacity, and enhance the ease and attractiveness of travel along the corridor.

By linking key shopping centres, schools, Christchurch Public Hospital, the University of Canterbury and the central business district, a cable car would enhance and optimize the existing public transport network, thereby significantly reducing travel times while increasing economic and employment opportunities for residents. We also consider the tourism opportunity by assessing demand for a Christchurch airport link to the CBD.

5. Summary

As our cities have grown, the pressure on our transport network has grown as well. We have now reached the effective capacity limits in our cities and need to be smarter about how we use the network.

For many purposes, private vehicles are essential, such as for freight, trades people and those with limited mobility. For the majority of private trips however, road based public transport can be a viable solution but due to congestion and route limitations, it often does not provide the service that is required. Cable cars can address this through removing the physical barriers that can limit connectivity as they can easily traverse rivers, roads, parks and other constraints, with no significant impact. Operating on a completely separated basis, while also allowing for additional interchanges and integrating seamlessly into the public transport network, travel times are consistent and reliable providing a much greater level of customer benefit compared to other modes.

Giving consideration to cable cars as a viable public transport offering can help address the many challenges faced by other public transport modes, and help provide the step change required to see our cities develop in the 21st century.

[1] More information can be found in the PT Future IBC. This can be provided on request.

6. Frequently Asked Questions

Q. I have limited mobility, can I use the cable car?

A. Yes, cable cars are designed to accommodate those with accessibility needs. Cable cars have step free access and easy boarding and alighting, so those using wheelchairs or having mobility impairments can board comfortably without feeling rushed.

Q. Can I take a pram/bike onto the cable car?

A. Yes, step free access allows for prams and bikes to be taken board. Folding seats creates space for their carriage.

Q. What happens during bad weather?

A. Cable cars are designed to be very secure and can operate safely under harsh climate conditions- such as in winds up to and above 100 km/h.

Q. How long does it take to construct a cable car network?

A. Construction of a cable car network typically takes less than two years – with minimal disruption as it does not involve road works. For comparison, the Bolivian city of La Paz constructed 3 gondola lines spanning 10km in just under two years. The Bergen Light Rail (Norway) is of similar size and took five years to complete 10km of track.

Q. How much room is needed to construct a cable car network? Will buildings be demolished?

A. Cable cars are one of the easiest transport networks to install and may require only relatively minor construction. Stations are ideally integrated into existing buildings and are off road. Intervening towers (that connect the cables) may have a footprint of as little as $4m^2$. The specific requirements for new stations will depend on the specific locations being considered and the interface with adjacent structures. In general, a 16 – 20m wide movement corridor is required as cable cars move into and out of stations.

Q. Will the cable car go past/over my property? Will passengers be able to see inside my home?

A. Cable cars are planned and designed with the privacy of surrounding neighbourhoods in mind. Wherever possible, cable cars are built along existing roadways and over public spaces. The height of a cable car (typically 20m-70m), the design of windows to prevent downward views, the availability of 'smartglass' that can render window glass opaque, are among the measures that can be used to prevent passengers being able to look down and see inside your home if needed.

Q. Will the cable car be noisy? Will it disturb my pets/wildlife?

A. Cable cars are one of the quietest modes of transport, particularly when compared to road or rail-based modes. They are fully electric and emit minimal noise. This has enabled cable cars around the world to be installed in highly populated residential areas.

Q. How much would it cost to ride the cable car? Can I use my transport card (e.g. AT HOP card)?

A. Every public transport system is subsidised. This will also apply to the urban cable car if it is fully integrated as part of the public transport network and should allow for seamless multimodal trips with your transport card or ticket for a similar fare.

Q. Are cable cars and stations safe? How can I contact staff?

A. All cable cars and stations have the highest level of security. They are well-lit and fitted with CCTV, stations are also staffed during operating hours. Cabins are equipped with systems that enable passengers to talk to operators at any time.

Q. How structurally sound are cable cars? What happens during an earthquake or a power cut?

A. Cable cars are among the safest modes of transport and are built to the highest standards. Cable car systems operate across the world, including in areas subject to significant seismic activity.

In the event of a breakdown, cabin recovery systems move the cabins into a station where passengers can alight. In tri-cable gondola detachable ropeways this approach is called ‘redundancy’, where all functionally relevant parts and equipment are duplicated and independent of one another. This means that each cabin always has a backup system available to ensure that passengers are safely returned to the nearest station if needed.

Q. Are cable car systems environmentally sustainable?

A. Cable cars are one of the most energy efficient means of transport available today. They are fully electric and can be powered by renewable energy. Other than initial construction, cable cars have a very low carbon footprint and emit almost zero emissions.

Q. Are they expensive?

Cable cars are also advantageous in terms of savings in cost and construction time. Generally, they are a third of the cost of light rail, and one tenth of the cost of underground train systems. For routes up to 10km distance, a cable car has greater flexibility of operation and a lower cost of operation compared to alternative modes.

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