



The transport capacity of a cable car system in public transportation

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AGENDA

1. STATISTICS

2. EXAMINED CABLE CAR SYSTEM

3. MEASURES TO INCREASE EFFICIENCY DURING PERIODS OF LOW-CAPACITY UTILIZATION

4. COMPARISON OF ALTERNATIVE CONFIGURATIONS

5. SUMMARY

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STATISTICS

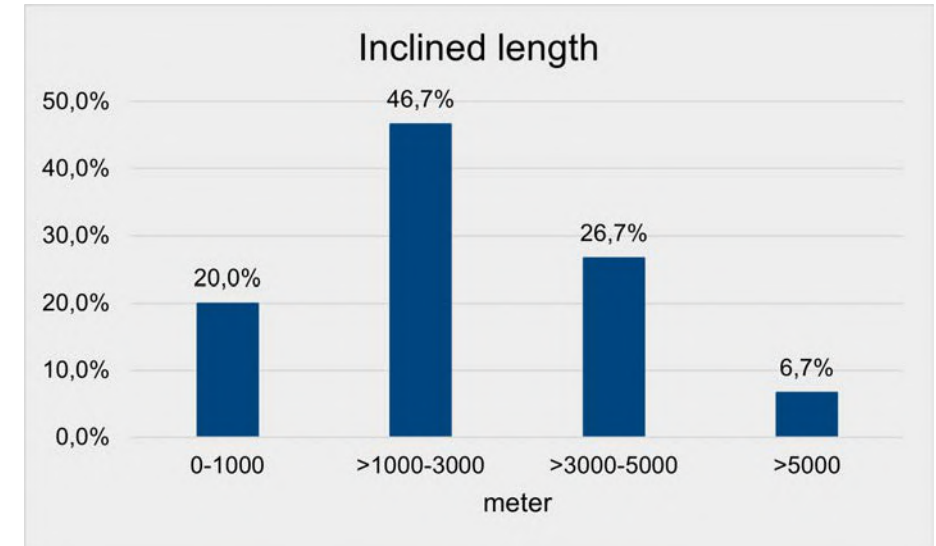
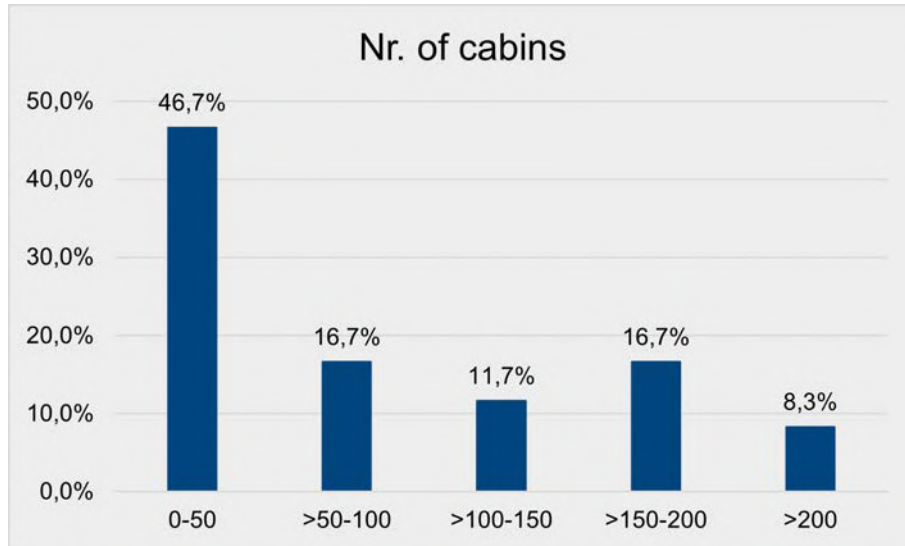
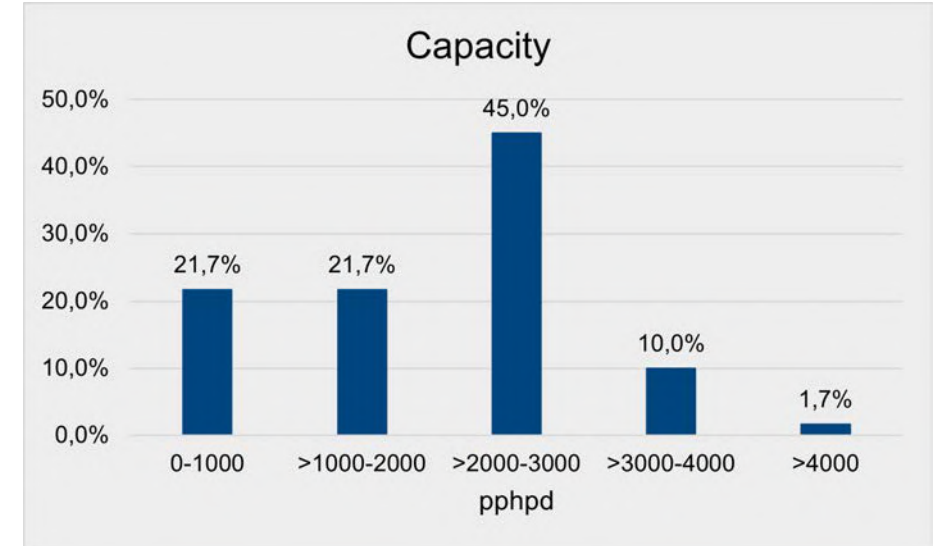
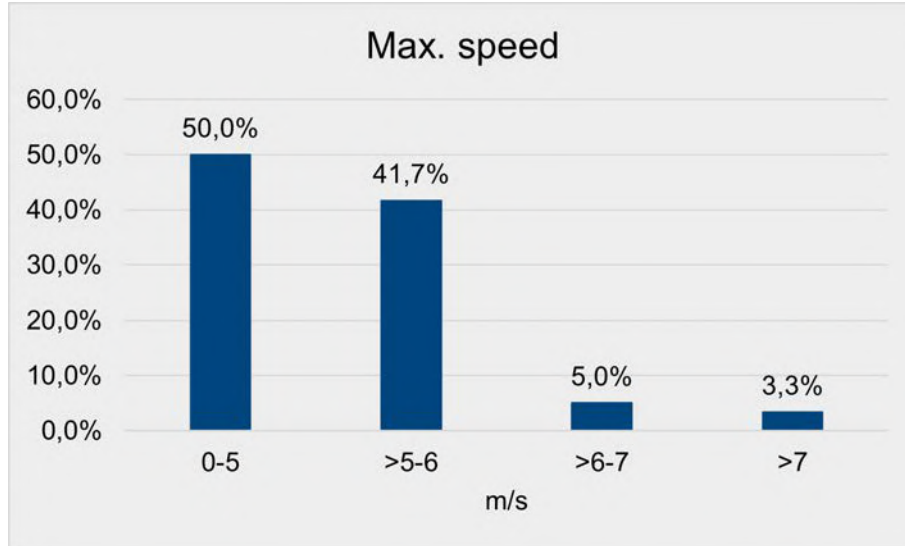
Distribution of urban cable cars worldwide



- Urban, aerial cable cars (not touristic)
- Built between 2004 & 2023
- 3 biggest manufacturers
- In total 60 installations, counted as cable car lines

STATISTICS

Statistics urban cable cars



1. STATISTICS

2. EXAMINED CABLE CAR SYSTEM

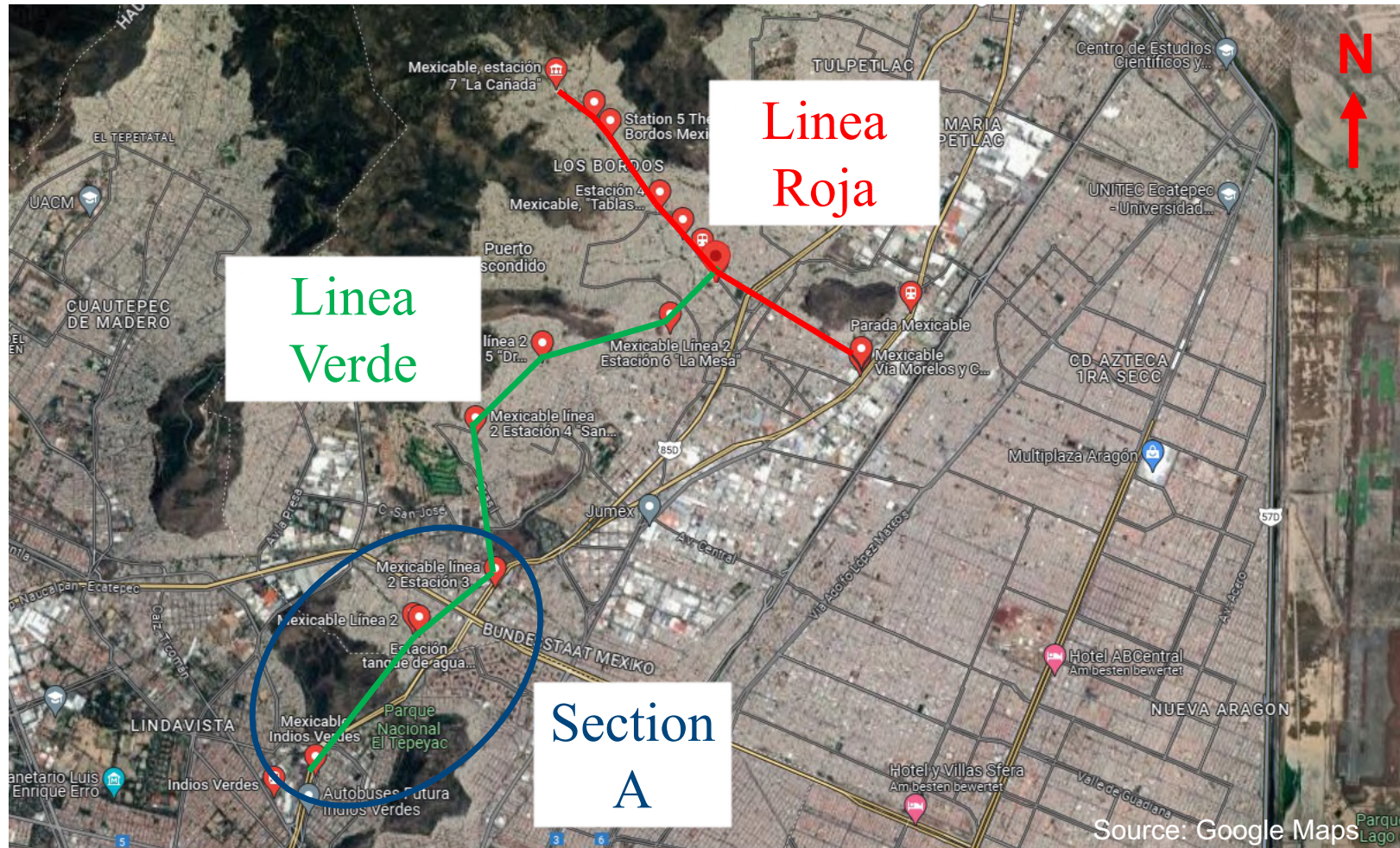
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EXAMINED CABLE CAR SYSTEM

Line routing of Mexicable network (Mexico City)



EXAMINED CABLE CAR SYSTEM

Line routing of Ecatepec Linea Verde - A (Mexico City)



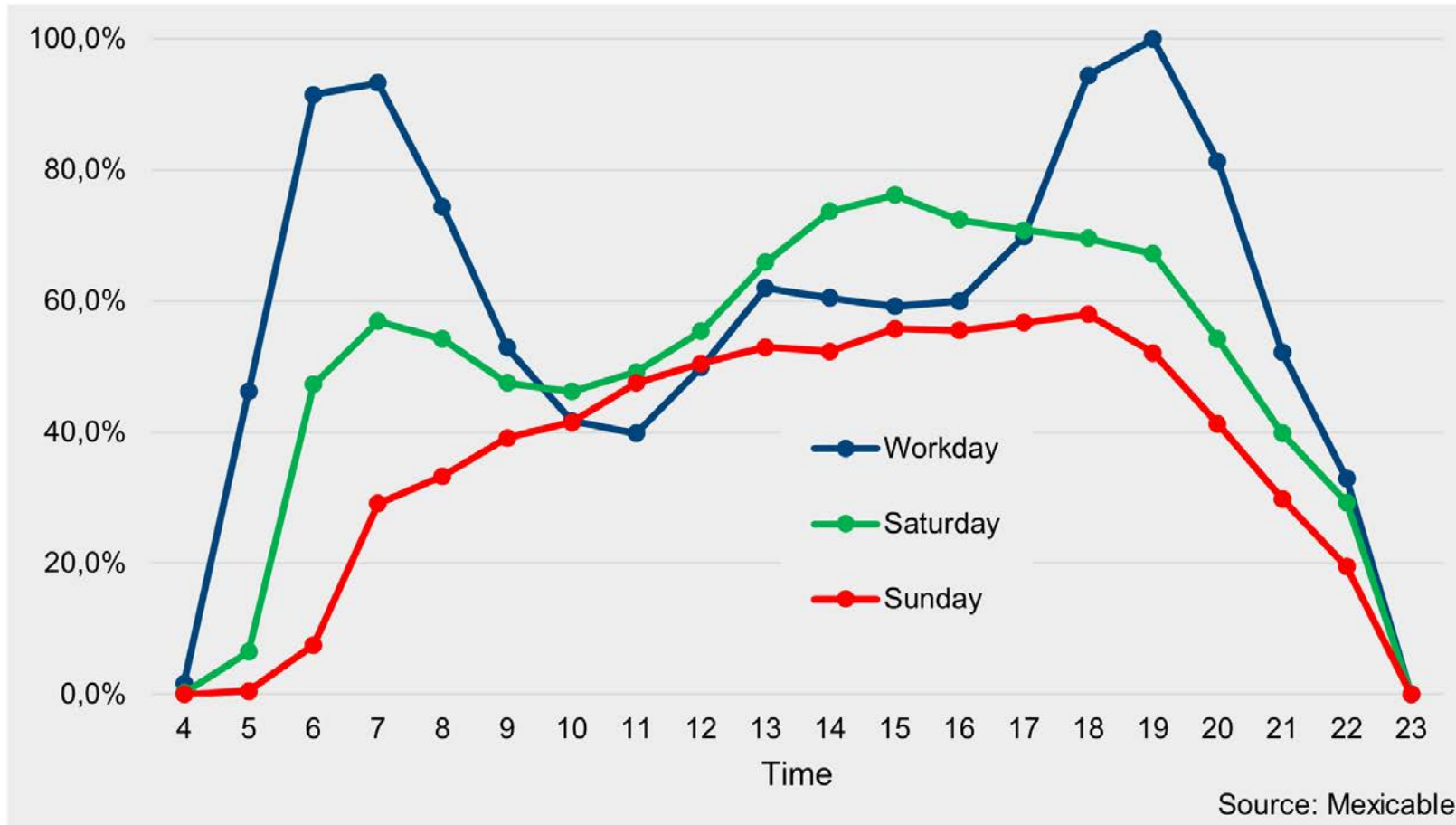
Ecatepec LV – A

 6 m/s

 3000 pphd

EXAMINED CABLE CAR SYSTEM

Daily passenger distribution Ecatepec Linea Verde



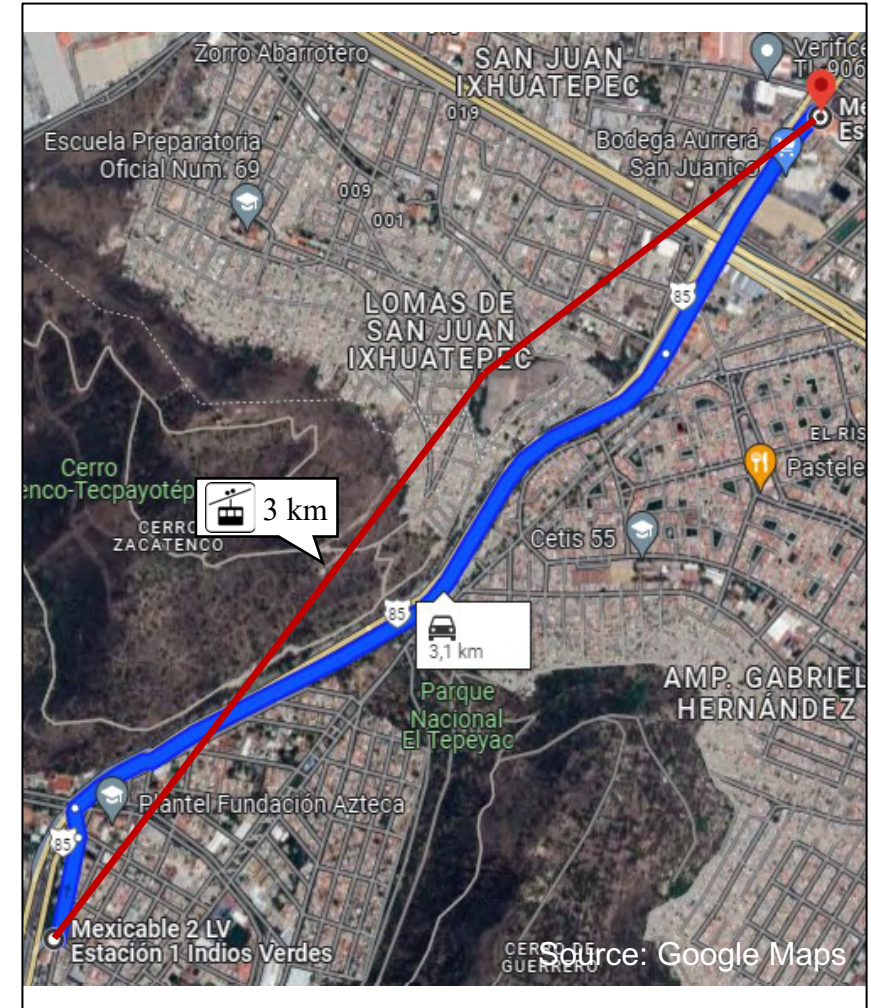
Distribution depends on

- Time of the day
- Day of the week
- Typical workday:
36,000 passengers per day
Operating from 5am – 11pm

EXAMINED CABLE CAR SYSTEM

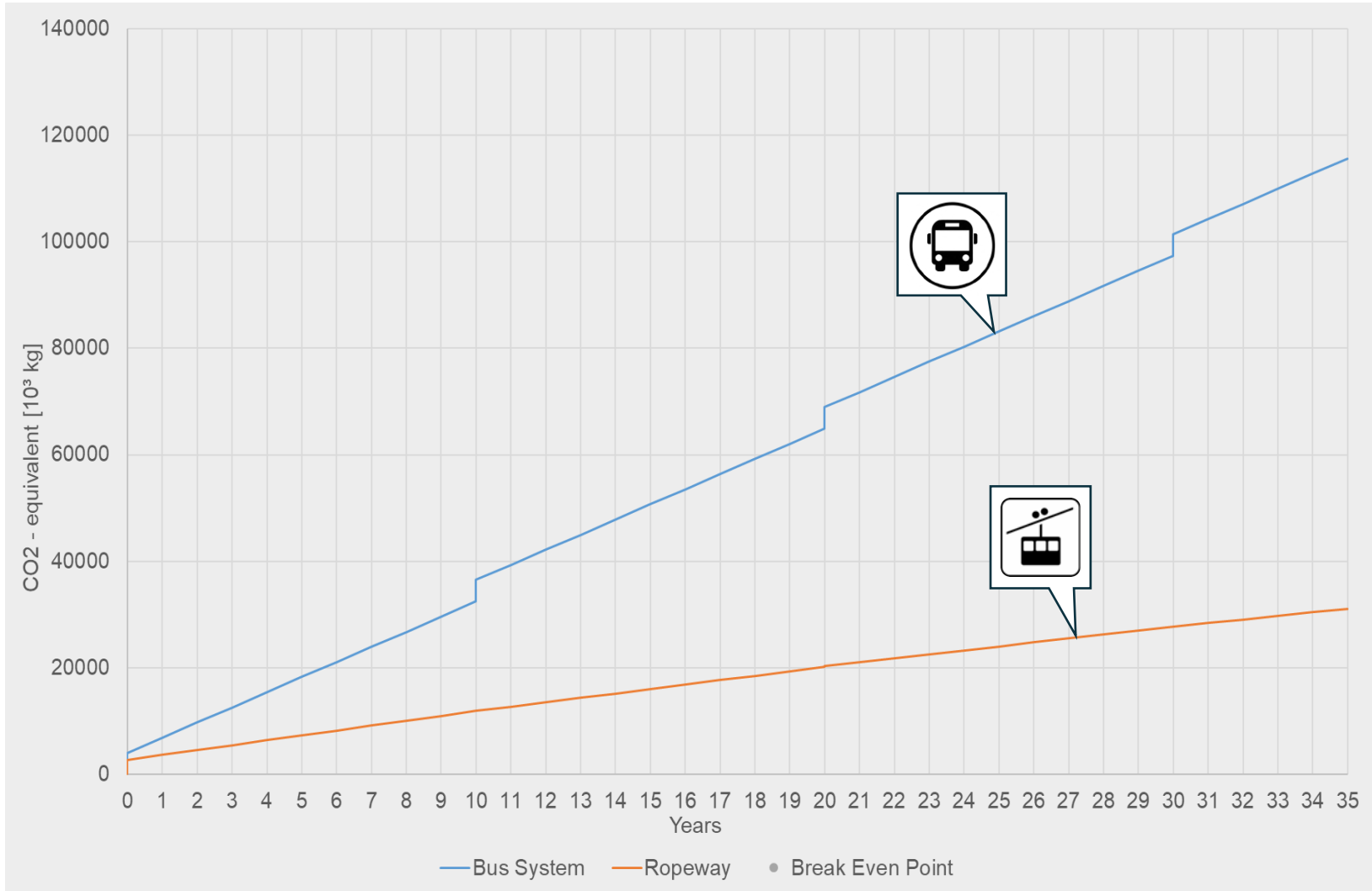
CO₂ emission comparison diesel bus and cable car system

- The Ecatepec Linea Verde cable car transports 12,000,000 people per year
- A diesel bus line could also be operated instead of a cable car
- Calculation tool (presented at OITAF congress 2017) can determine the CO₂ footprint over the service life of a cable car of 35 years (complete Life Cycle Assessment according to ISO 14044 and ISO 14040)
- A CO₂ equivalent of 300 g CO₂/kWh is calculated for electricity production (Climate Transparency Report 2022). This value is reduced by 10 % every 10 years, as an increase in renewable energies is assumed
- The cable car pays for itself after just 1 year (from an environmental point of view)



EXAMINED CABLE CAR SYSTEM

CO₂ emission comparison diesel bus and cable car system



In 35 years of operation:

420,000,000 passengers

- 84,000 t CO₂ (-72%)

CO₂eq = 24.5 g / p km

(p km = passenger kilometer)

EXAMINED CABLE CAR SYSTEM

CO₂ emission comparison diesel bus and cable car system

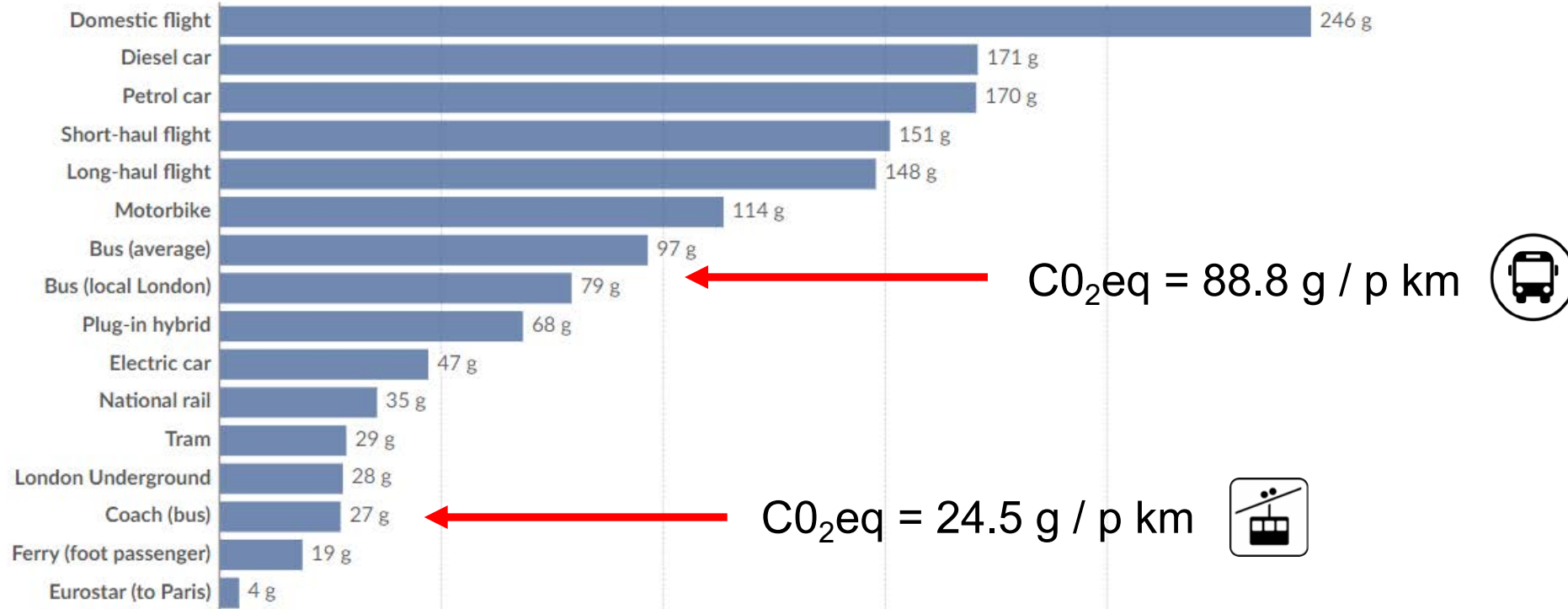
Carbon footprint of travel per kilometer, 2022

The carbon footprint of travel is measured in grams of carbon dioxide-equivalents per passenger kilometer. This includes the impact of increased warming from aviation emissions at altitude.

Our World
in Data

Table Chart

Edit countries and regions



Data source: UK Government, Department for Energy Security and Net Zero – [Learn more about this data](#)

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2. EXAMINED CABLE CAR SYSTEM

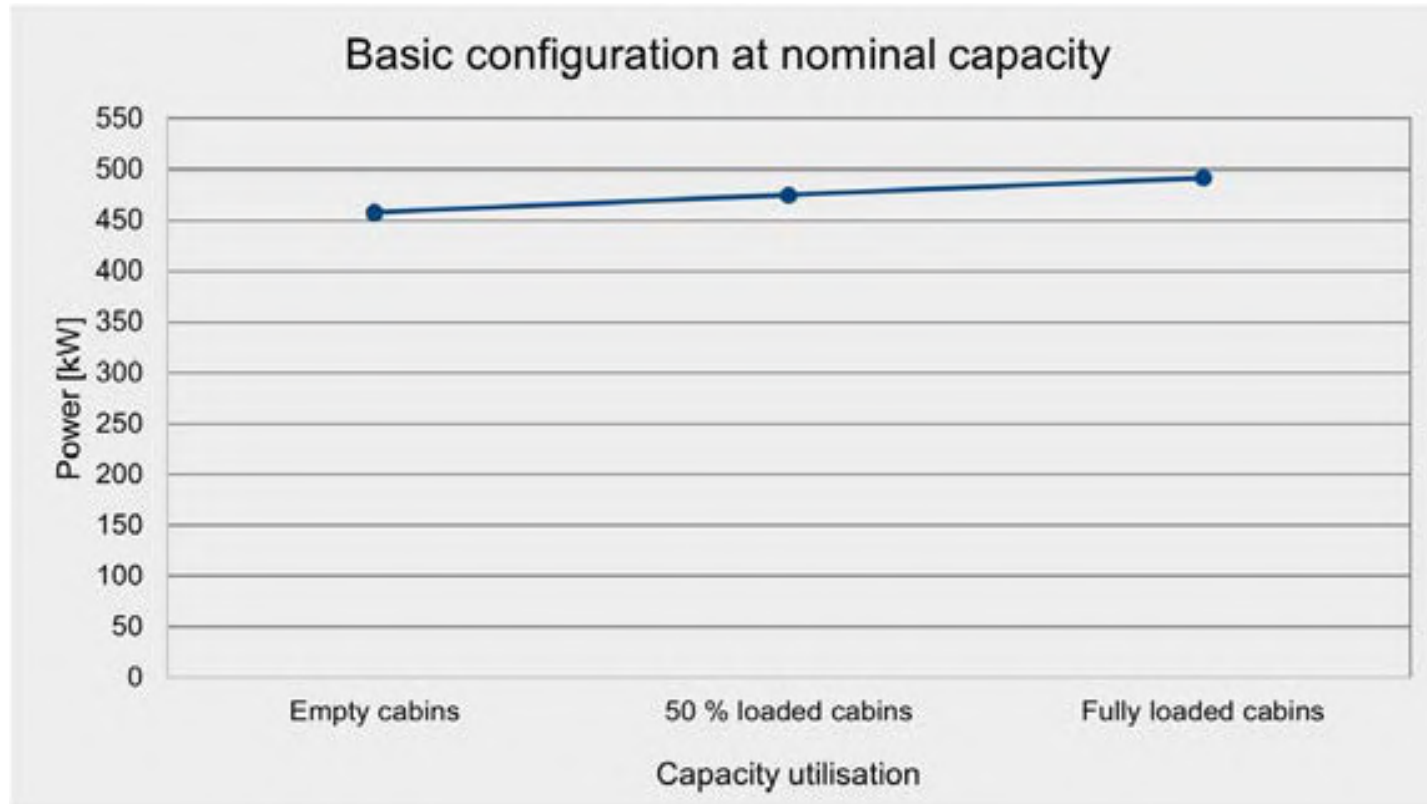
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MEASURES TO INCREASE EFFICIENCY

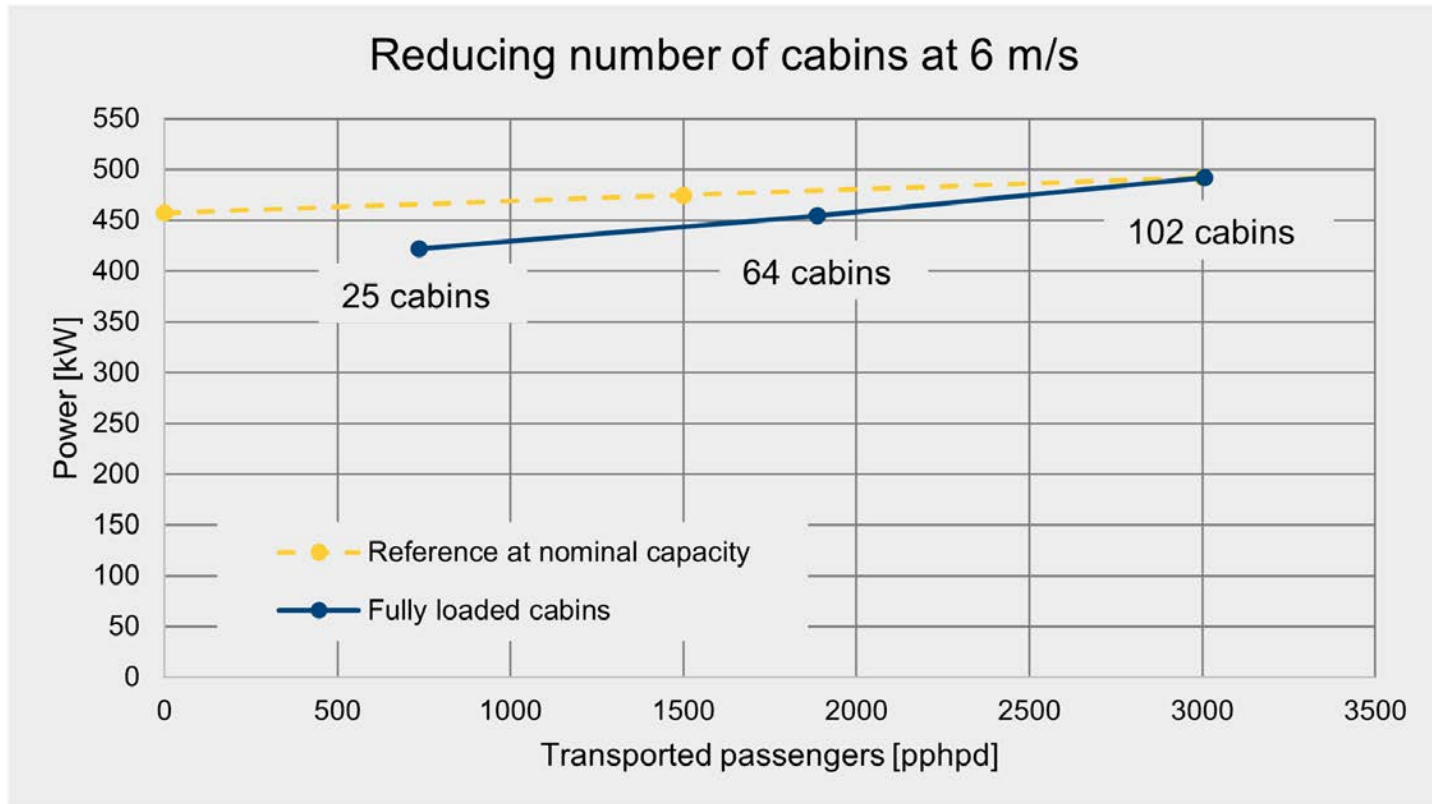
Electrical power vs. capacity – basic configuration



- Capacity utilization by reducing the number of passengers per cabin at nominal speed has a minor effect on energy consumption
- Not even 10 % of the energy consumption depends on the capacity utilization

MEASURES TO INCREASE EFFICIENCY

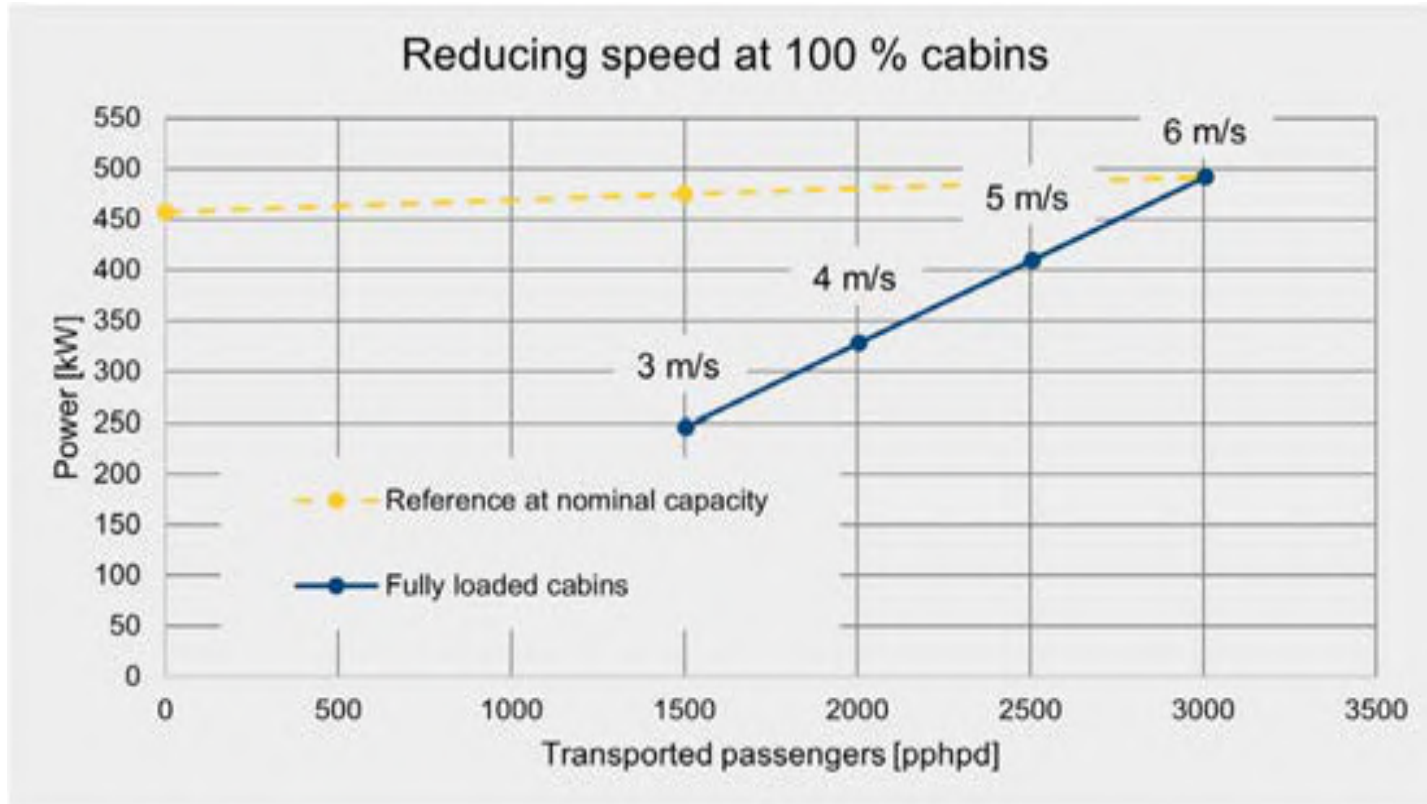
Reduction of capacity by reducing number of cabins



- Number of cabins has a minor impact on energy consumption
- It is more efficient to reduce the number of cabins than to reduce the passengers per cabin
- An oversized installation with too many cabins circulating is not energy efficient

MEASURES TO INCREASE EFFICIENCY

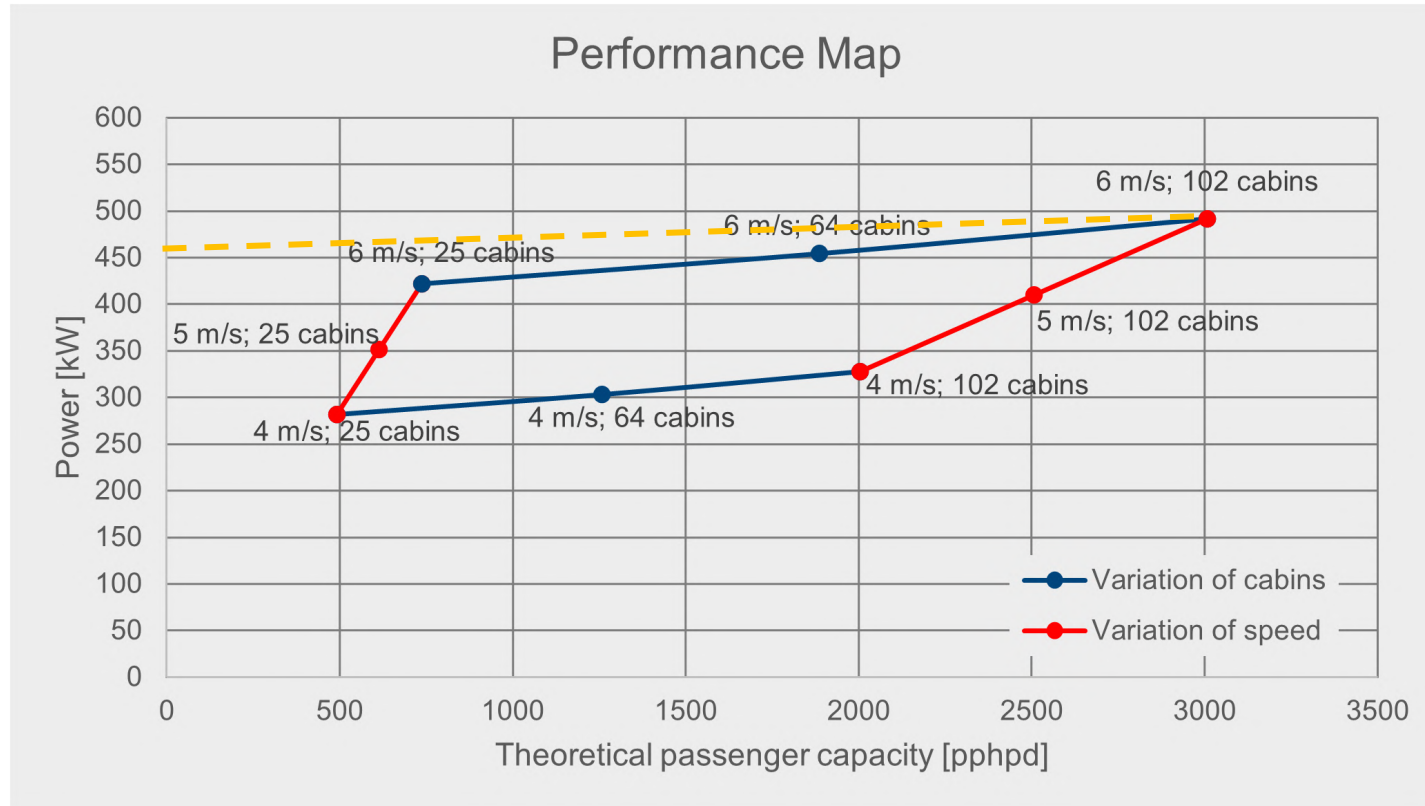
Reduction of capacity by reducing speed



- Speed has a major impact on energy consumption
- The relationship between speed and energy consumption is almost linear

MEASURES TO INCREASE EFFICIENCY

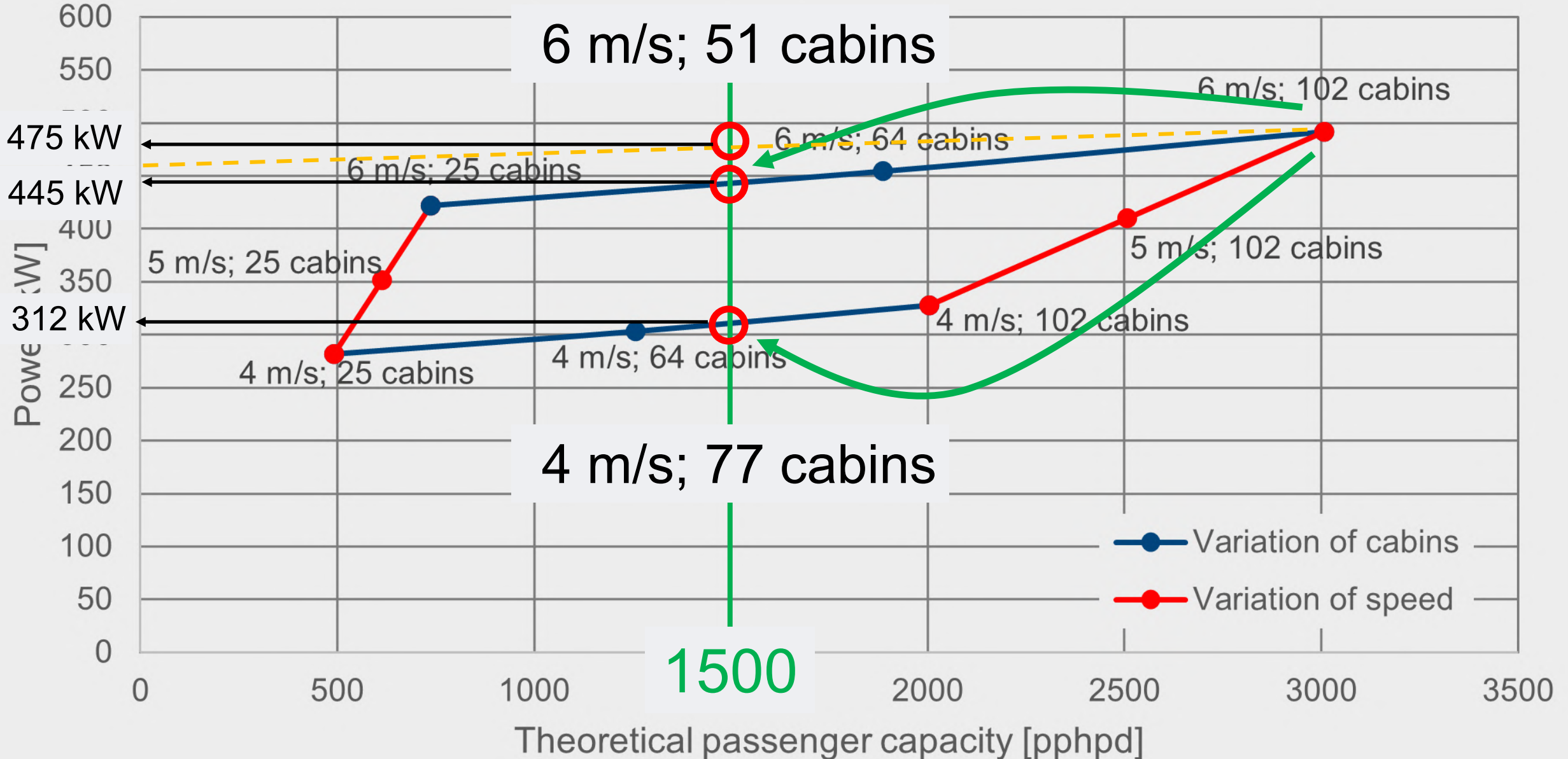
Performance Map



Domain of utilization

- Defined by minimum speed and minimum number of cabins
- Reducing speed has a major impact on energy consumption
- Reducing cabins has a minor impact on energy consumption

Performance Map - Example



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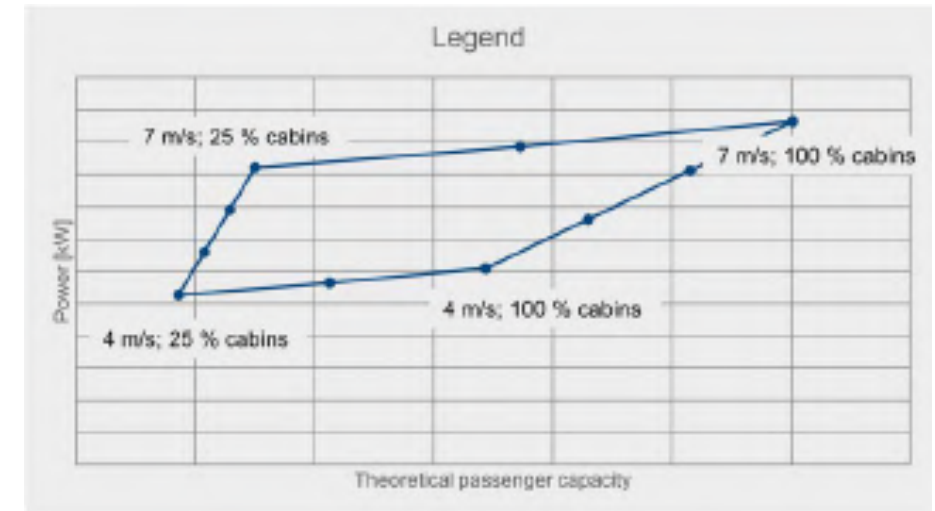
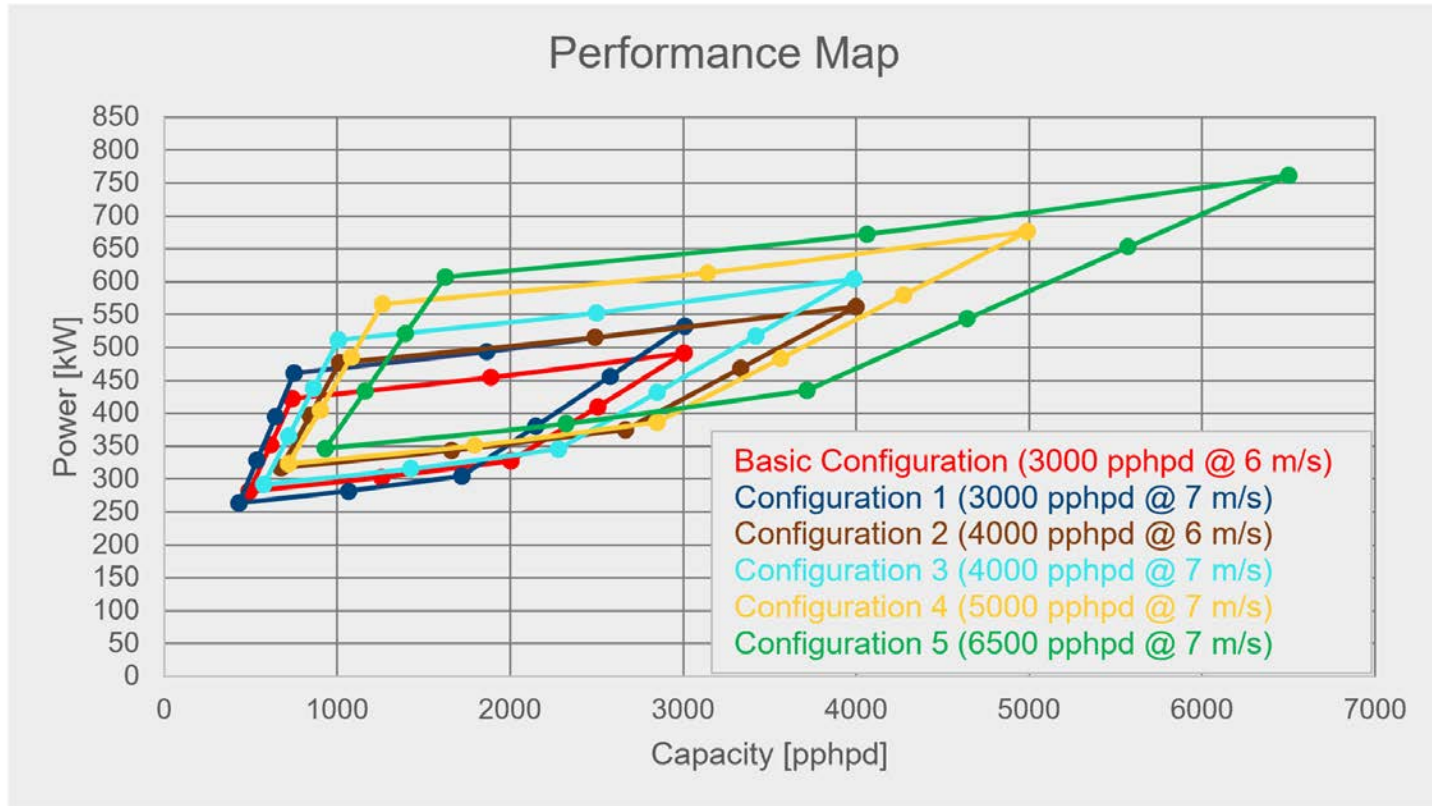
5. SUMMARY

ECATEPEC Alternative configurations

	Basic Configuration (Ecatepec LV-A)	Config. 1	Config. 2	Config. 3	Config. 4	Config. 5
	6 m/s	7 m/s	6 m/s	7 m/s	7 m/s	7 m/s
	3,000 pphpd	3,000 pphpd	4,000 pphpd	4,000 pphpd	5,000 pphpd	6,500 pphpd

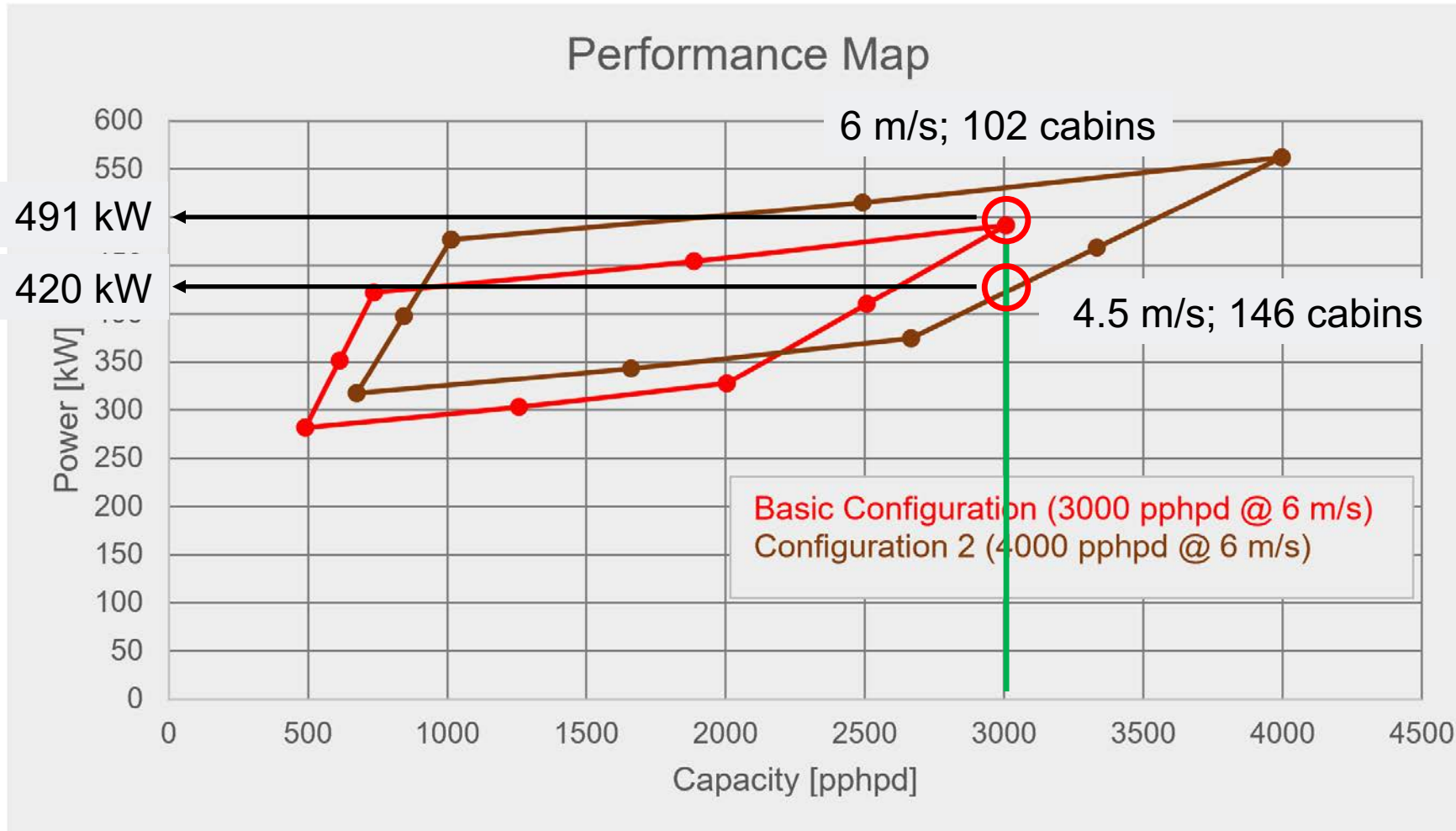
COMPARISON

Operating data of the different configurations



COMPARISON

Operating data of the different configurations



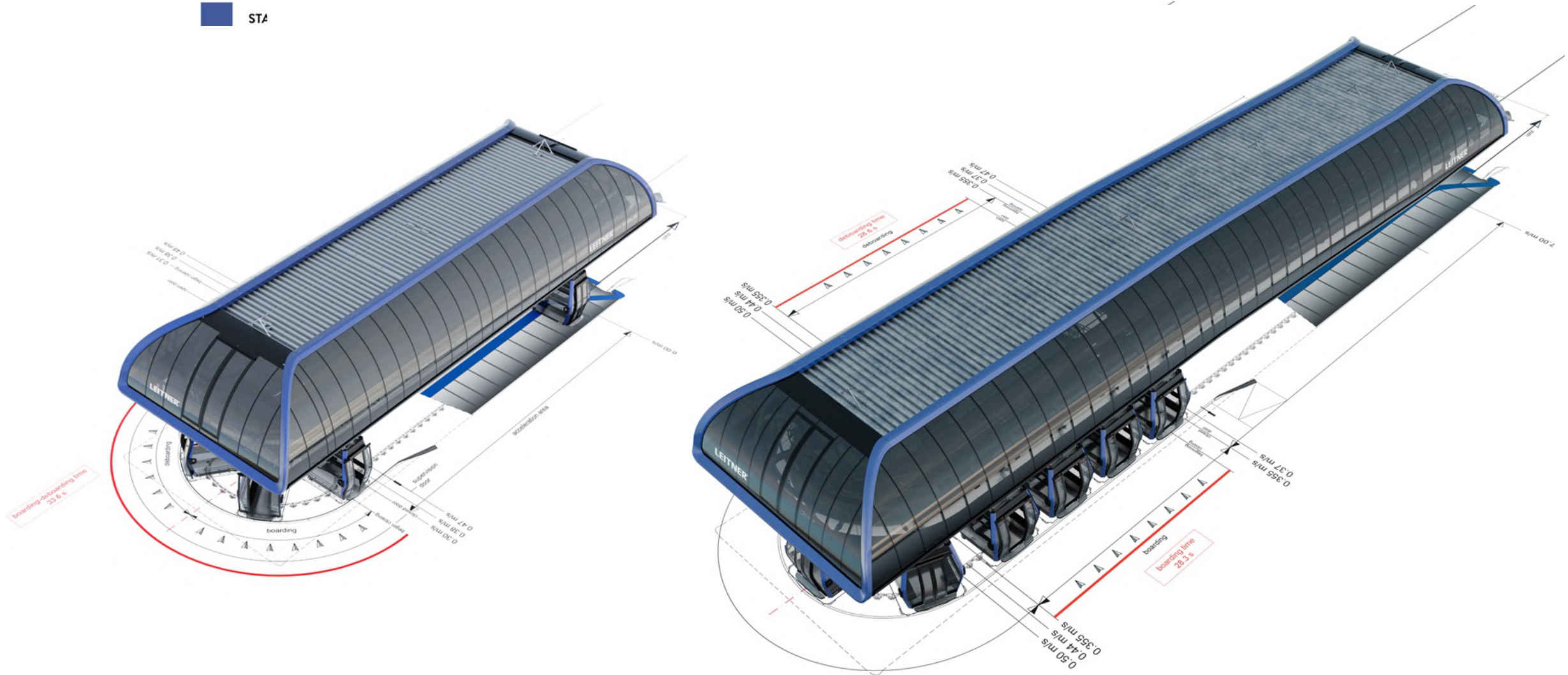
Example

A configuration with higher nominal capacity could have a lower energy consumption at reduced capacity utilization

COMPARISON Station design



■ STA



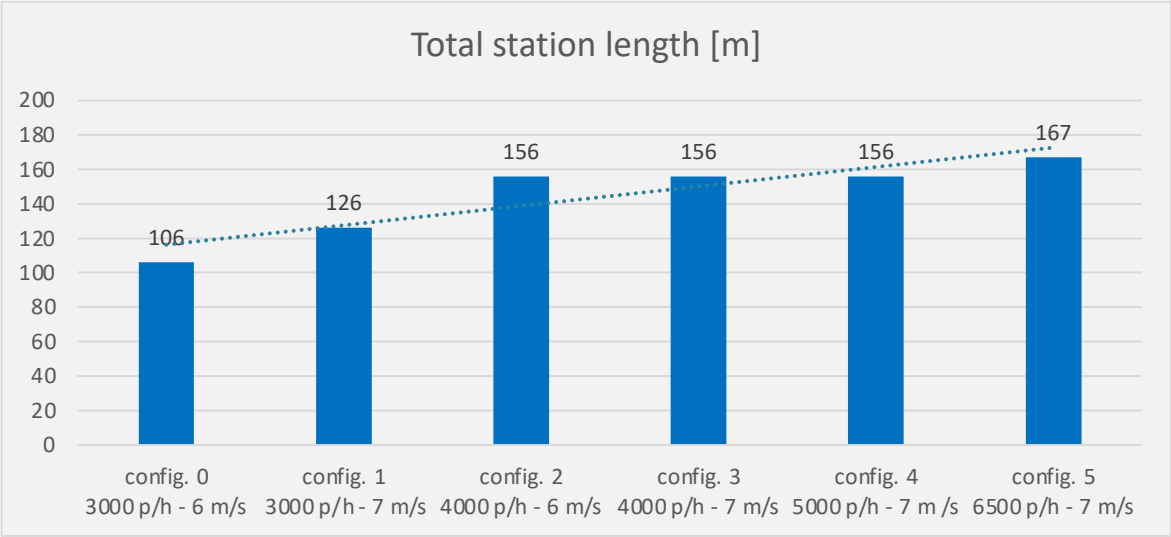
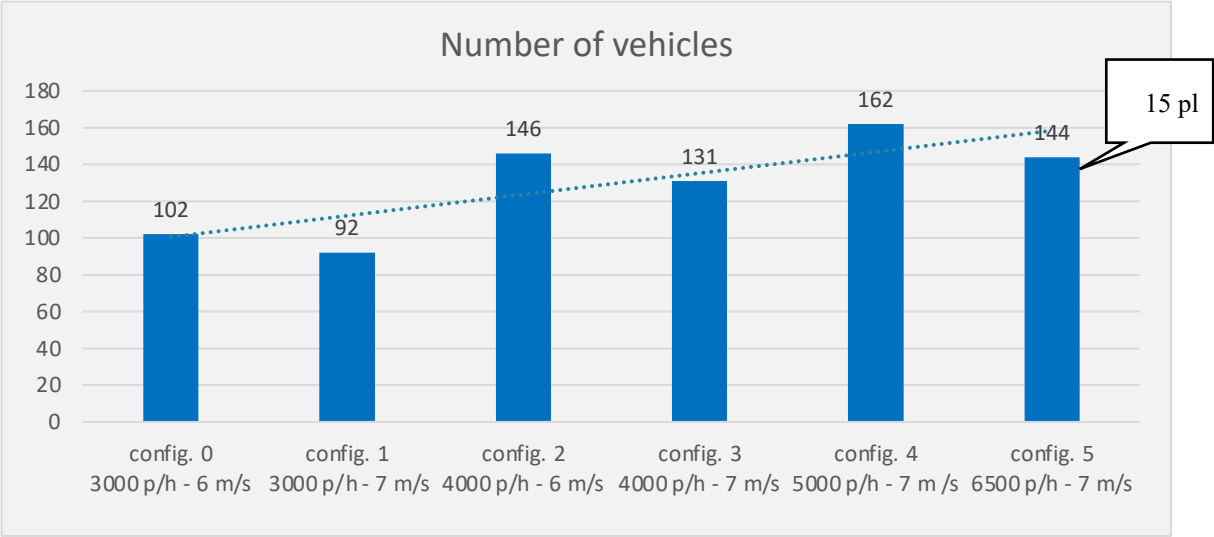
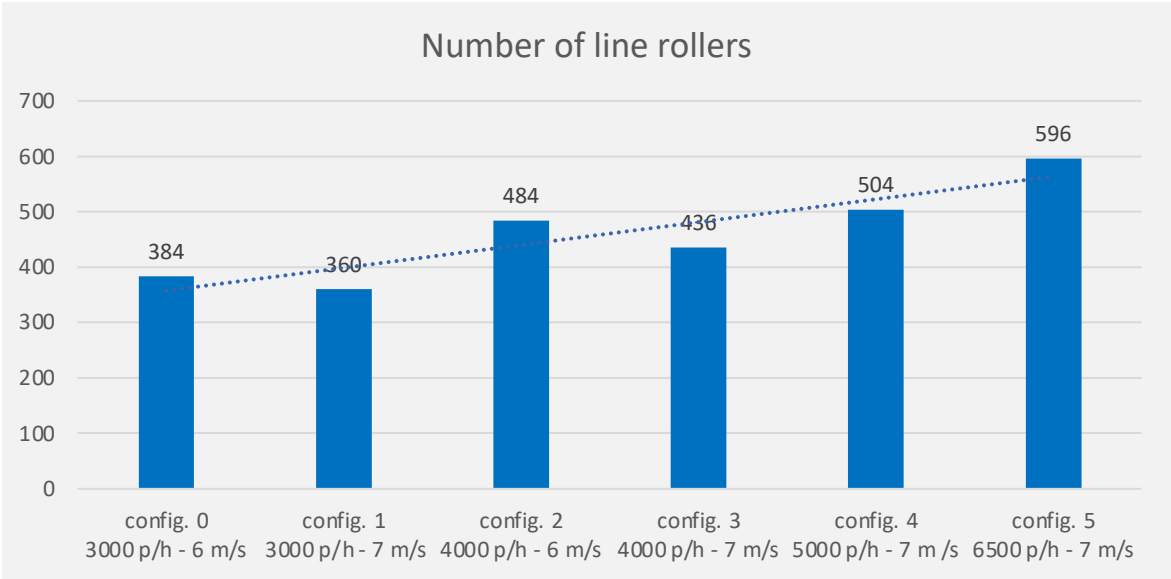
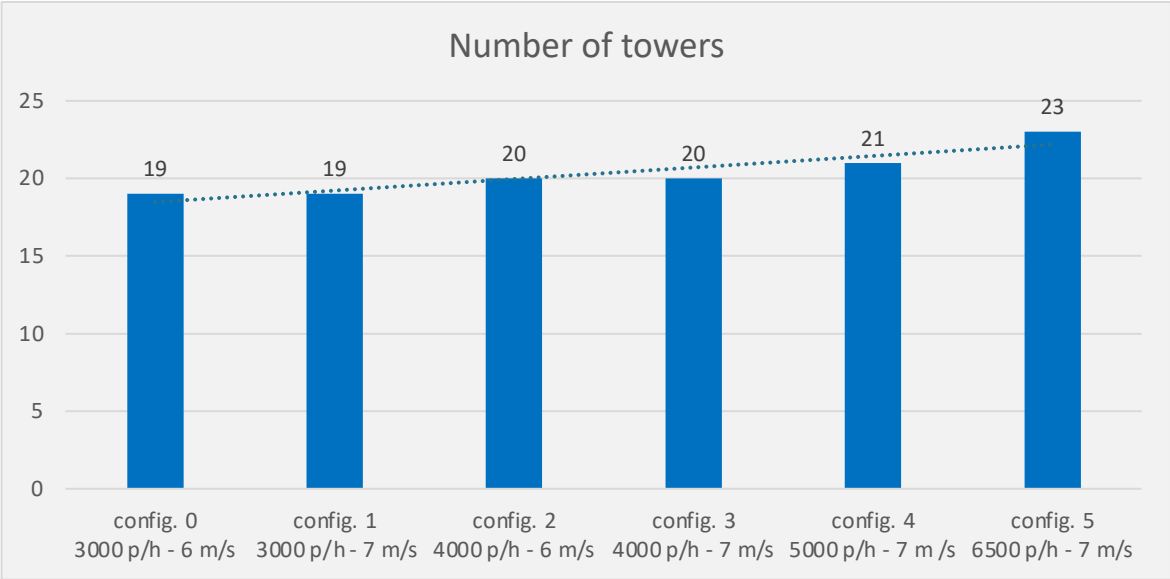
COMPARISON

Investment costs

	Basic Configuration (Ecatepec LV-A)	Config. 1	Config. 2	Config. 3	Config. 4	Config. 5
	6 m/s	7 m/s	6 m/s	7 m/s	7 m/s	7 m/s
	3,000 pphpd	3,000 pphpd	4,000 pphpd	4,000 pphpd	5,000 pphpd	6,500 pphpd
\$	100%	102%	124%	118%	132%	185%

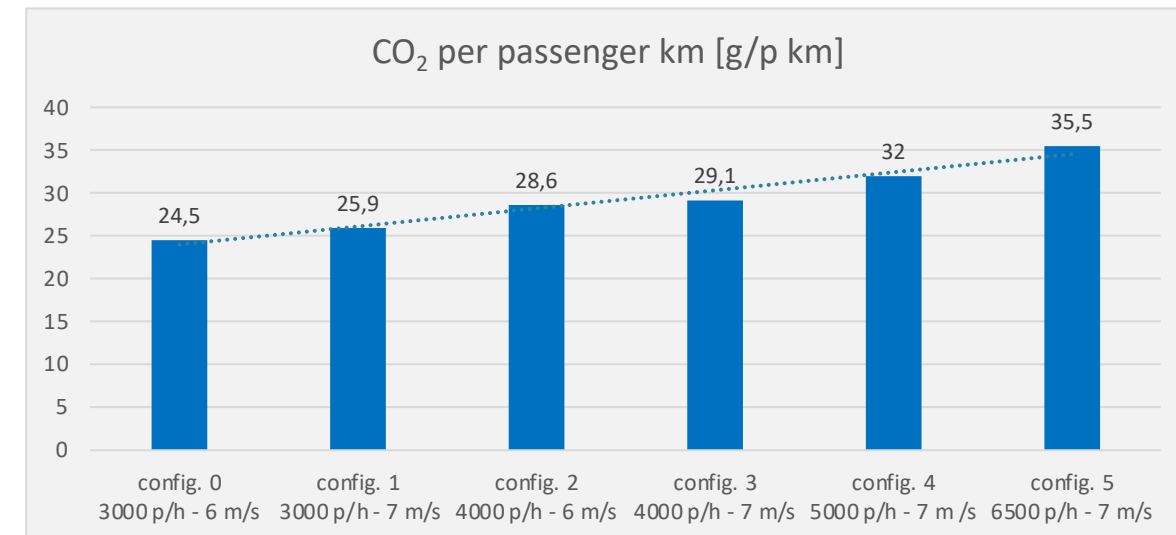
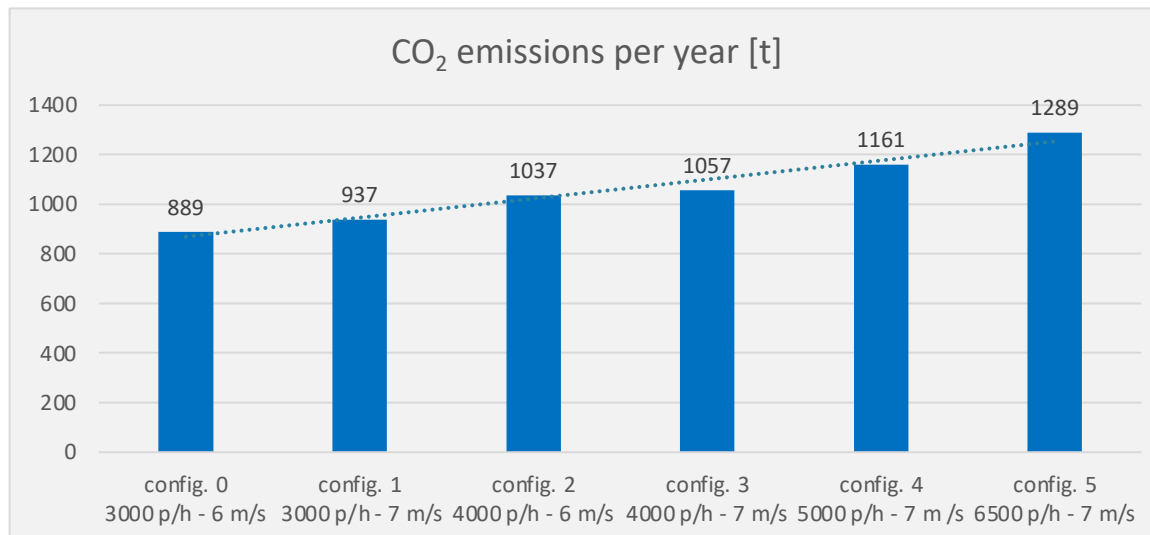
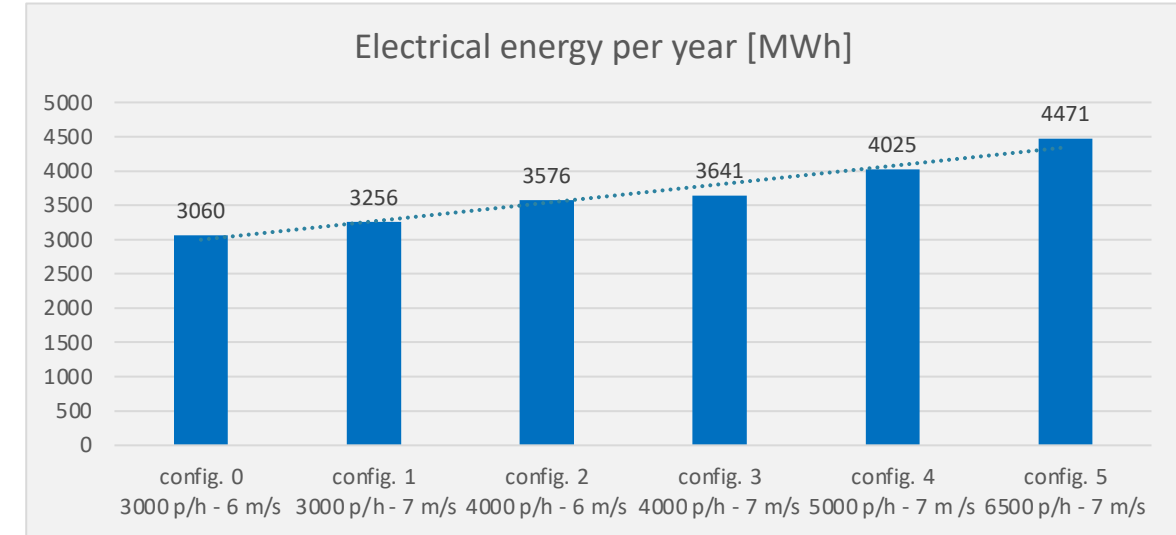
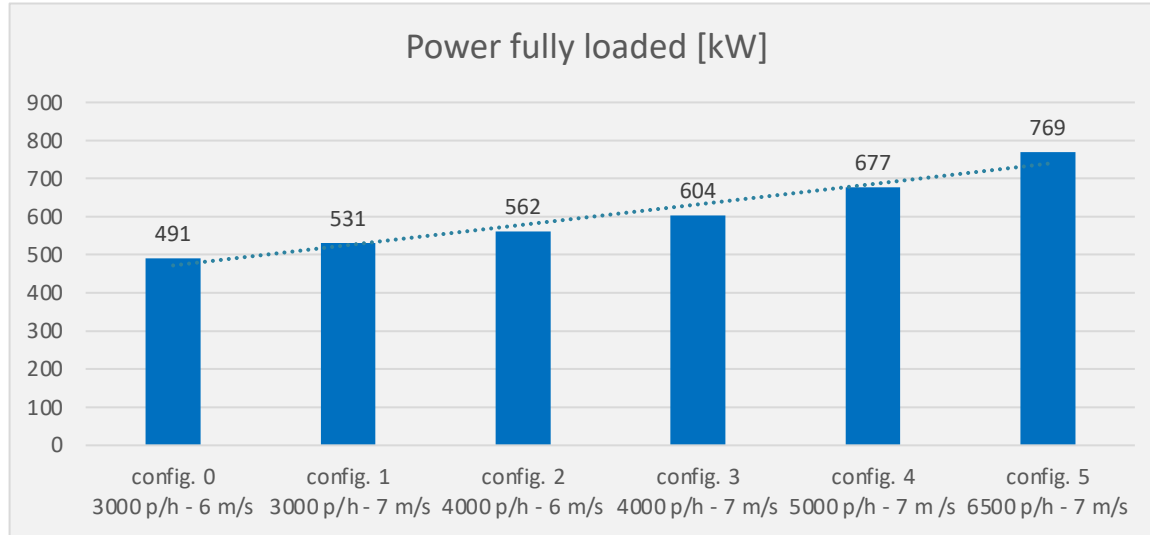
COMPARISON

Lifecycle costs



COMPARISON

Environmental impact



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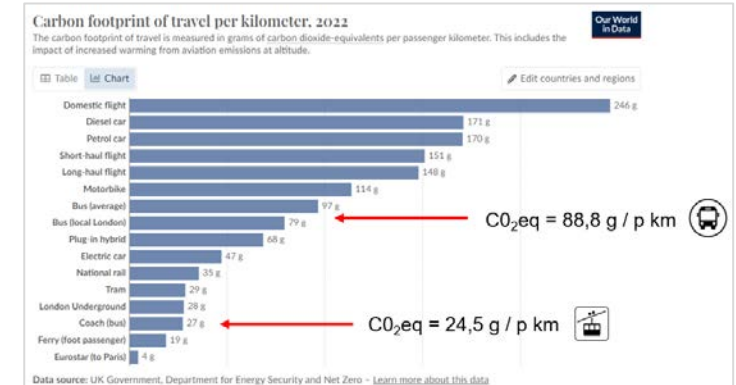
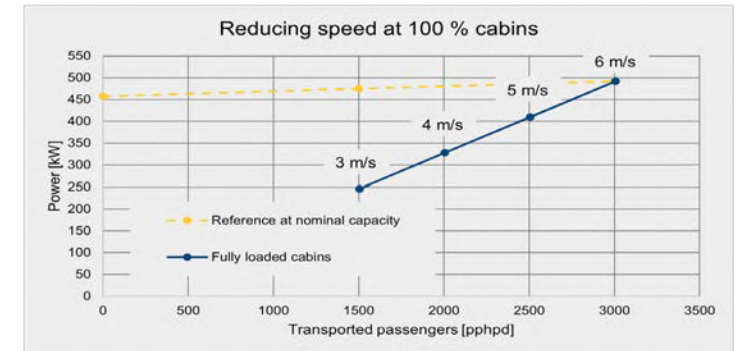
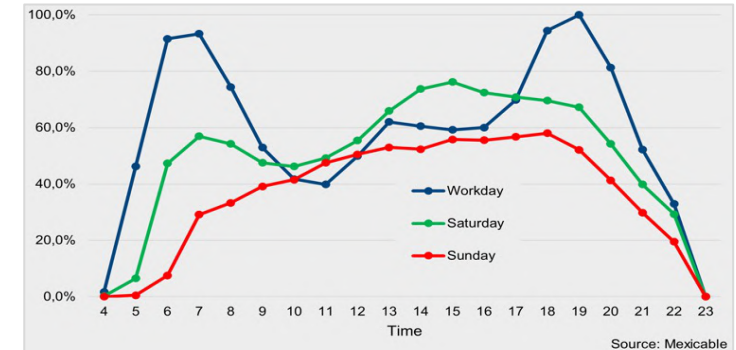
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SUMMARY Experience

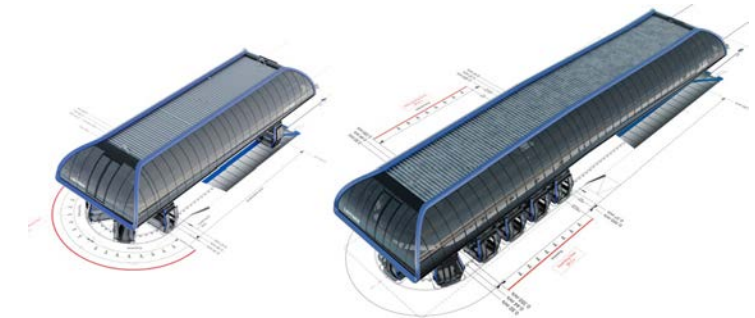
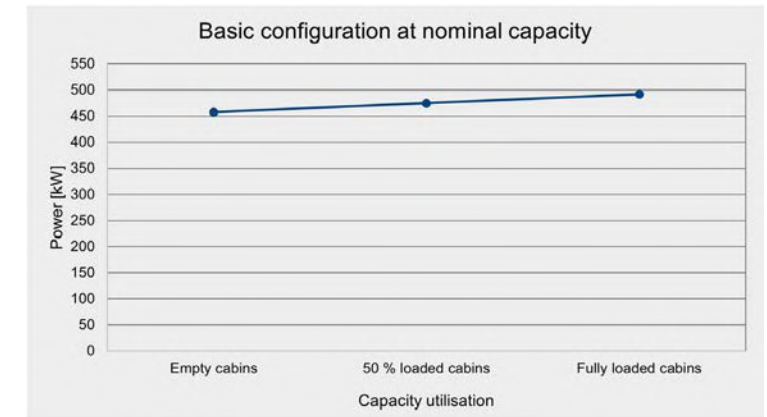
- Based on the practical experience at the Ecatepec Linea Verde installation:
- A daily passenger flow up to 36,000 – 40,000 could be realized with an installation designed for a capacity of 3,000 pphpd
- A yearly passenger flow up to 12 – 15 million could be realized with an installation designed for a capacity of 3,000 pphpd
- There are two peak periods where 100% of the capacity is needed. A limited waiting time could be accepted during rush hours (7 min is observed at the Ecatepec installation)
- The reduction of the speed in periods with lower passenger flow is advisable with a reduction of energy consumption and CO₂ emissions of 15-20% by reducing from 6 m/s to 5 m/s
- The carbon footprint of travel per passenger kilometer of 24.5 g is almost unrivalled.



SUMMARY

Recommendations

- Cable cars are infrastructure-driven means of transport. The real utilization rate has a minor influence on investment cost and lifecycle costs
- A precise analysis of the expected traffic flows is highly recommended
- Undersizing leads to long waiting times and is almost impossible to rectify
- Oversizing leads to high investment and operating costs and to a higher carbon footprint
- Slight oversizing ensures a margin for future higher traffic volumes
- It is advisable to create this margin by designing the installation for a higher number of vehicles and not for a higher nominal speed.





LEITNER®



MEXICABLE NETWORK Red Line and Green Line

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Technical Director Leitner

Paul Abed
President of Mexitelefericos S.A. de C.V

MEXICABLE Zones

MEXICABLE ZONES

Economic Sector:

D+, D- Floating Population

Users branch of industry:

Sales, Shop Assistant (267k)

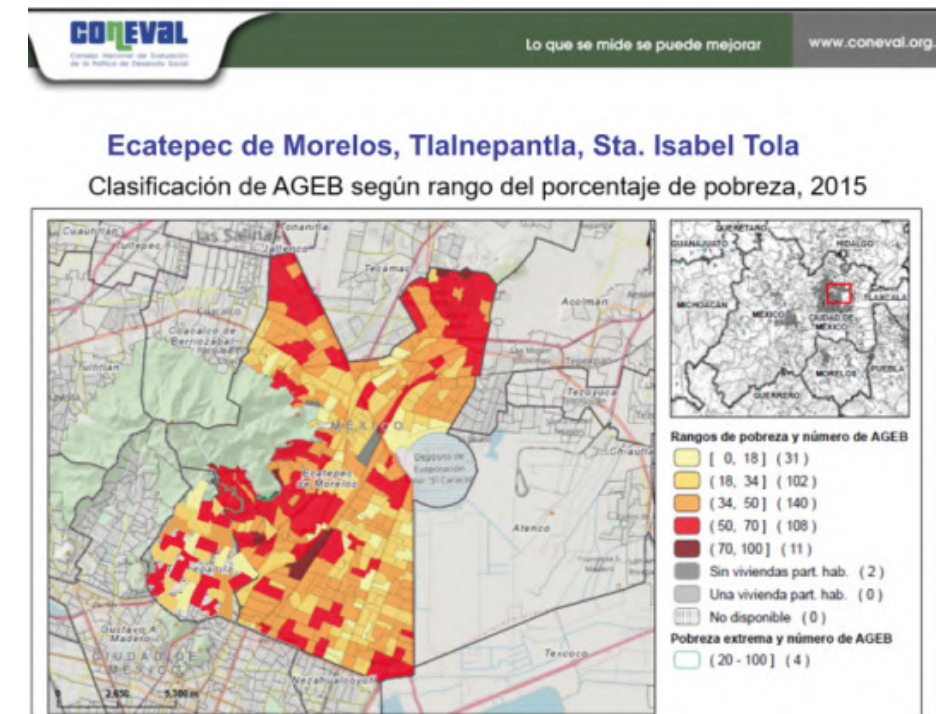
Merchants in Establishment (218k)

Domestic Worker (167k)

Ecatepec, Tlalnepantla, Sta. Isabel Tola to Indios Verdes Subway – Mexico City

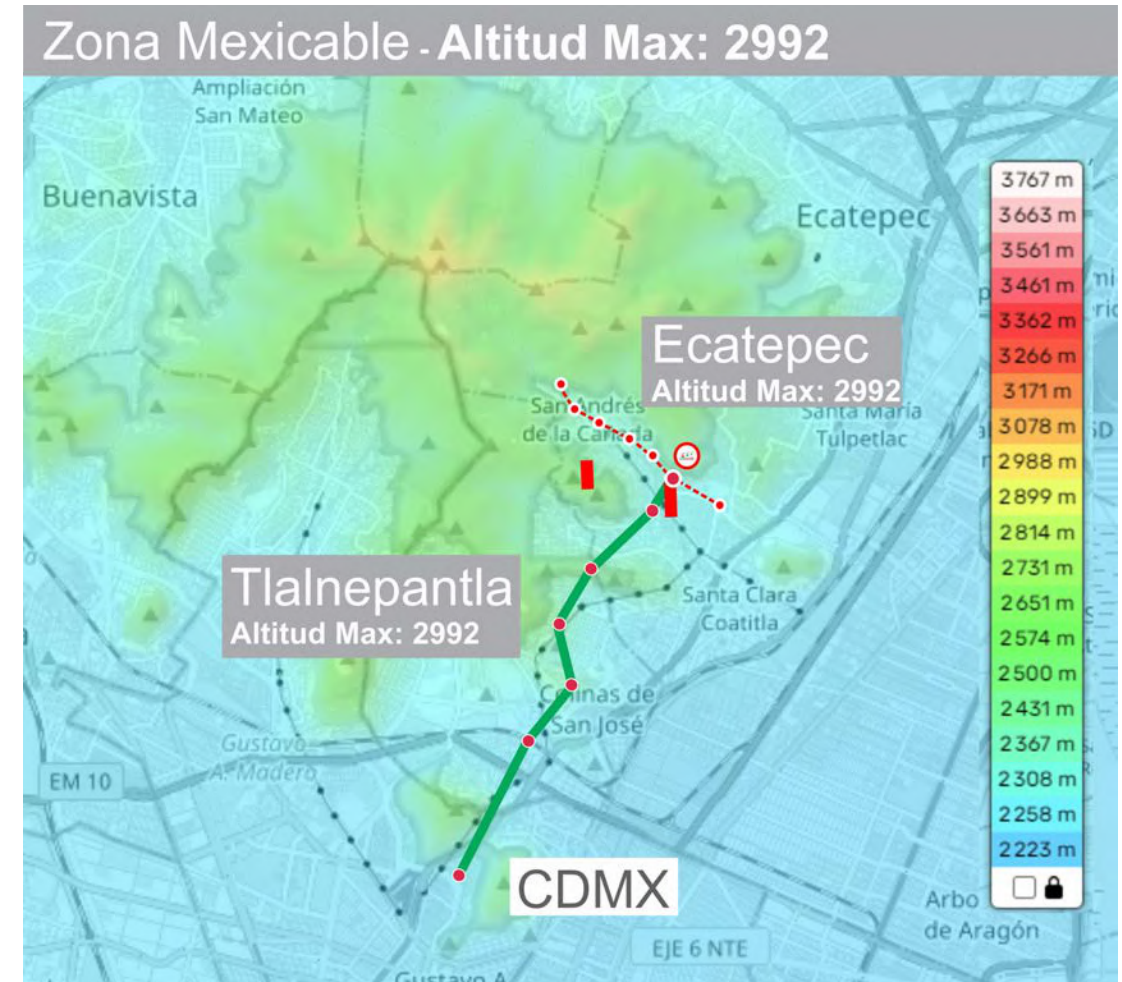
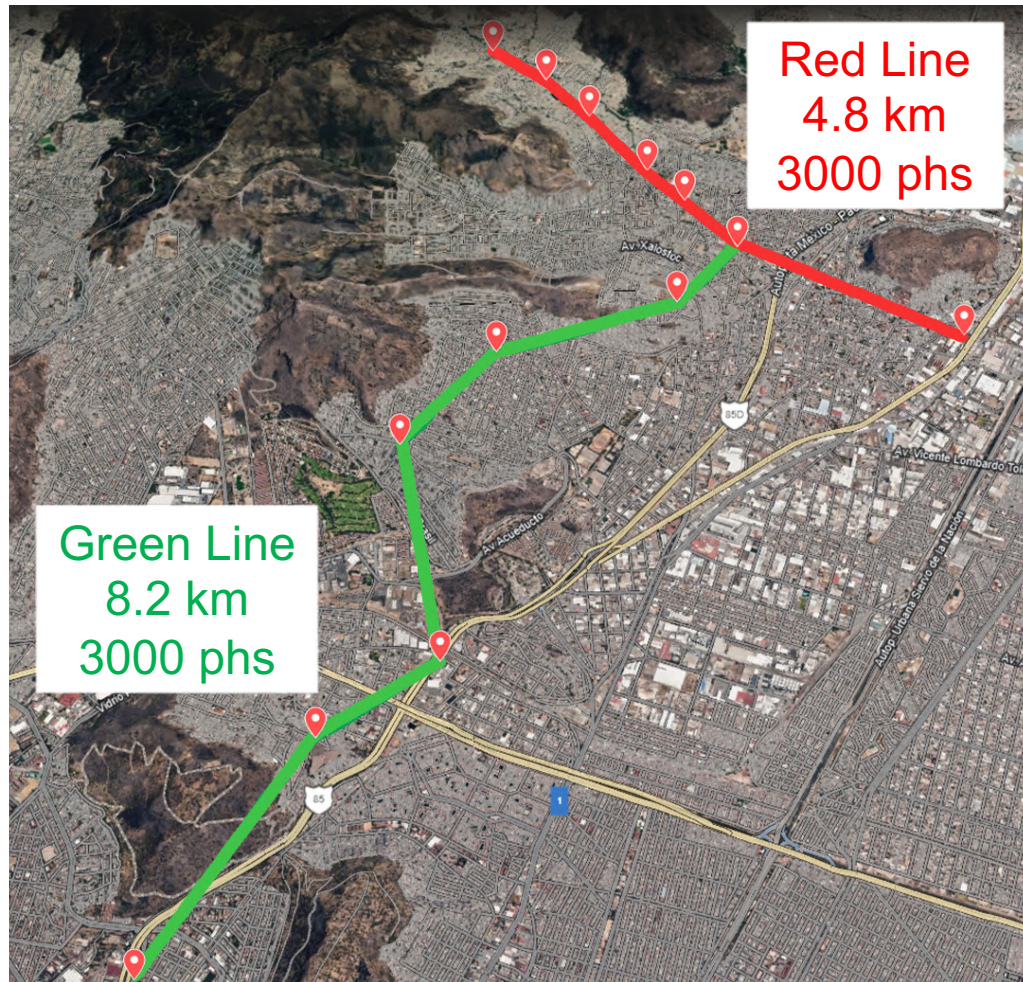
Travel Time:

1 – 2 hrs. In Buses & Metro.



MEXICABLE SYSTEM MAP

Layout of the red and green line – Maximum Altitude 2092



MEXICABLE Connection

MEXICABLE CONNECTION WITH MEXICO CITY



ECATEPEC LV – A

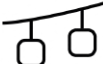
MEXICO CITY



 6 m/s

 3000 pphd

 715 kw

 283 (10 passengers)

 52

MEXICABLE

The Real Problems

Land Availability



Users need a fast ropeway



TRANSLATION:

“Hello, I’m outside the Aurerra (store) in San Andrés and the Mexicable Gondolas are slow...”

MEXICABLE Operation

ECATEPEC LV

MEXICO CITY



Average Passengers	
Per Day	36,000
Per Month	1,000,000
Per Year	12,200,000
Mexicable Network Per Day	51,000
Operation Hours	
Per Year	6,885
Number of Employees	530

MEXICABLE – USERS BOARDING

Station “INDIOS VERDES”



MEXICABLE – AERIAL VIEW



MEXICABLE – AERIAL VIEW

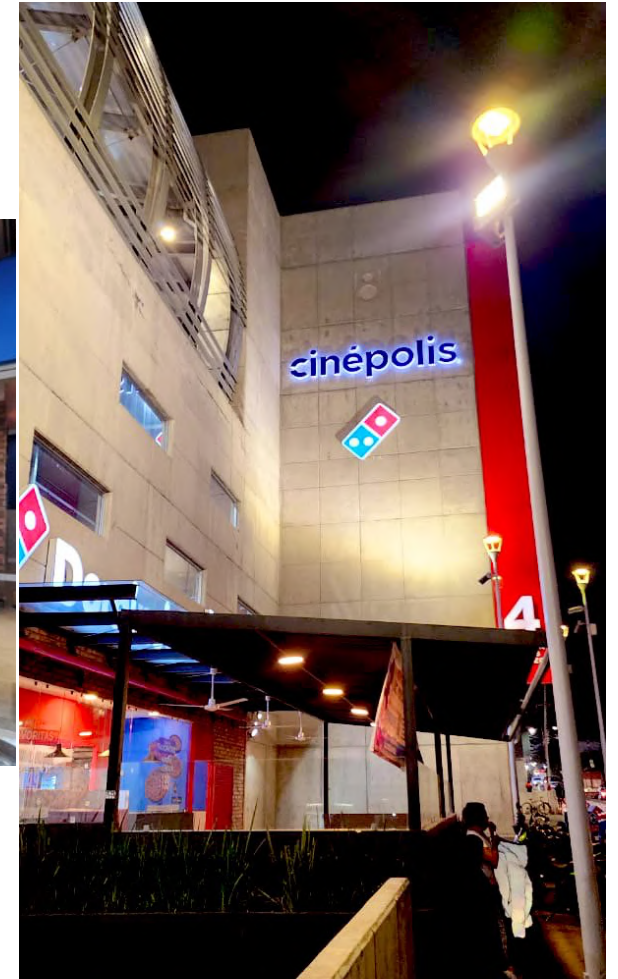


MEXICABLE – AERIAL VIEW



INTEGRATION OF COMMERCIAL AREAS

and direct access to 5 movie theater halls with 780 seats





LEITNER®



**Thank you for
your Attention!**