



URBAN TRANSPORTATION as a FACTOR in SOCIAL EXCLUSION: the VENICE Case Study



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December 12, 2022

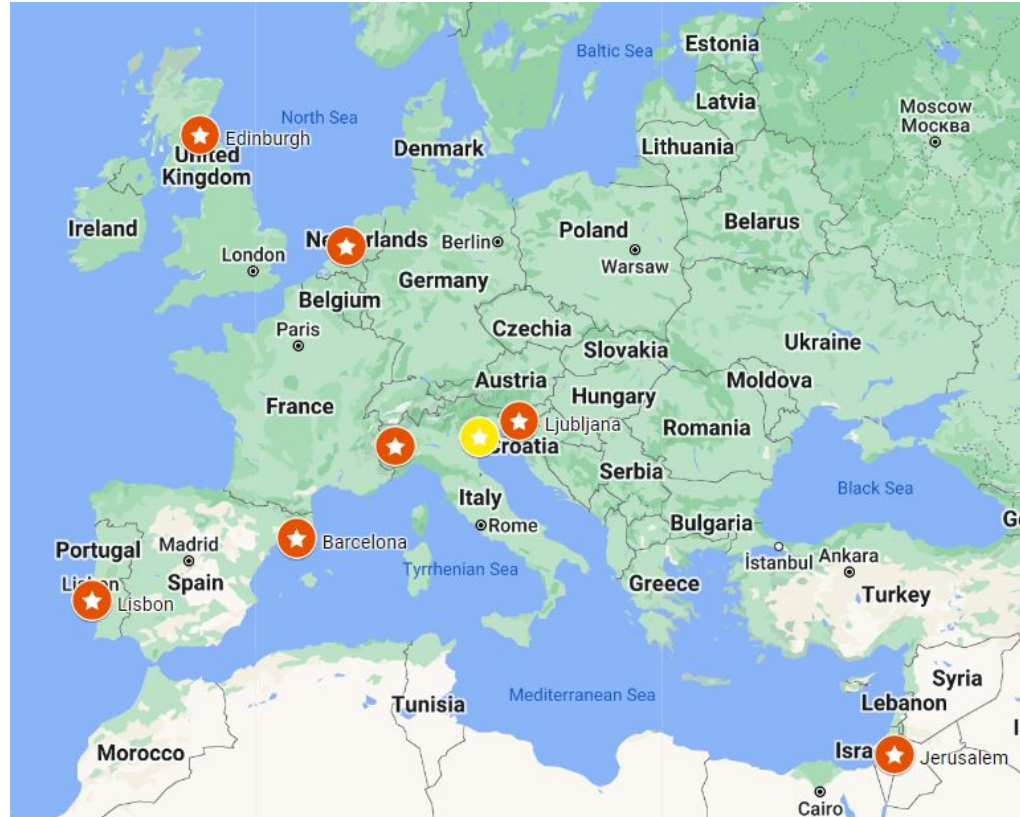


We are contributing to the SmartDest EU Project



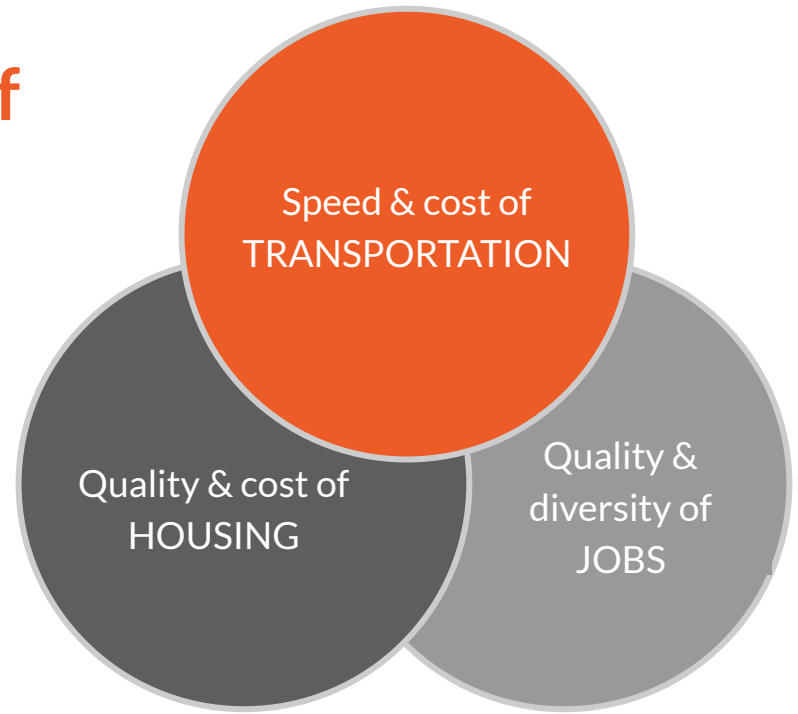
1. Identify social exclusions due to **overtourism**
2. Hypothesize possible **solutions**
3. Proposed shared **corrective policies**

Jan 2020 - Sept 2023
8 case study cities
funded by the EU:

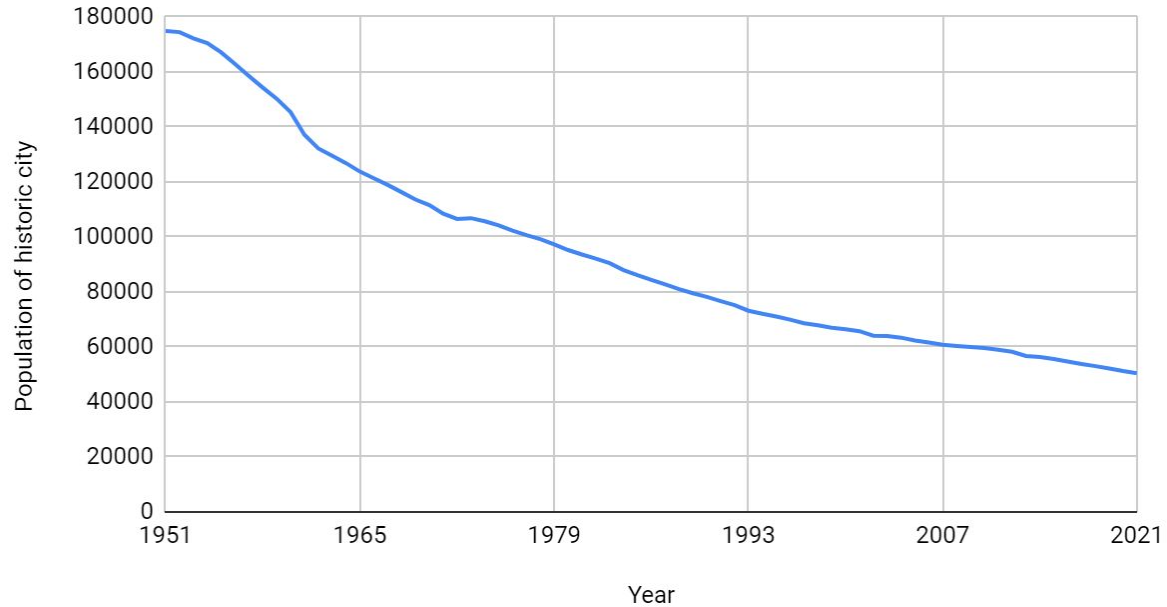




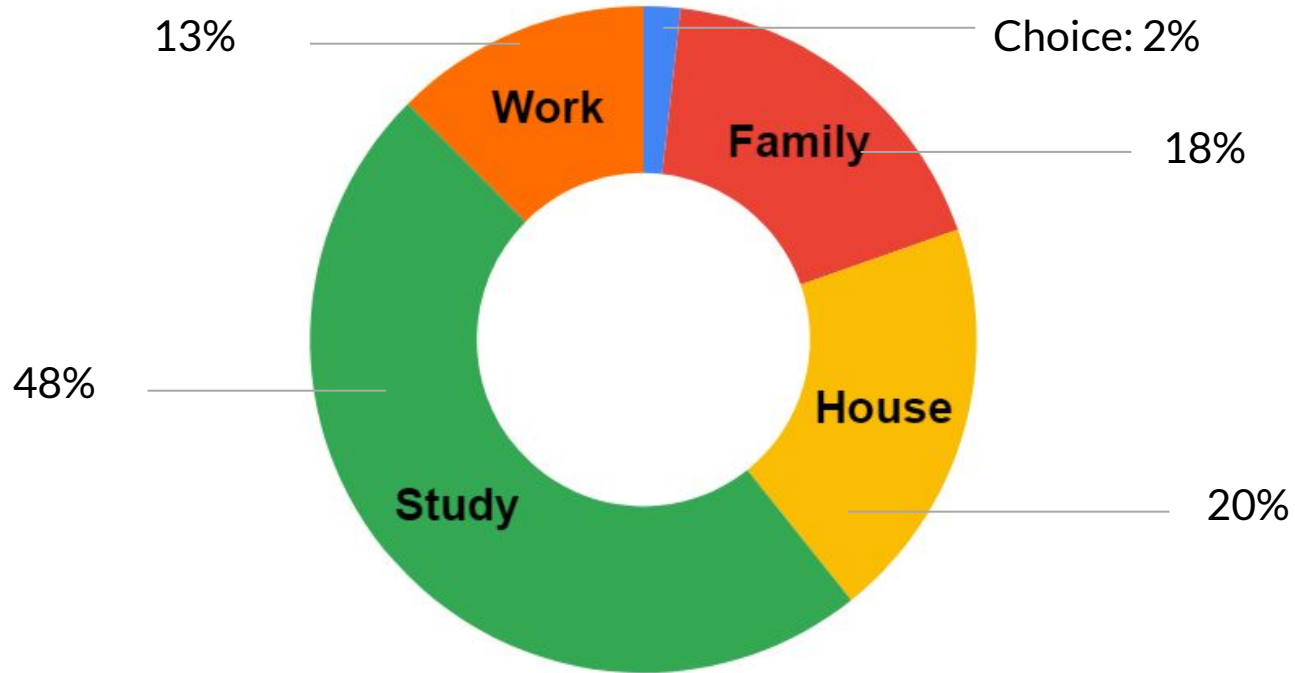
Exclusion of residents



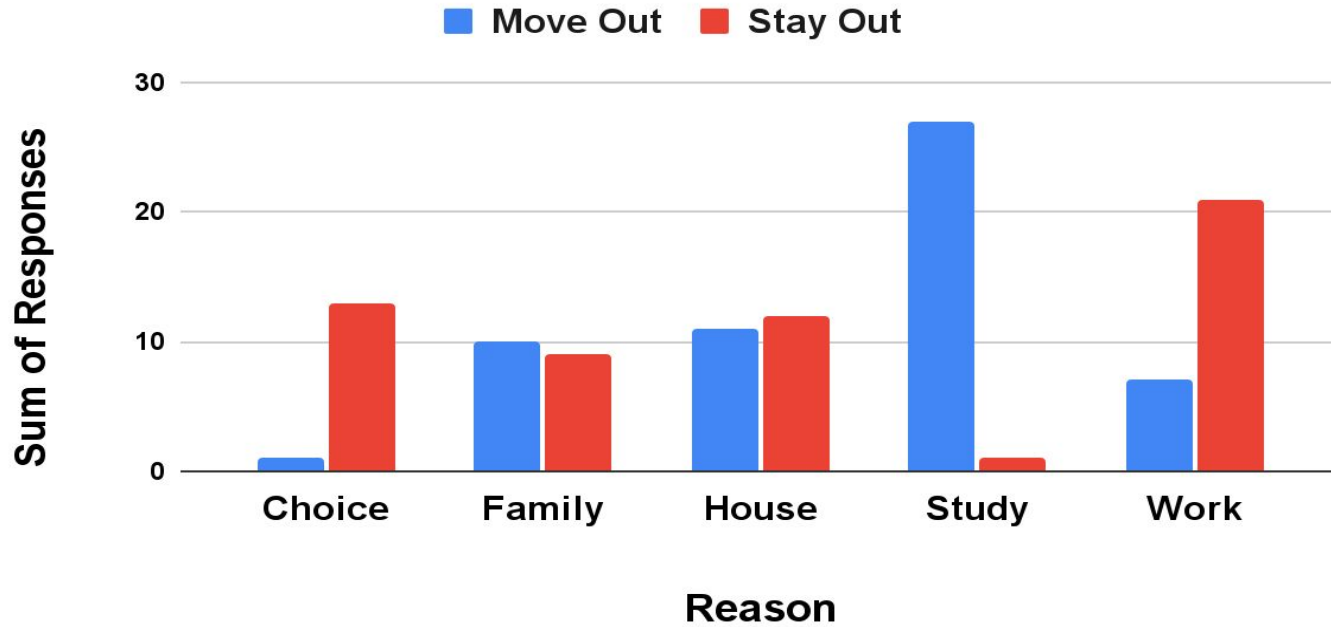
The population of Venice has decreased by 125,000 since 1951



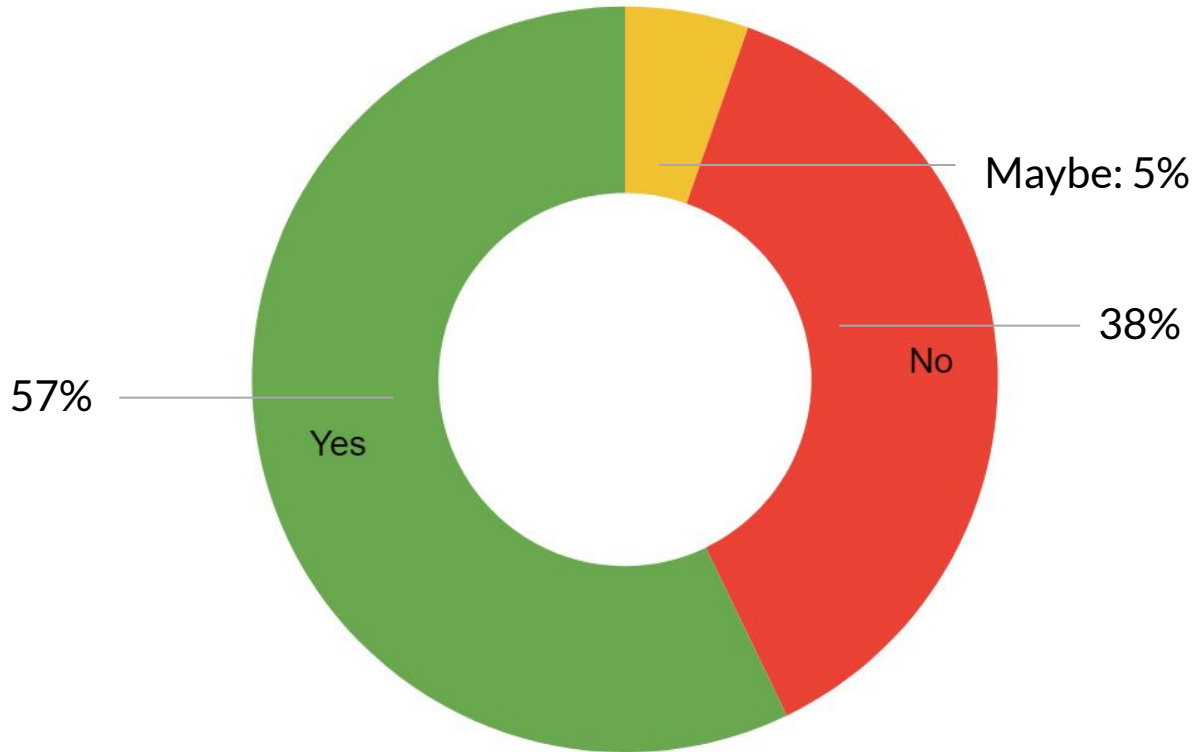
Results from 56 interviews conducted by SmartDest show that residents migrate out for school...



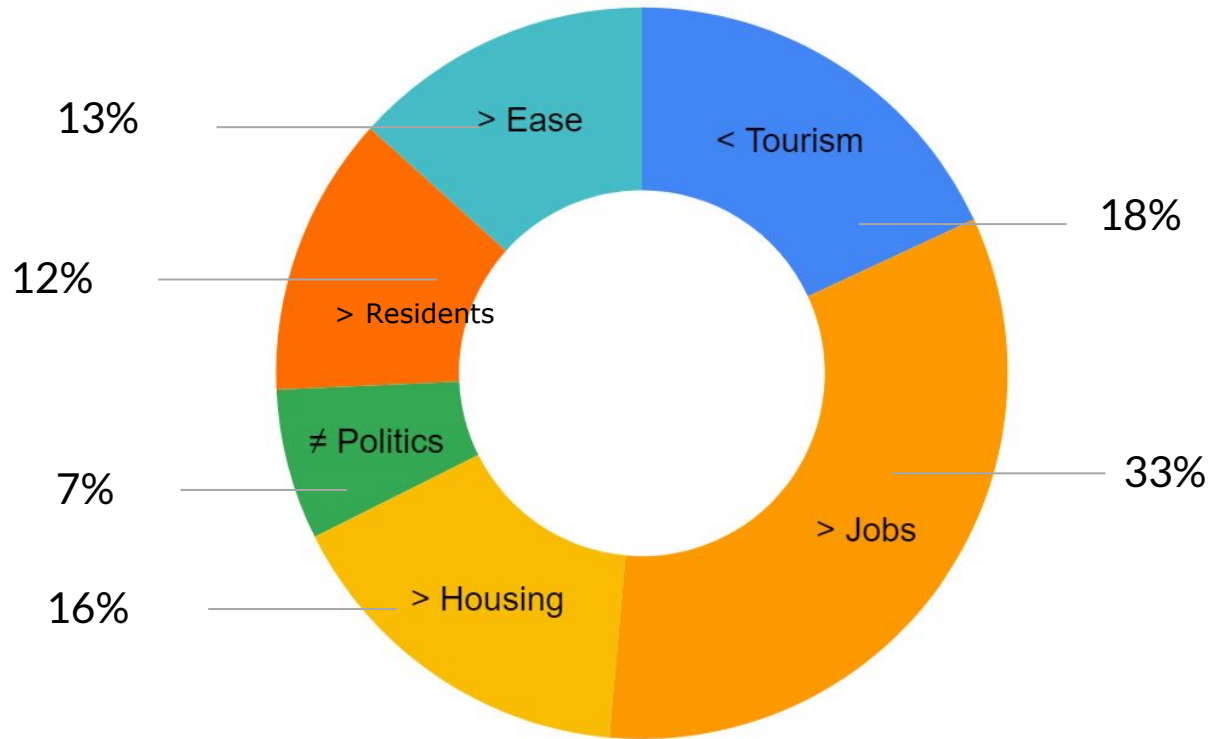
and remain away because of work



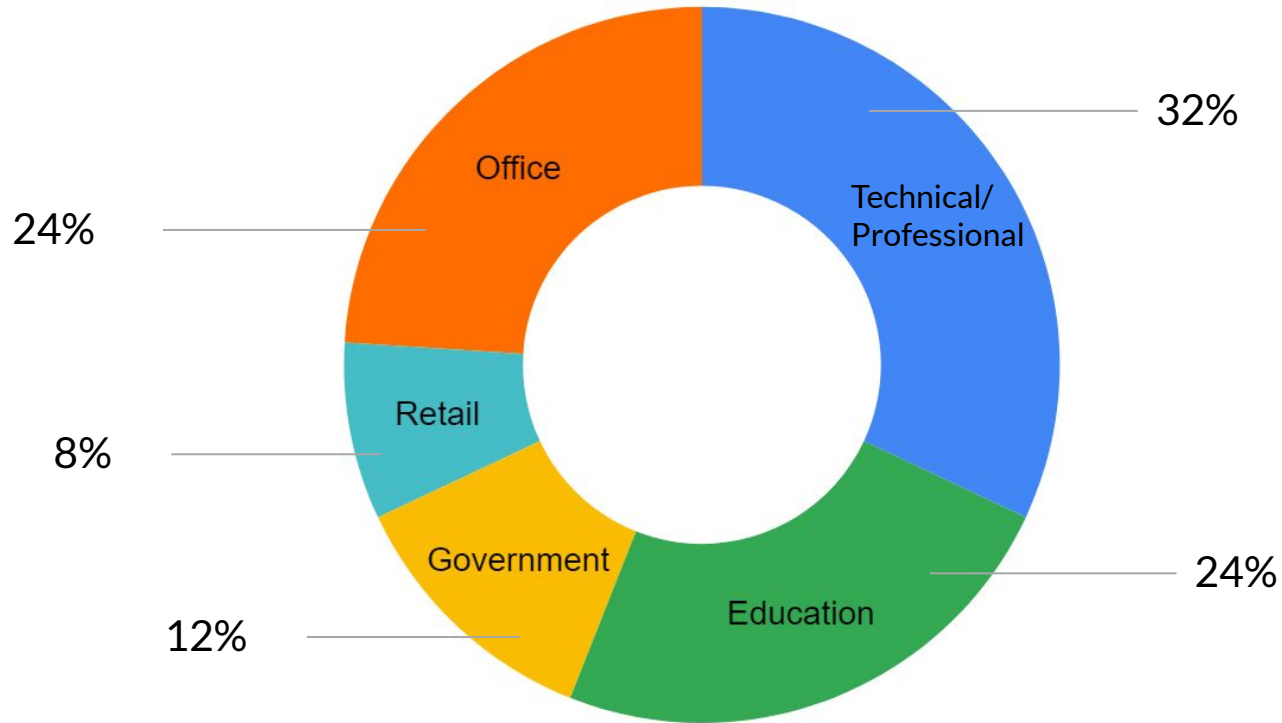
...but would love to return to Venice



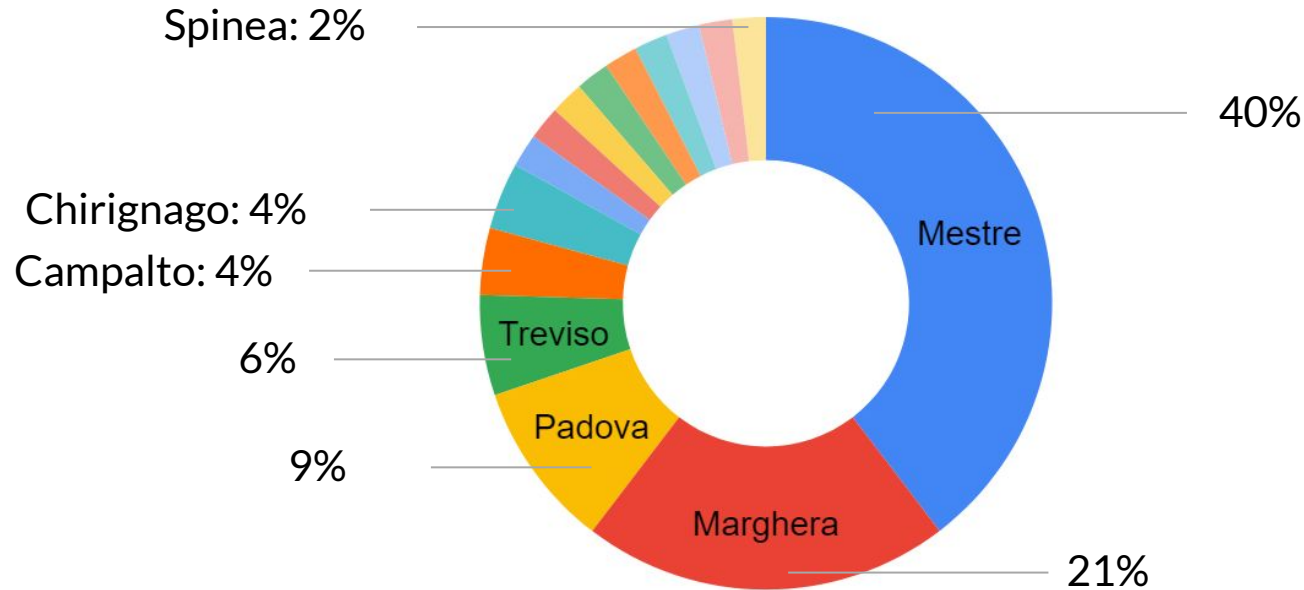
... if Venice had more jobs, more homes and fewer tourists



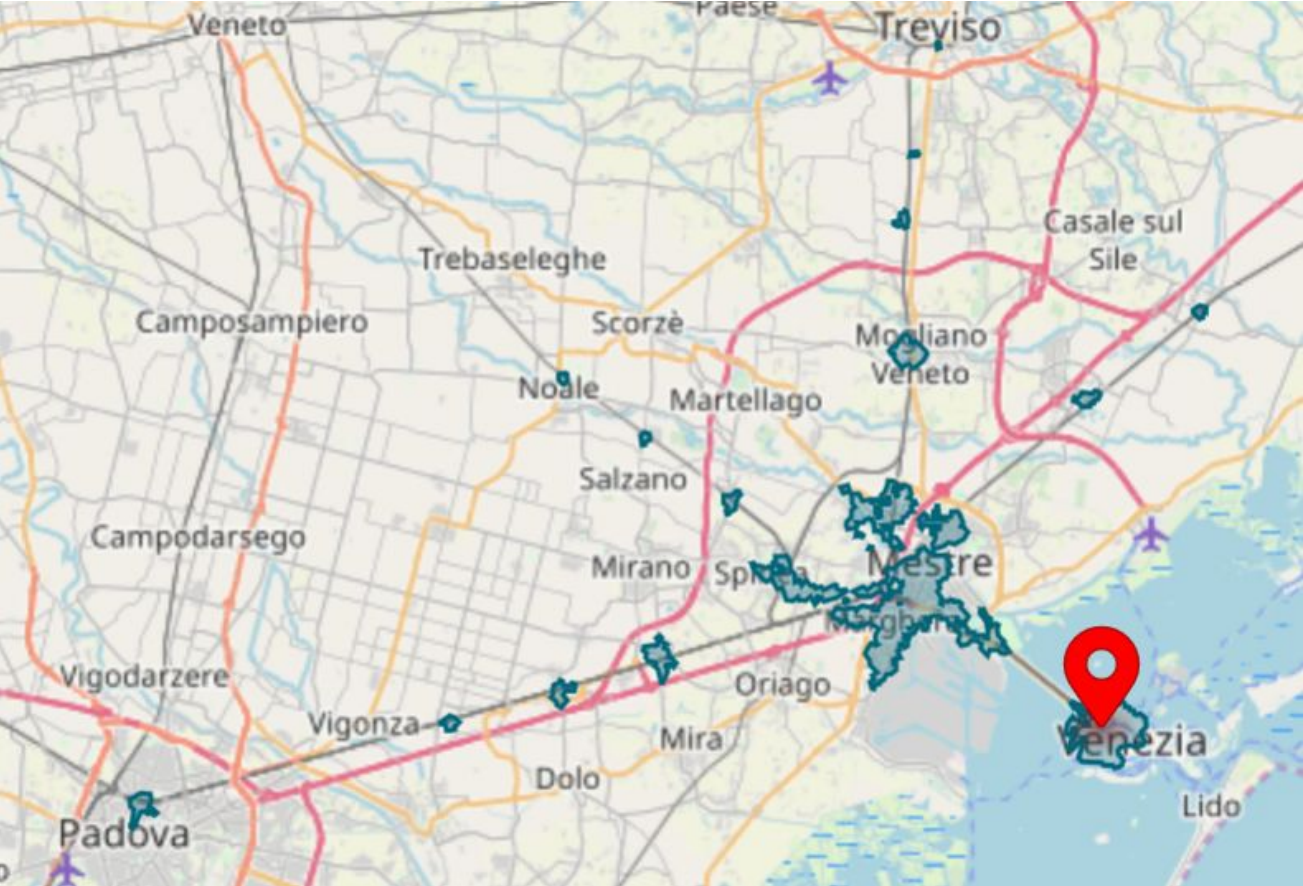
Some residents work outside of Venice in higher-end jobs



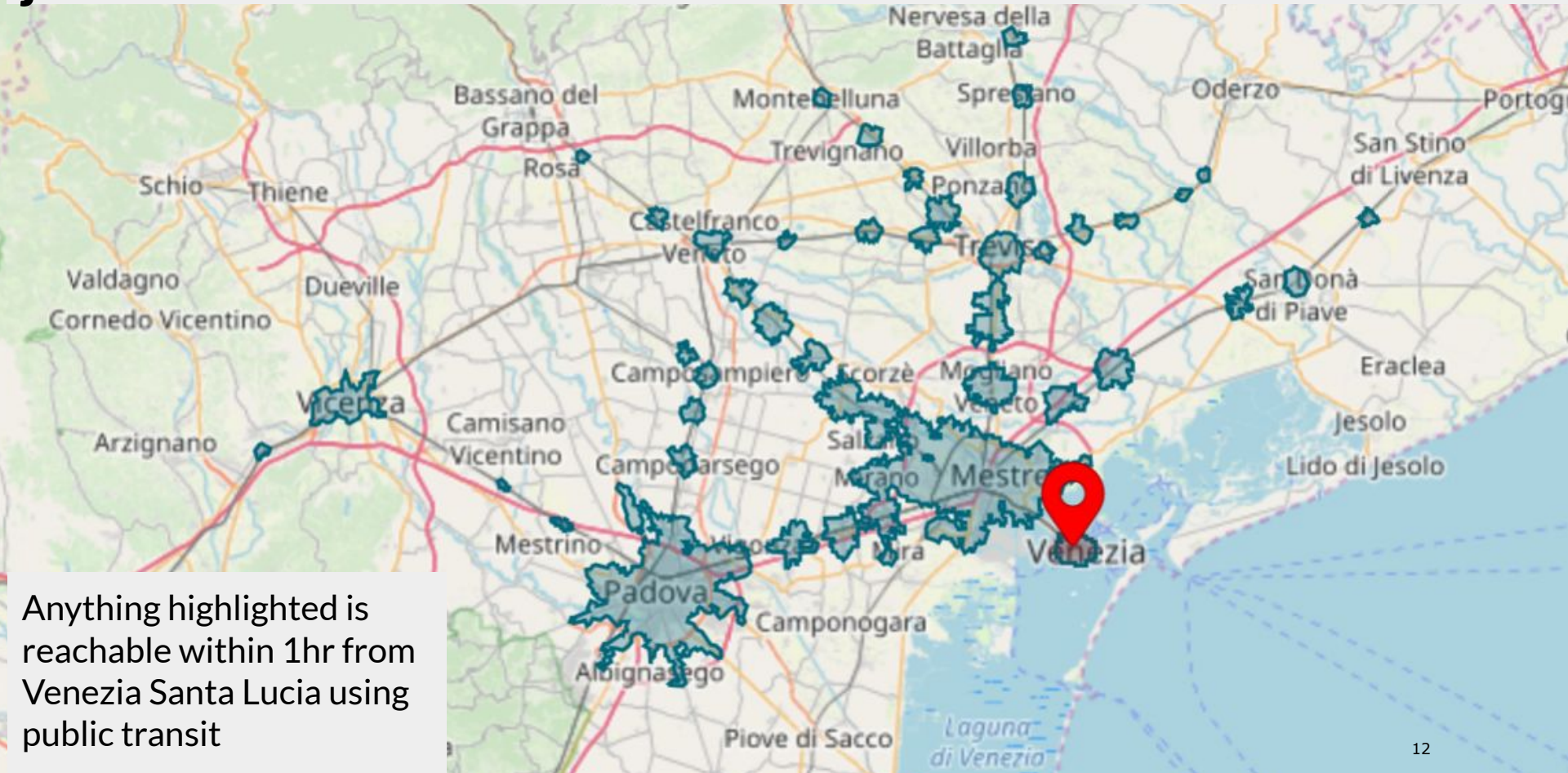
And commute to (and from) relatively close destinations on the mainland



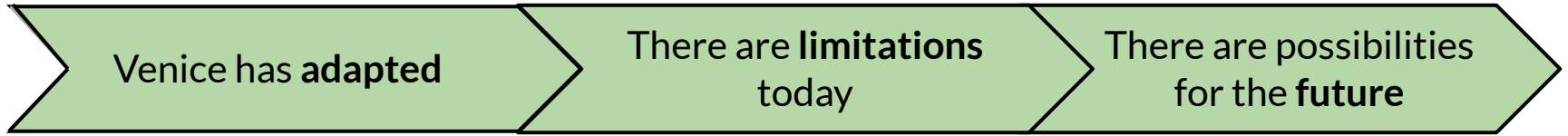
Commuters with high-paying jobs are commuting to destinations on the mainland that are reachable within 30 minutes



Getting commuters to the mainland faster would make more jobs accessible within a 1hr commute



Anything highlighted is reachable within 1hr from Venezia Santa Lucia using public transit





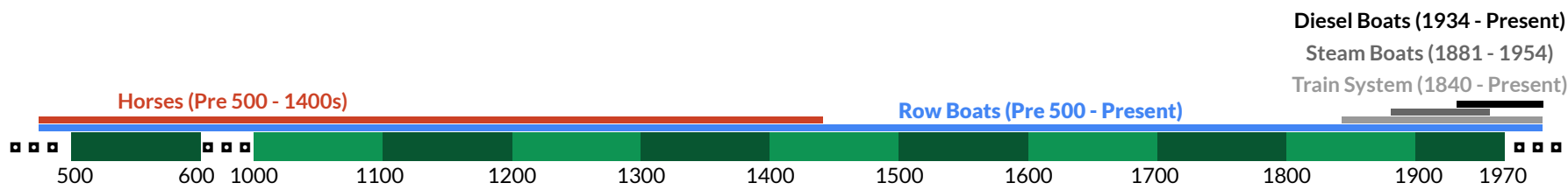
Venice has adapted

There are **limitations**
today

There are possibilities
for the **future**

Evolution of Transportation in Venice

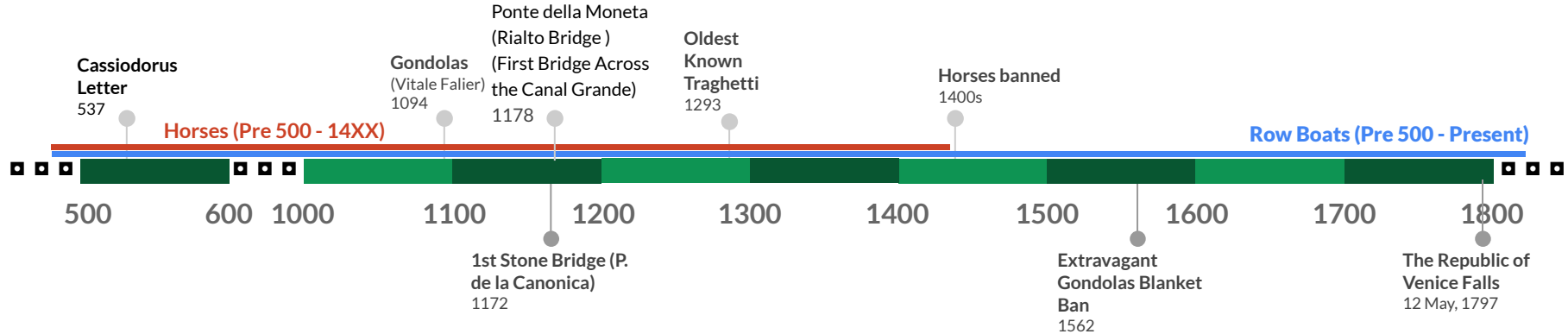
Evolution of Transportation in Venice



The Groundwork for Future Changes, 500 - 1800

Row Boats (Pre 500 - Present)

Since the founding of Venice in 497 AD, row boats have been used to traverse between the mainland and the historic city, as well as moving within the historic city. Many different types of row boats can be found throughout the history of Venice, but the most common and popular choice were Gondolas, thin, traditional, flat-bottomed Venetian rowing boat, well suited to the conditions of the Venetian lagoon and gifted to the people of Venice in 1094 by the Doge (leader) at the time, Vitale Falier. Today, traghetti are used to cross the Canal Grande in certain spots.



Horses (Pre 500 - 1400s)

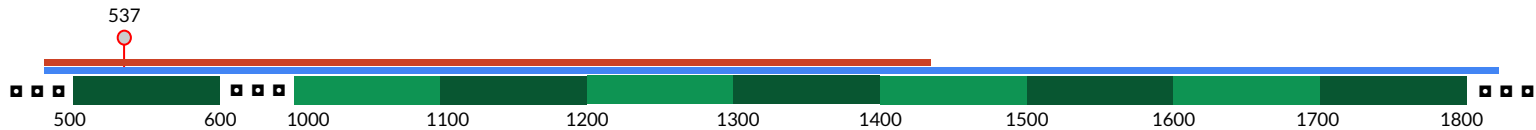
Horses were used to traverse within the historic city in the early history of Venice. They were useful in crossing smaller canals because they could wade through the waters while carrying products and people. As Venice began to add cobblestone walkways, horses became less popular because they would slip on the slick stones. When Venice added retaining walls to the sides of the islands, horses were no longer easily able to climb into and out of the water, making them even less popular. In the 15th century, they were outright banned by the Venetian noble class, preferring Gondolas as the main travel method within the historic city.

Cassiodorus wrote about early Venetians



*“Therefore diligently repair
the ships which you keep tied
to the walls of your houses
like animals,”*

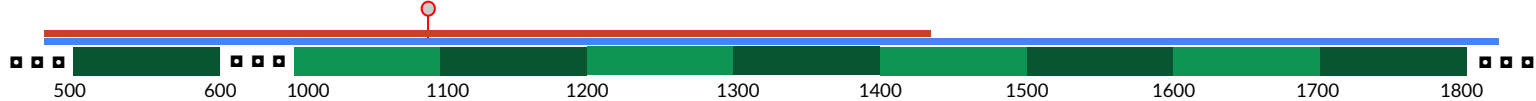
- Cassiodorus, 537



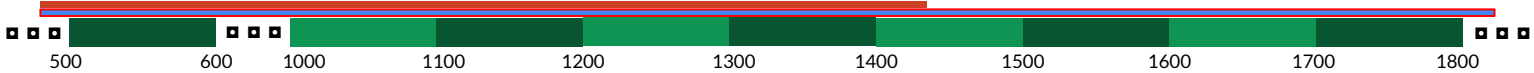
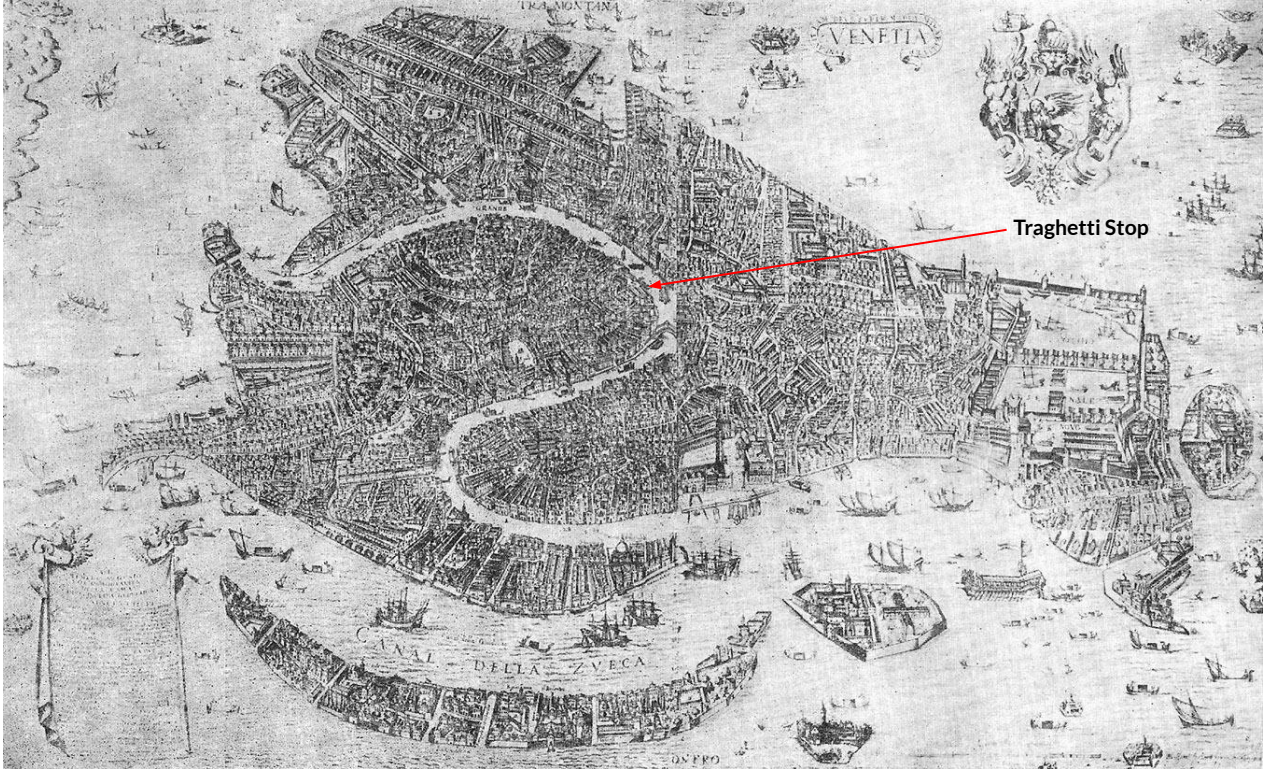
A new form of row boat is used to reduce canal crowding



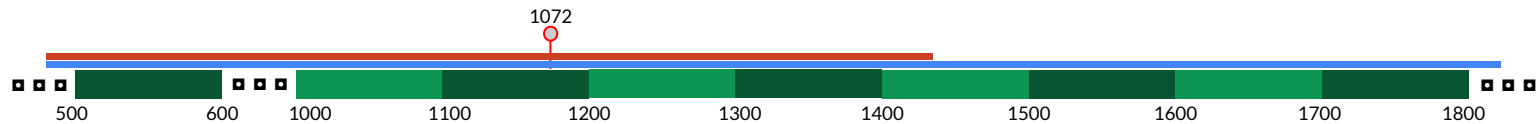
1093



Traghetti are the most important transportation system



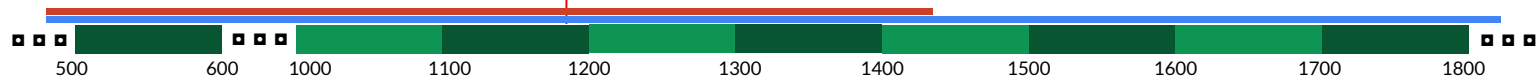
The stonefication of Venice led to the downfall of horses



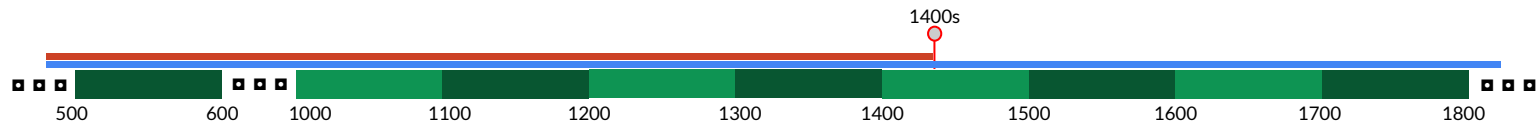
The Rialto was the first dry connection over the Canal Grande

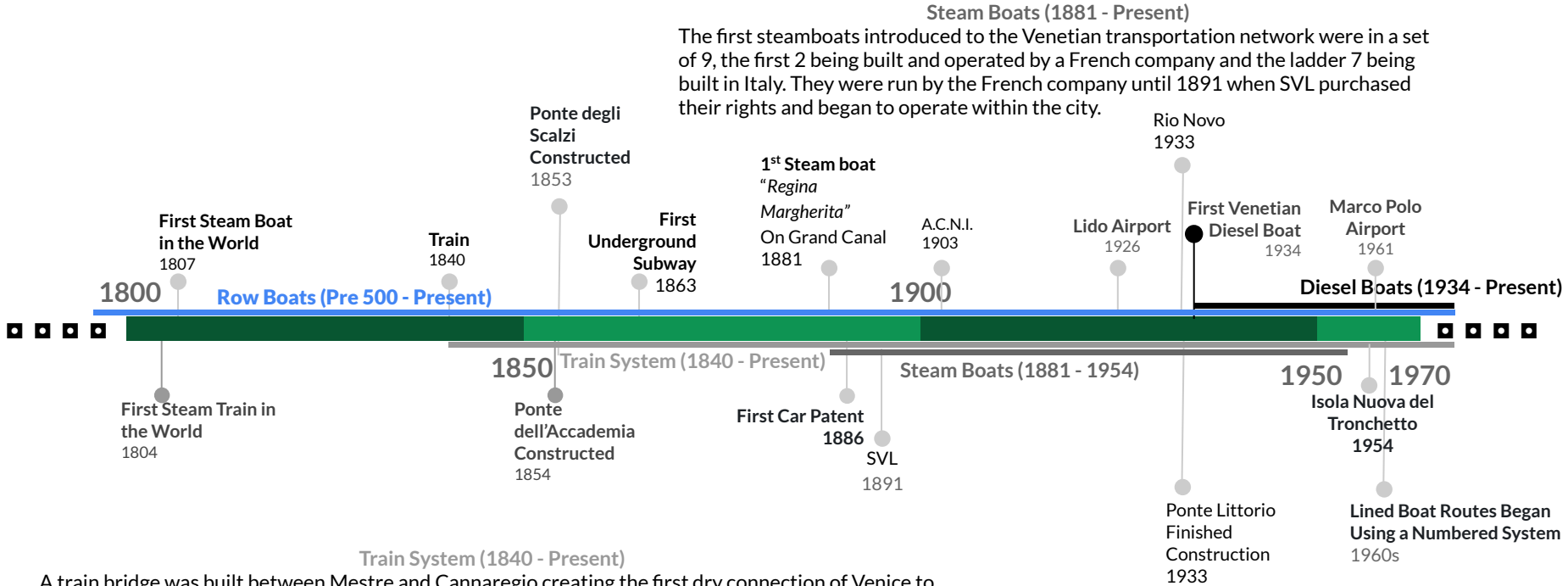


1078



There were only boats and bridges between the 14th and 19th century





Train System (1840 - Present)

A train bridge was built between Mestre and Cannaregio creating the first dry connection of Venice to the mainland. This bridge, being 2.4 miles long, ended with the Santa Lucia Train Station which was the last stop in the Milan to Venice railway line. The bridge allowed for more people and goods to arrive into the historic city and at a faster rate.

Steam Boats (1881 - Present)

The first steamboats introduced to the Venetian transportation network were in a set of 9, the first 2 being built and operated by a French company and the latter 7 being built in Italy. They were run by the French company until 1891 when SVL purchased their rights and began to operate within the city.

Diesel Boats (1934 - Present)

Diesel Boats were added to the A.C.N.I fleet in 1934 with the introduction of the first seven boats.

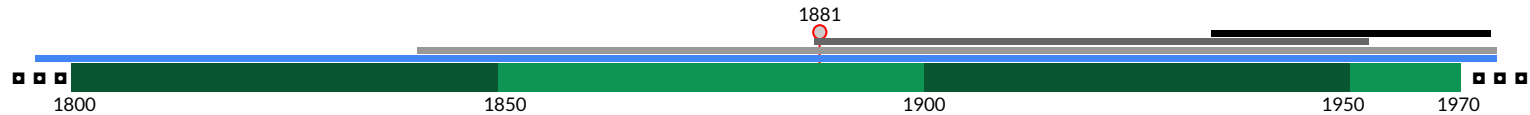
Train Bridge, 1840



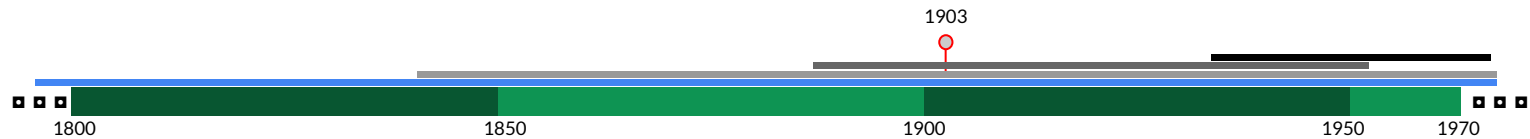
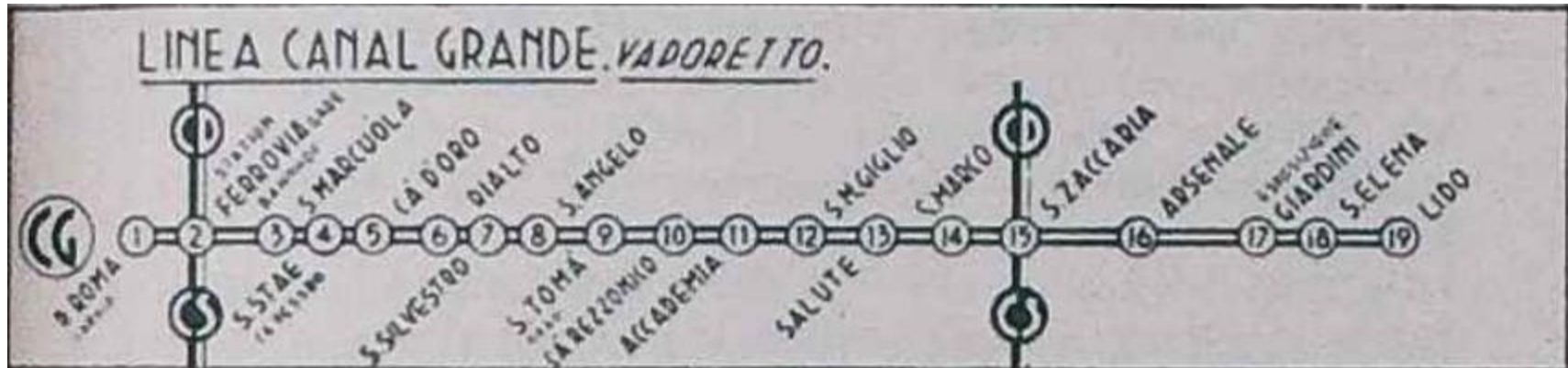
The second step in transportation evolution were steamboats

Regina
Margherita

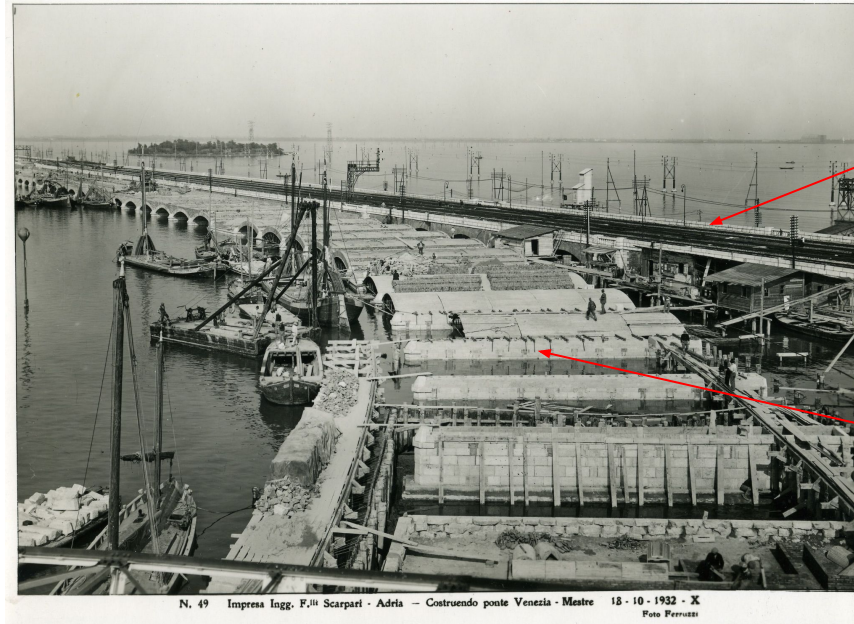
Venice's
First Steam
Powered
Boat



ACNI takes over the public boat transportation

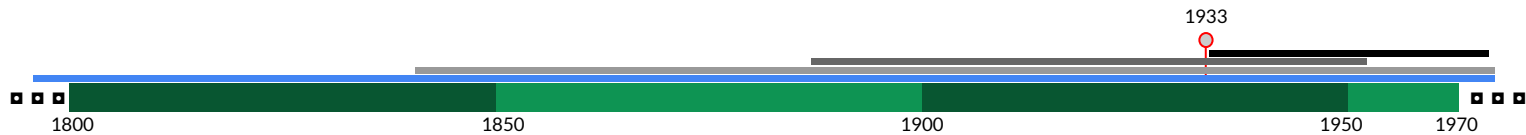


Car bridge allows for faster travel

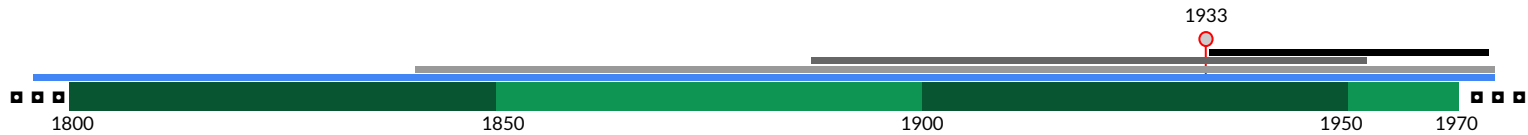


Train Bridge

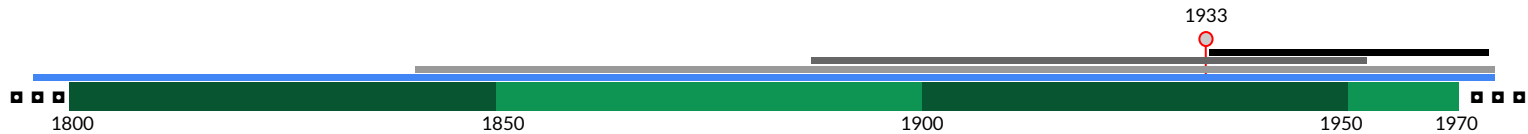
Ponte del
Littorio



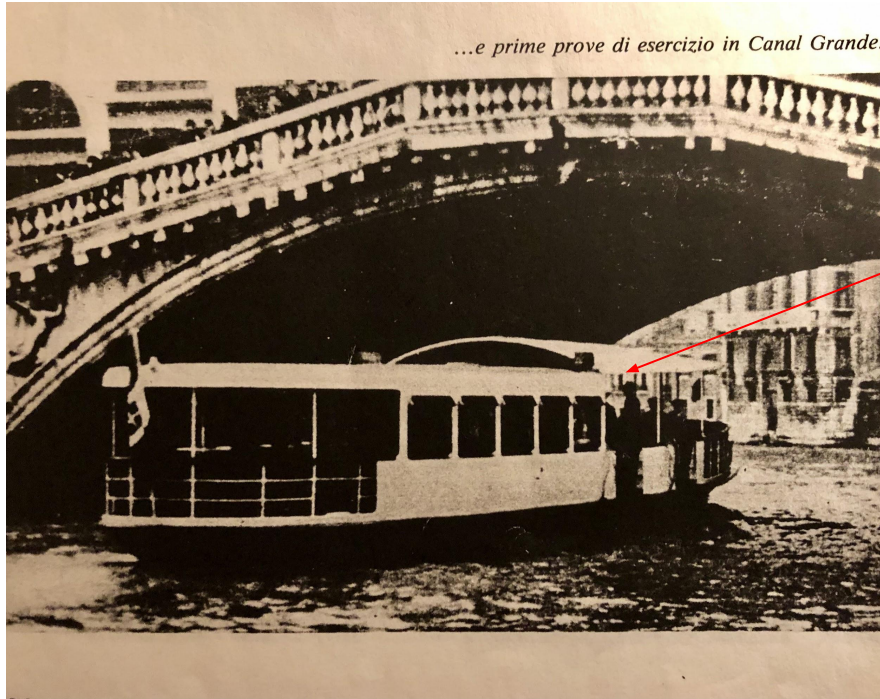
With a car bridge comes the need for parking



Rio Novo was constructed to connect Piazzale Roma

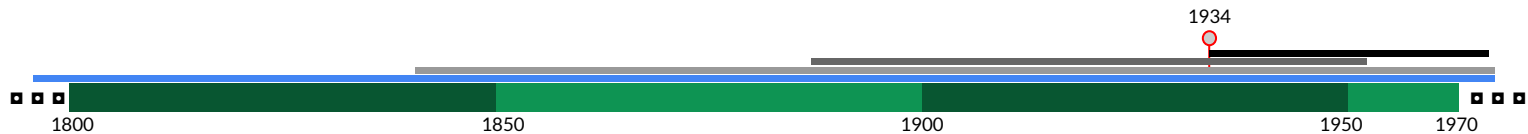


Diesel boats were also purchased and used before WWII

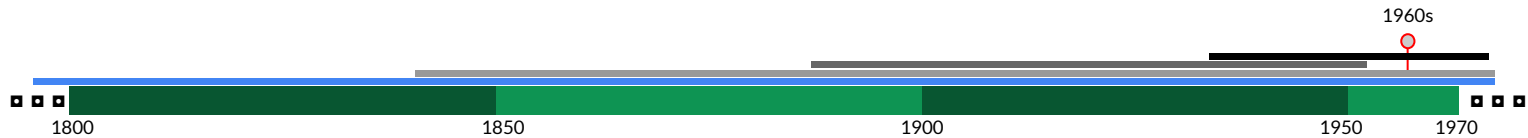
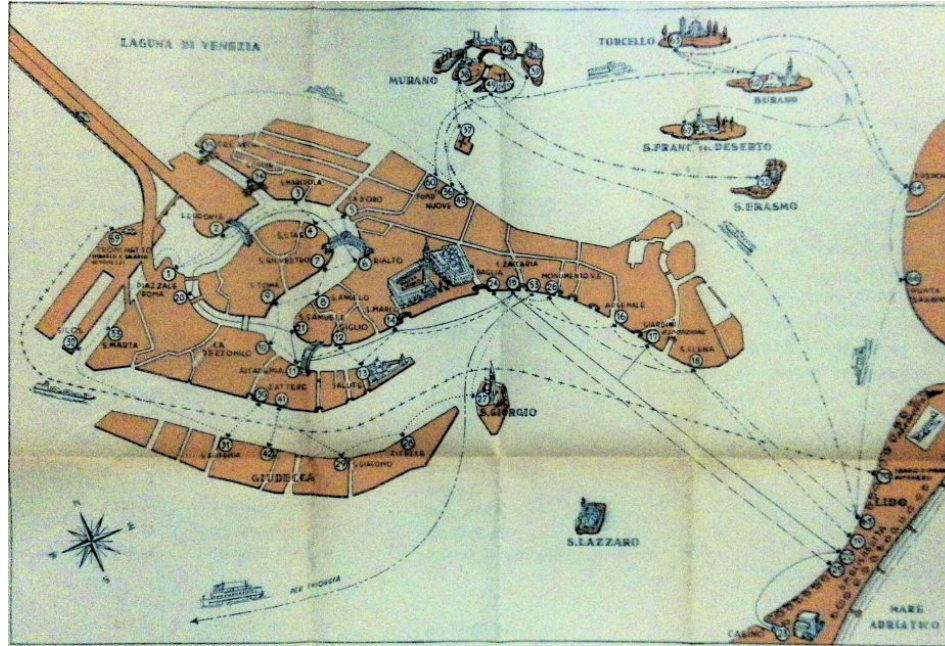


NO. 42 Annibale
Foscari (now
HIPOPOTAMO)
on its Maiden
Voyage

One of the boats
in the First Fleet
of Venetian Diesel
Boats



Prior to the 1960s, only linear routes (not circular) were used to traverse the historic city



Venice has adapted

There are **limitations**
today

There are **possibilities**
for the future

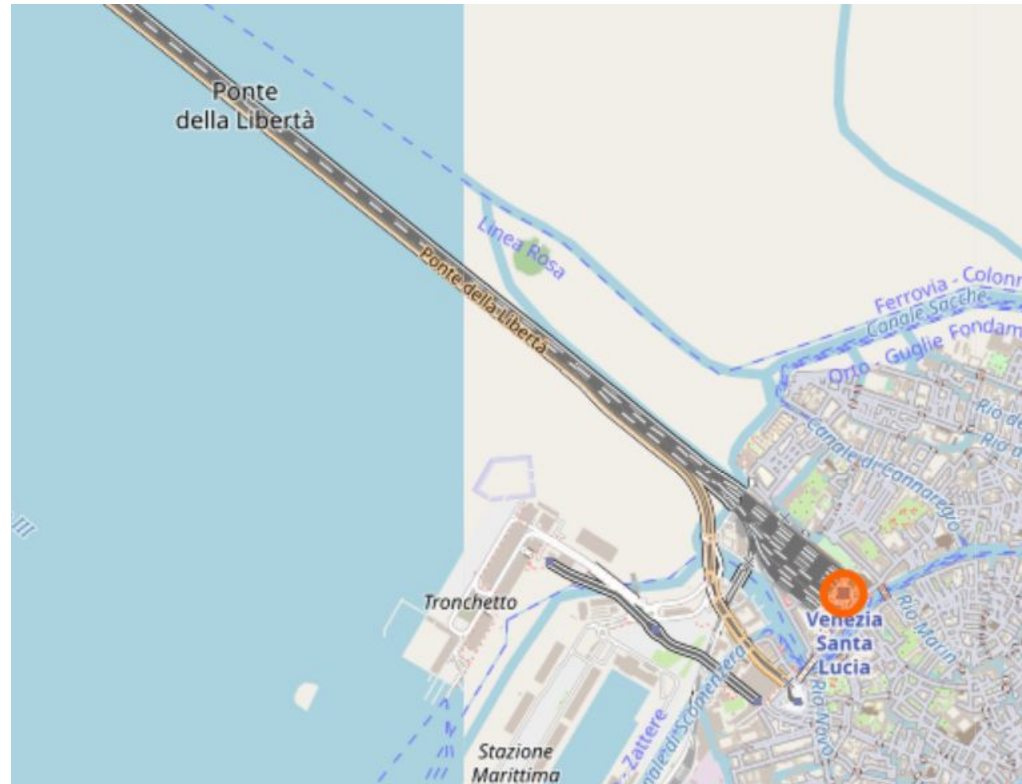
Current Transportation System

Getting in and out of Venice

The Ponte della Libertà brings commuters out of Venice by road and rail. There are also boat routes, especially from Marco Polo airport



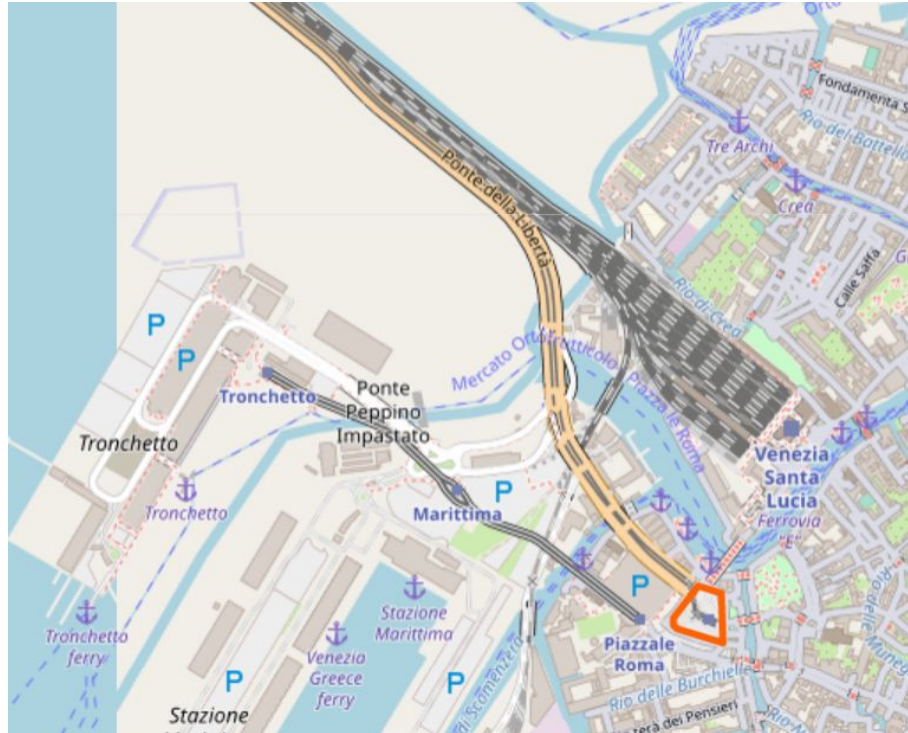
Everyday, 371 trains arrive at Venezia S. Lucia, and 378 trains depart from the station



The Ponte della Libertà also carries transportation over road



Multiple bus companies, including ACTV and ATVO, have bus routes with terminus at Piazzale Roma



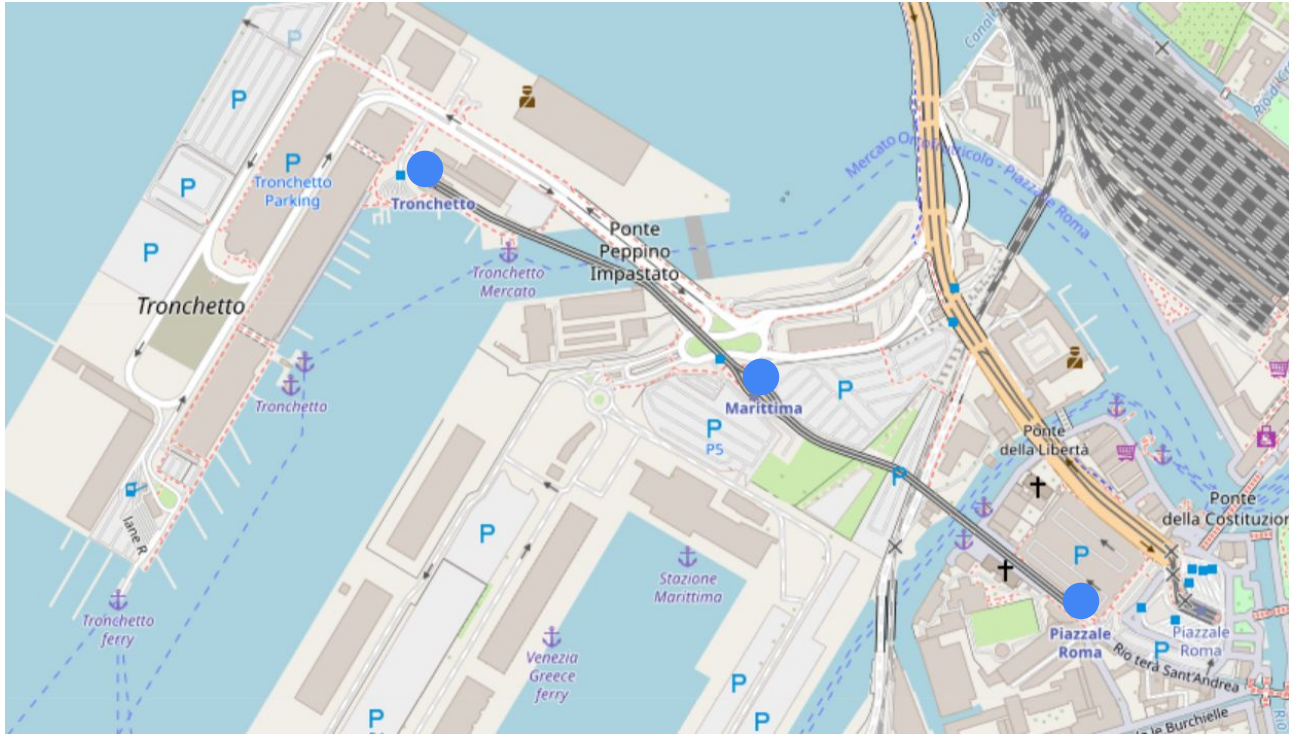
Trams connect commuters to Mestre and Marghera

Line T1 Favaro - Venice
Line T2 Mestre - Marghera.



Stop added in 2015

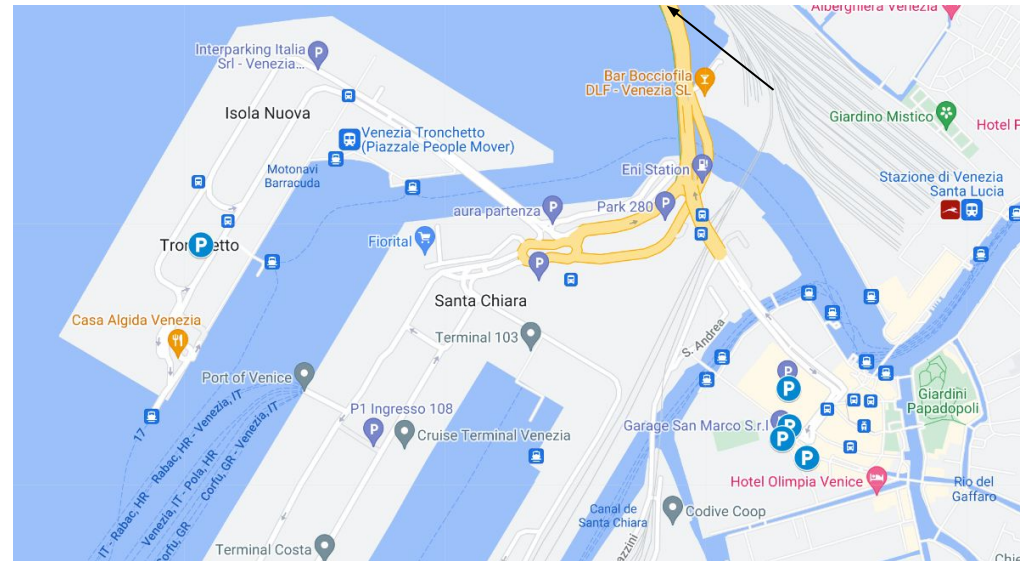
The People Mover moves 3200 people hourly between 3 transportation hubs in 4 minutes



There are 8200 parking spots in the historic city

Parking Facility	Number of car parking spots available	Cost to park for a day
Tronchetto	3957	€ 22 for 24h
Municipal Parking	2196	€ 35 for 24h
San Andrea	102	€ 72 for 24h
Aree portuali	1000	€ 78 for 24h
San Marco	900	€ 45 for 24h
Parcheggio Doge	45	€ 45 for 07:00 - 01:00 (not open 24/7)
Total	8200	n/a

Parcheggio San Giuliano



Ferry Boats transport cars and cargo between Lido and the mainland

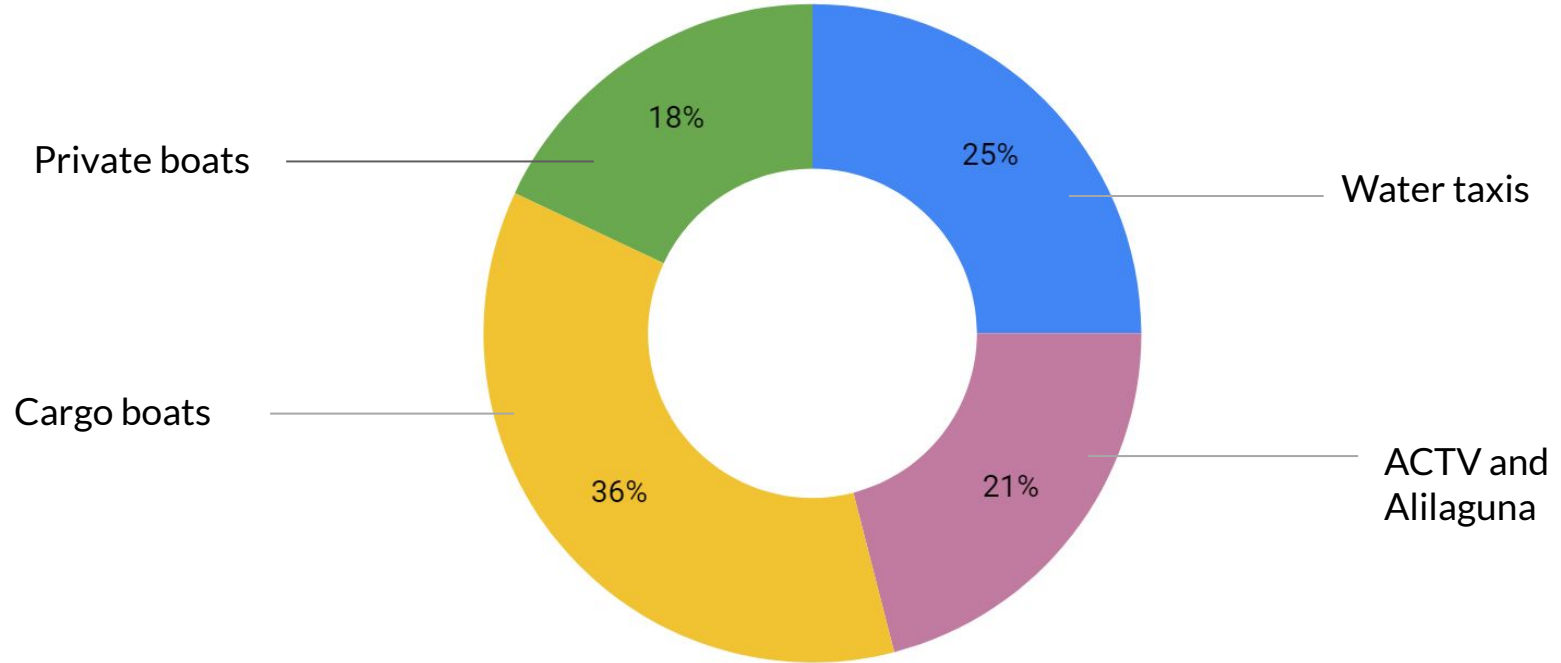


A trip on Line 17 from Lido S.Nicolò to Tronchetto lasts **35 minutes**
Approximately **70 cars** can fit on a Ferry Boat

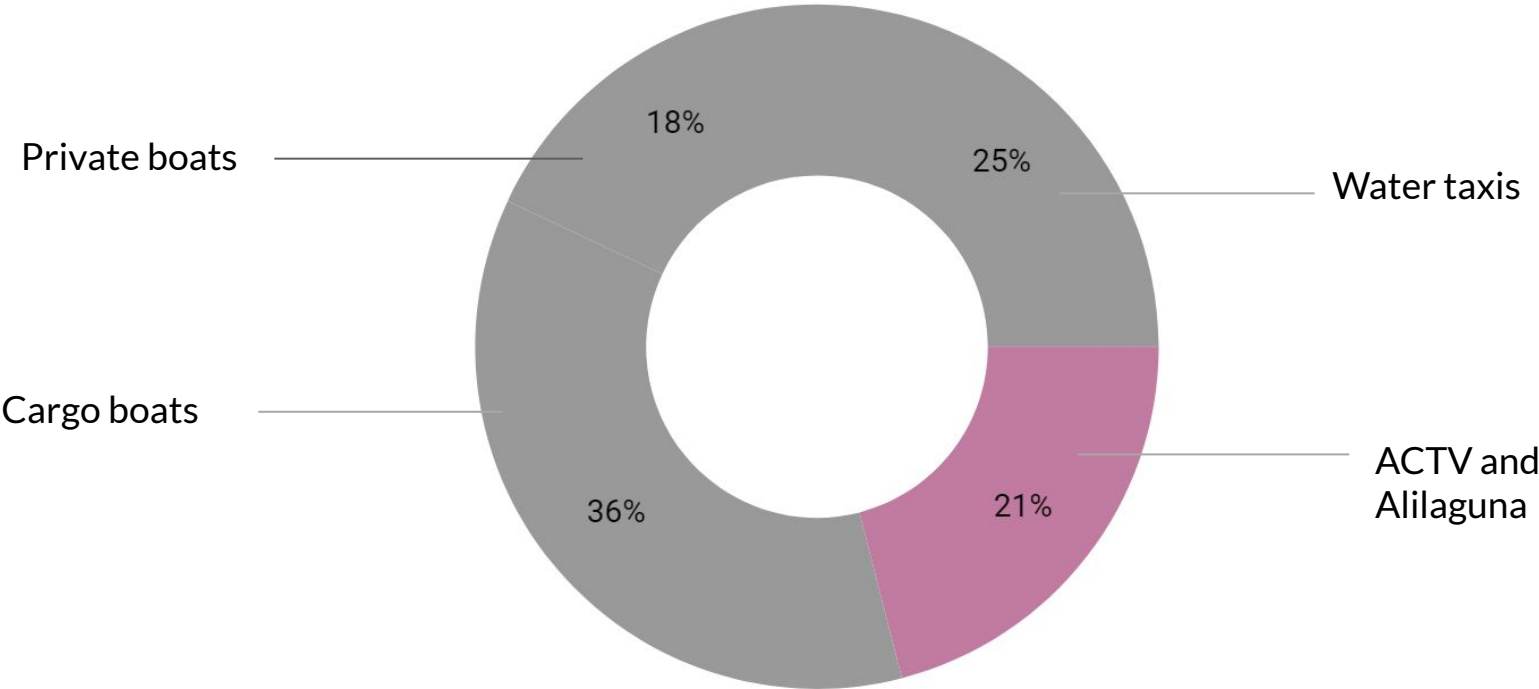
Boats can provide transportation over water to the historic city



There are four main types of boats in the Venetian canals

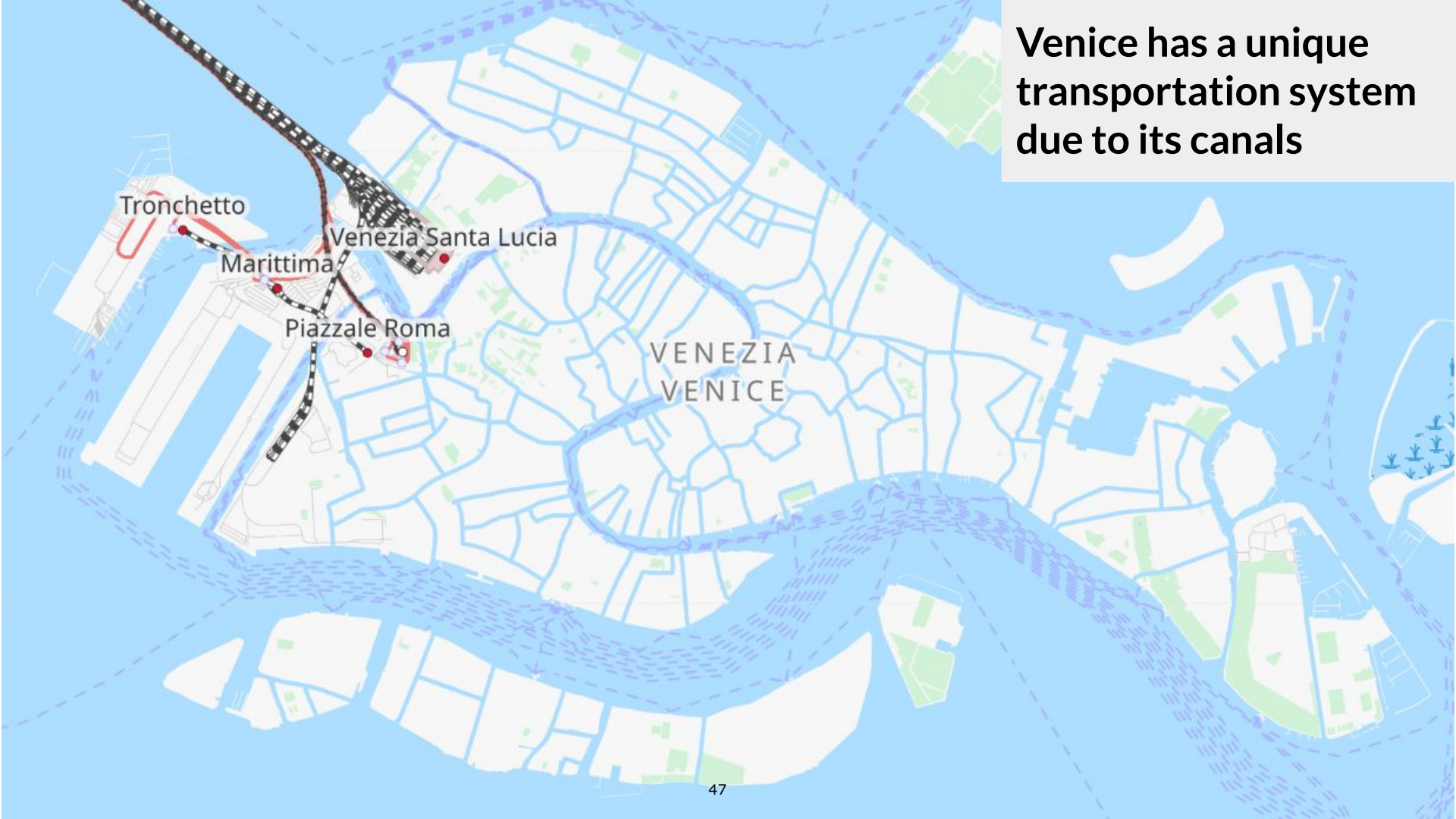


Lined public transportation boats don't cause a lot of traffic

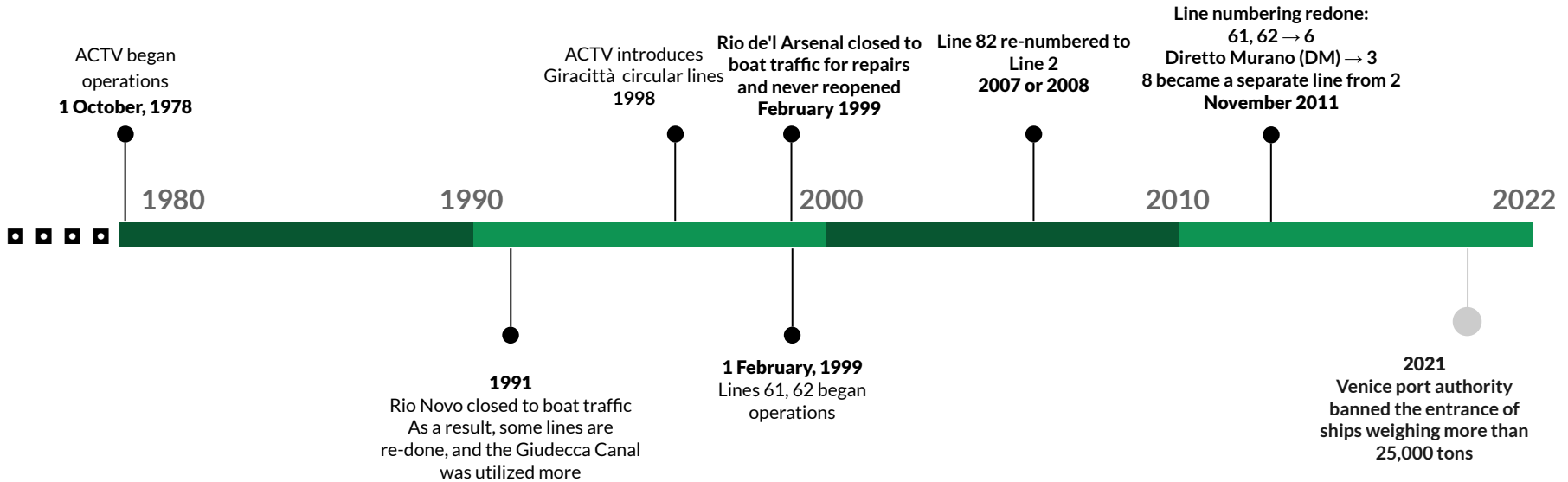


Getting around within the historic city

Venice has a unique transportation system due to its canals



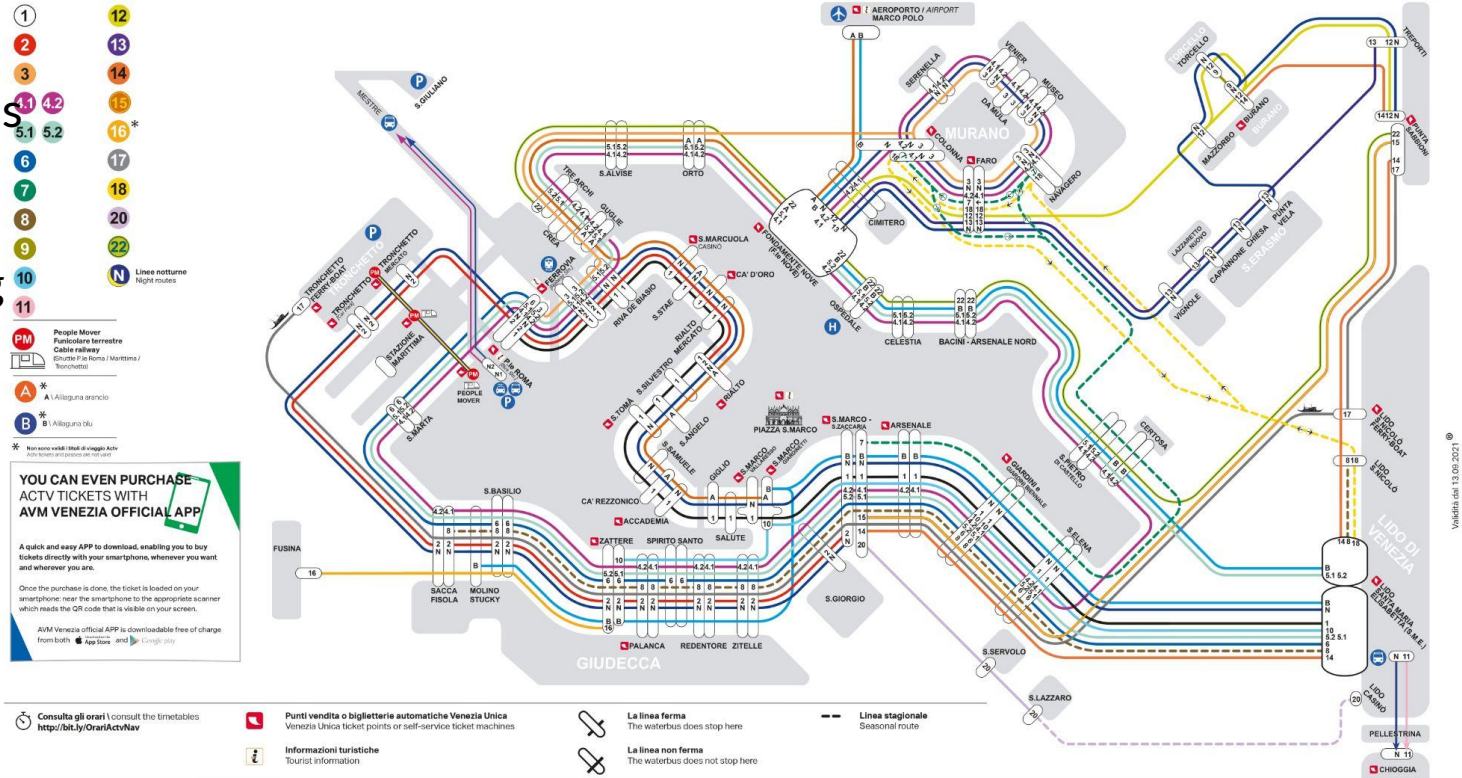
ACTV has adapted and evolved since its inception



Corposanto & Raven, 2022

Water buses are the main mode of transportation in the canals

- 26 water bus lines
- 160 boats
- 150 floating pontoons
- Up to 1150 passengers per hour on Line 1



***Vaporetti* are used on Lines 1, 2, 7, 13, and Night lines**



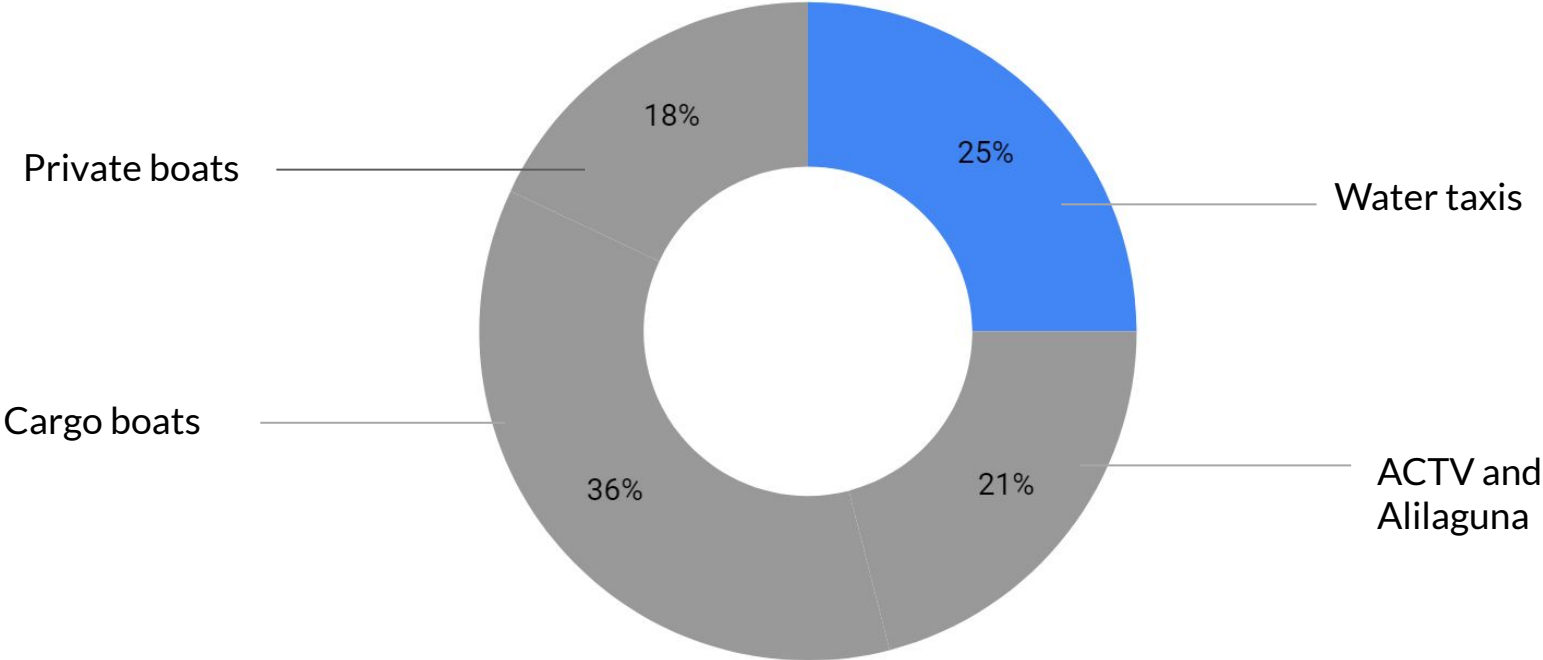
Passenger capacity: 215-230

Motoscafi are used for Lines 3, 4.1, 4.2, 5.1, 5.2, 6



Passenger capacity: 150

Private water taxis are point-to-point transportation



There are 250 licensed taxis

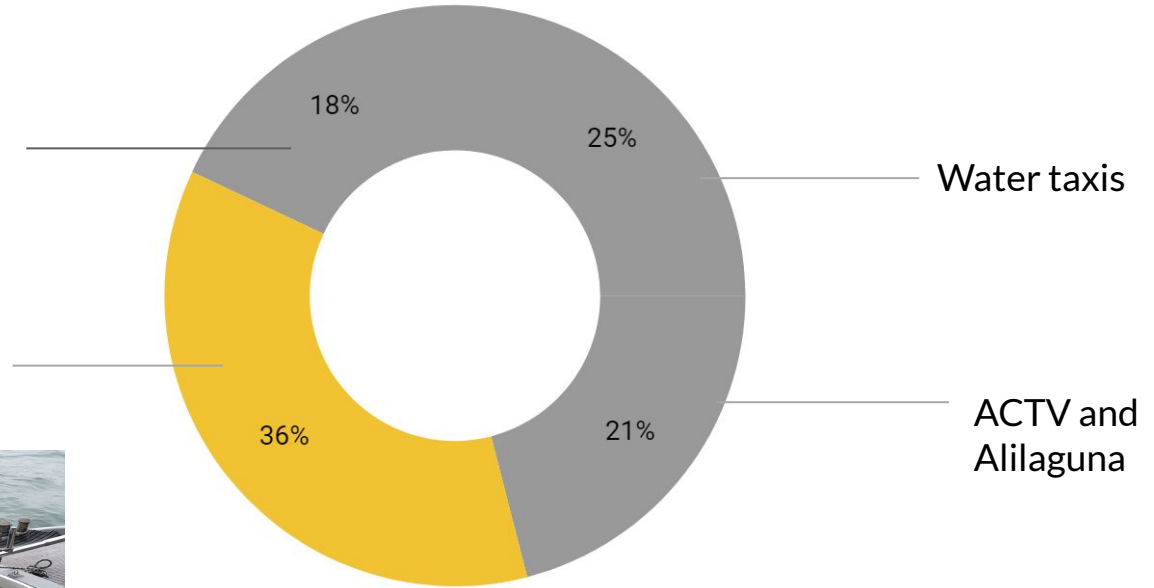


There are 410 licensed cargo boats

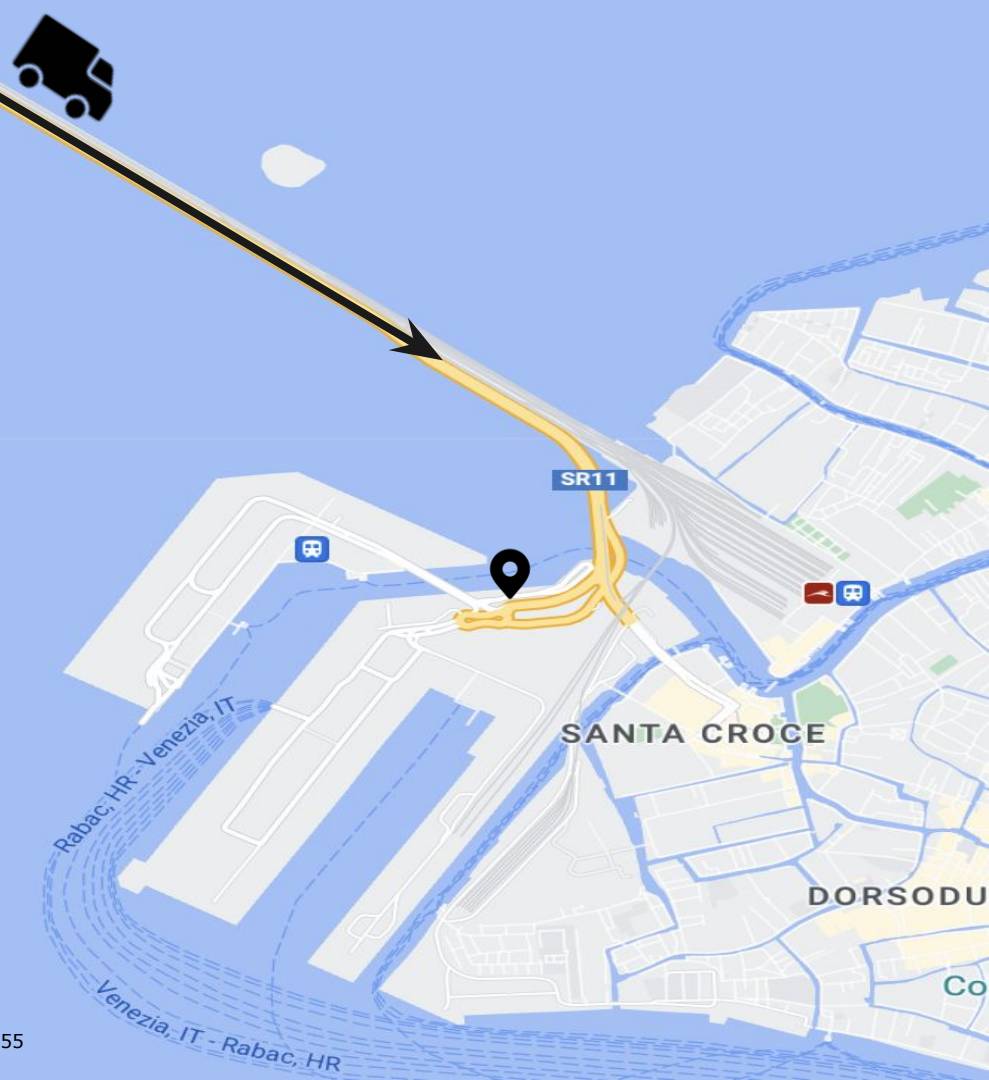


Private
boats

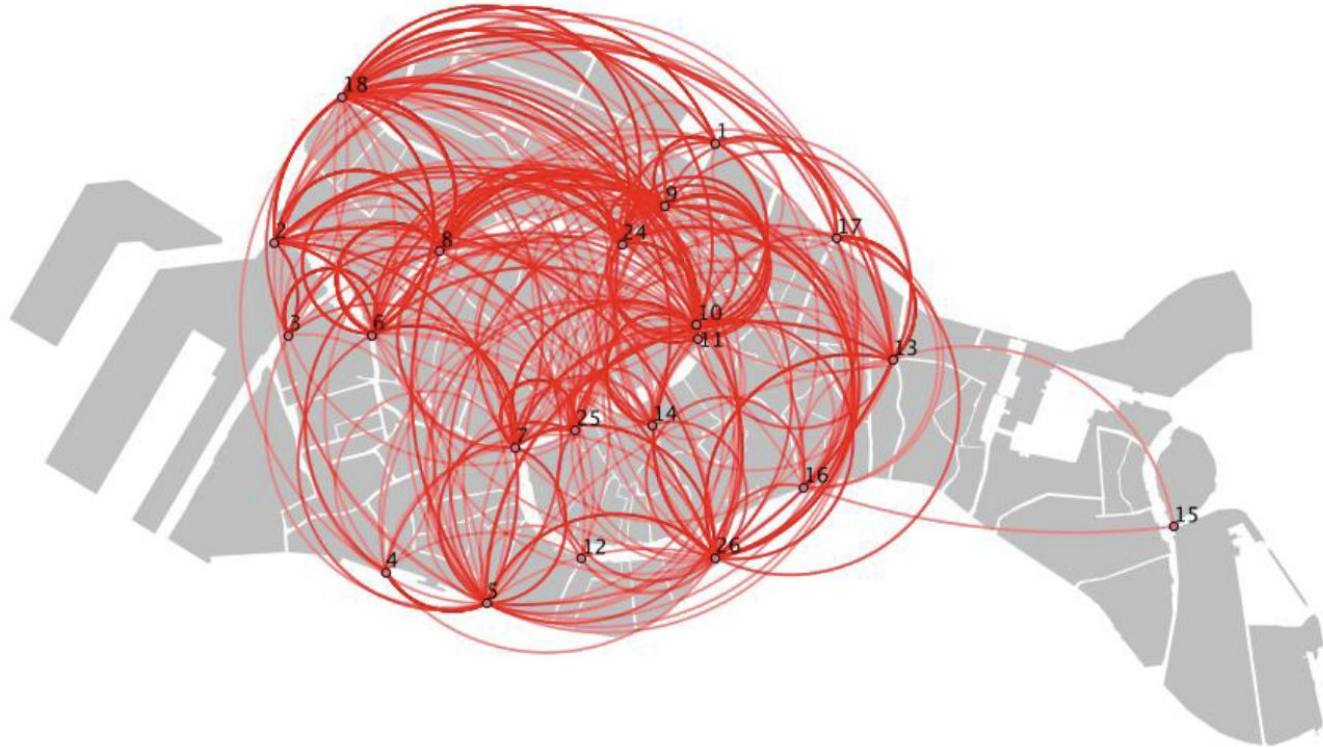
Cargo
boats



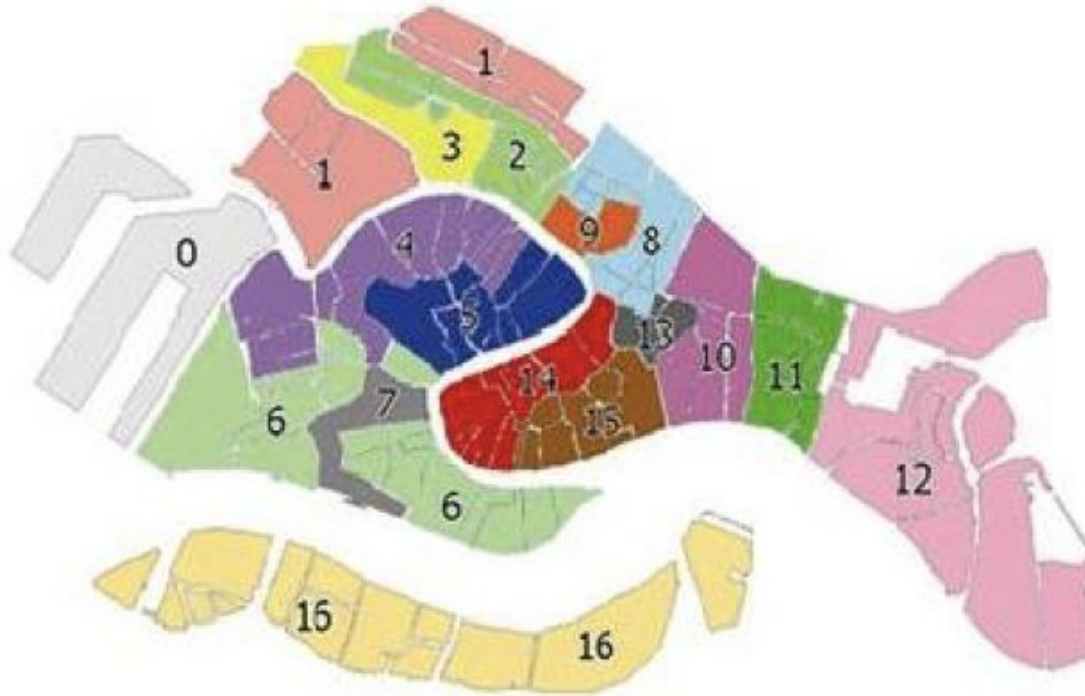
Trucks deliver cargo products to Venice



Cargo boats deliver around 32,000 packages every day with a total distance of 3,000km



In 2001, a group of students from WPI suggested a system of cargo delivery by location instead of by product



Problems with the current system

There are too many boats in the canals



Fog limits the operation of boats

There are cancellations and delayed to regular ACTV lines because it's not safe to navigate



***Acqua alta* limits the ability of boats to cross under bridges**

Boats can usually get to their destination, but need to re-route to avoid low bridges



***Moto ondosos* causes damage to canal walls and buildings**

It's estimated that it costs up to **\$11,680** to fix one square meter of damaged canal wall (2013)



Venice has adapted

There are limitations
today

There are possibilities
for the future

Exploration of a Sublagunare in Venice

- 1911
- Ing. Daniele Donghi
- Set of bridges, trams, and underwater passages
- Throughout the historic city, mainland, Lido, Pellestrina, and Chioggia
- Underwater connection between Lido Quattro Fontane and San Zaccaria

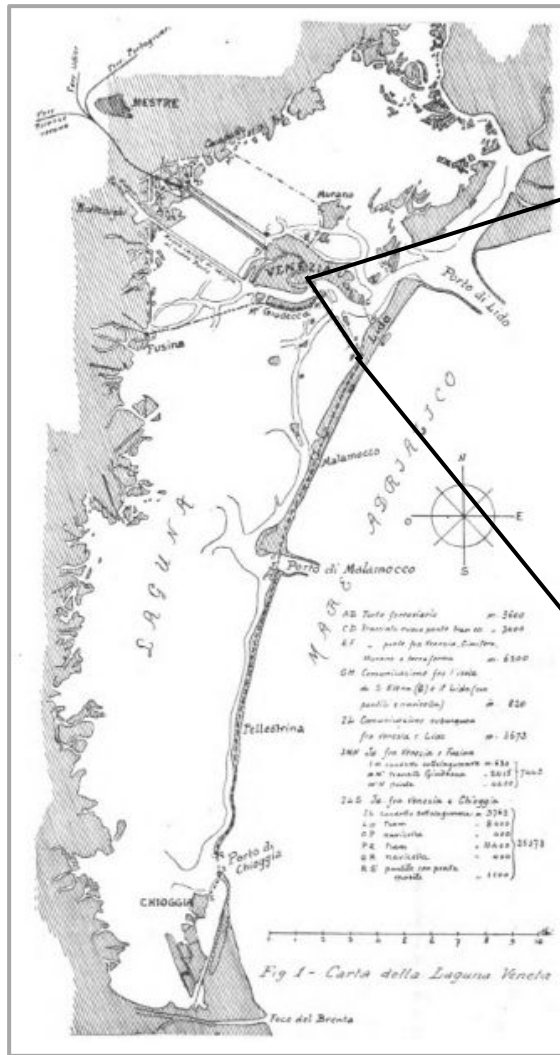
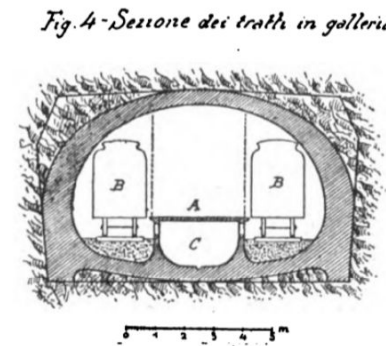
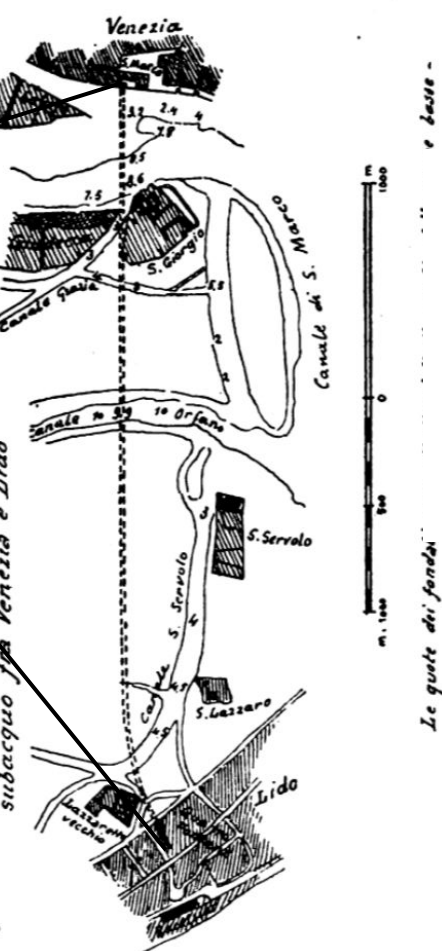
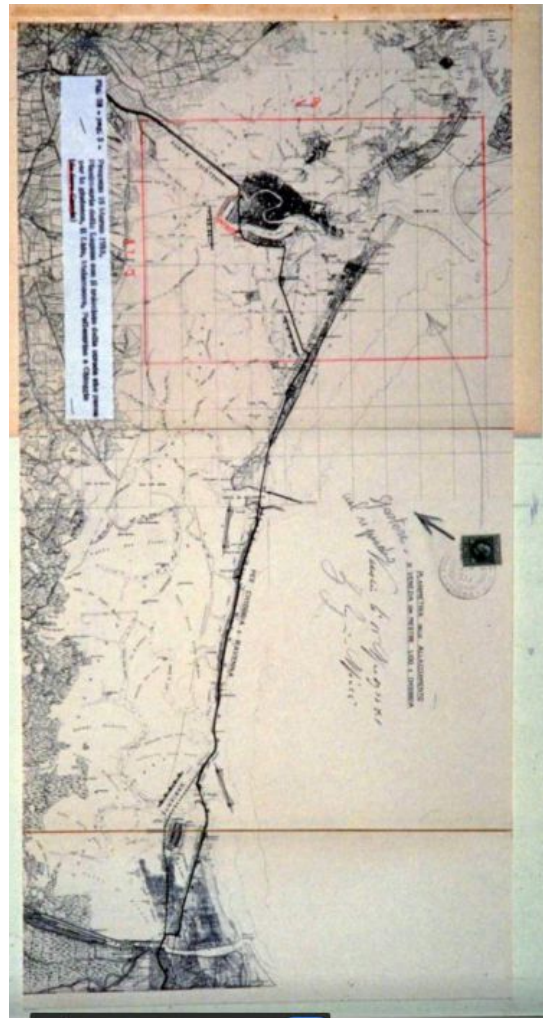


Fig. 2 - Planimetria generale dell'allacciamento subacqueo fra Venezia e Lido



Pedestrian tunnel flanked by electric trams

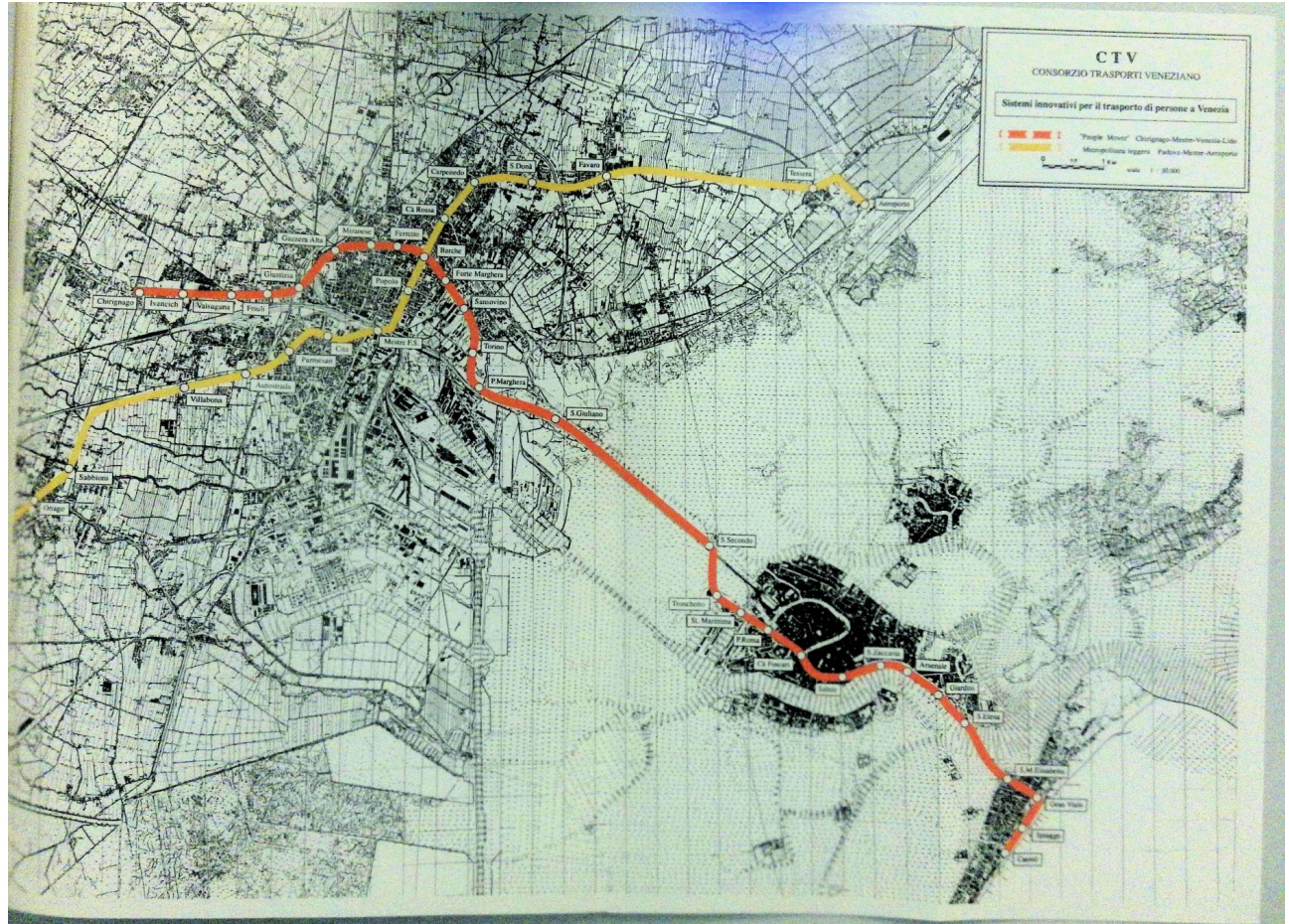
- 1933
- Ing. Miozzi
- 1 sublagunare route
- Connecting Venice, Mestre, Lido, Chioggia



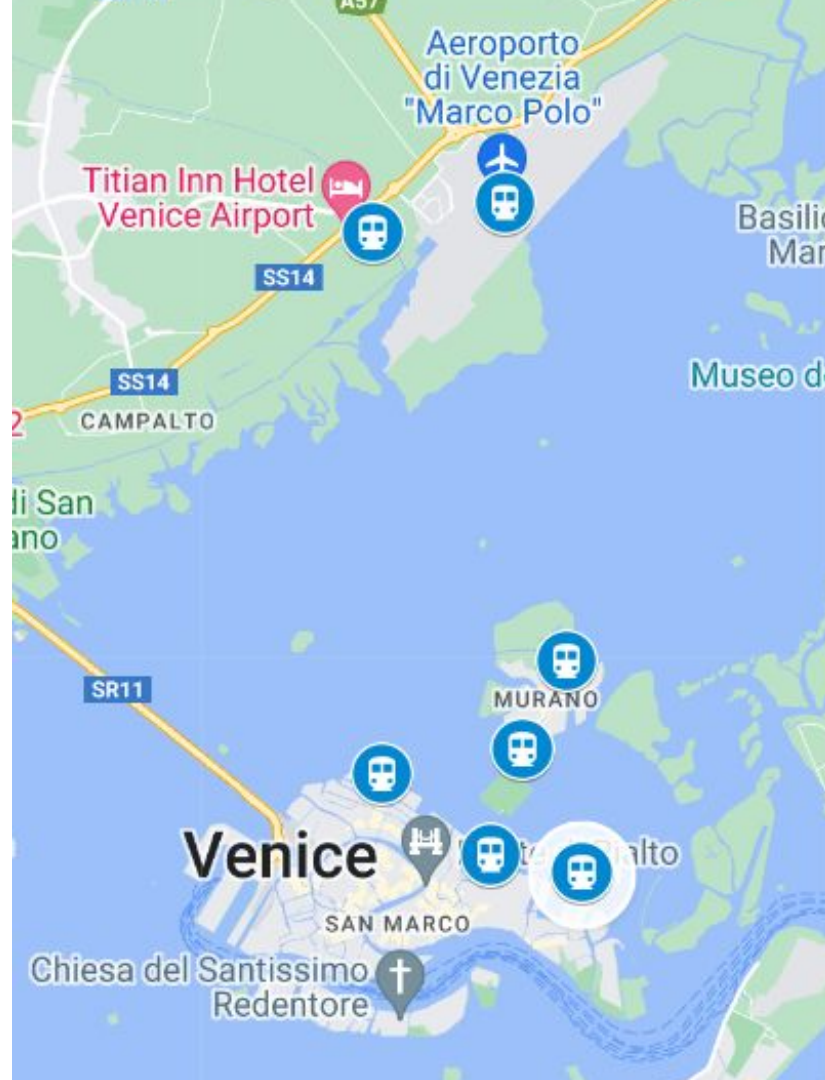
- 1959
- Town Plan
- Motor road and underground highway
- Ponte della Libertà to a proposed eastern terminal via F.te Nove



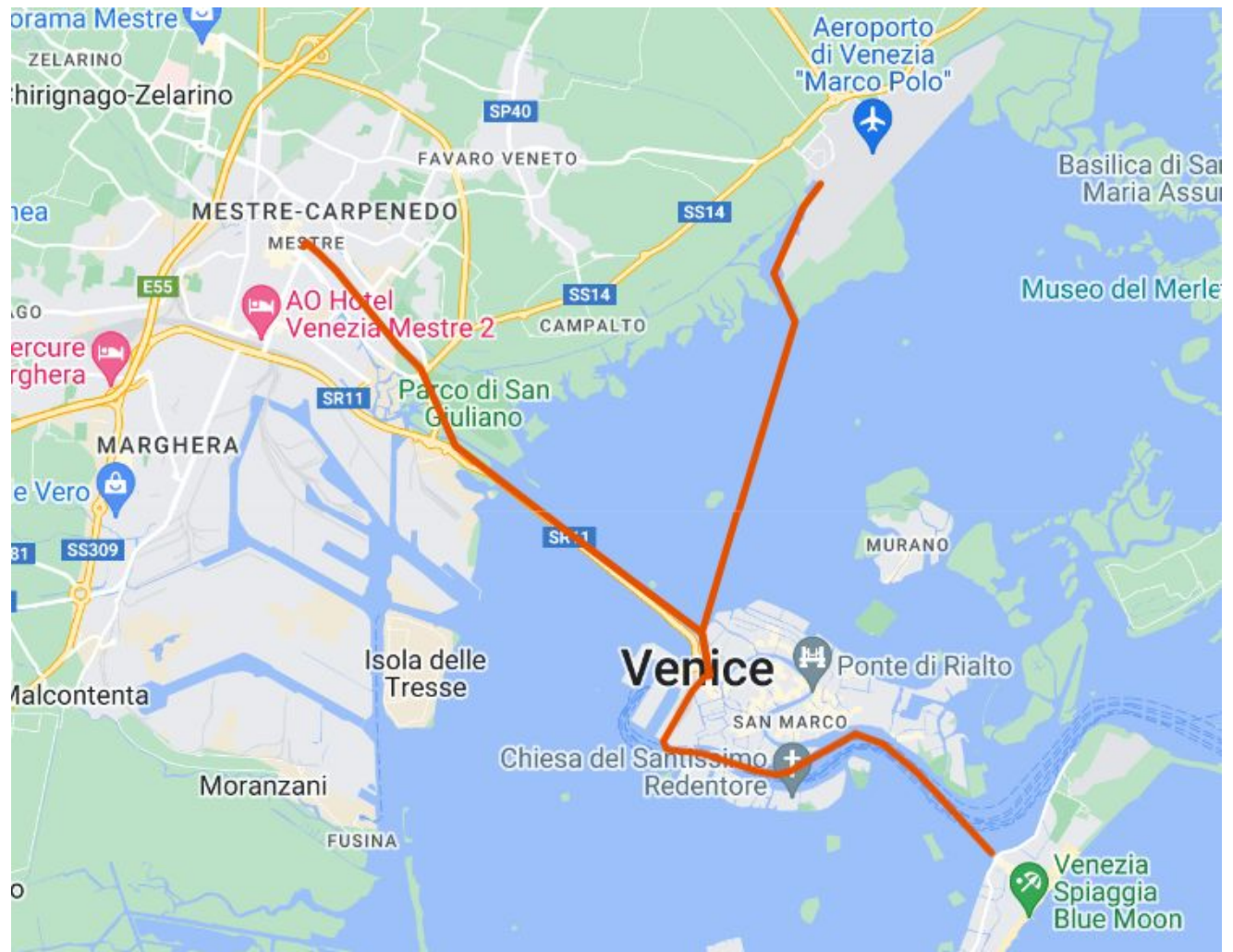
- 1990
- Consorzio Trasporti Veneziano
- 2 lines of tram and *sublagunare*
- Mestre/Marghera, historic city, Lido

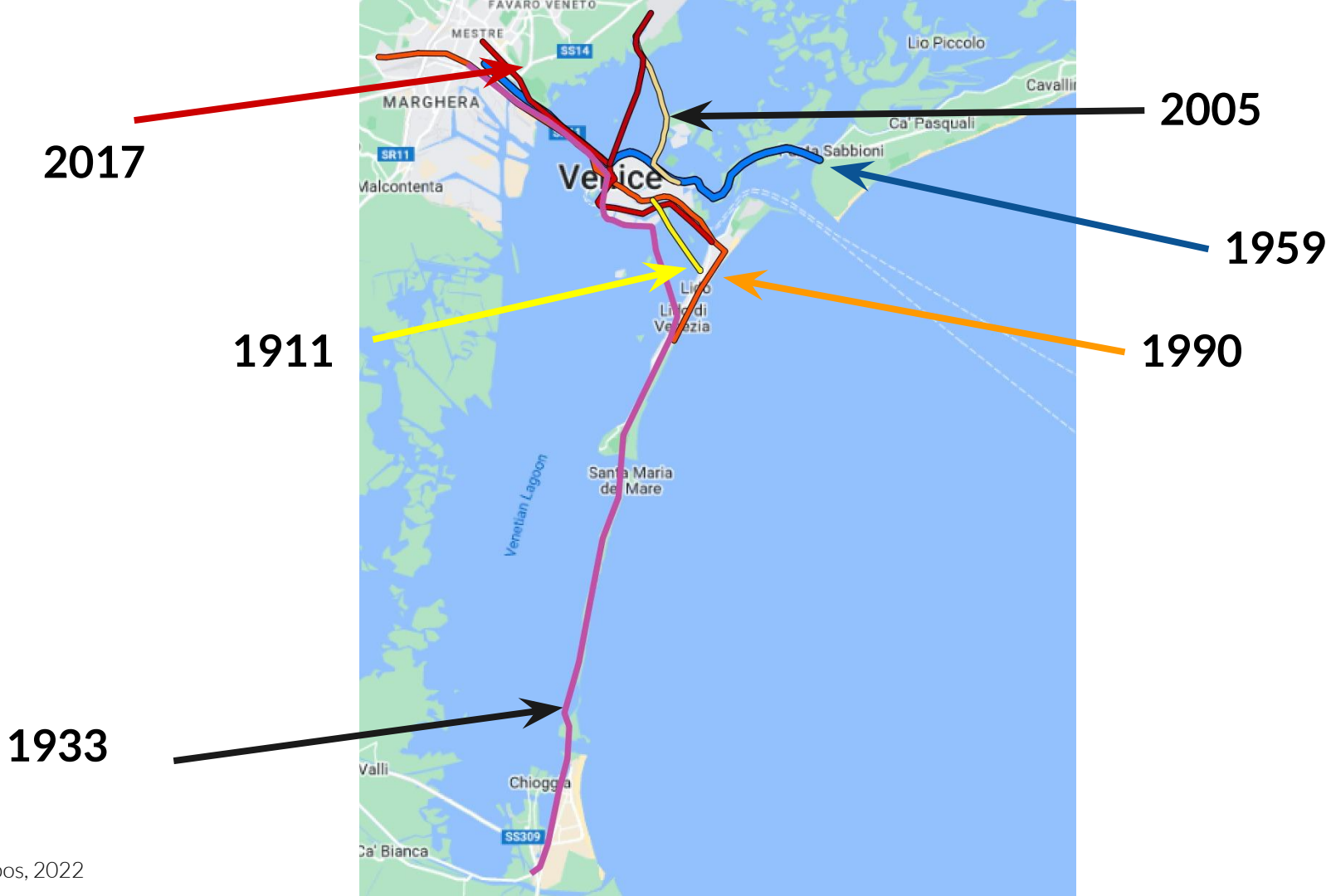


- 2005
- Mayor of Venice
- *Sublagunare*
- Airport/Favaro, Murano, historic city

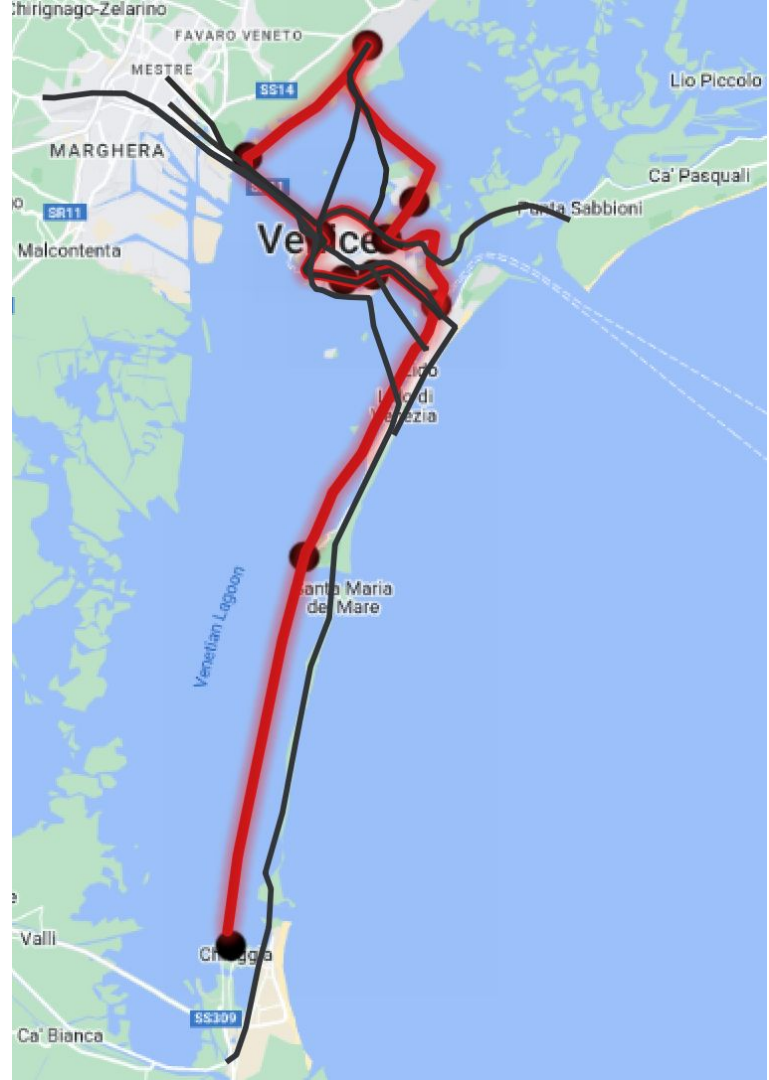


- 2017
- WPI students
- Extension of 2005 proposal



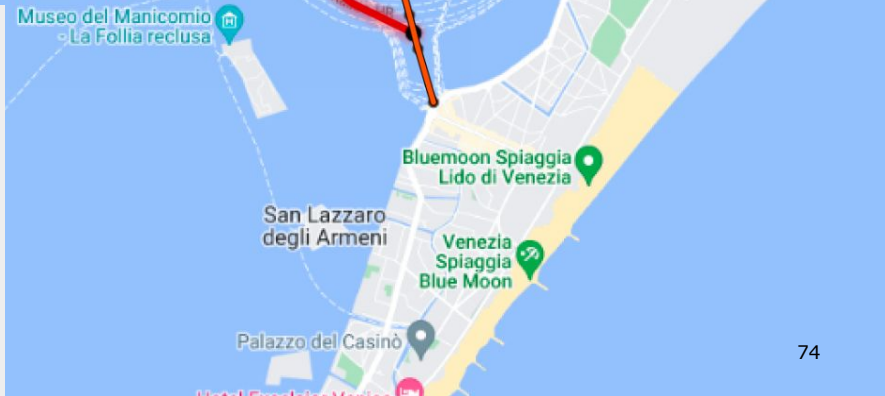
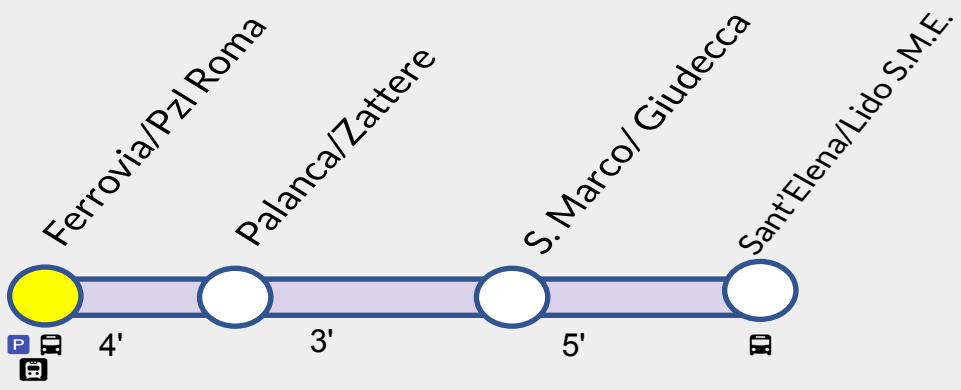
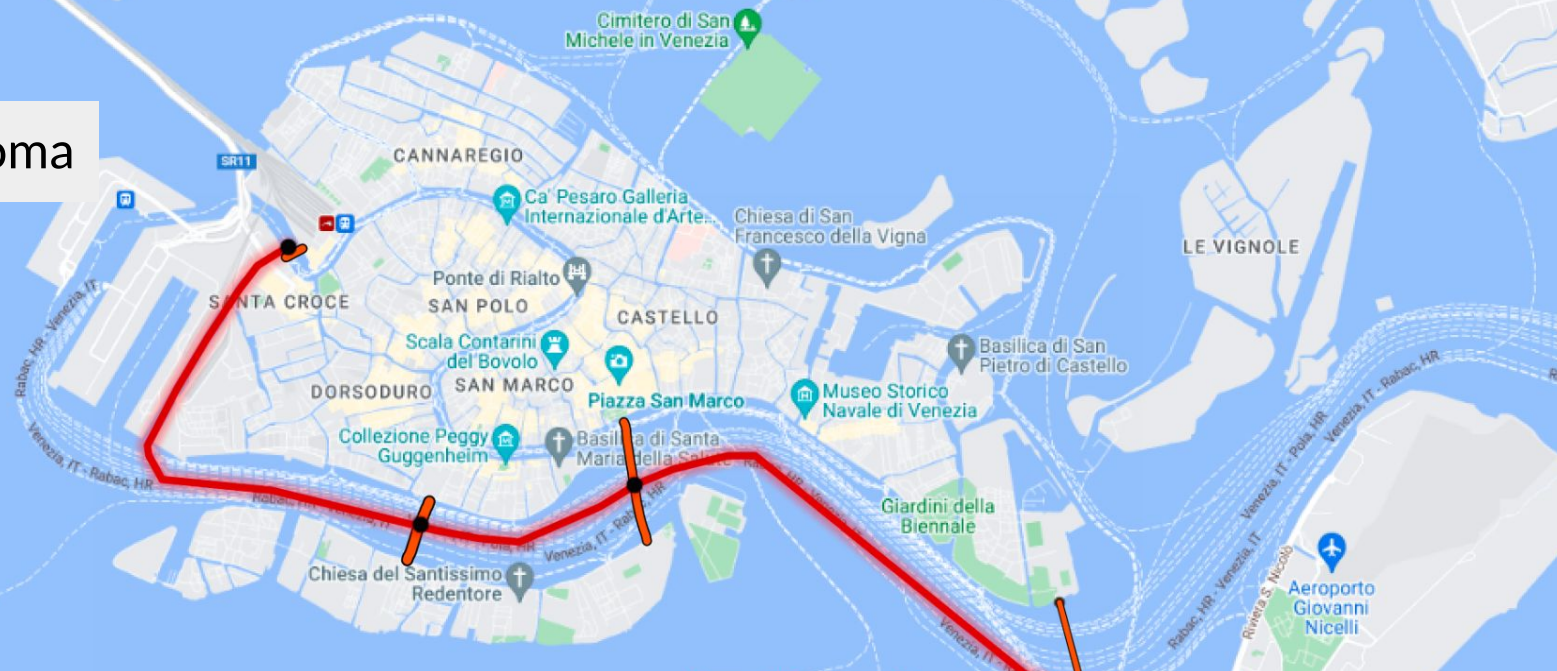


A faster way in and out of Venice



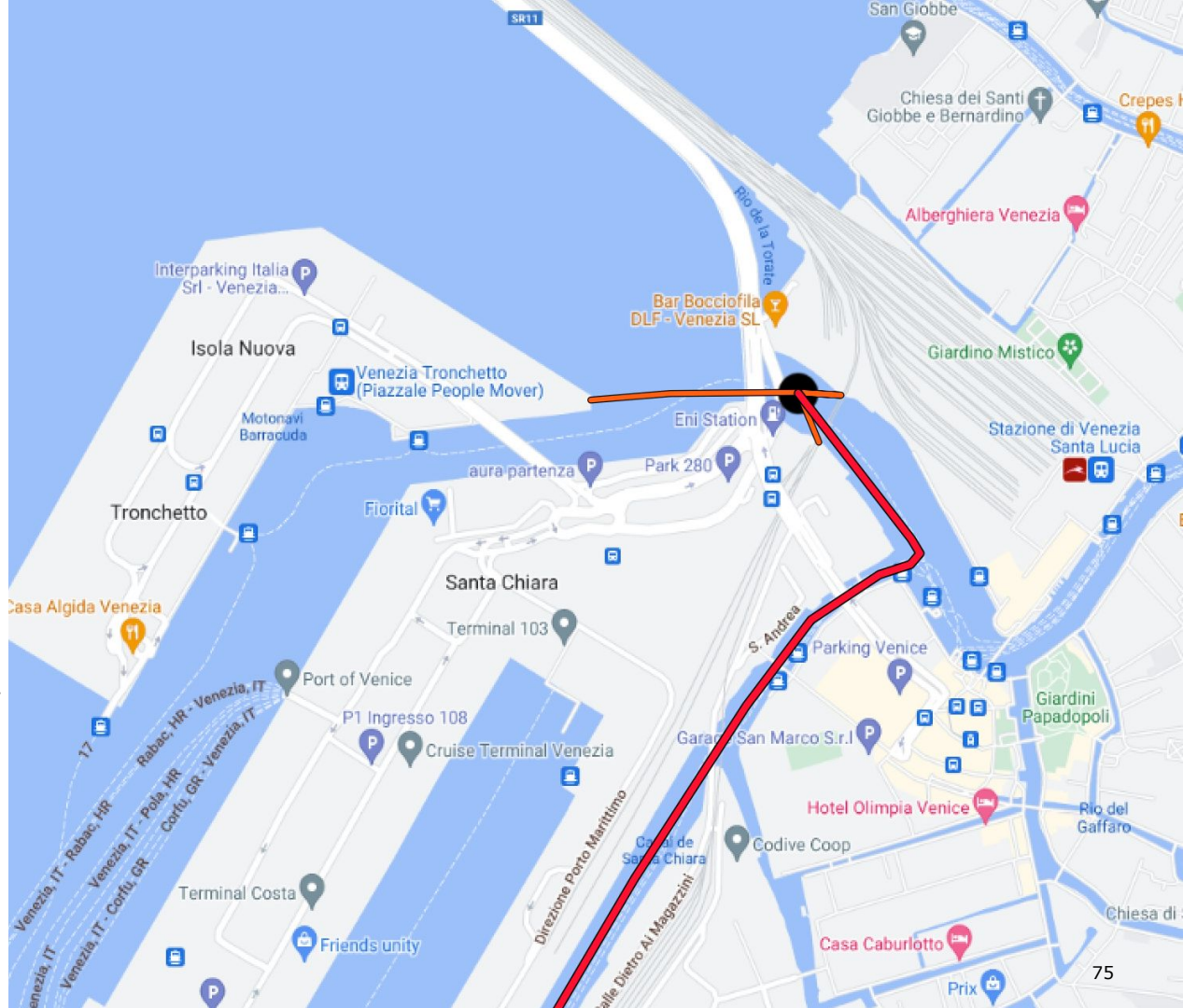
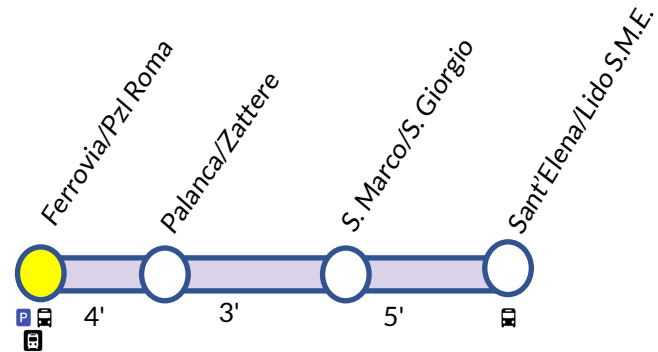
Phase 1

Ferrovia/Pzl Roma

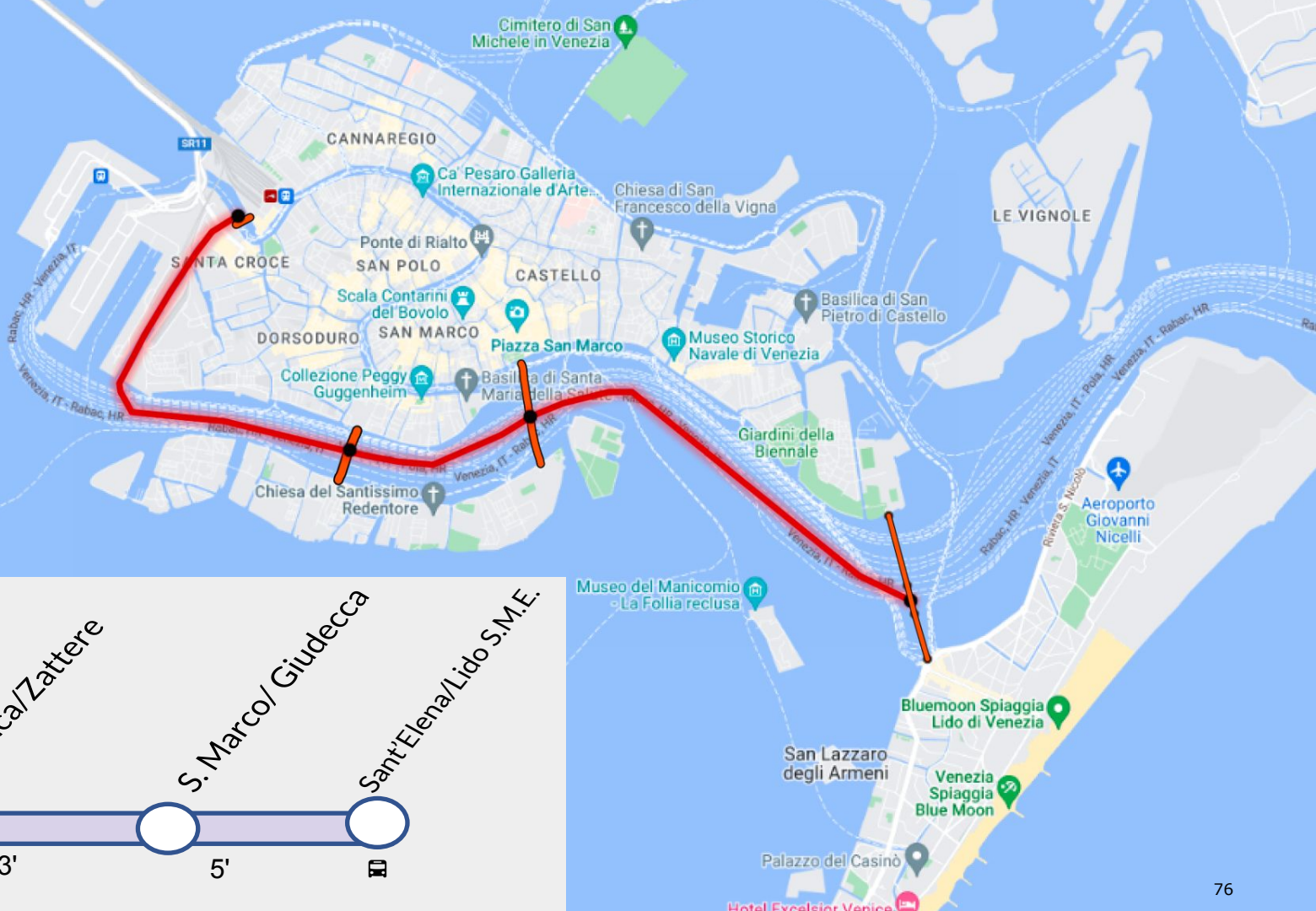


Ferrovia/Pzl Roma/Tronchetto

- Access to the mainland
- Quick access to Ferrovia



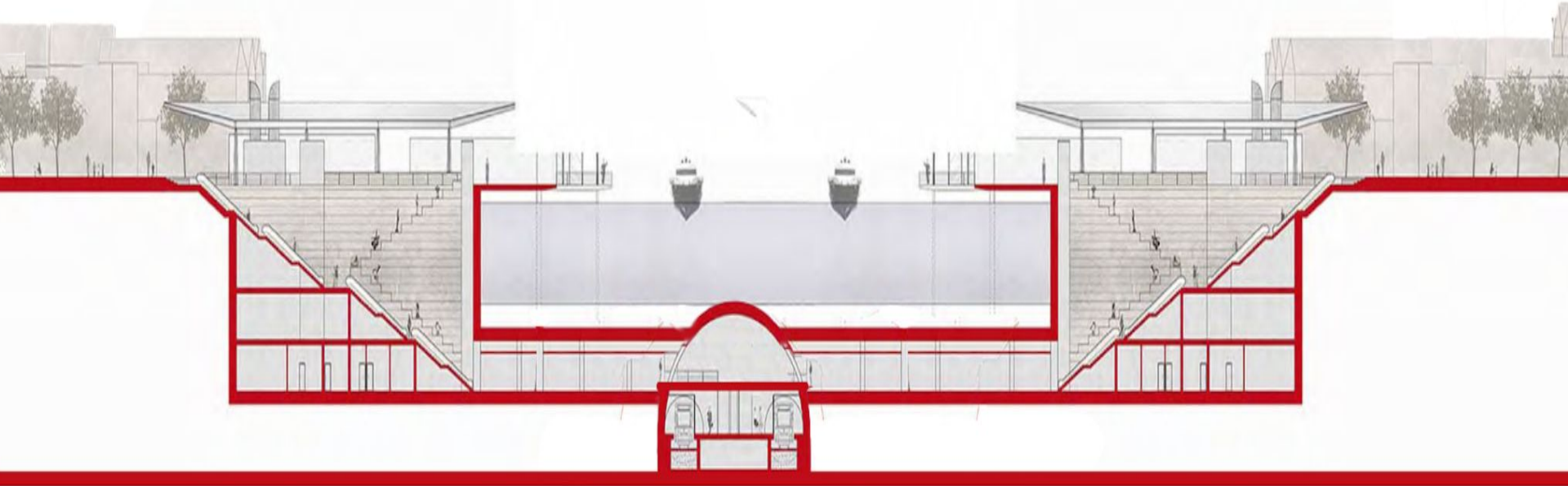
Phase 1



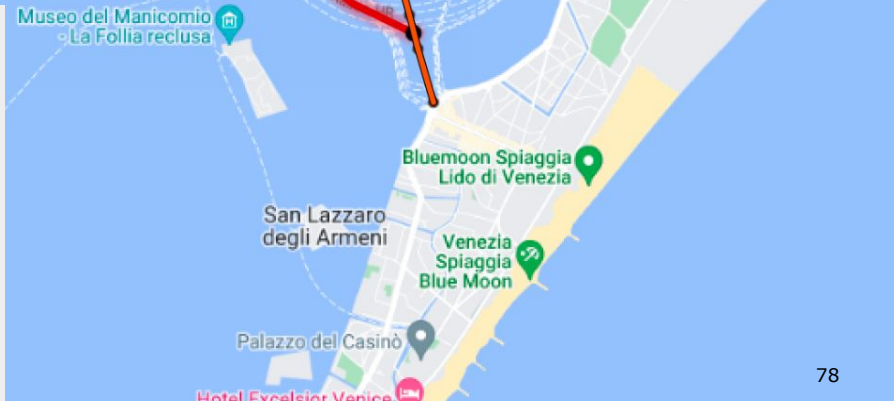
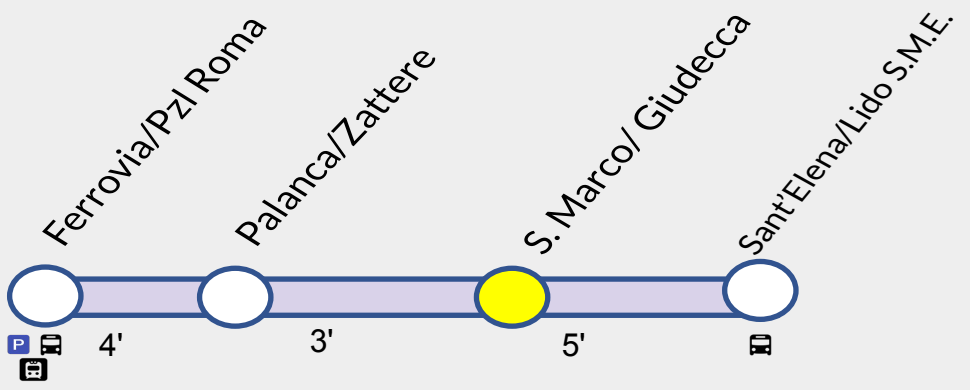
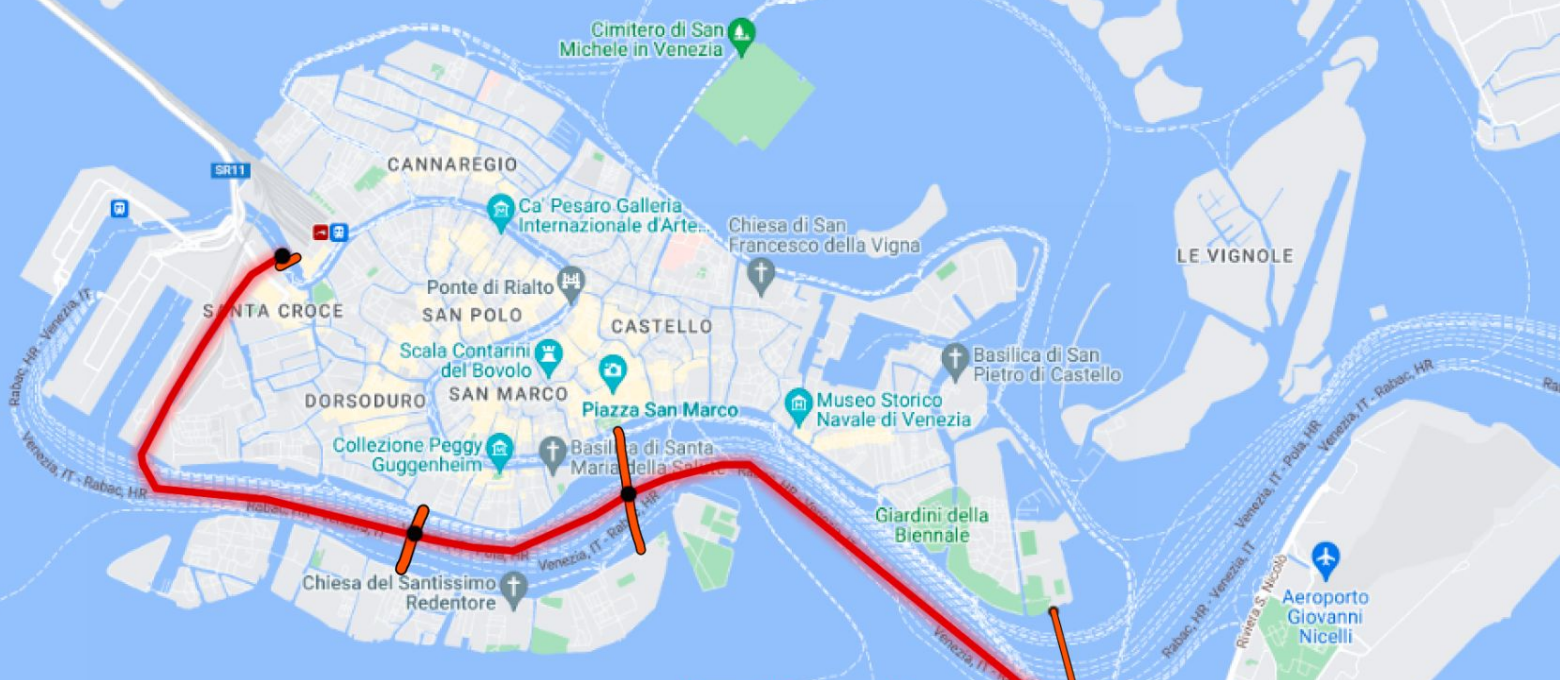
Station with two pedestrian connections

Zattere

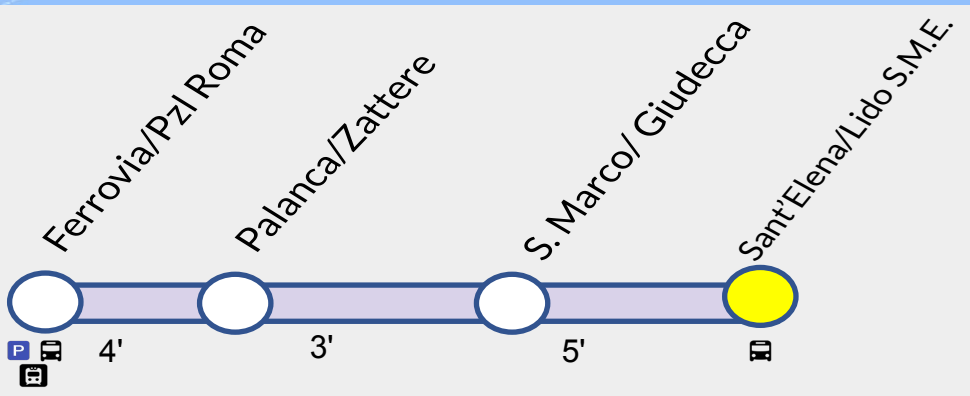
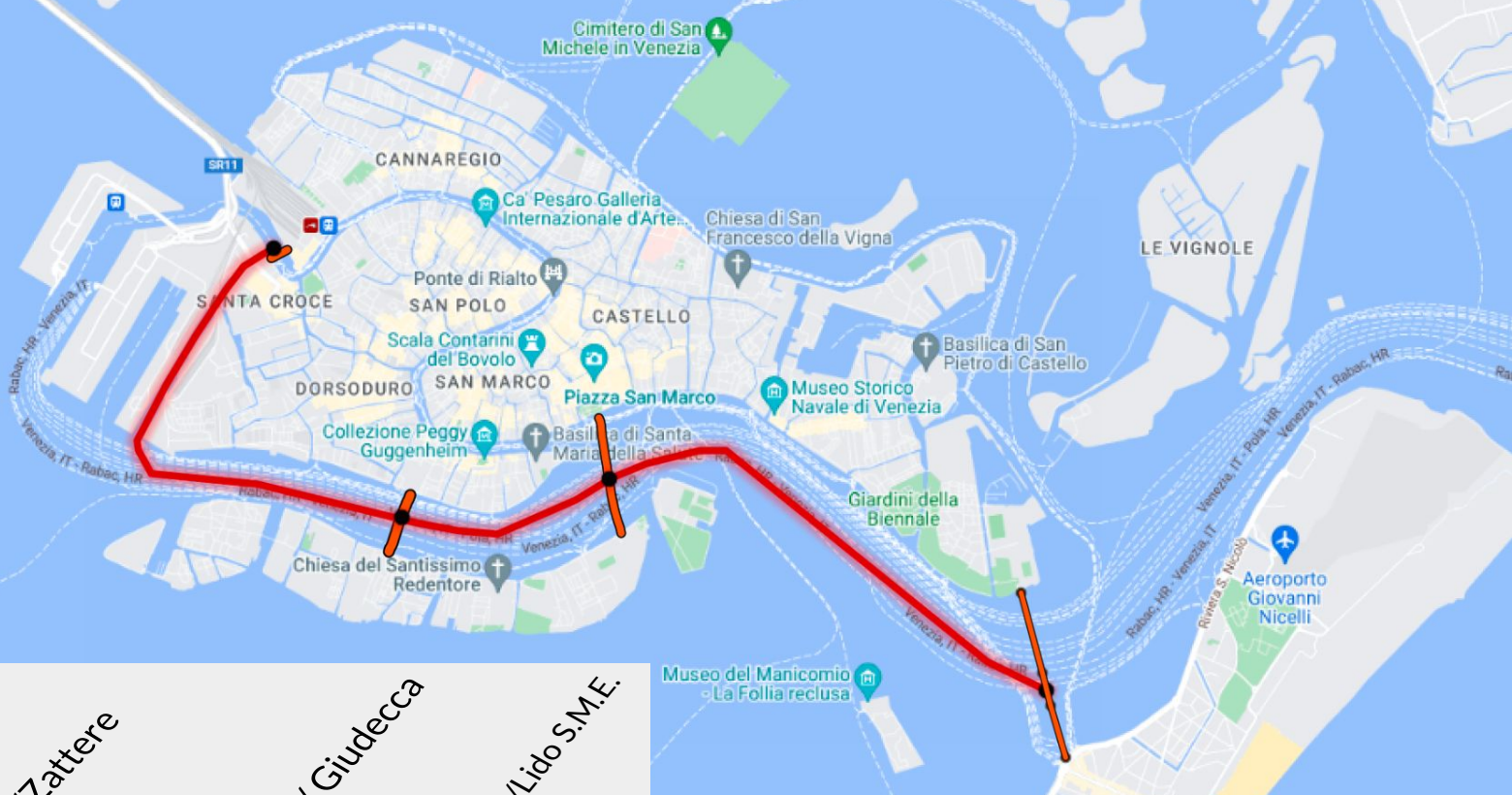
Palanca



Phase 1

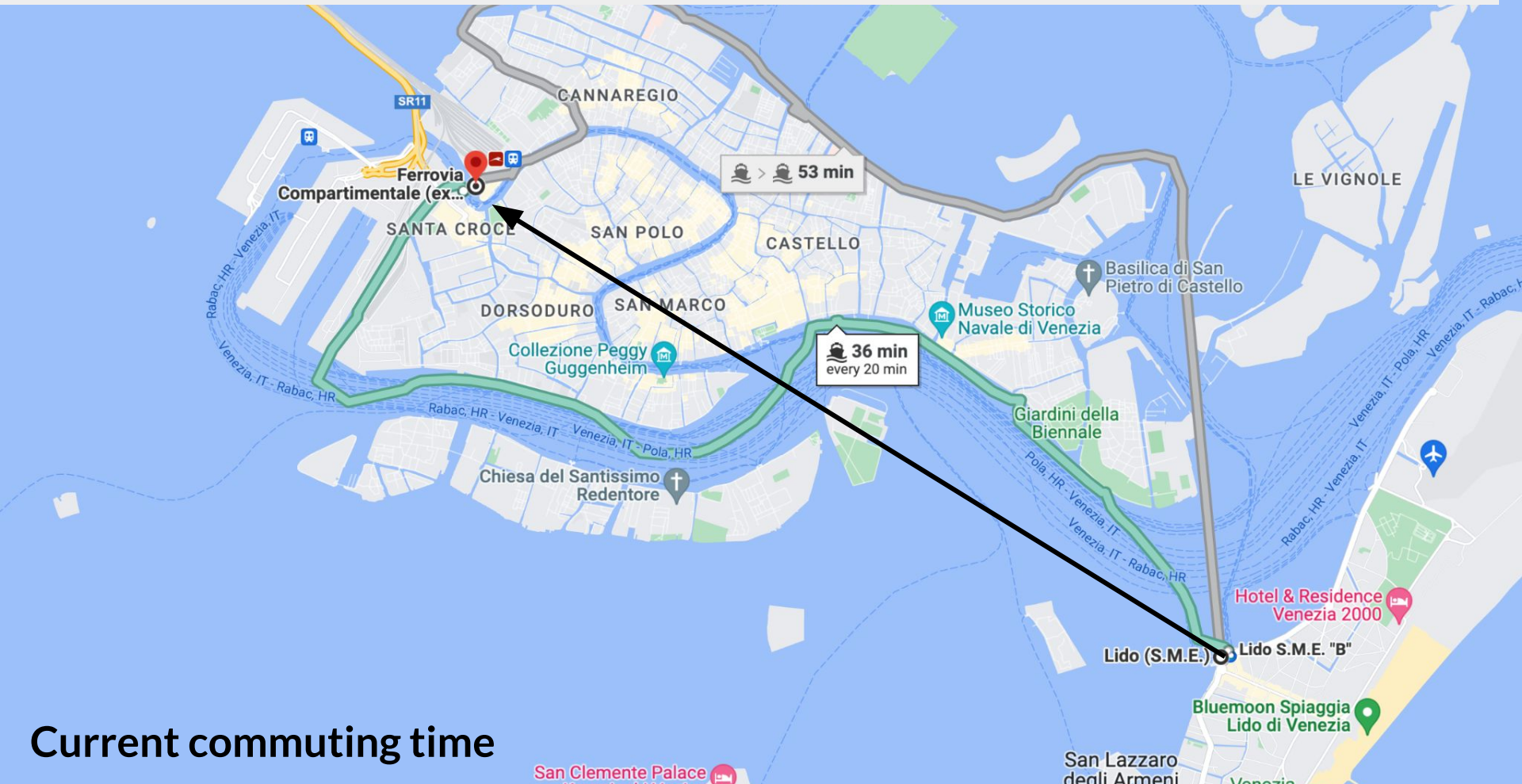


Phase 1



Sant'Elena/Lido S.M.E.

Connecting Ferrovia/Pzl Roma/Tronchetto to Lido S.M.E.



Current commuting time

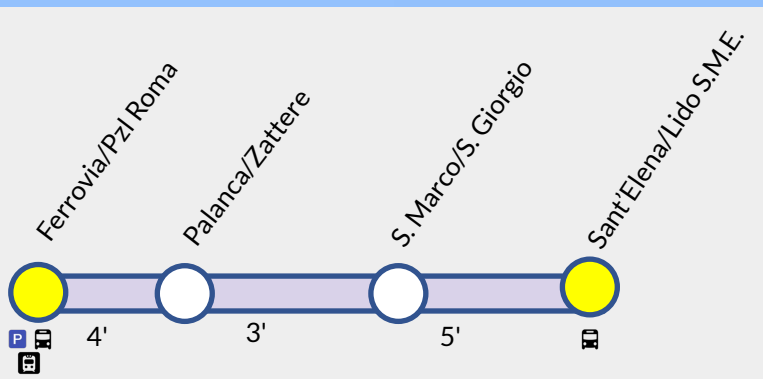
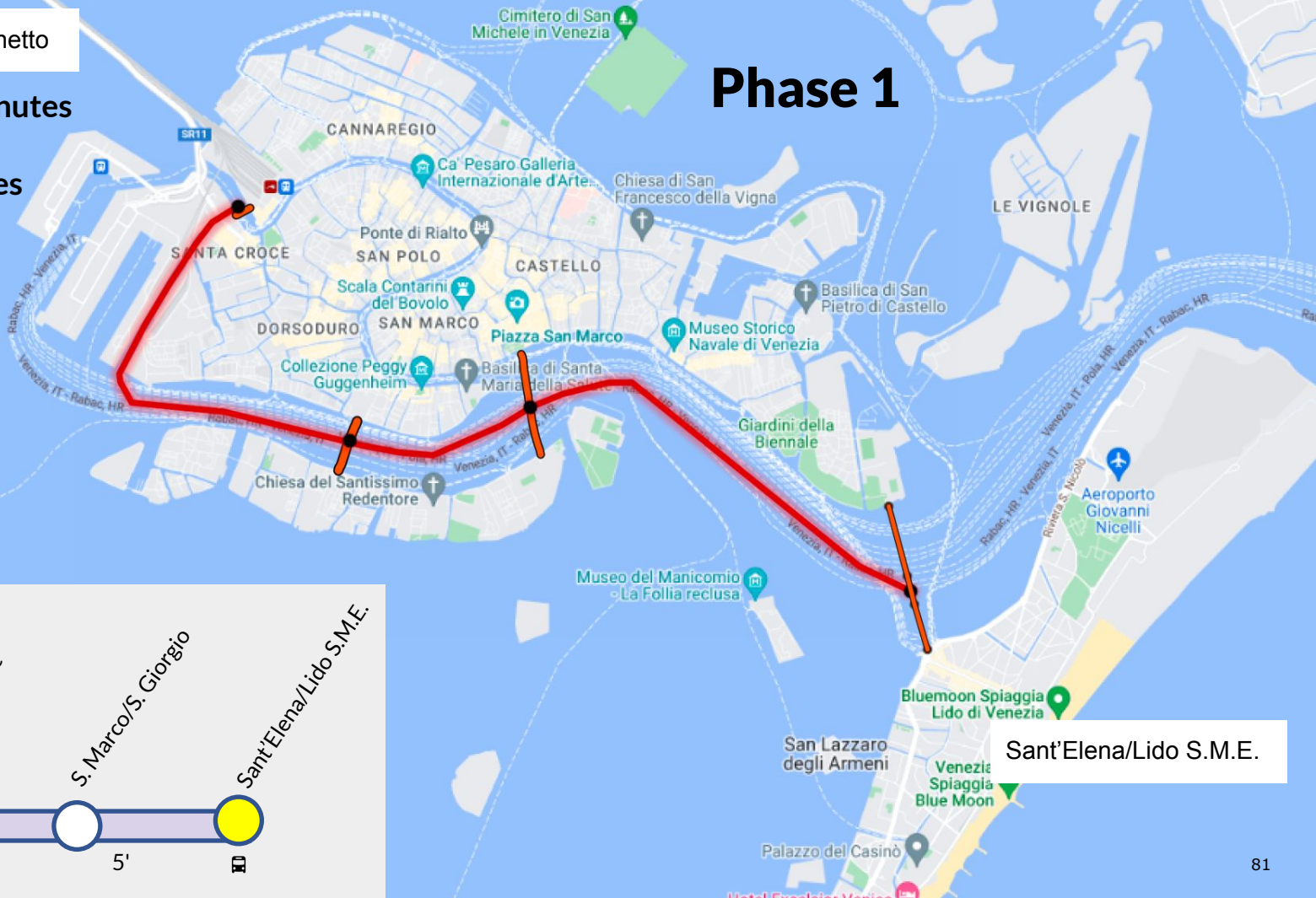
San Clemente Palace

Ferrovia/Pzl Roma/Tronchetto

Current time: 36 minutes

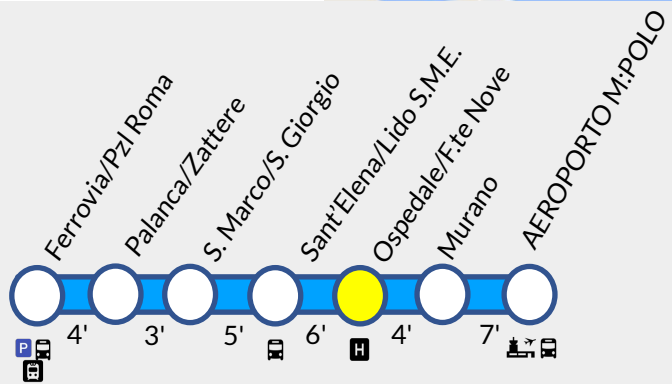
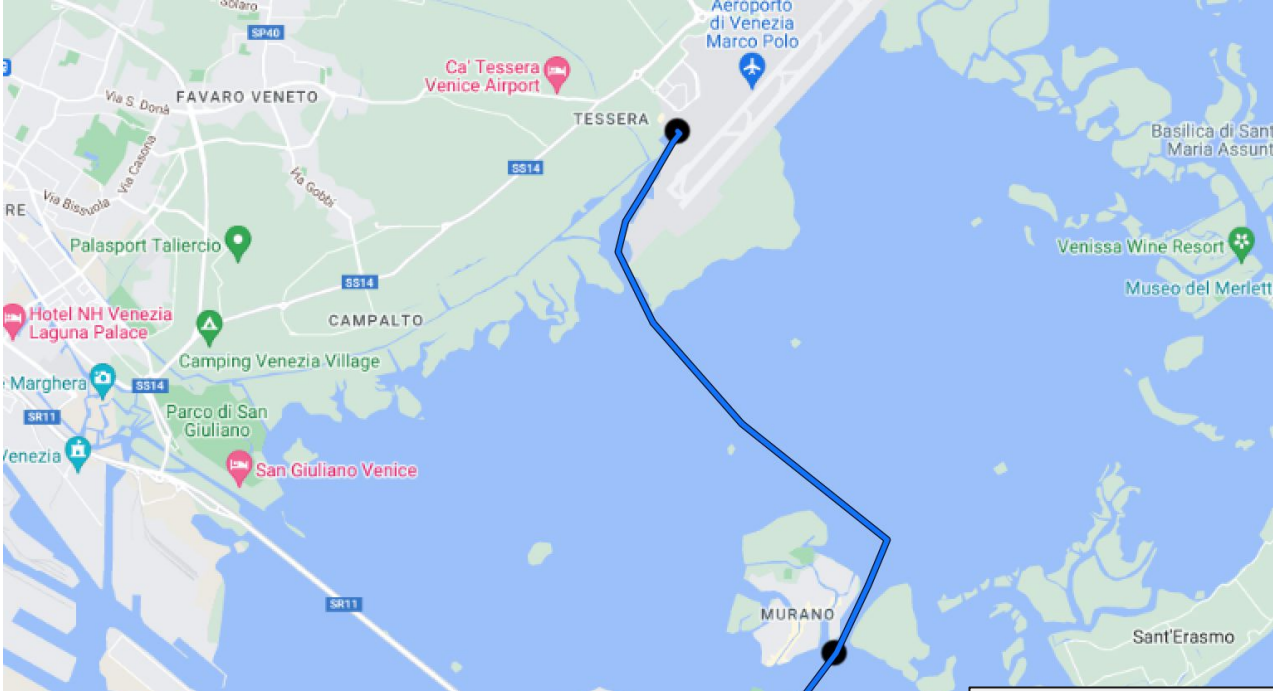
Total time: 12 minutes

Phase 1

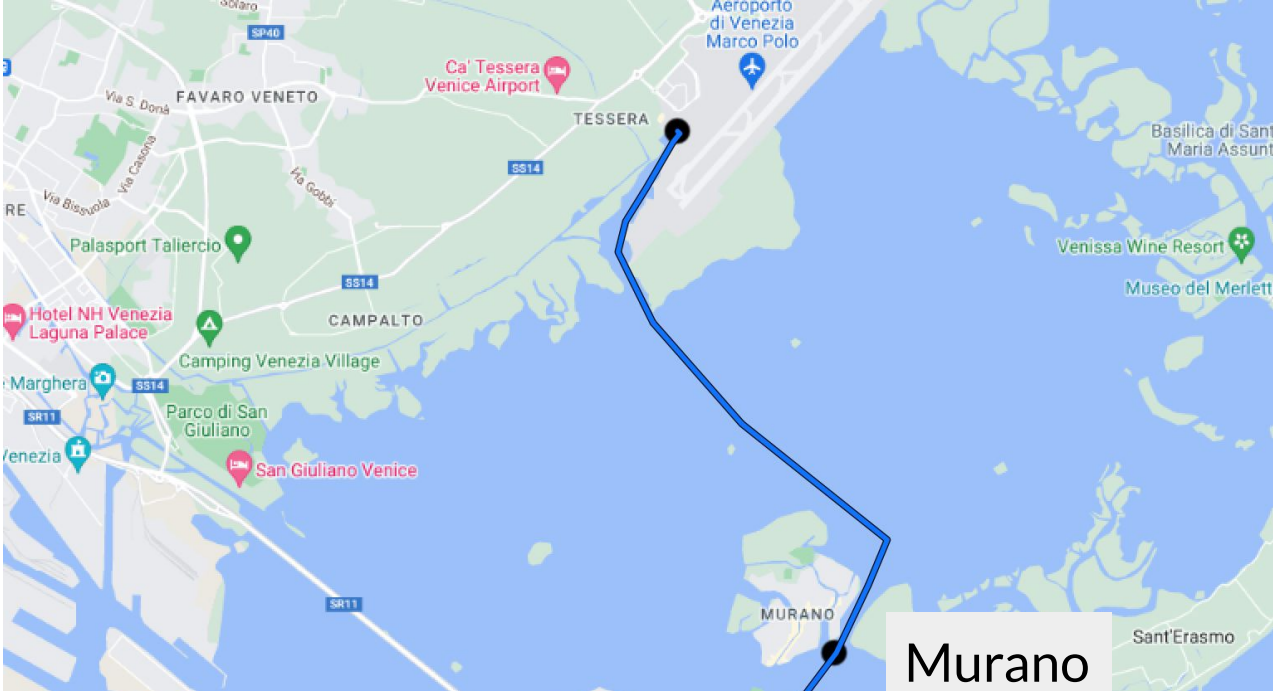


Sant'Elena/Lido S.M.E.

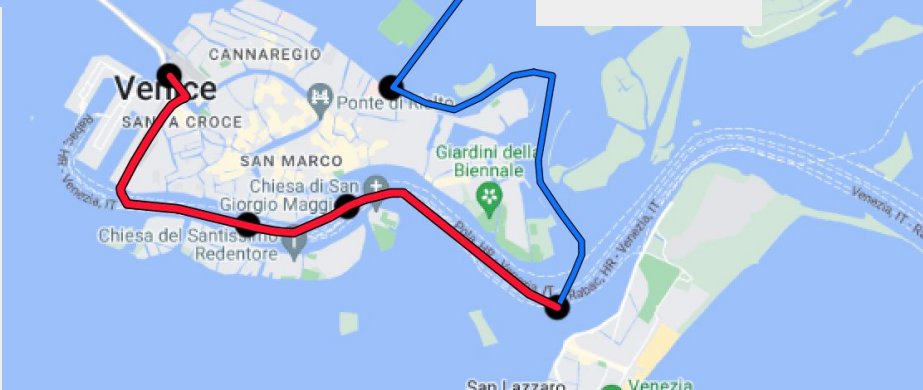
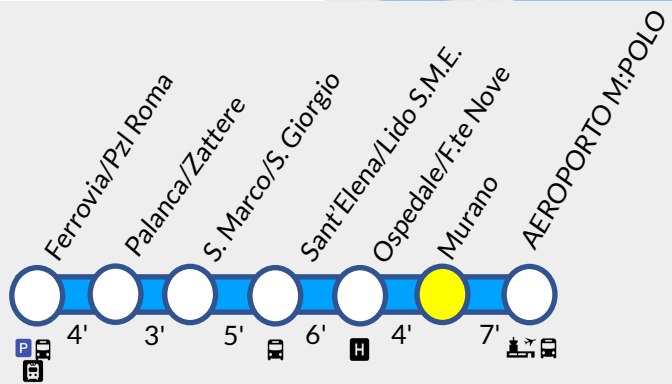
Phase 2



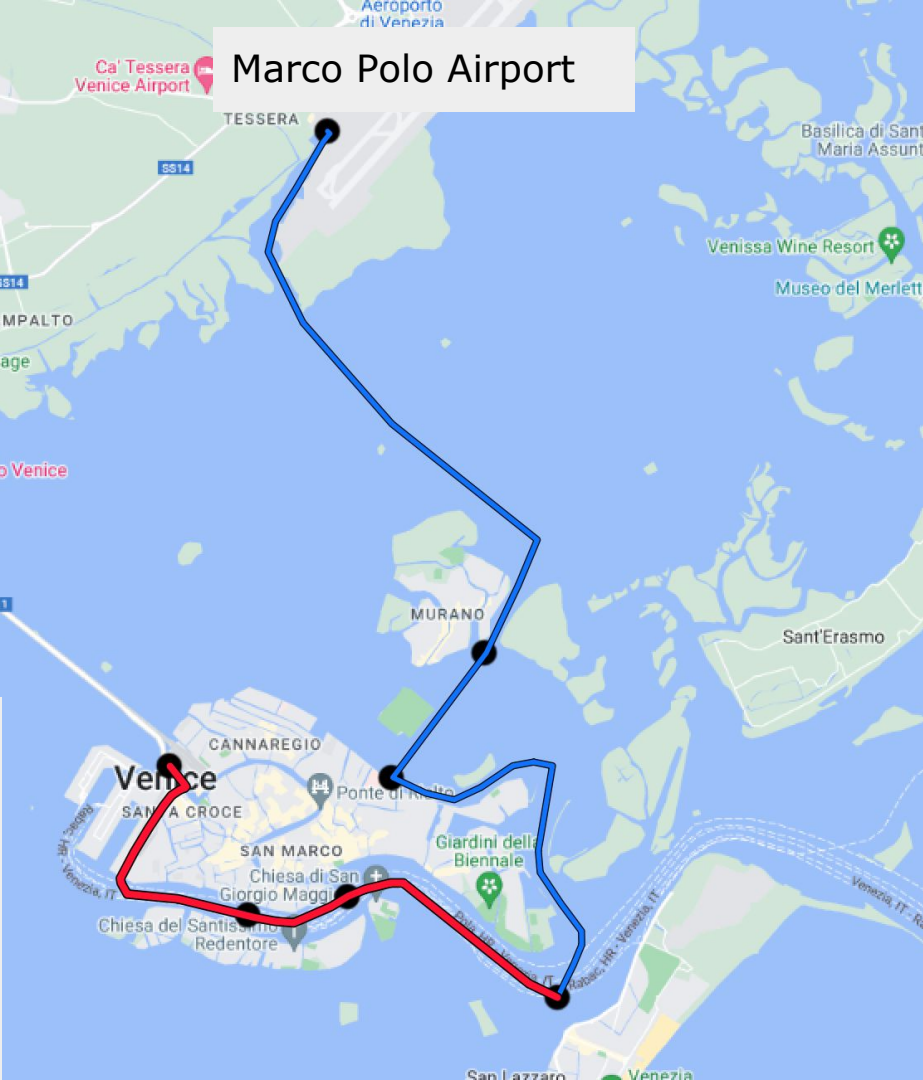
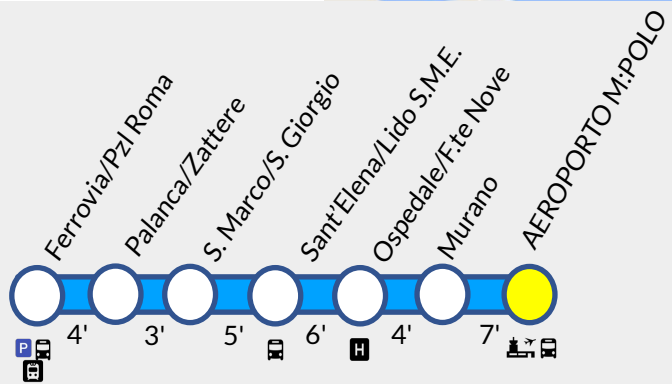
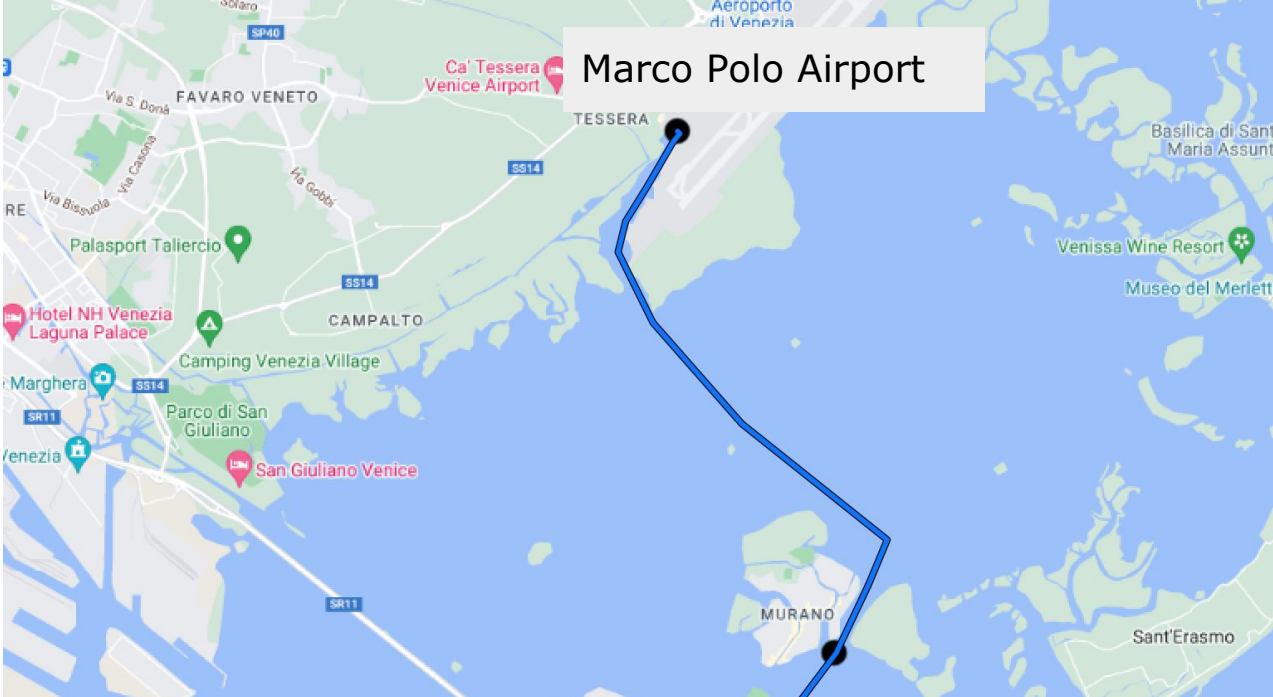
Phase 2



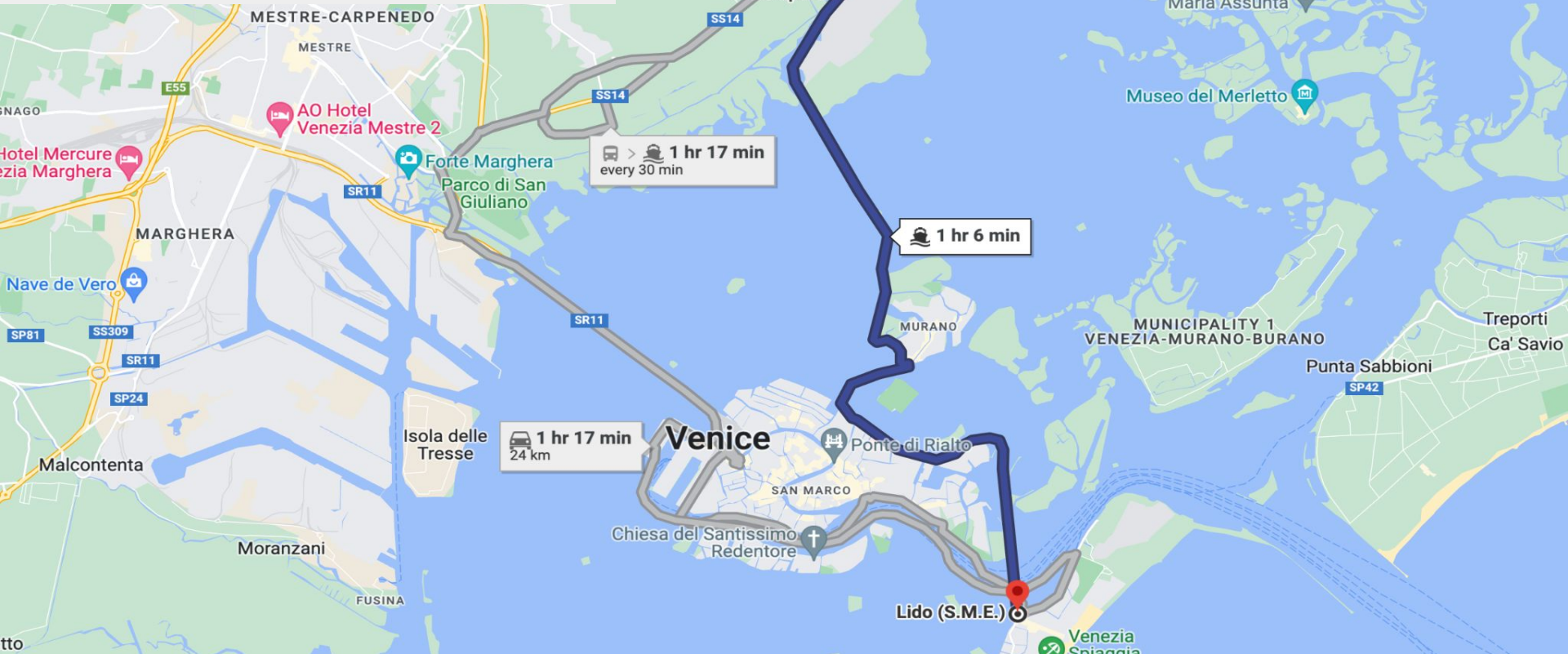
Murano



Phase 2



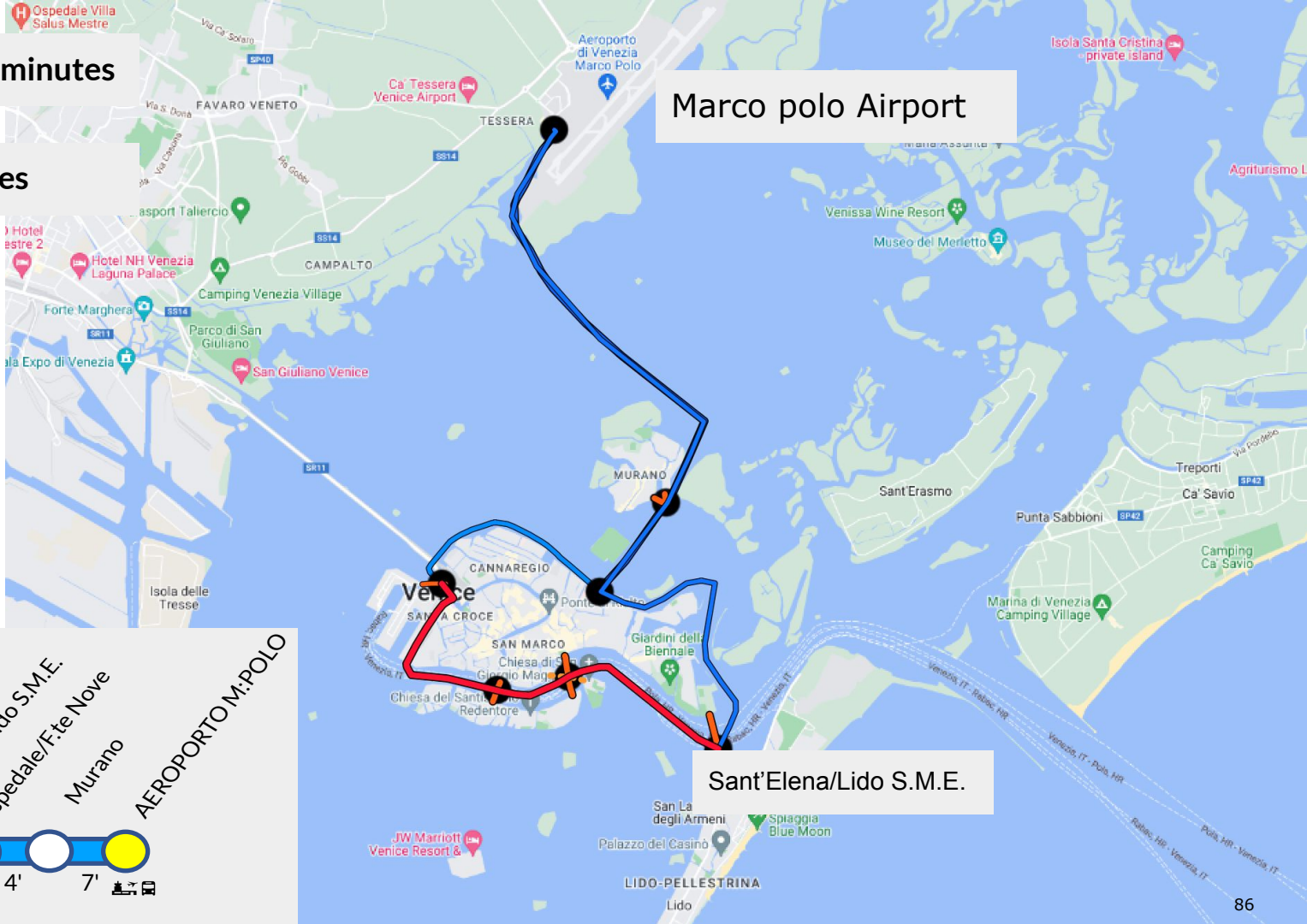
Connecting the historic city to the airport



Current commuting time

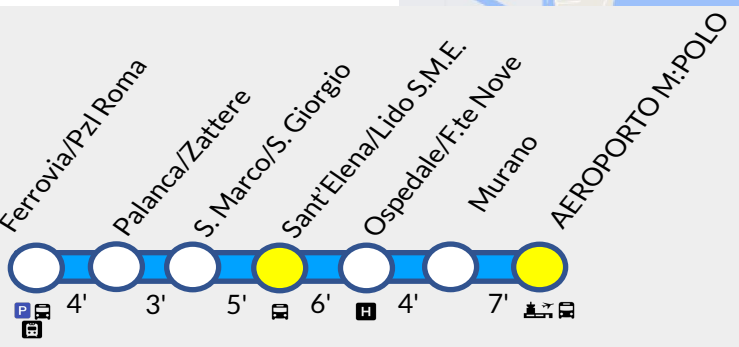
Current Time: 1 hr 06 minutes

Total Time: 17 minutes



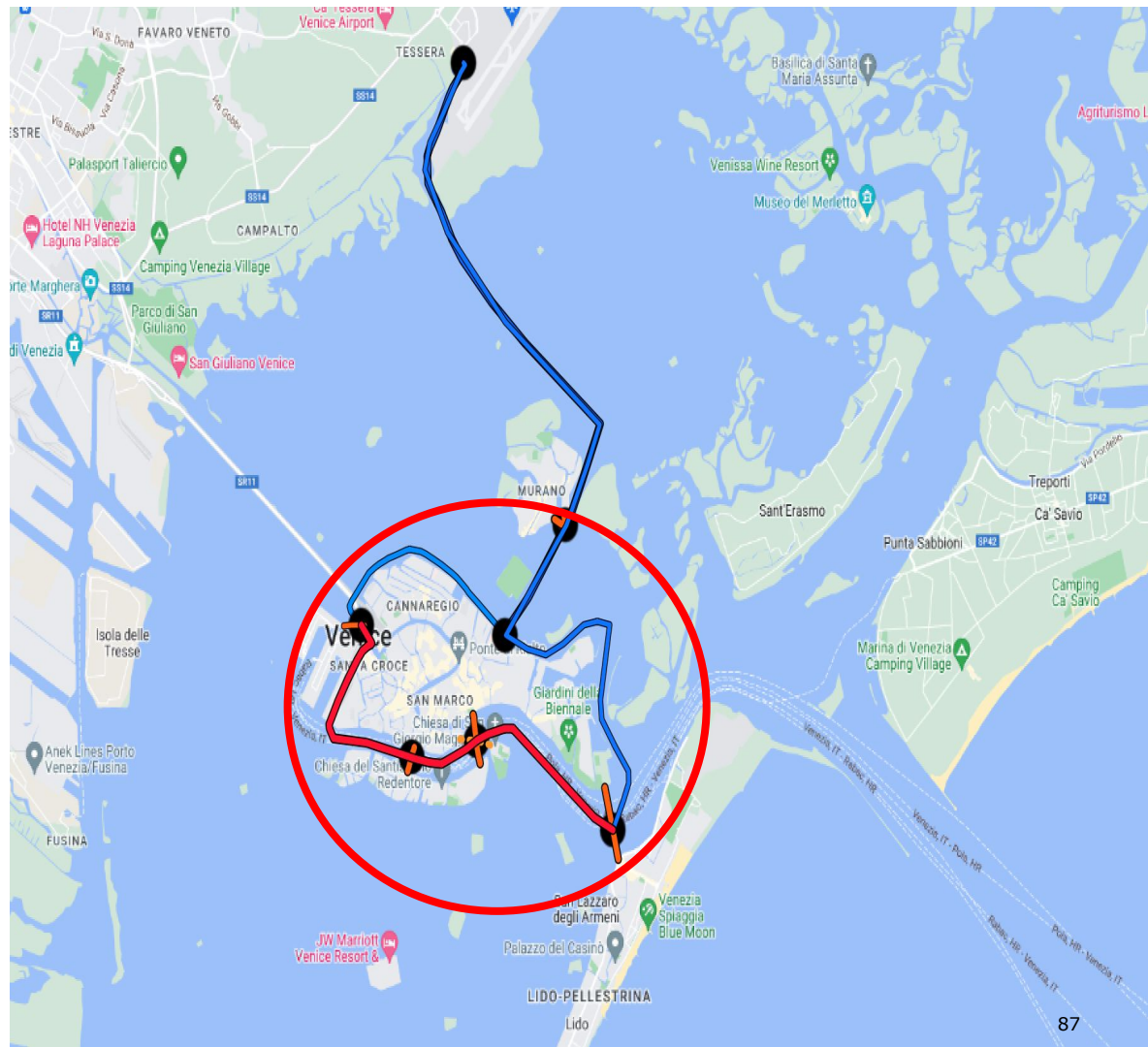
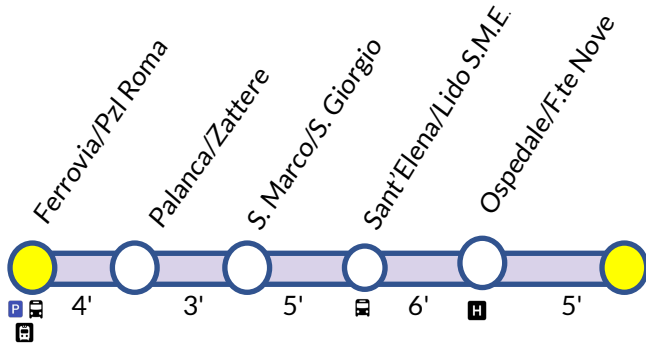
Marco polo Airport

Sant'Elena/Lido S.M.E.

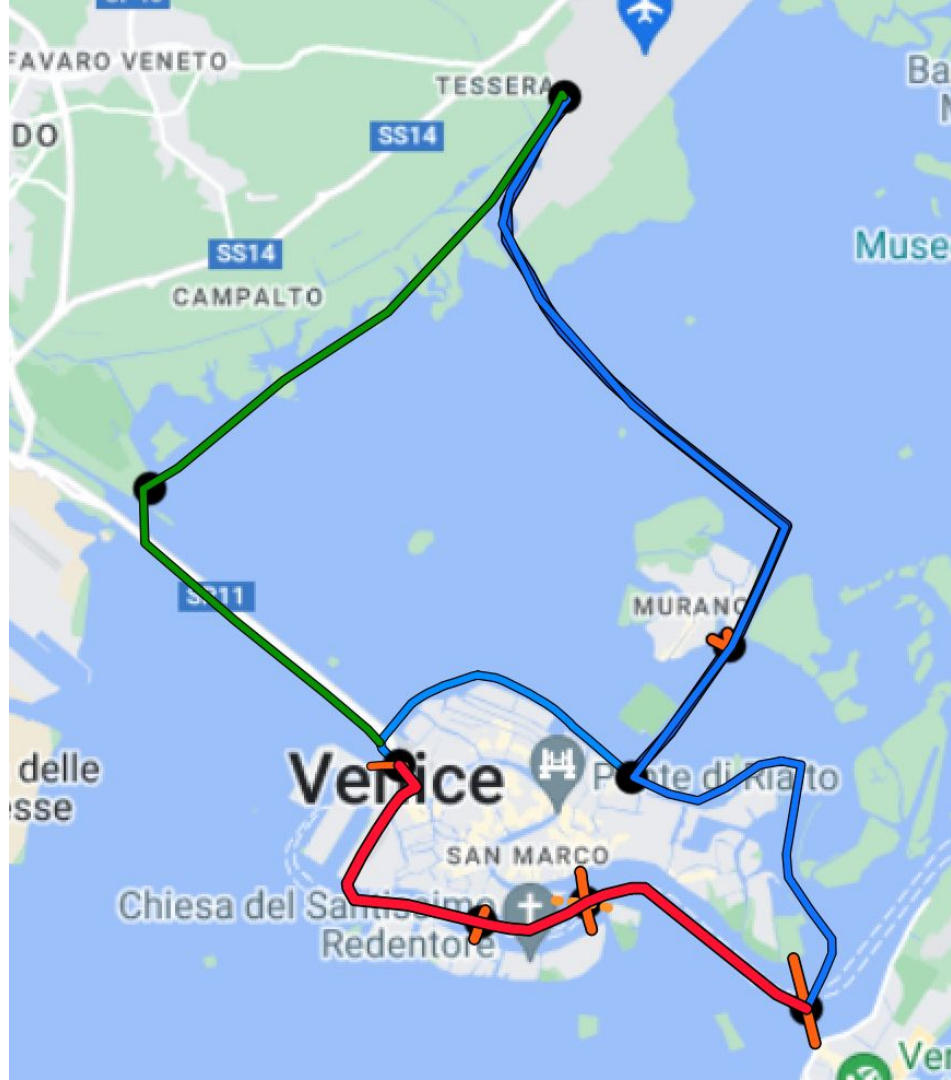


Phase 2

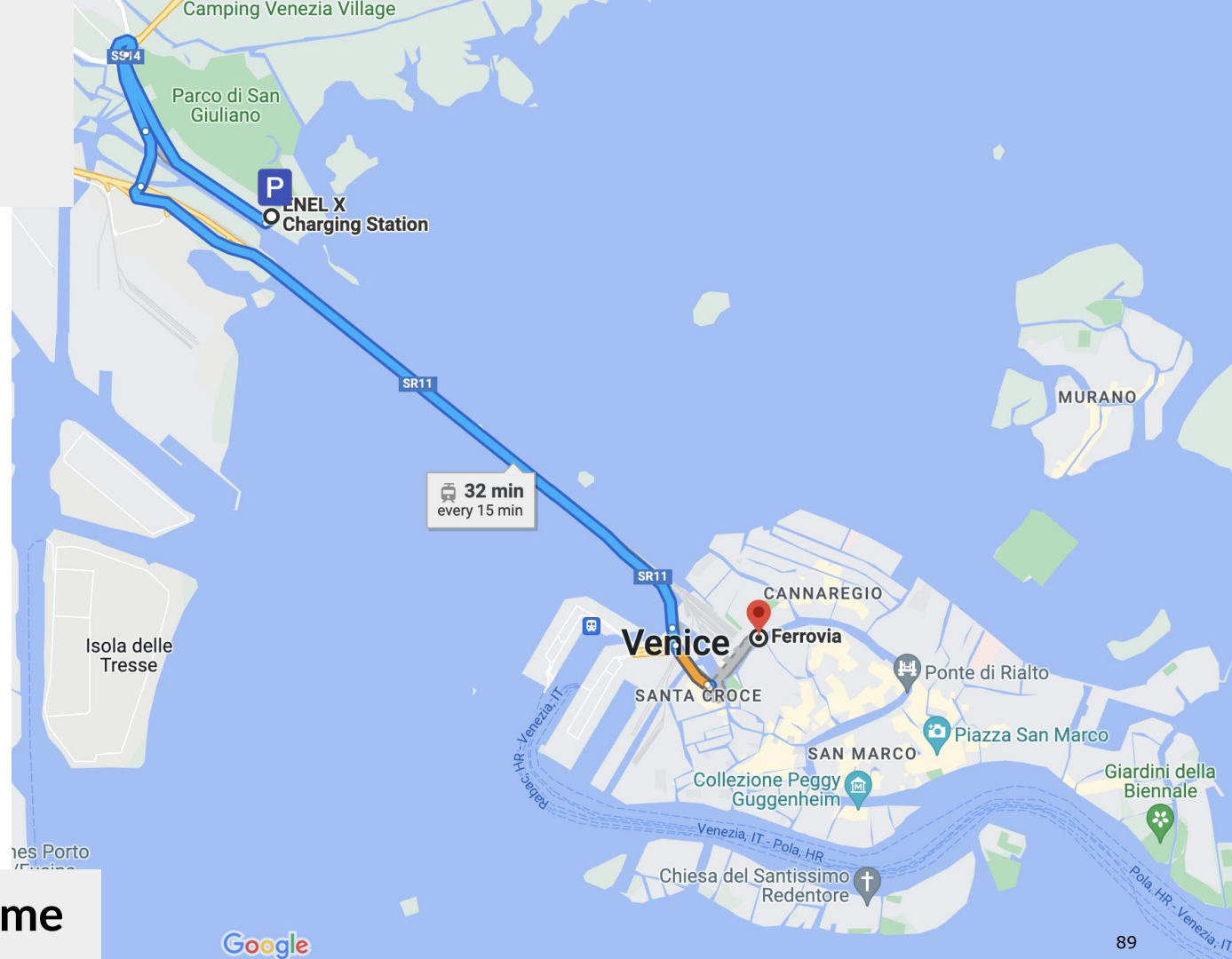
Total Time loop 23 minute



Phase 3



Connecting San Giuliano to the historic city

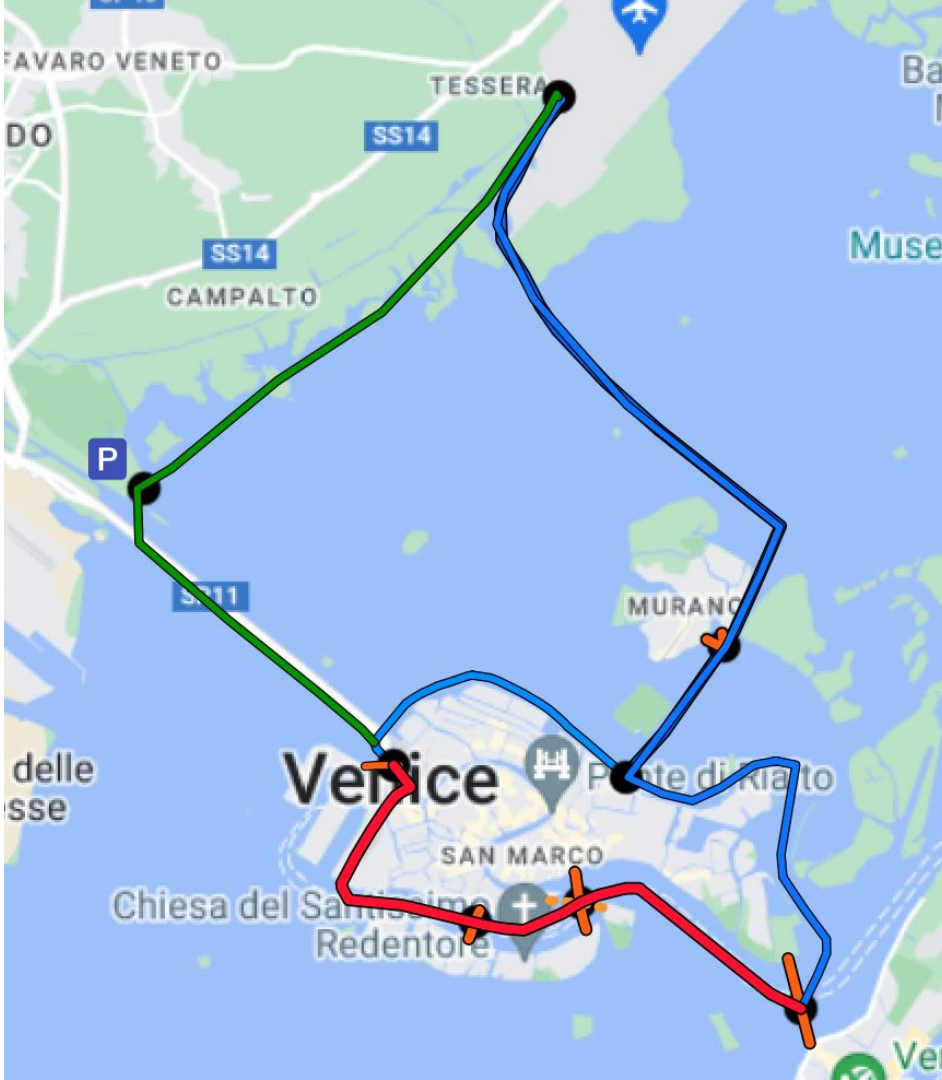
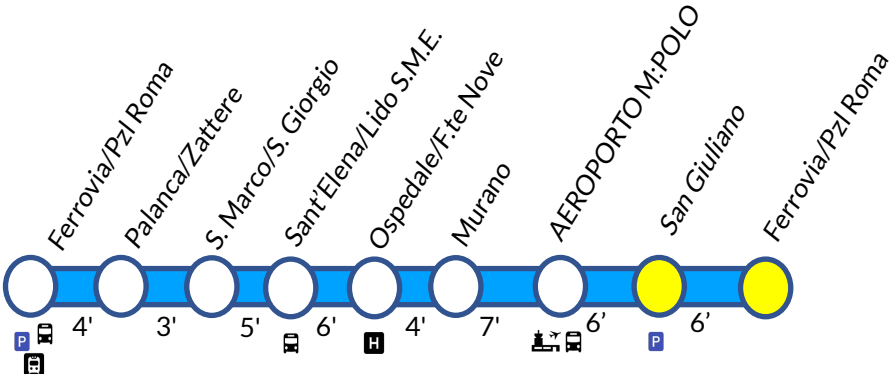


Current commuting time

Phase 3

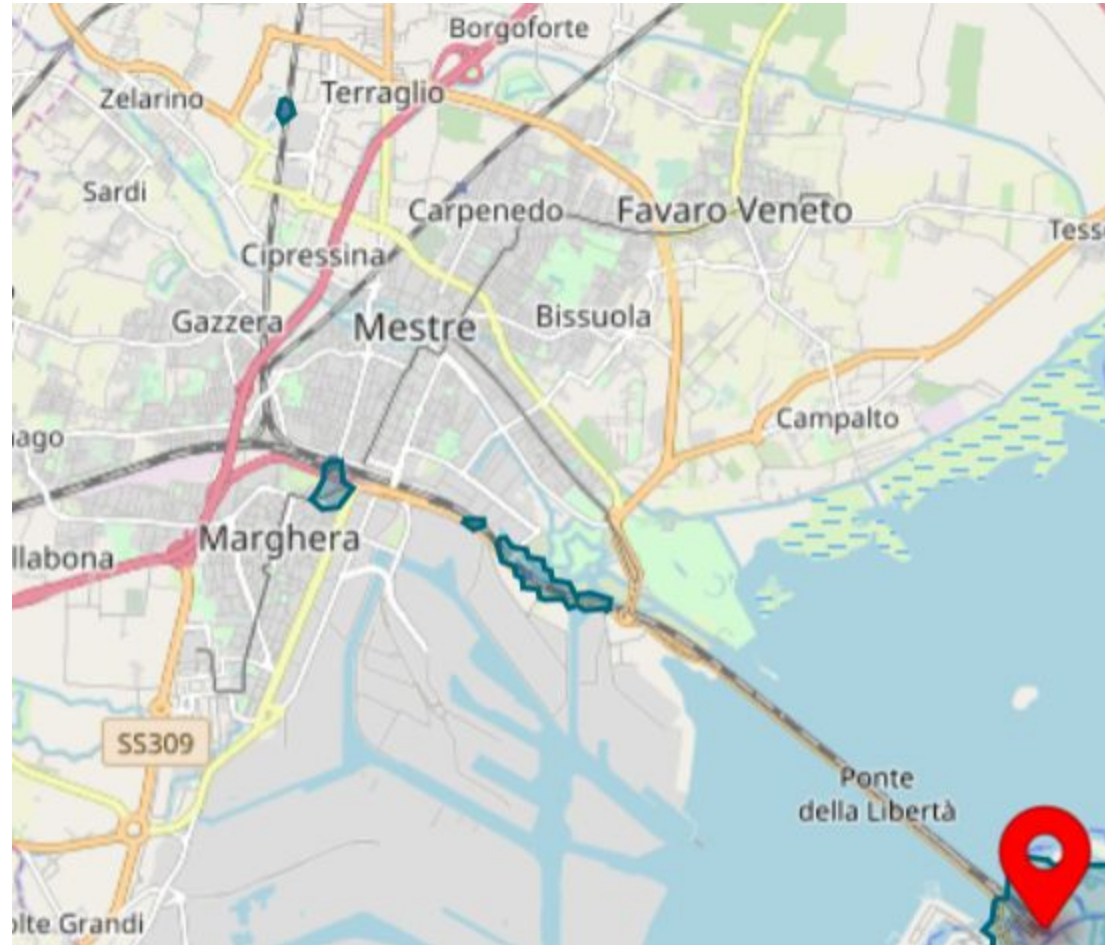
Current time: 32 minutes

Total Time: 6 minutes



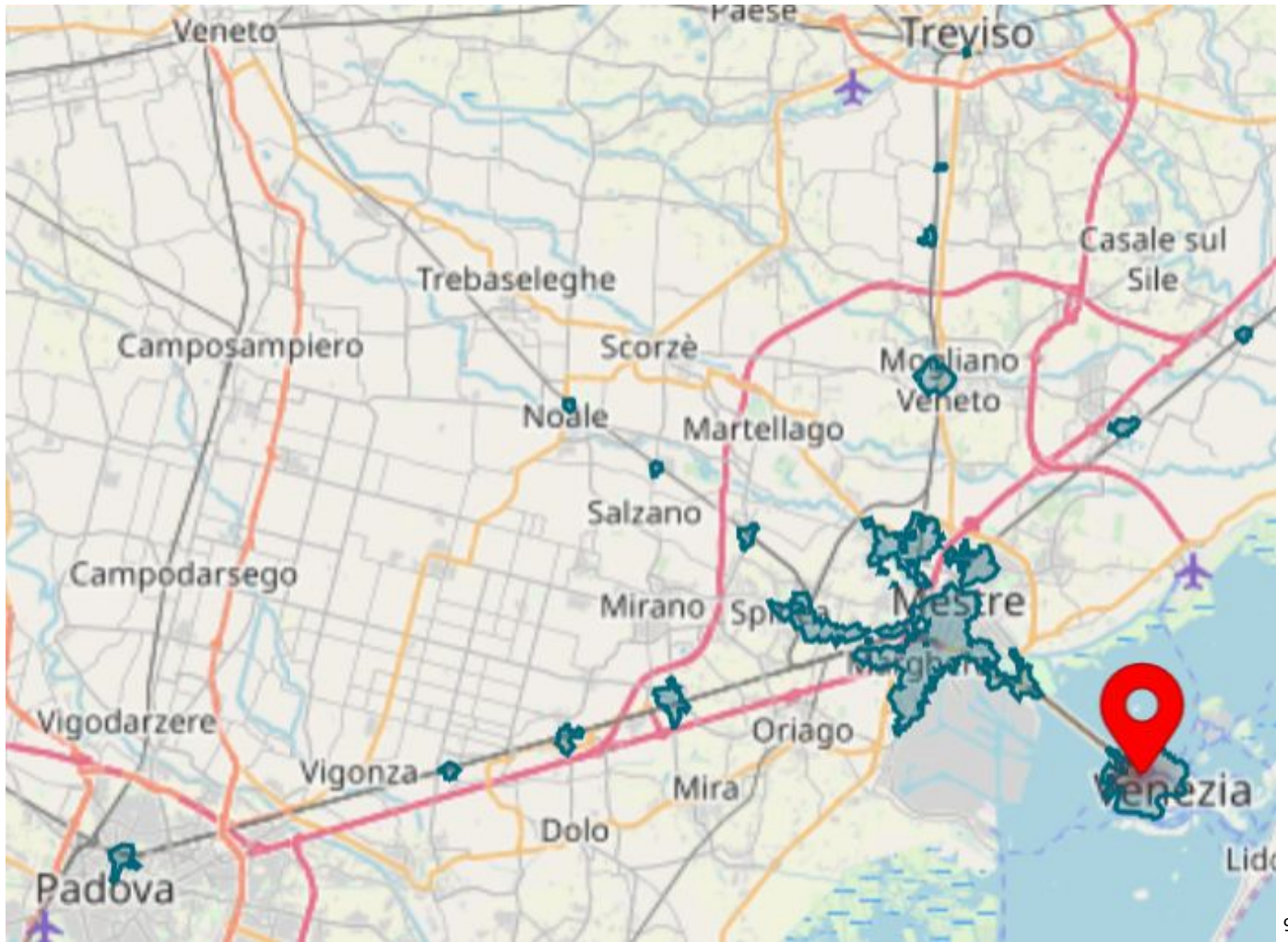
Most Venetians aren't commuting >15 minutes on the mainland

Highlighted areas are reachable within 15 minutes from Ferrovia



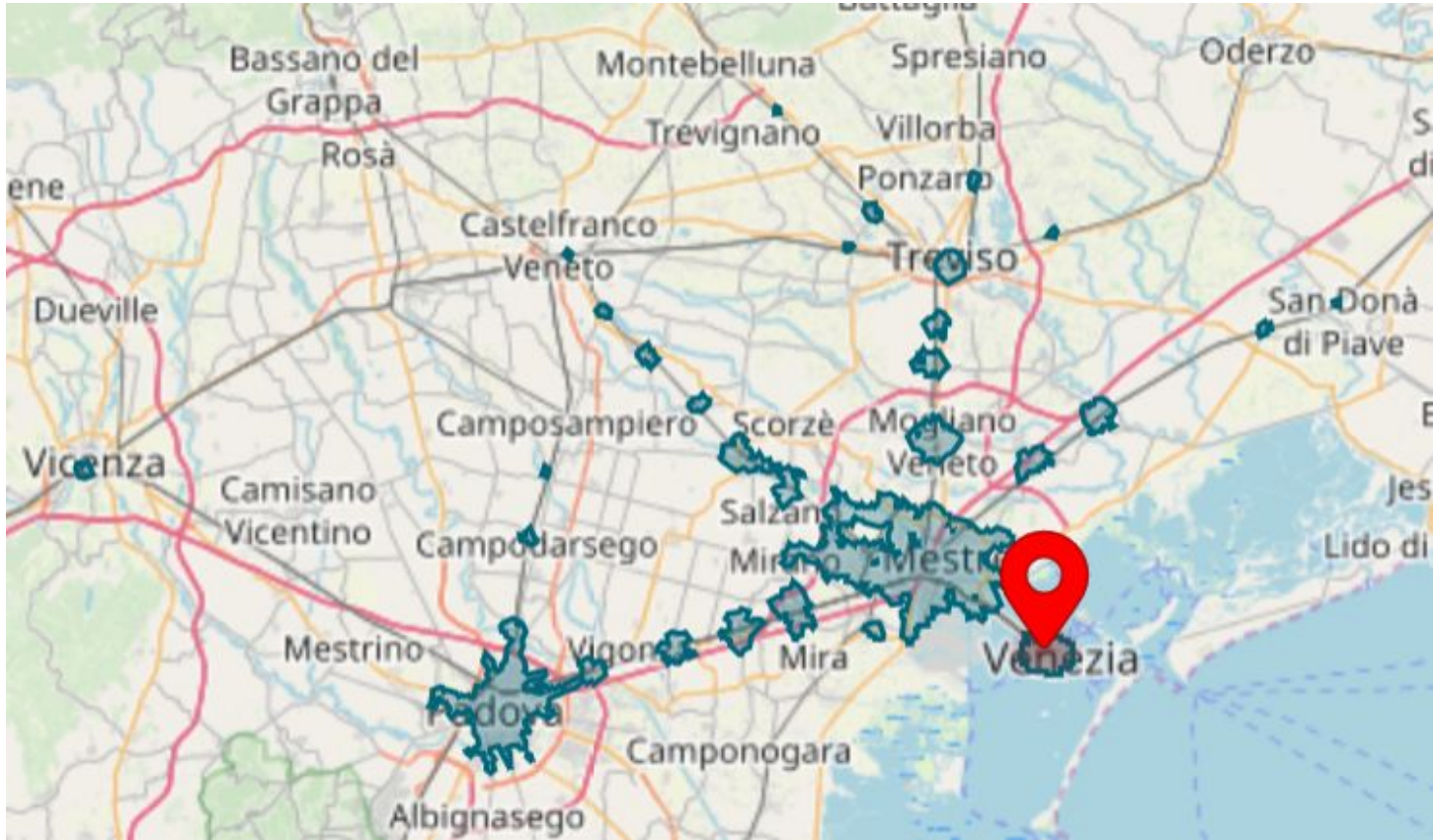
Some Venetians commute up to 30 minutes on the mainland

Highlighted areas are reachable within 30 minutes from Ferrovia



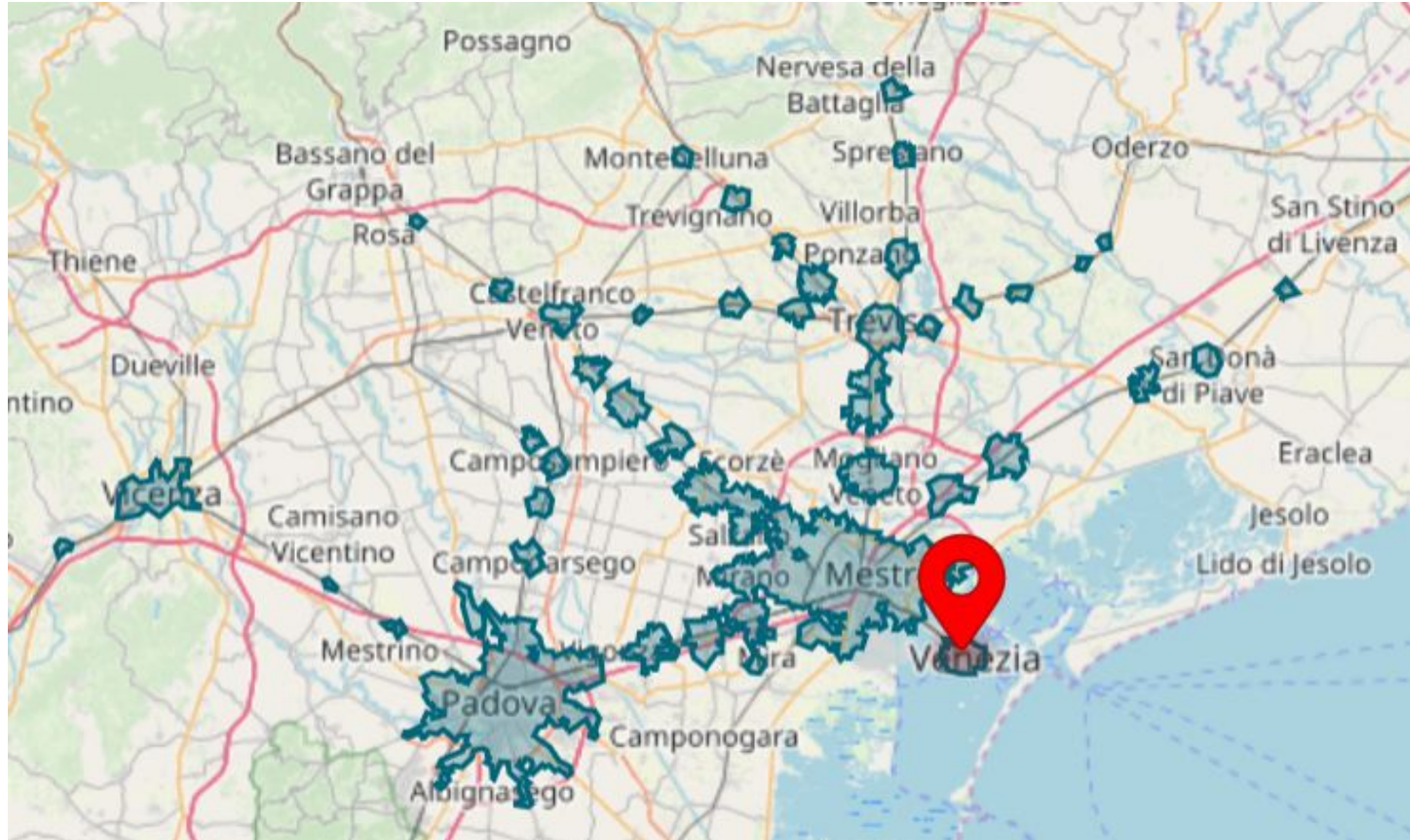
If commuters could get to Ferrovie/Pzi Roma faster, they could spend more time (up to 45 minutes) commuting on the mainland...

Highlighted areas are reachable within 45 minutes from Ferrovie



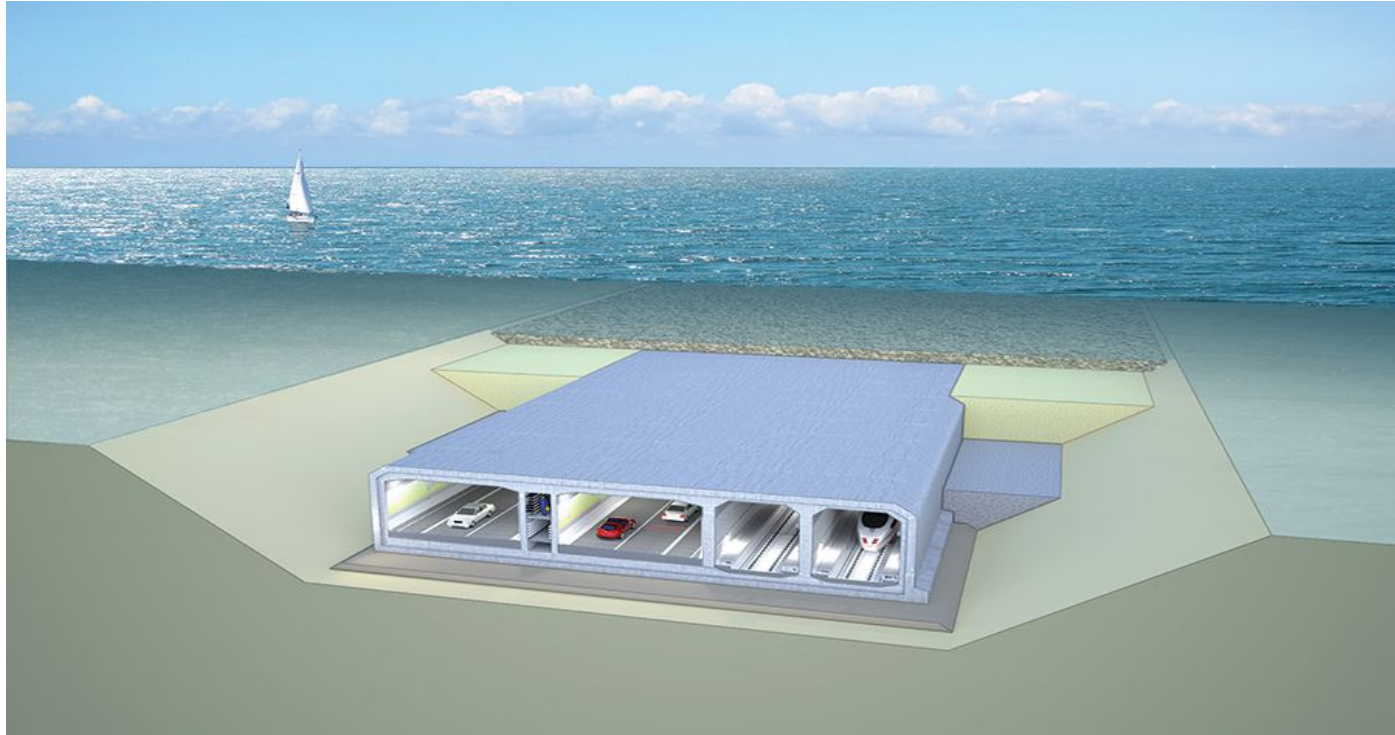
...and would be able to reach even more jobs within a 60+ minute commute

Highlighted areas are reachable within 60 minutes from Ferrovia



**How do we build
an underground
subway?**

The Immersed Tube Tunnel construction method will be the cheapest for a *sublagunare* in Venice



MOSE used the Immersed Tube Tunnel method



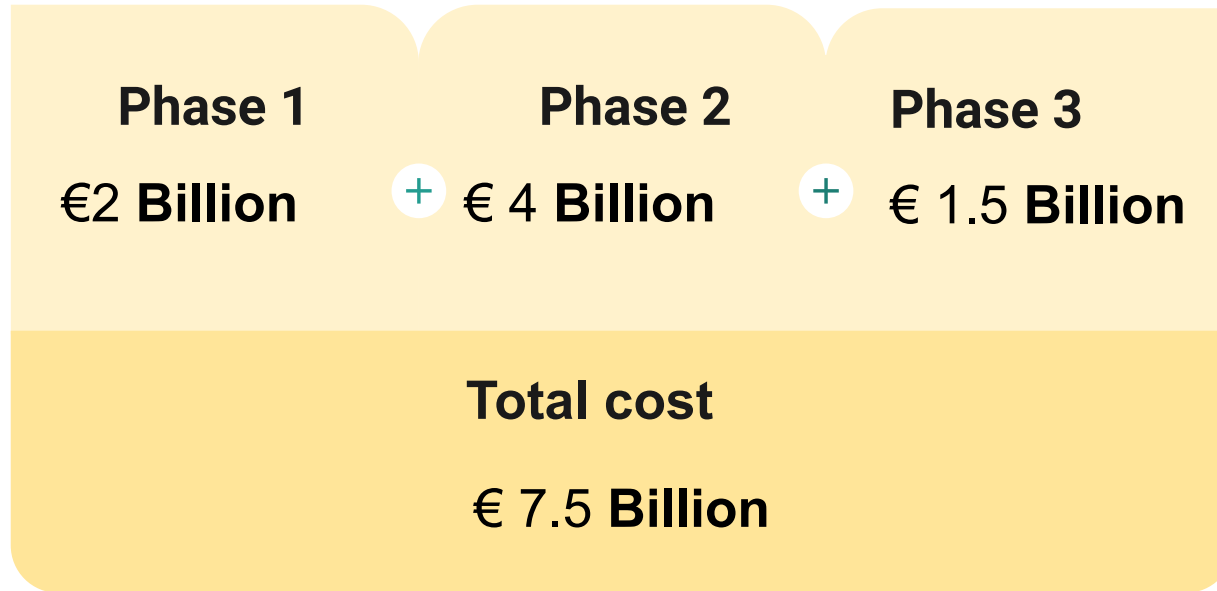
MOSE's immersed tunnels are located at three ports on the eastern side of the Venetian Lagoon



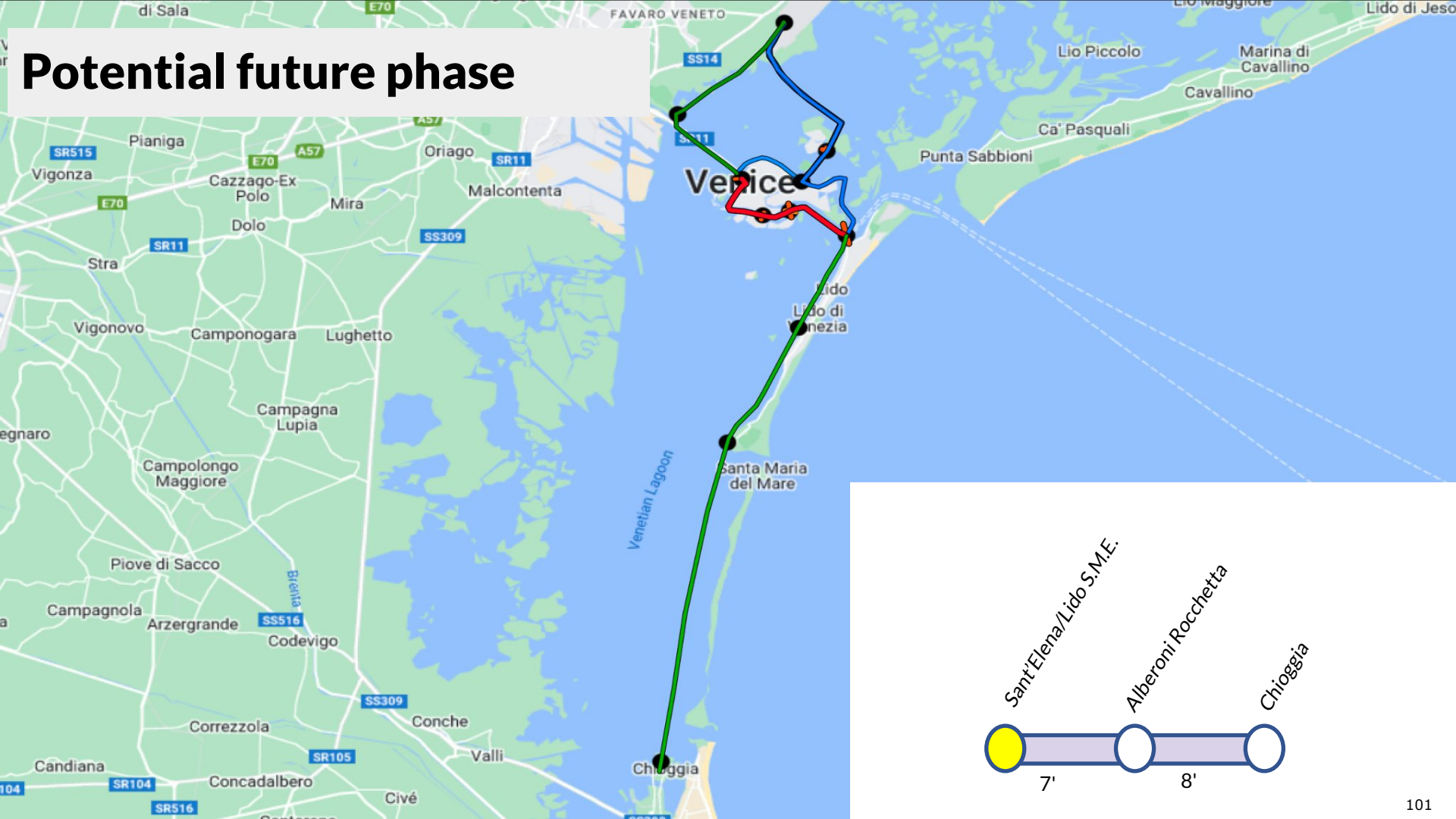
The trains used in the new Milan subway system, which could also be used in Venice, are **driverless**



Based on previous projects, the estimated cost to build an underground subway system using the Immersed Tube Tunnel method is € 7.5 Billion



Potential future phase



Benefits to having a *sublagunare*

- Reducing commuting time, **expanding job market for Venetians**
- Reducing *moto ondosso*
- Reducing congestion in the canals
- Ability to work in any weather

MOBILITY

Venice Project Center REPOSITORIES

Mobility Timeline

Row boats

Personal and cargo transportation was primarily by row boats until WWII. Until 1840, arriving in Venice entailed a gondola ride from Mestre

Steam Boats

Vaporetti provided steam-powered public transportation from 1900 until 1945

Motor boats

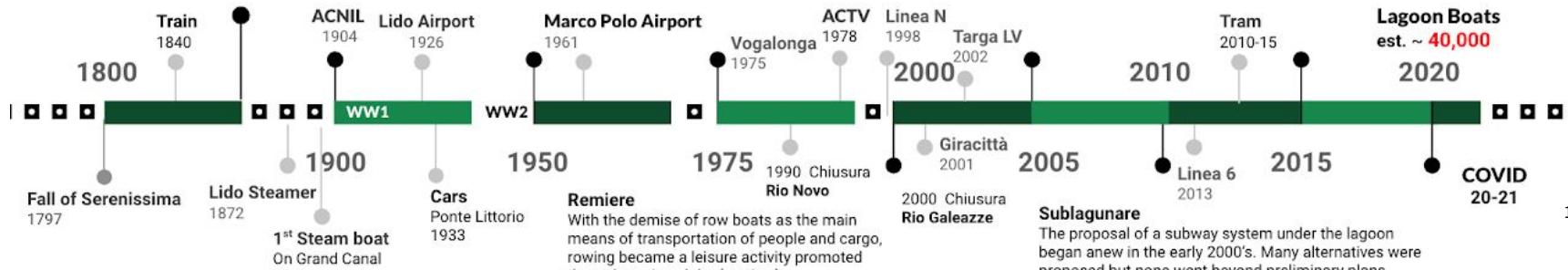
WWII brought widespread use of gasoline and diesel-powered motors in the general population. Taxis and cargo boats were first

Plastic boats

Since the 1980's gradually more and more boats were made of plastic, leaving only a niche market for traditional wooden boats

Electric/Hybrid boats

The first ACTV electric passenger boat debuted in 1996. In 2017, Alliguna introduces Scossa, a hybrid passenger boat. Several entrepreneurs began developing electric/hybrid systems applicable in Venice



Thank you!

Contact us at

ve22.mobi@gmail.com

gr-ve22-mobi@wpi.edu

<https://sites.google.com/view/ve22-mobi/home?authuser=9>



Tyler Brown, Emmaline Raven, Raul Villalobos

Cargo transportation is divided into two categories :



Conto proprio



Conto terzi

***Proprio (Own)* licenses are for those who are transportation goods for their own businesses**



Conto Terzi (third parties) are licenses for transporting things on behalf of third parties

Currently: 410 authorizations



Unit load products are raw materials, heavy machinery, and construction materials



Refrigerated products are one type of cargo product delivered to Venice

total capacity of refrigerated cargo 293 m³



Dry products are one type of cargo product delivered to Venice

The total volume of dry cargo is 6278 m^3

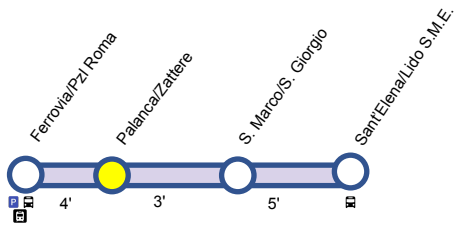
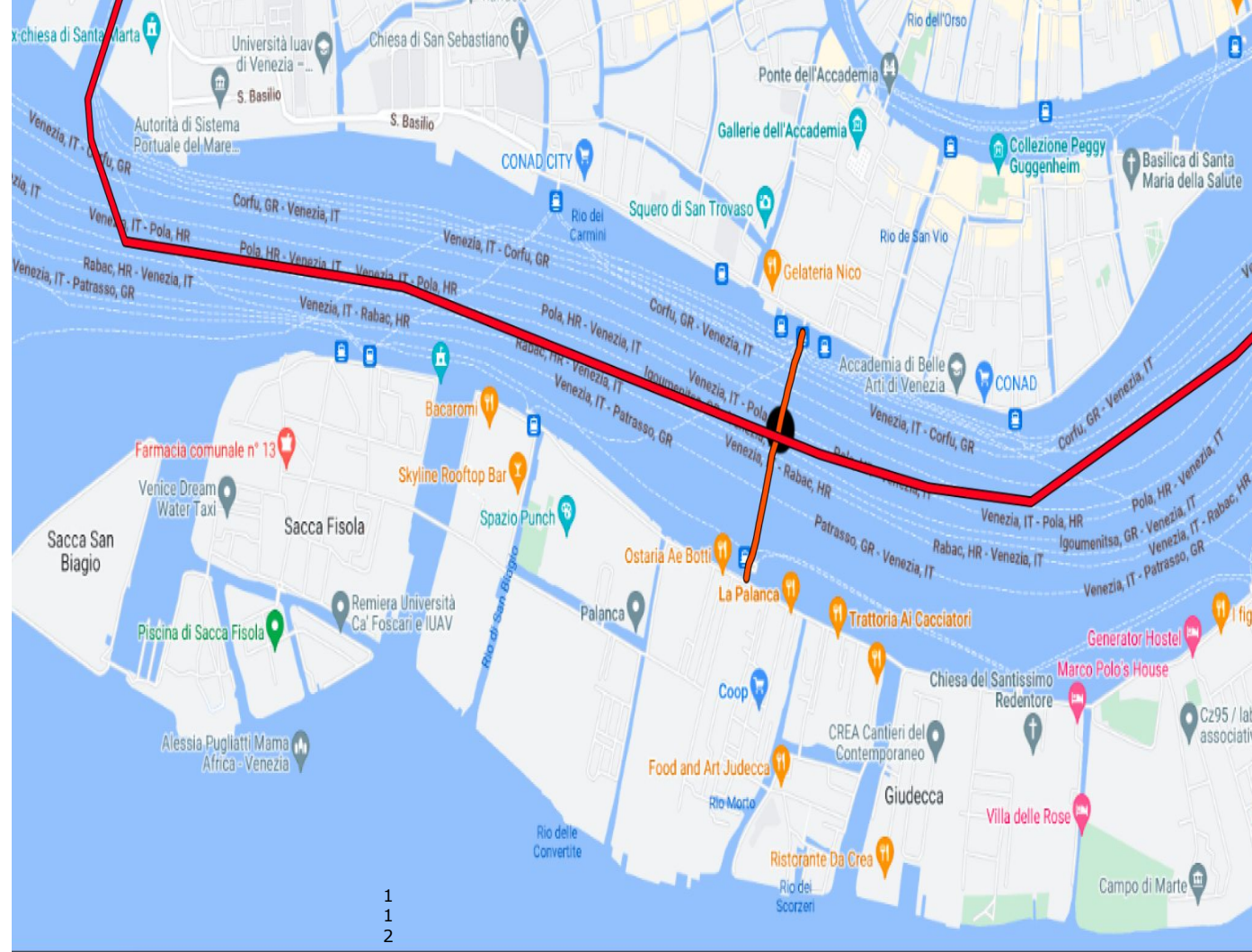


Dry and refrigerated products are delivered to the businesses by cargo dolly



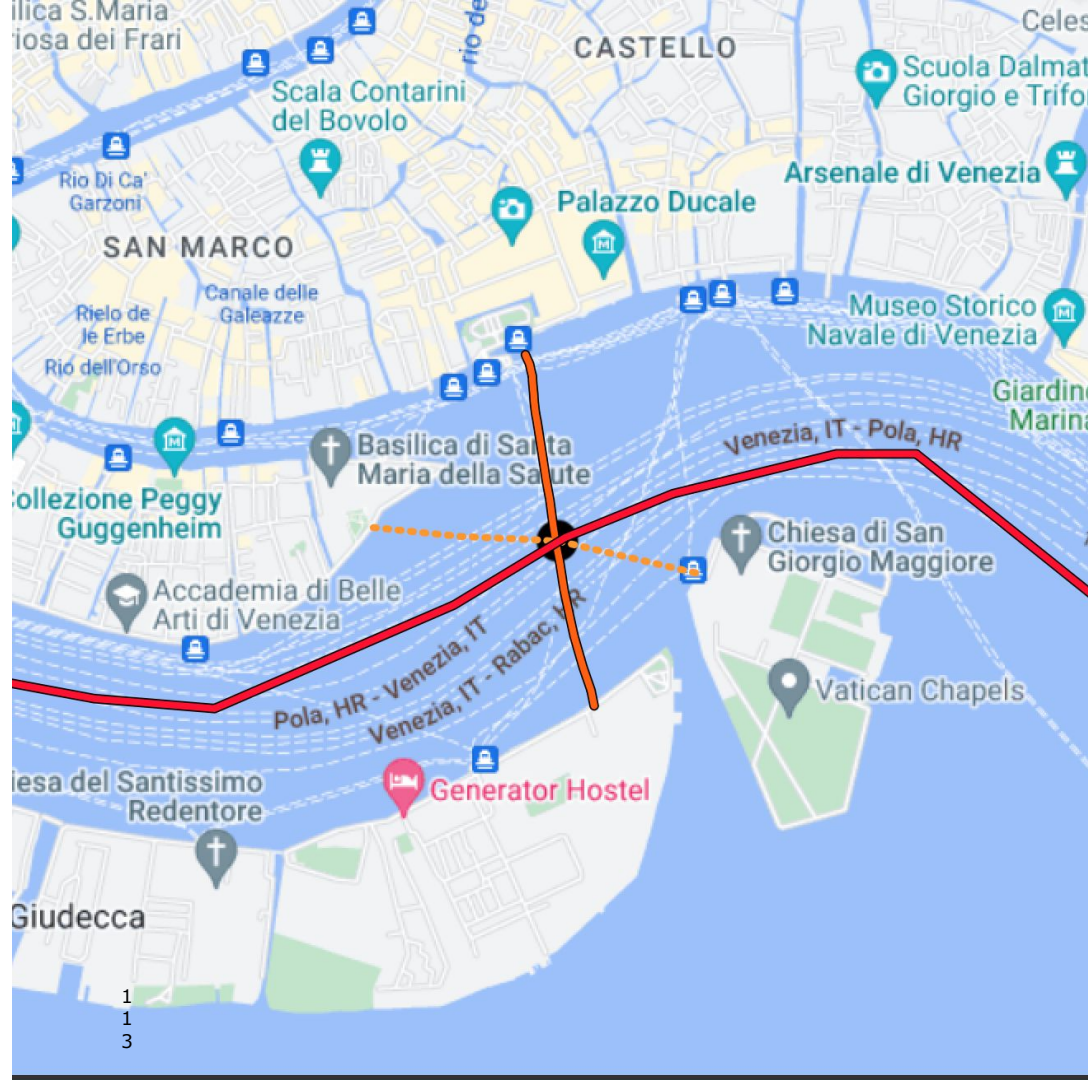
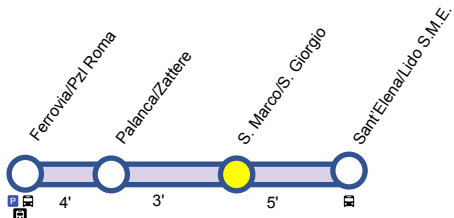
Palanca/Zattere

- Pedestrian tunnel between central Giudecca Palanca and Zattere
- Zattere is near universities and the Accademia Bridge



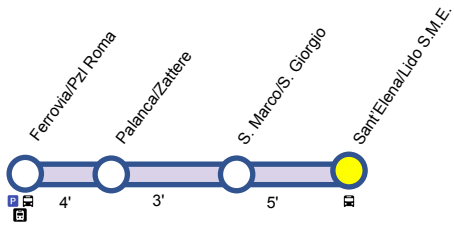
S. Marco/S. Zaccaria/ S. Giorgio

- Pedestrian tunnel between East Giudecca and San Marco.
- One of the most visited sestieri.
- Piazza San Marco and the Basilica di San Marco



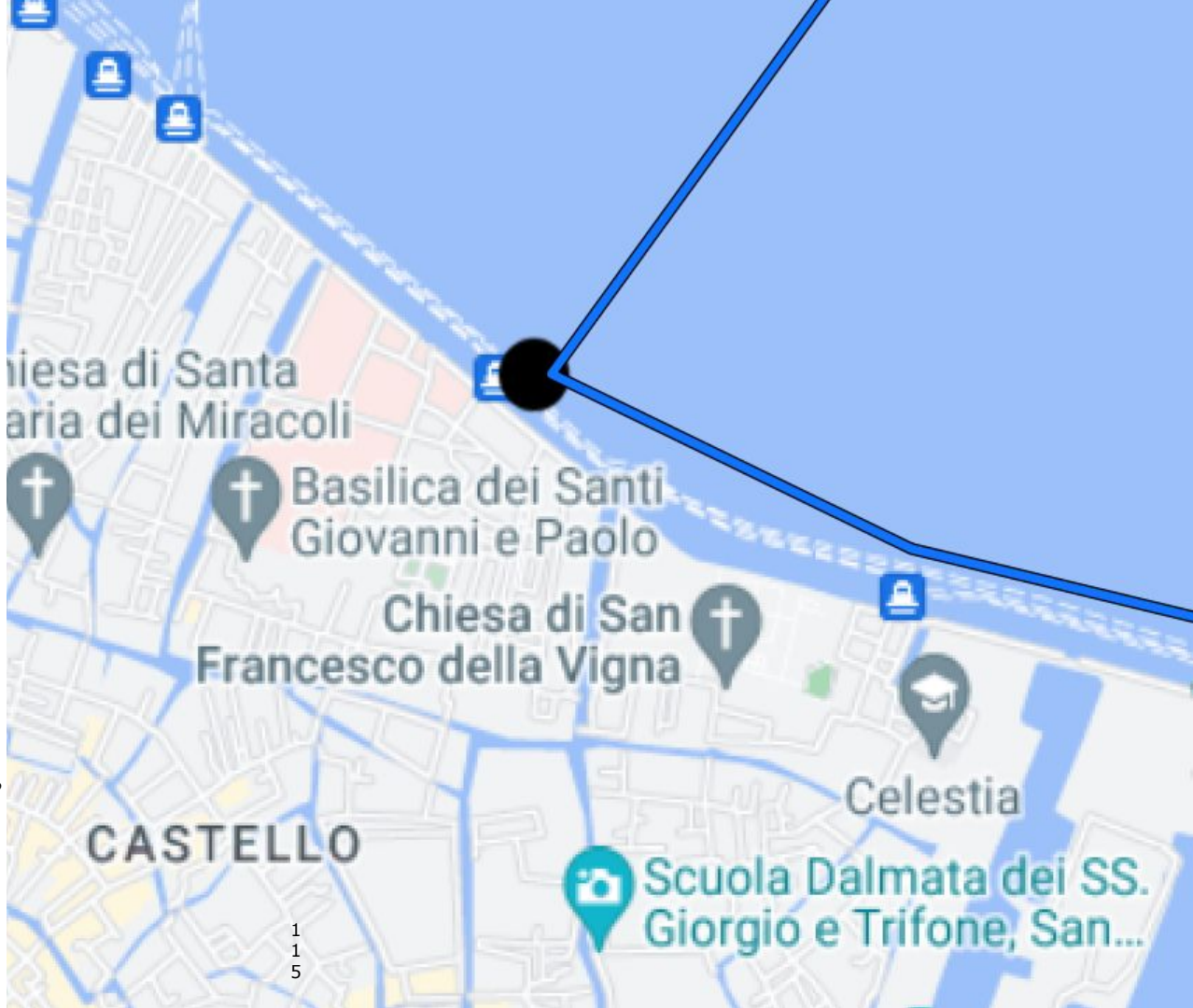
Stop Rationale: Sant'Elena/Lido S.M.E.

- Pedestrian tunnel between Lido and S.Elena
- Home to nearly 20,000 residents
- Lido is an 11 km-long area and it is considered the city's beach



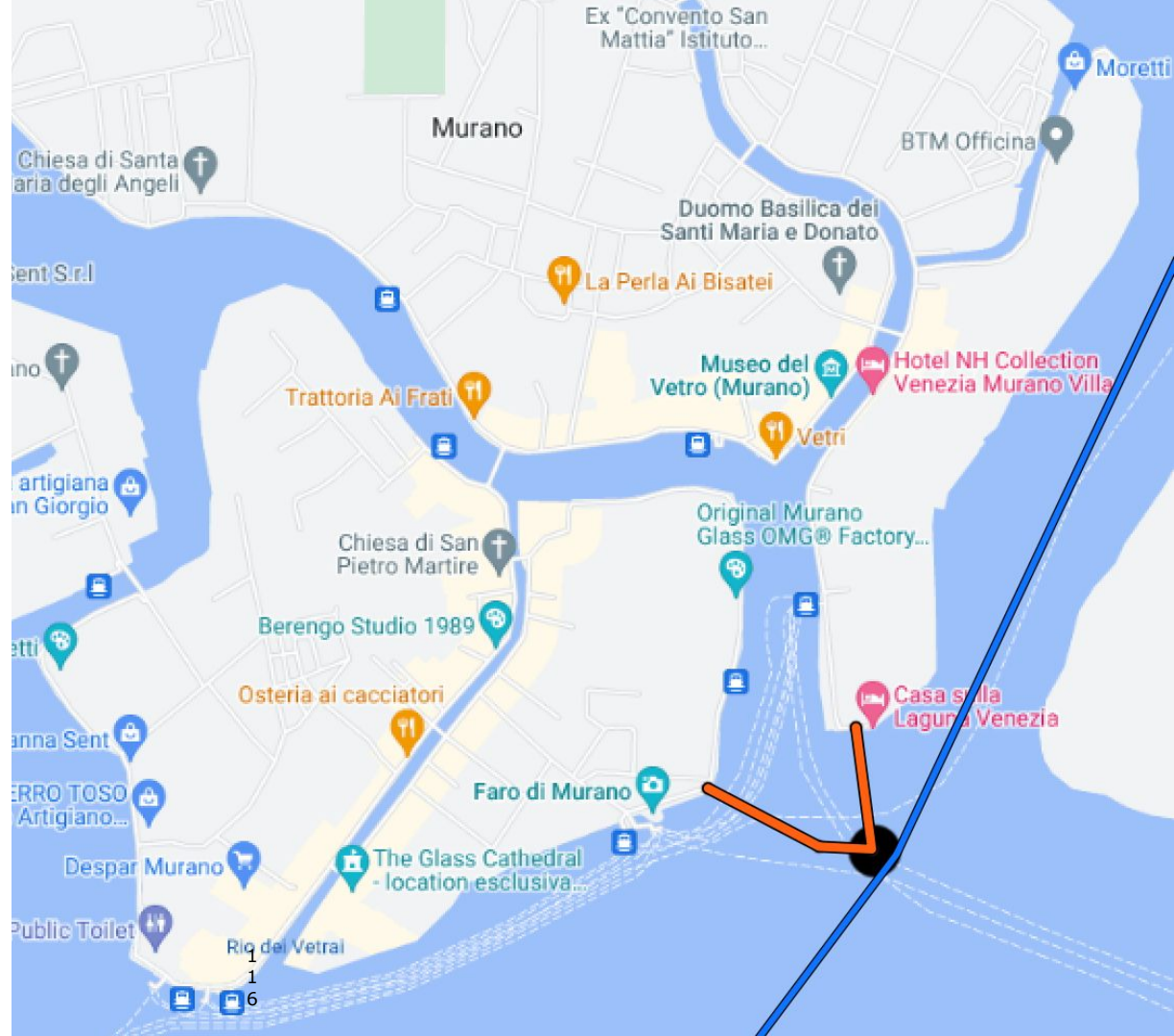
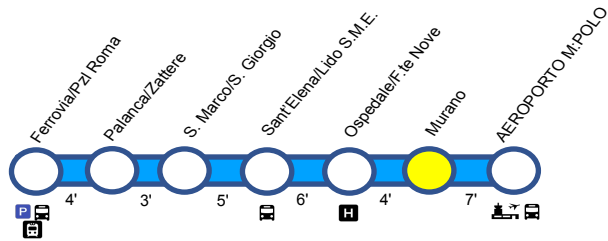
Ospedale/F.te Nove

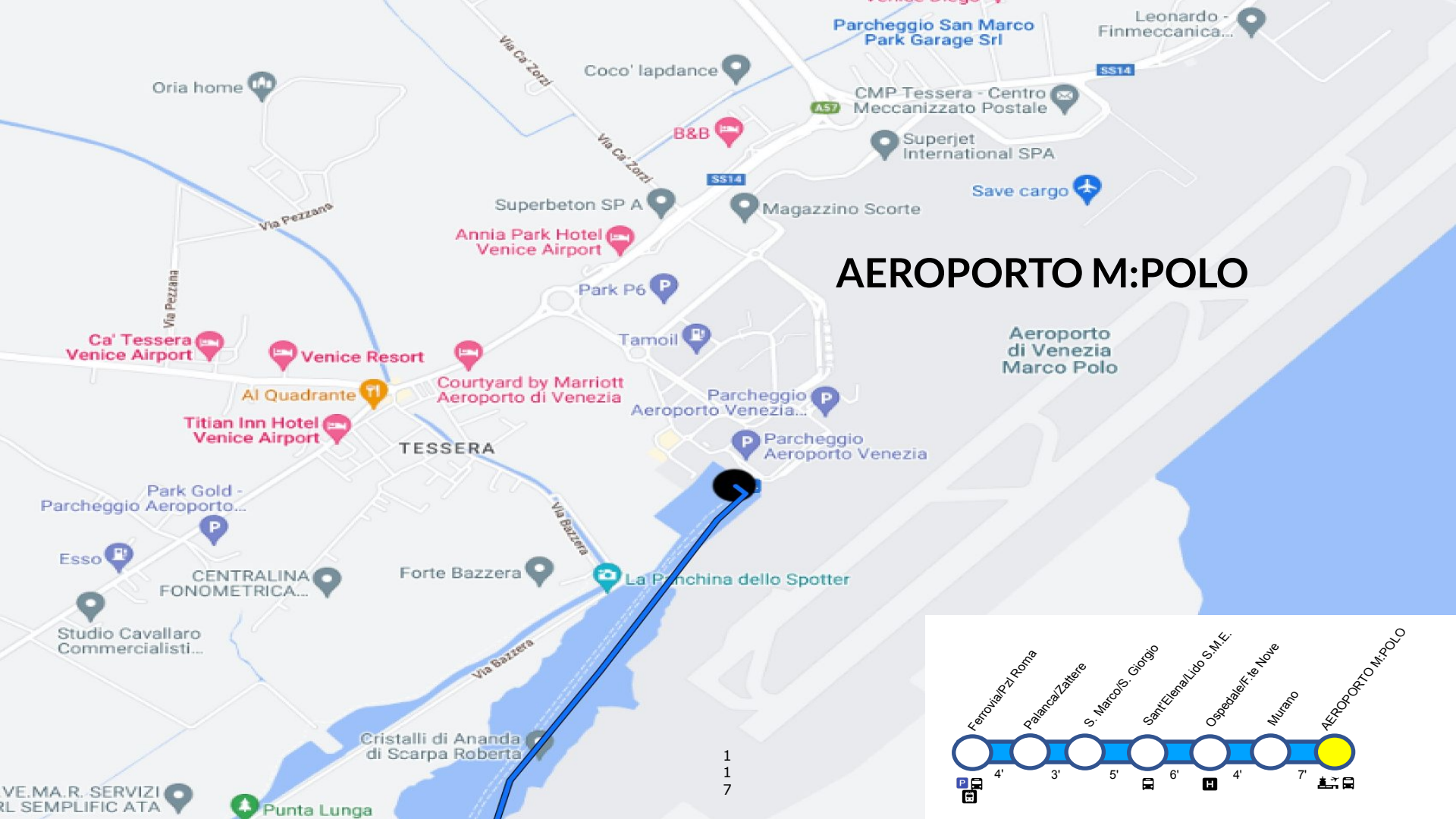
- Accessibility for healthcare workers, and patients.



Murano

- Accessibility for residents, workers and tourists.
- Murano's population is about 4,506 as 2011.





AEROPORTO M:POLO

Aeroporto di Venezia Marco Polo

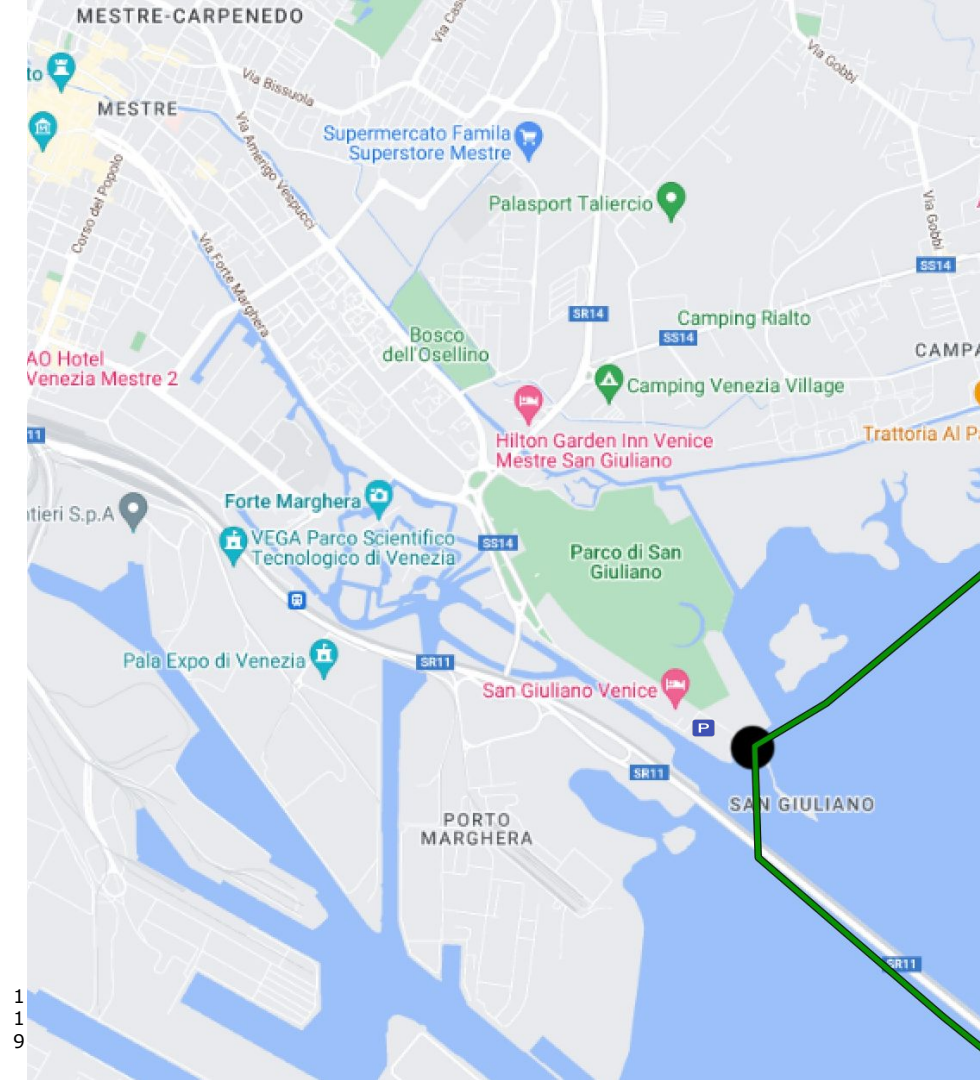
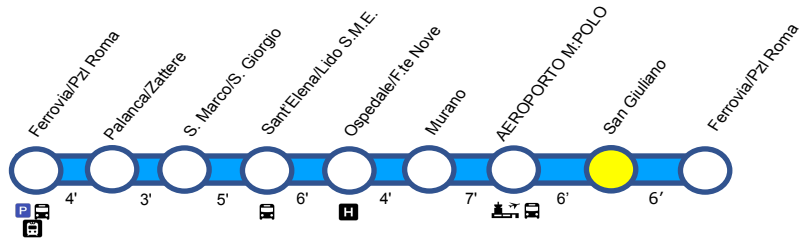


1
1
7

VE.MA.R. SERVIZI
RL SEMPLIFICATA

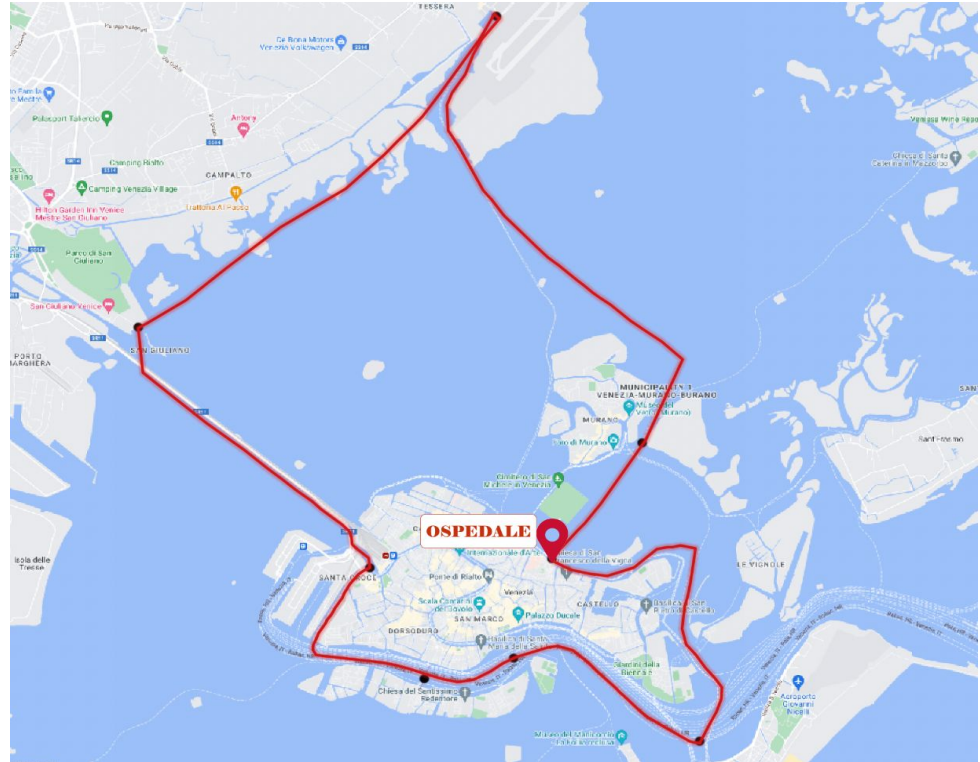


San Giuliano



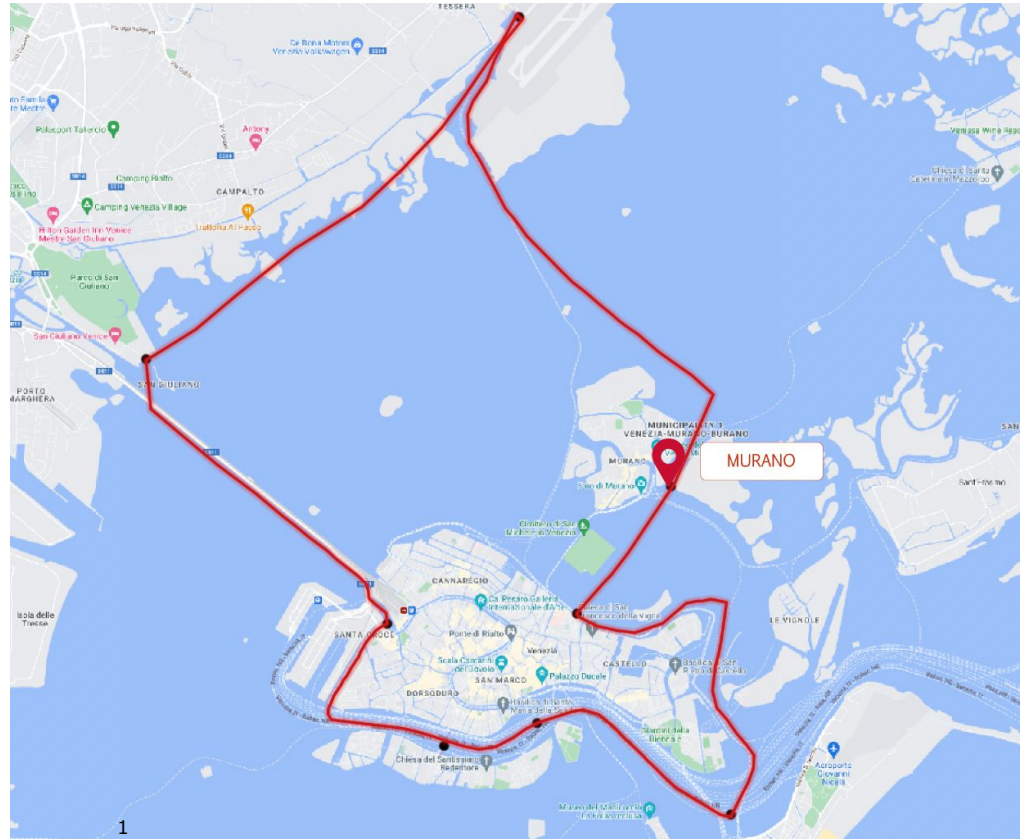
Stop Rationale: Ospedale

- Accessibility for healthcare workers, and patients.
- Castello is consider it as the working class area where the locals live and work



Stop Rationale: Murano

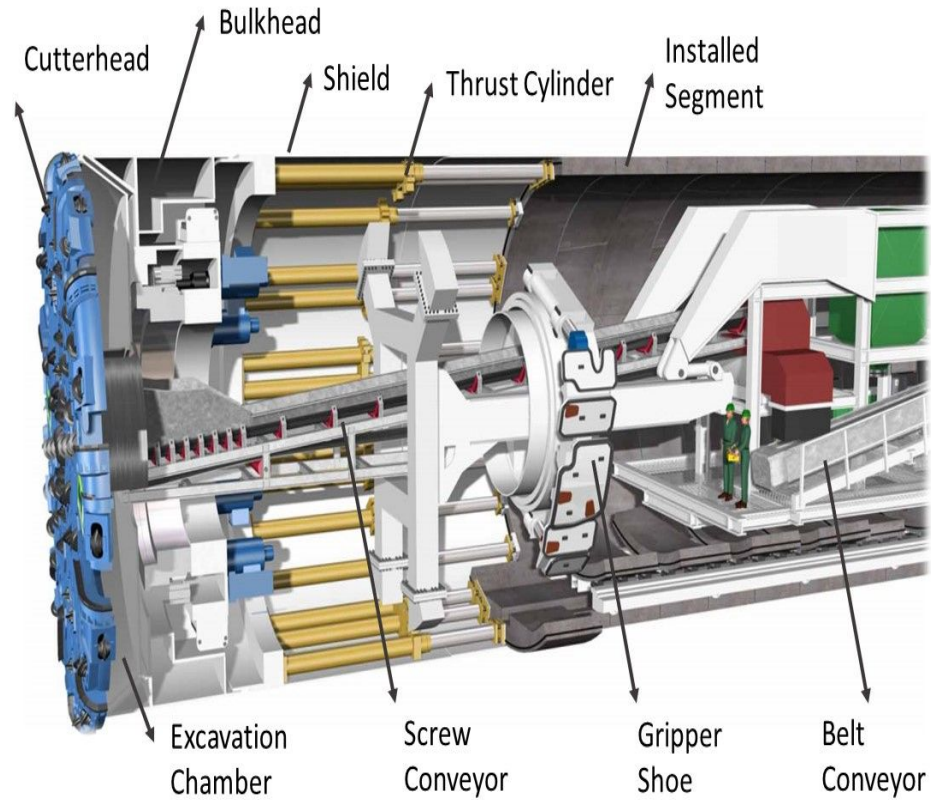
- Accessibility for residents, workers and tourists.
- Public transportation such as the Vaporetto takes longer around 40 - 60 minutes. Vaporetto stops all along the way around the island.
- Murano's population is about 4,506 as 2011.



Methods for building a *sublagunare* in Venice

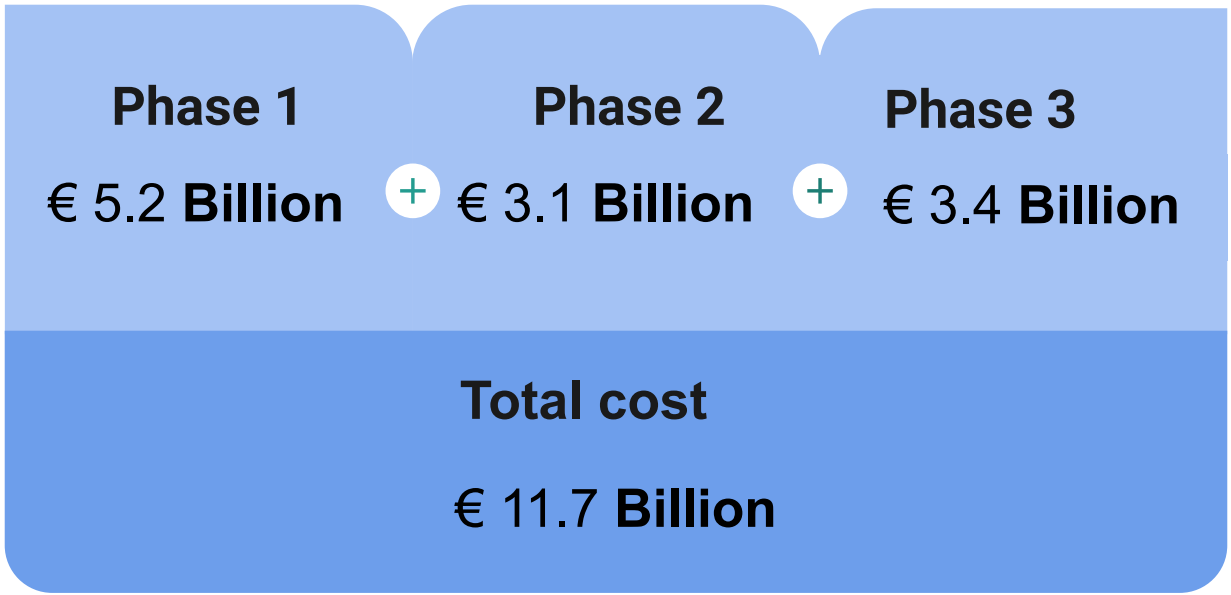
- Tunnel Boring Machine (TBM)
- Immersed tunnel

Tunnel Boring Machine (TBM)



Tunnel Boring Machine (TBM).

Based on previous projects, the estimated cost to build an underground subway system using the Boring Machine method is **€ 11.7 Billion**



Immersed Tube Tunnel

Advantages

- The **speed** of construction
- Minimal disruption to the canal, if crossing a shipping route
- **Safety** of construction (for example, work in a drydock as opposed to boring beneath a canal)

Disadvantages

- on the lagoon bed, risking a sunken ship/anchor strike
- Direct contact with water necessitates careful waterproofing design around the joints

Example of Immersed Tube Tunnel

Fehmarnbelt Fixed Link

Germany and Denmark

Cost: € 7.1 Billion

Distance: 18 Km

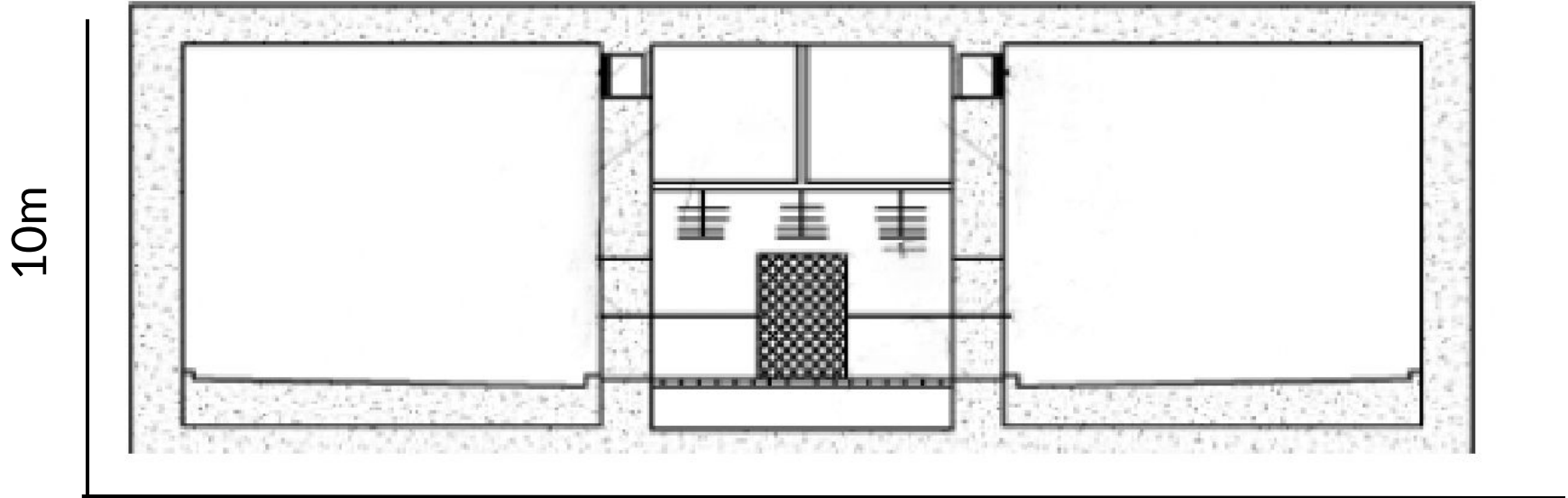
Width: 42m

Start construction : 2020

Cost per km: €394 million

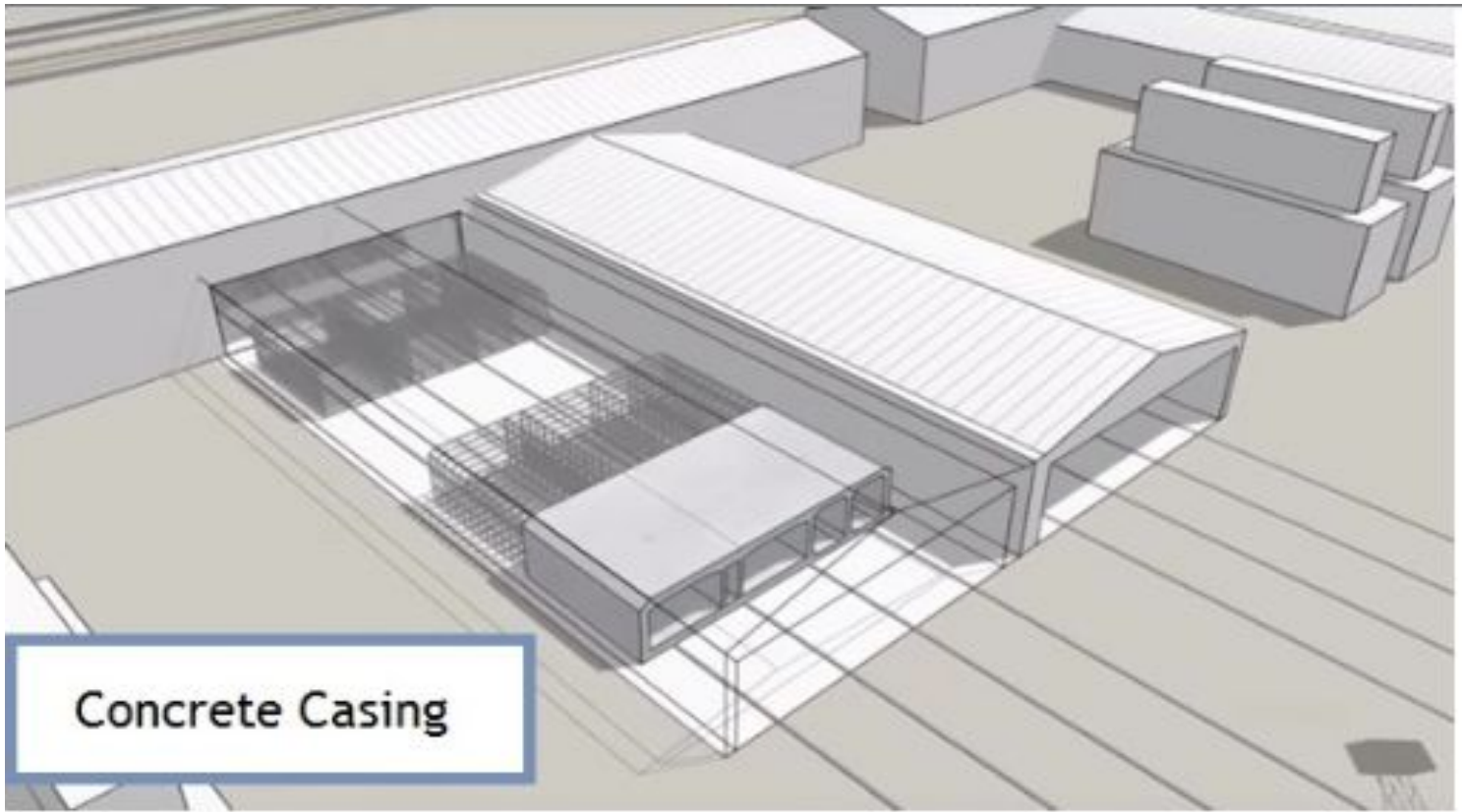


The width of the cross section of the underground tunnel system is 18m, and it's 10m tall



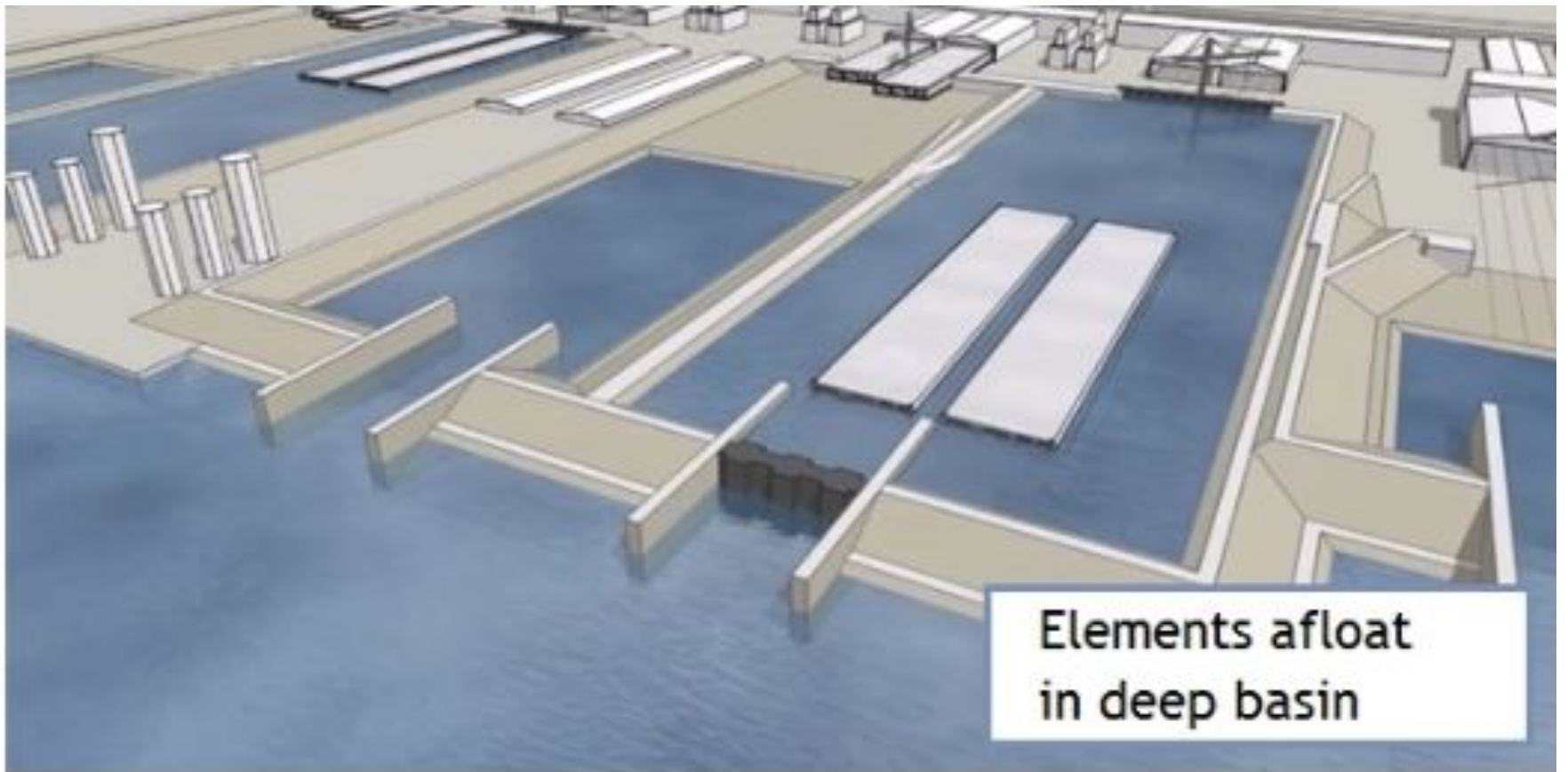
18m

1
2
7



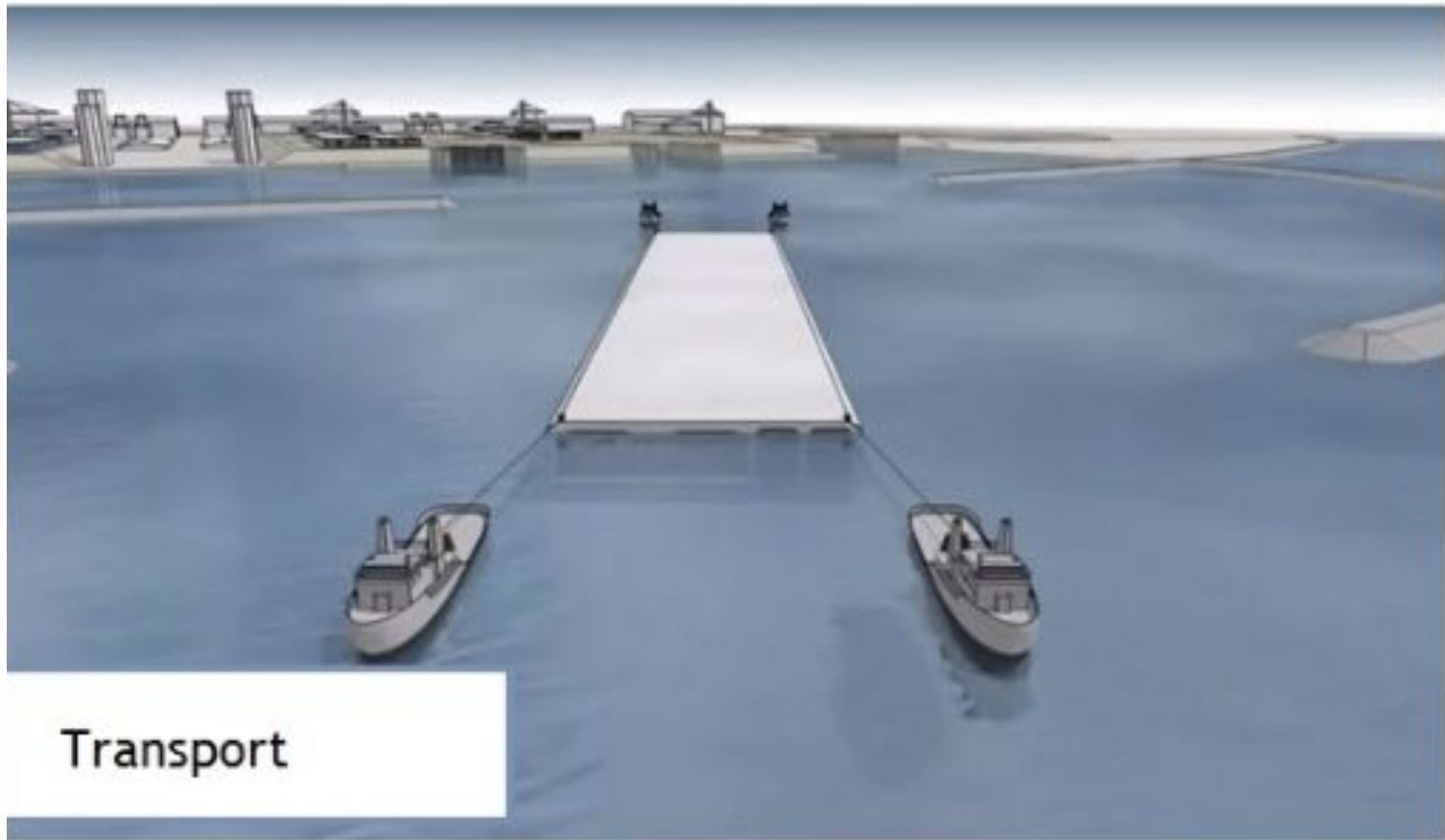
Concrete Casing

Immersed Tube Tunnel

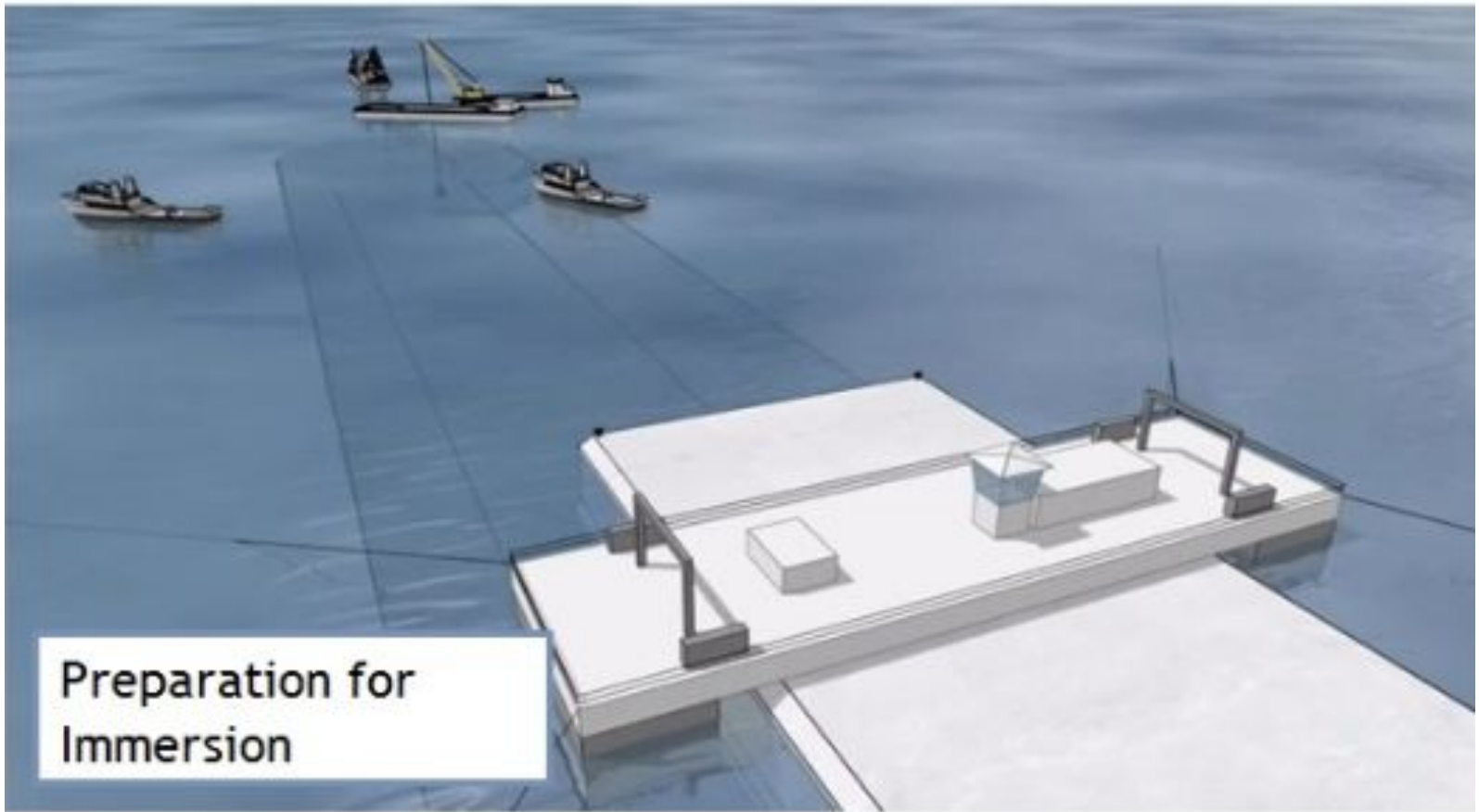


**Elements afloat
in deep basin**

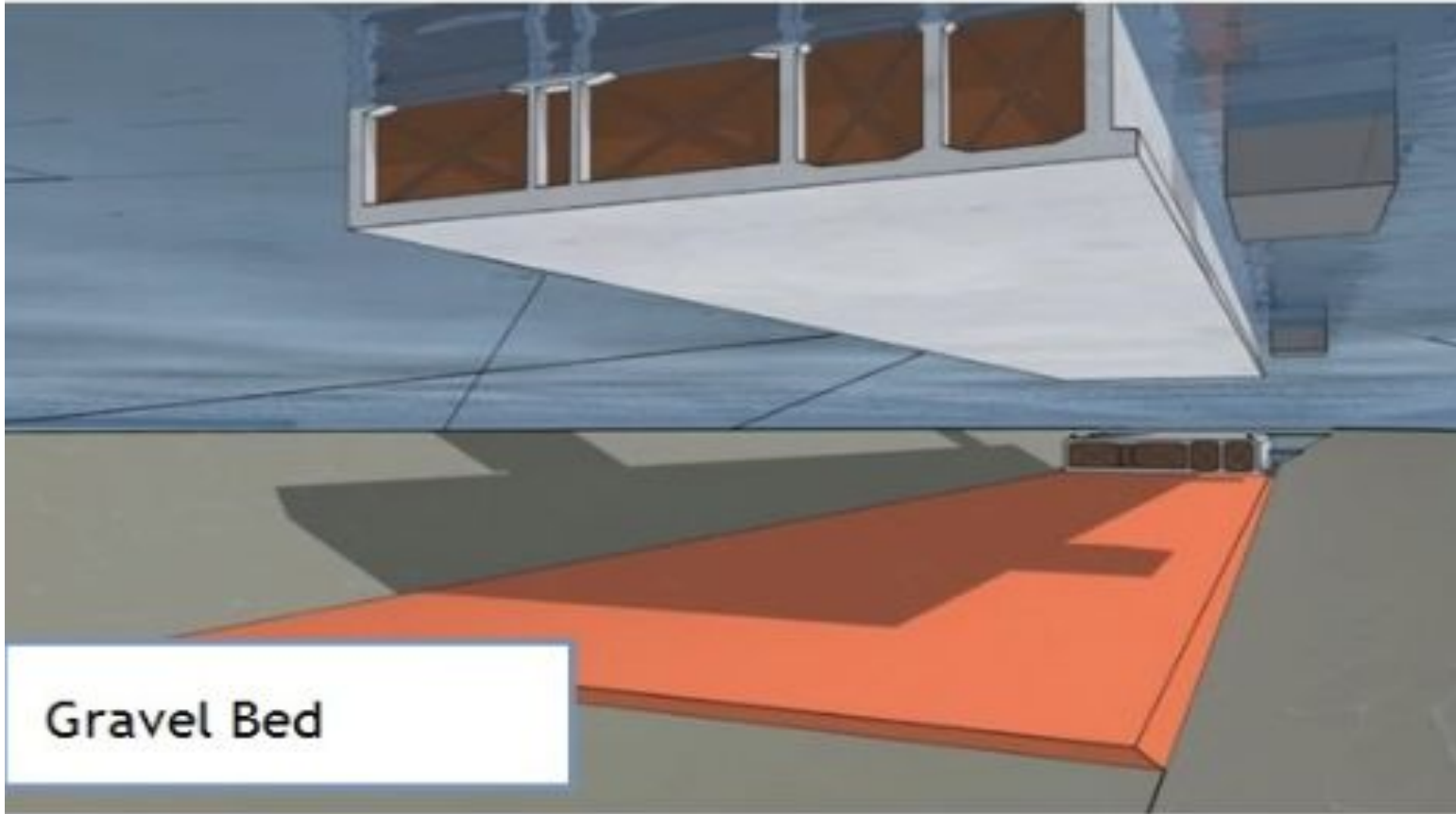
Immersed Tube Tunnel



Transport



Immersed Tube Tunnel



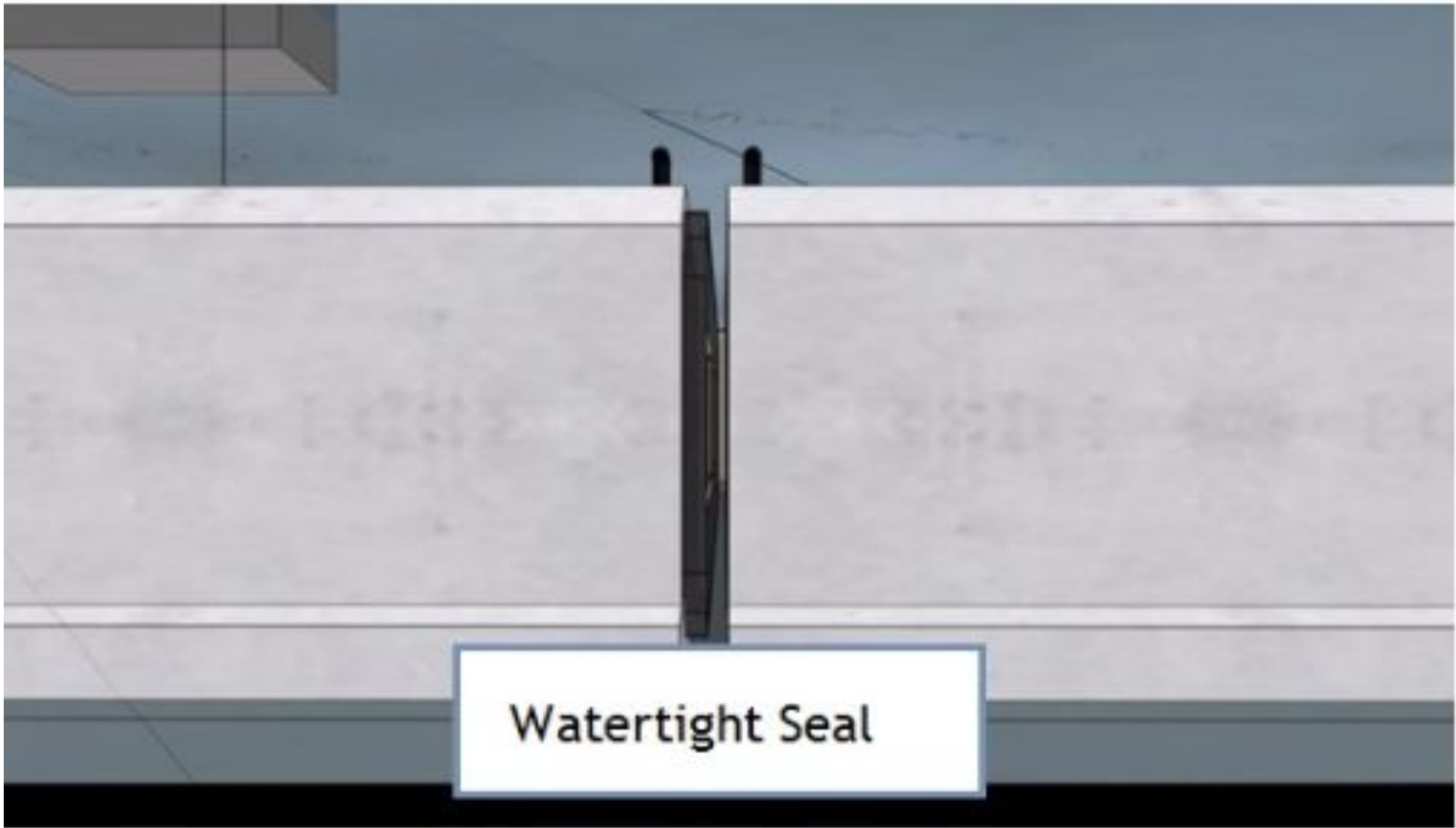
Gravel Bed

Immersed Tube Tunnel

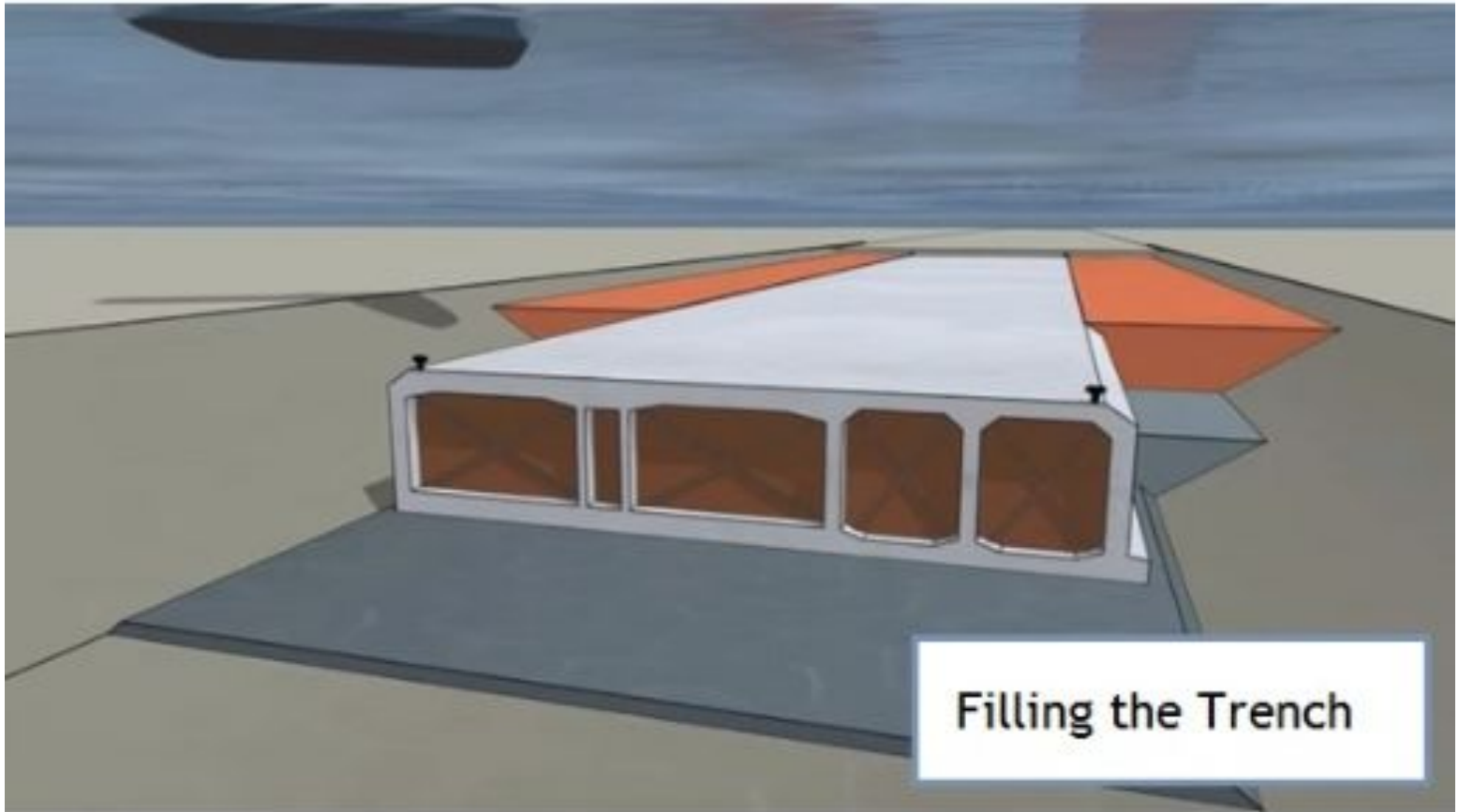


Immersion

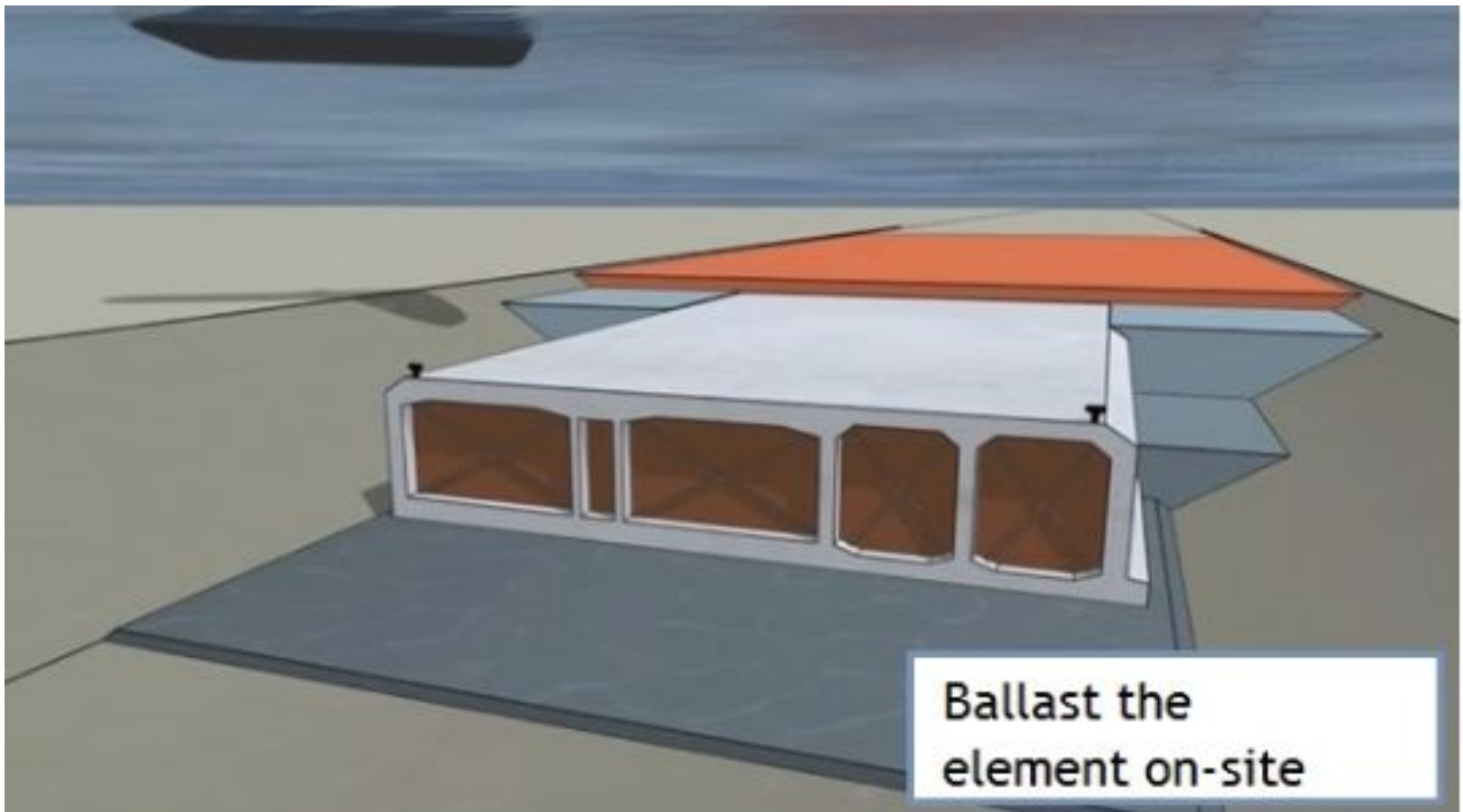
Immersed Tube Tunnel



Immersed Tube Tunnel



Immersed Tube Tunnel



**Ballast the
element on-site**

Immersed Tube Tunnel

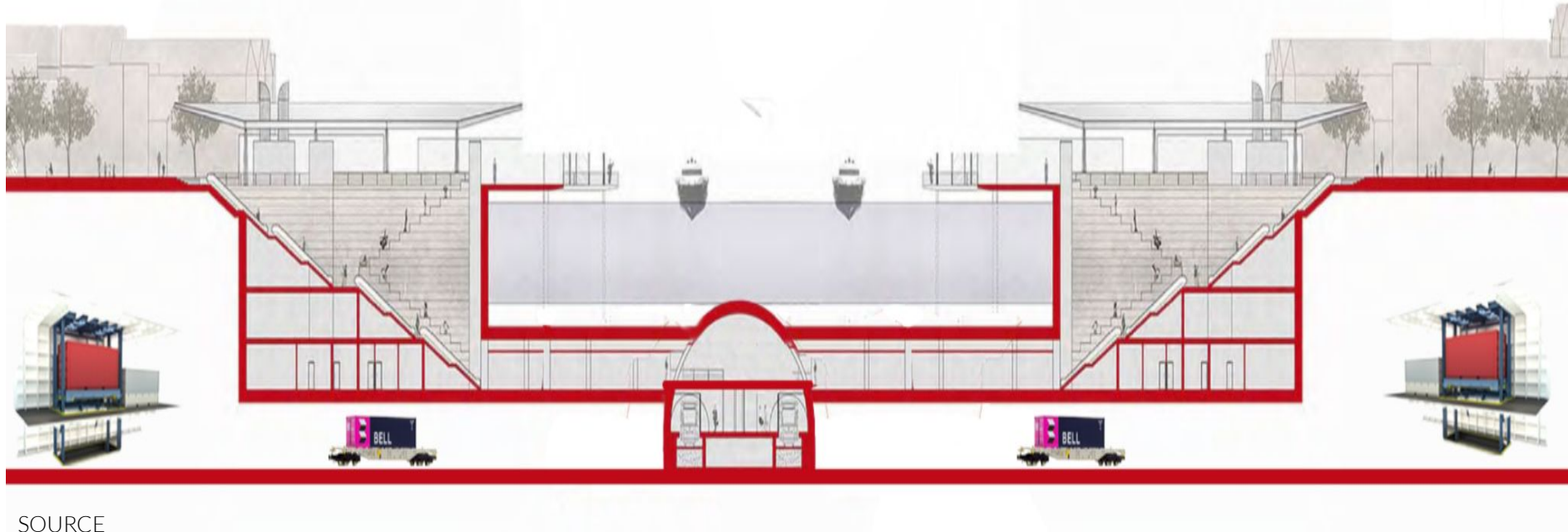


Immersed Tube Tunnel

Station with cargo hitching integration

Zattere

Palanca



SOURCE