SPILLOVER APPLICATIONS TO ACCELERATE THE VALORIZATION OF HYPERLOOP

Exploring the possibilities for PI relevant spillover applications

Hyperloop: what ?

- A network that connects airports/cities for people and goods
- A network of a standardised system of tubes with low air pressure substantially free of air resistance allowing for high speeds (up to 1000 kph)
- Above ground where possible, under ground where needed
- Faster than aviation, more energy efficient & cheaper to build than high speed rail
- A pathway towards a net zero positive transport alternative

Hyperloop: why ?

- Increased pressure on and severe congestion of existing infrastructure
- Increased demand for faster and flexible mobility – interconnectivity
- Increased demand for automated, safe and resilient transport system
- Increased demand for smart and optimized supply chains to meet requirements of the on-demand economy
- Shift towards sustainability; no short-term alternative for aviation

Questions from a PI perspective

- How can the fifth transport mode contribute to the Physical Internet ?
- How can the technology contribute in the short/mid term to PI related challenges ?

Track 1: Integration of cargo in network

- In the full vision of a Hyperloop network, cargo will be one of the users of the available capacity in the network:
  - Valorisation of capacity
  - Ultimate combination of flexibility & reliability
  - Zero emission supply chains
  - Resilient transport mode
  - Design for Supply Chain

EVOLUTION 2023/2024:

- Hyperloop Association – moving towards standardisation and technological convergence
- Building phase of test tracks starting CA, ES, NL, , SUI, US …

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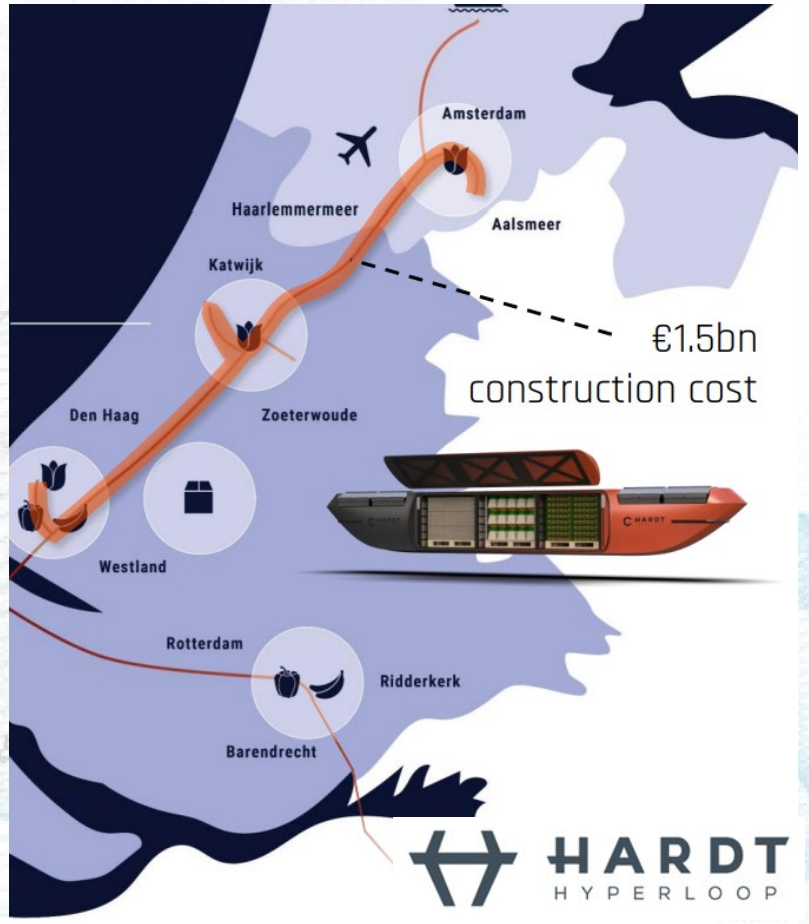
EMPOWERING LOGISTICS

Track 2: Dedicated cargo network

- Dedicated cargo routes
- Connect routes into smaller networks
- Connect routes to other transport modes (in/out)
- Integration into production, distribution and demand centres
- Form follows function

EVOLUTION 2022/2023:

- CARGOLOOP (Hardt) initially as spillover application (lower speeds, less technical complexity)
- No longer seen as scalable – moving towards PI sized pallets & market requirements pushing solution to larger (network standard) diameters
- Dedicated solutions (not upscaled into networks) remain valid



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EMPOWERING LOGISTICS

HARDT

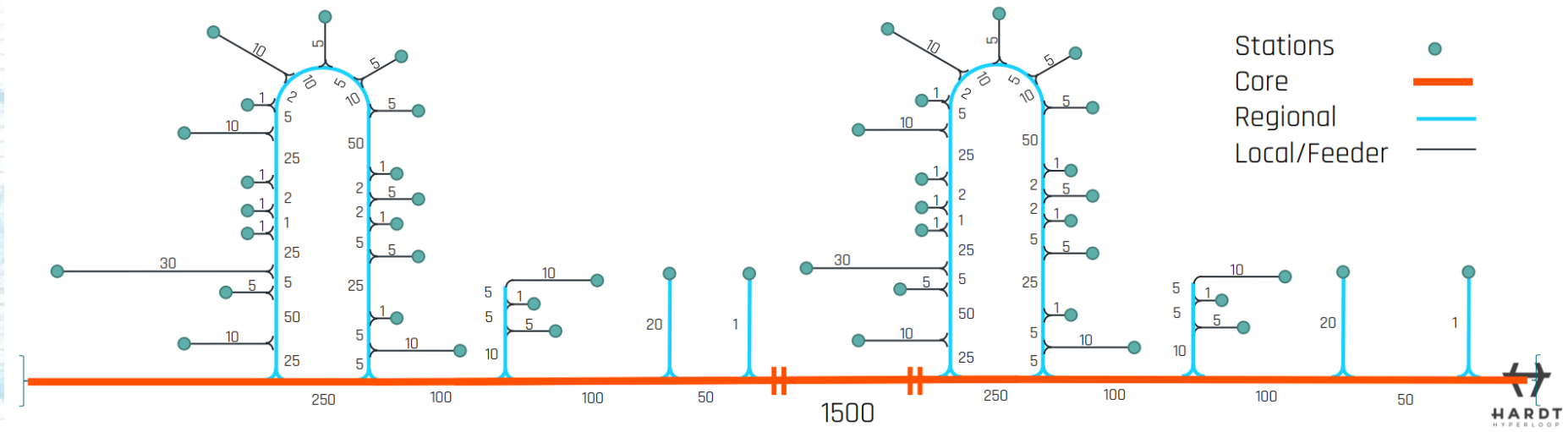
The Hyperloop network

The Hyperloop network carries both passengers and cargo in dedicated vehicles

'The Highway Principle'

Hyperloop ensures a continuous flow

hoover here to click on play



HARDT HYPERLOOP

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Swisspod testing site, Lausanne, Switzerland

World’s first functional hyperloop facility for long duration testing

swisspod

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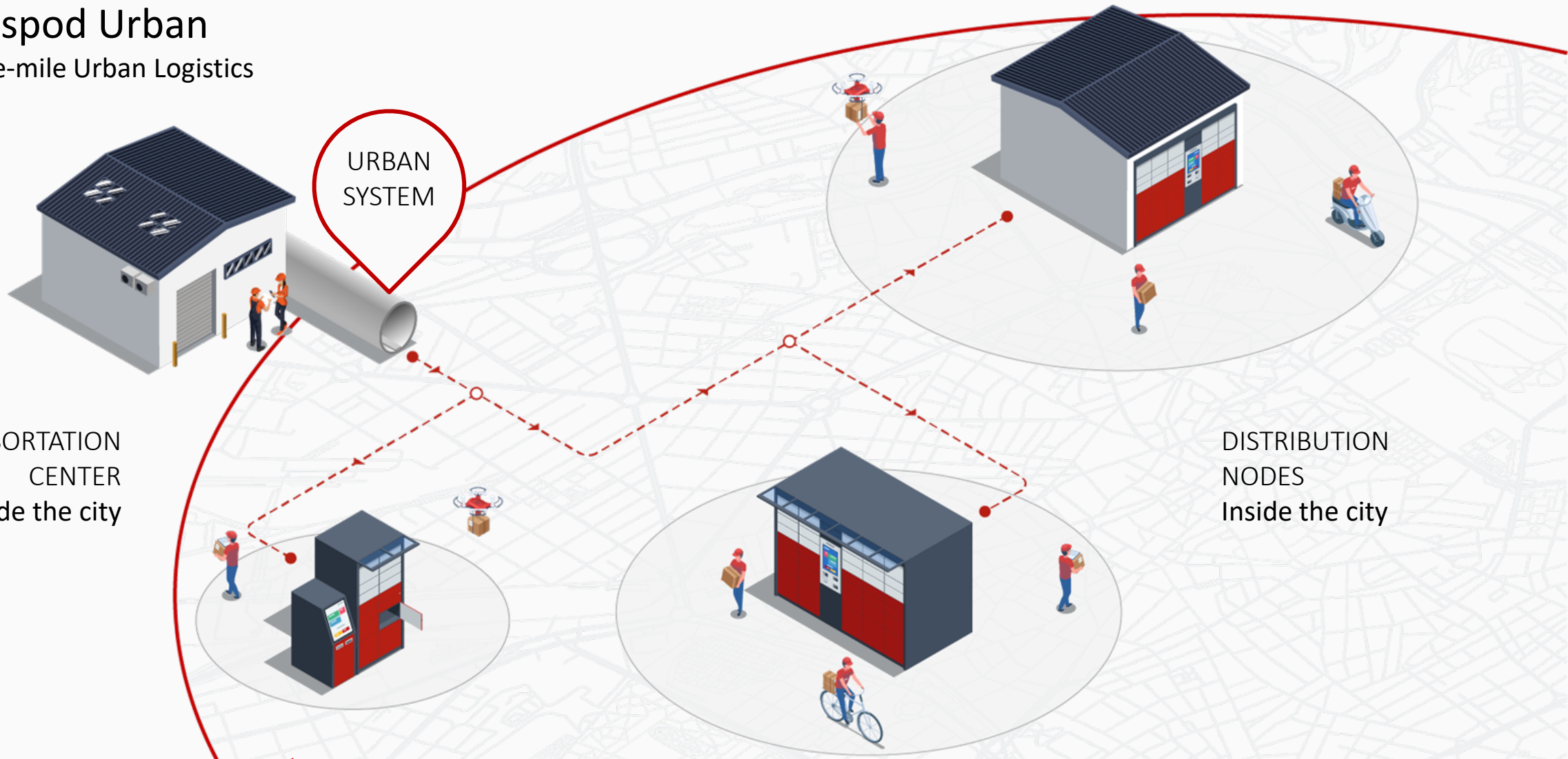
Swisspod Urban

Middle-mile Urban Logistics



SORTATION
CENTER
Outside the city

DISTRIBUTION
NODES
Inside the city

swisspod

* Swisspod Urban Solution brings automation outside the warehouse, by connecting logistics centers with a resilient, autonomous transportation system for pallets and small parcels, that uses Hyperloop technology to optimize flow of goods, while reducing energy consumption and CO2 footprint.

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Track 3: spillover tech to automated solutions

- Real –life port and hub operational challenges PoAB
  - Case 1: connecting maritime terminal to barge quay – 1 km – 85.000 TEU
  - Case 2: connecting # terminals – 2 km – 125.000 TEU
  - Case 3: connecting 2 ports – 80 km – ? TEU
- Ecological & low to no noise
- Autonomous
- Reliable
- 24/7
- Unlocking multimodal solutions

Port of Antwerp Bruges

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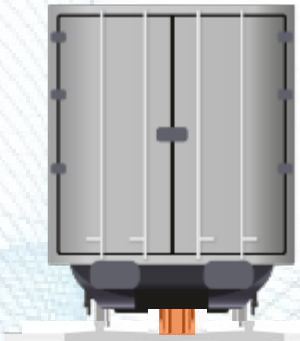
Products: upgrade from legacy towards frictionless future

MagRail allows a stepwise upgrade of legacy railways with components bringing automation, electrification & full digitization

Nevomo's digital bridge systems:
(possible as cargo & passenger versions)

	Legacy	MagRail Booster	MagRail	Hyperloop
		 Existing vehicles*	 New vehicles	
Cargo:	120kph | 75mph	120kph | 75mph	160kph | 100mph	600kph | 375mph
Passenger:	330kph | 205mph	330kph | 205mph**	550kph | 340mph	1200kph | 745mph
	Analog & hard to fully digitalize	**New digital components quickly implementable to upgrade legacy tracks**		**Vacuum rail of the future**

Linear motor

Magnetic levitation

compatible*

with:

NEVOMO

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* interoperable

** or even 360 kph | 225 mph, which is currently planned on the fastest High-Speed Rail lines in Europe

Nevomo's MagRail will enable railways by adding needed features

Solving railways' challenges with a portfolio of MagRail solutions

MagRail features:

Automation & electrification	More power & better dynamics	Flexibility	Velocity

Applications:

- Automated, flexible shunting
- Shuttling of wagon-groups
- Electrification of terminals

- Higher loading limits on inclines
- Faster acceleration out of passing tracks
- Faster acceleration/ deceleration in stations

- Dedicated pods operating with high frequency and high flexibility
- No locomotives needed – easy adaptation to demand fluctuations

- High-Speed passenger travel (550 kph) with levitation

Benefits:

NEVOMO

Capacity ↑ **Flexibility ↑** **TCO* ↓**

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* TCO – Total Cost of Ownership, comprising, i.a., CAPEX and OPEX

Technology is ready for piloting on real infrastructure

MagRail Booster is heading towards pilot implementation with leading infrastructure managers starting in 2023/2024

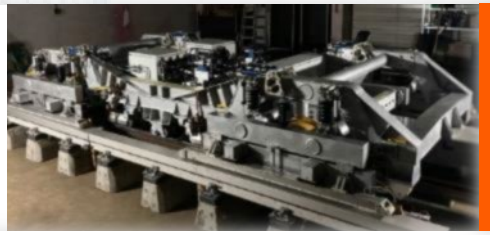
Cooperation with:

RFI RETE FERROVIARIA ITALIANA
GRUPPO FERROVIE DELLO STATO

RFI plans to co-finance Bologna San Donato with "Europe's Rail" funds*. Other railways & suppliers have been invited.

Europe's Rail

Test center
Expected 2024/2025 (1st phase), after current Europe's Rail project



After successful tests of combined propulsion & levitation focusing on Cargo Booster delivery

Full-scale test track
H1/2023

First demonstration
Q4/2019

Medium-scale test track
Q1/2021

NEVOMO

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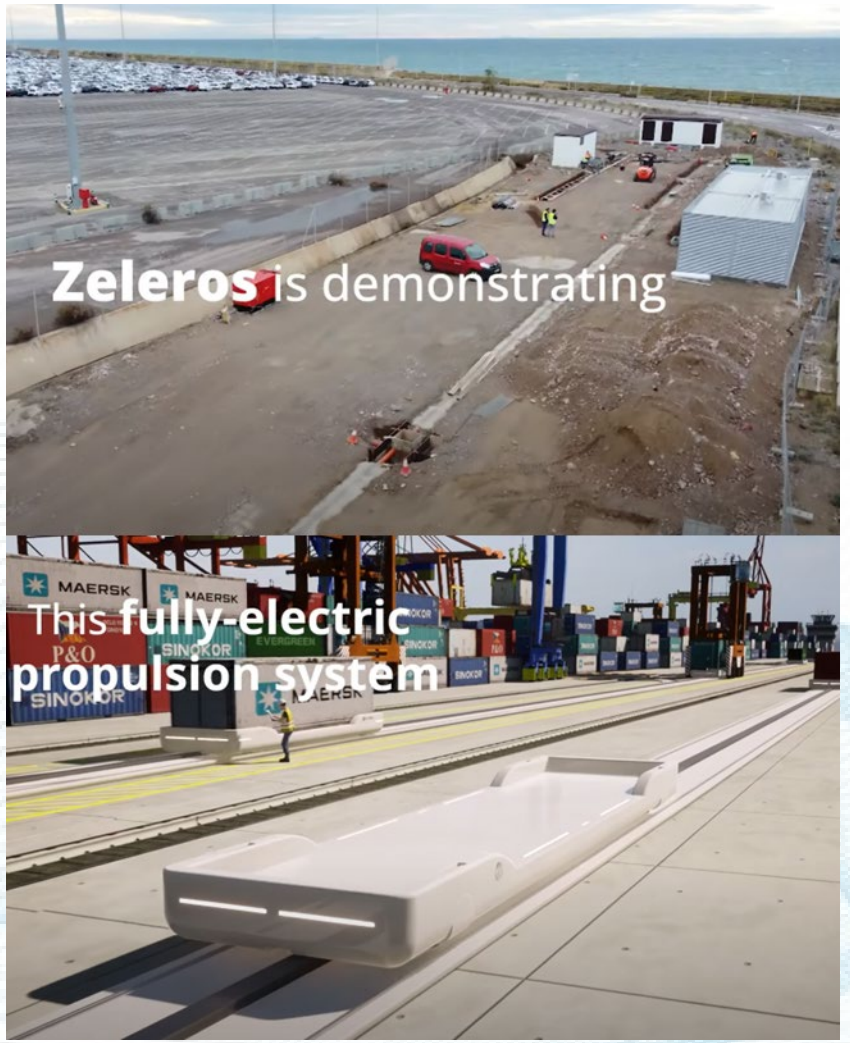
* €1.2bn EU Research & Innovation program

ZELEROS

- Deployment capabalities linear motor systems
- Adaptation of Maglev propulsion to move heavy weights at lower speeds (no tube)
  - Decongest
  - Zero direct emissions & low noise
  - Autonomous – 24/7
  - Improve OPEX



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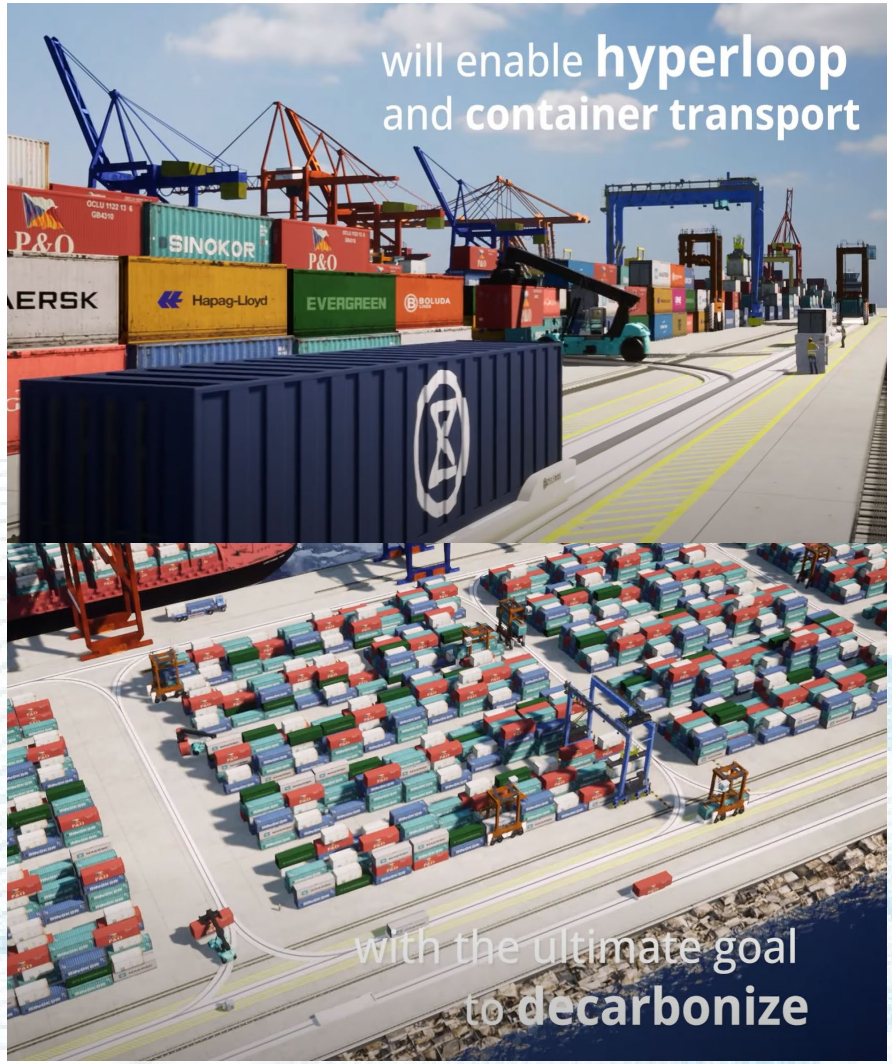
ZELEROS

- Test track Sagunto (Port of Valencia): platform ready
- Fine-tuning
- Testing 2nd half 2023



ZELEROS

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TRANSPOD

- Possibly propulsion system applied to port, airport or industrial environments

- High safety requirements:
  - Smart sensors possible to detect micro-faults in any hardware with big potential for predictive maintenance at ports, airports, terminals … impact on OPEX (immediate) & CAPEX

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9th International
Physical Internet Conference

June 13-15, 2023
Athens, Greece

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