NEVOMO

Into the future

MagRail overview

November 2023

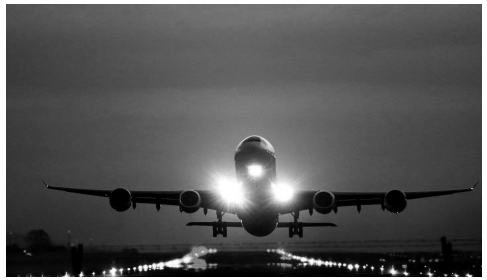
World of mobility is at a turning point

Railways are the hope – but hope needs to be enabled by radical innovations

Mobility challenges

Huge congestions in all modes

Tremendous greenhouse gases emissions



Poor customer experience

Changing travel behavior after COVID

The hope is in rail:

sustainable, comfortable, mass transport...

but rail has to be enabled by innovations.

Railway industry faces four major challenges

Issues with full digitalization of legacy infrastructure prohibit railways from meeting the growing demand

Issue	Capacity limit	Limited speed**	High cost & lengthy implementation	Increasing competition
	Internal			External
				
Impact	Inefficient legacy analog propulsion interface* resulting in long breaking distance	Inability to operate with reasonable OPEX at speeds above 350 kph	High CAPEX to add new capacity*** combined with overall high OPEX	Competitive inroads from road and air transport (getting greener and more autonomous)

European Green Deal 2030 target is at risk – railways are unable to adapt their networks to increase freight market share to 25% and double the number of transported passengers

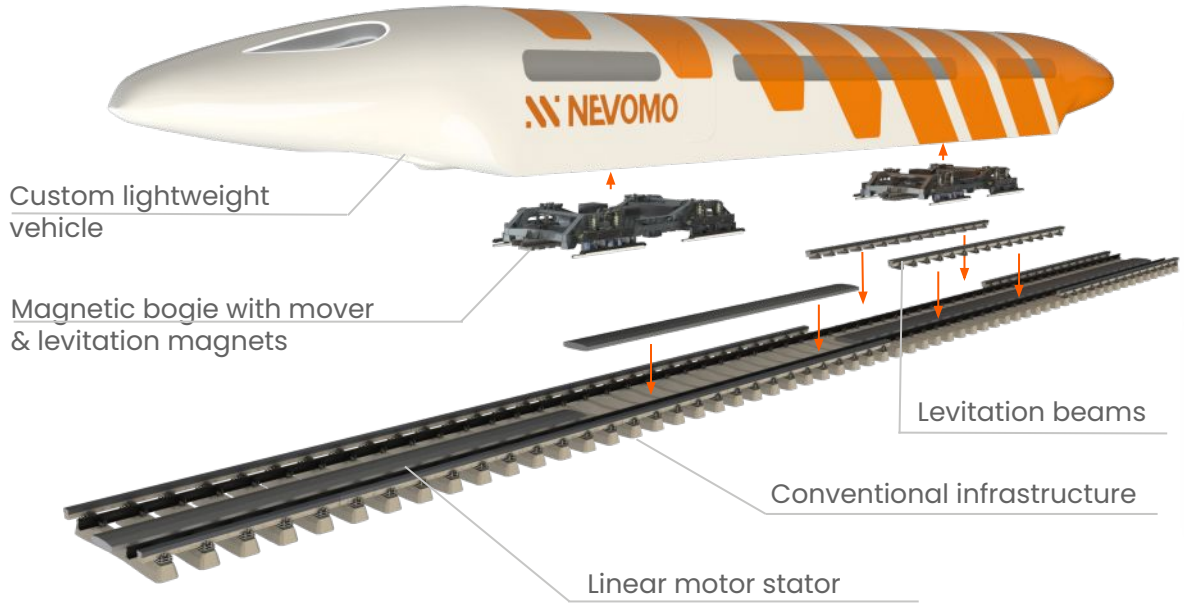
78m ton CO_2 reduction at risk

* steel-on-steel wheel-rail interface is inefficient for traction (acceleration & braking)
** not allowing railways to compete with aviation
*** due to high resources intensity & long planning and design

Nevomo's solutions

Introducing new fully-digital modes of propulsion and suspension as the interface between the vehicles and infrastructure

~~Capacity limit~~ **Increased capacity**	~~Tech complexity~~ **Tech simplicity**	~~High cost & long time~~ **Fast implementation, low TCO***	~~Increasing competition~~ **Regaining competitive edge**



Technological advantages

Effects on system functionality

Enhanced system performance

Greatly increased speed
Improved acceleration & braking

Full automation

Increased frequency and flexibility
New efficient operation modes

Direct frictionless propulsion

Slippery effects eliminated
Invulnerability to weather conditions

AI-based infrastructure diagnostics

Minimized risks of system failures
Reduced cost of maintenance

EUROPEAN GREEN DEAL

78m ton CO2 reduction **achievable** – EU level

500m ton+ CO2 reduction **achievable** – global level

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

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

Cargo: 120kph | 75mph

Passenger: 330kph | 205mph

Analog & hard to fully digitalize

MagRail Booster

120kph | 75mph

330kph | 205mph***

MagRail

160kph | 100mph

550kph | 340mph

Linear motor

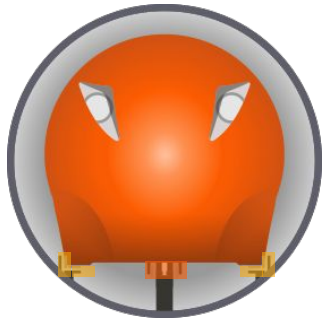
Magnetic levitation

New digital components quickly implementable to upgrade legacy tracks

compatible**

with:

Hyperloop



600kph | 375mph

1200kph | 745mph

Vacuum rail of the future

** interoperable

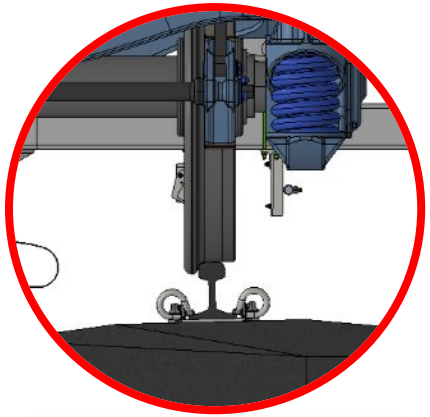
*** or even 360 kph | 225 mph, which is currently planned on the fastest High-Speed Rail lines in Europe

MagRail Booster & MagRail explained

Introducing new, fully-digital & contactless mode of propulsion and frictionless suspension as the interface between vehicles and infrastructure

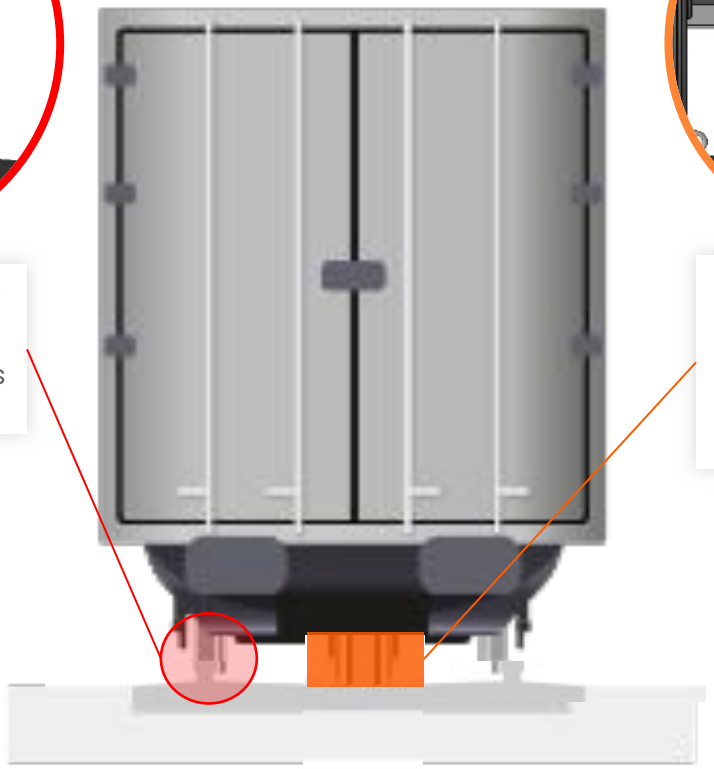
MagRail Booster*

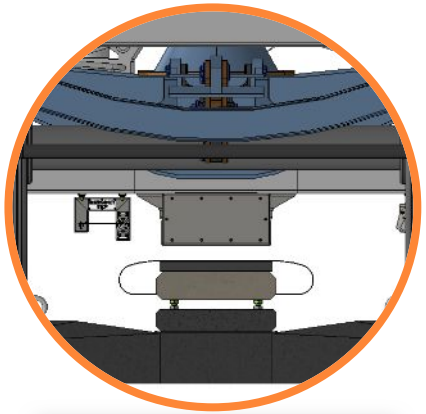
Vehicle retrofit
Infrastructure retrofit



Limited wheel use

For rolling & guidance only, no traction forces transmitted



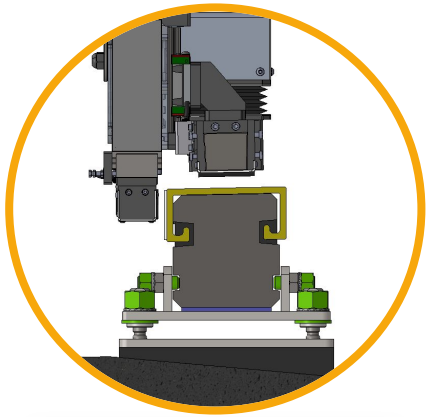


Direct contactless linear motor propulsion

Slippery effects eliminated

MagRail

New vehicle
Infrastructure retrofit



Frictionless suspension – magnetic levitation

Overcoming speed limits at attractive OPEX, incl. maintenance costs

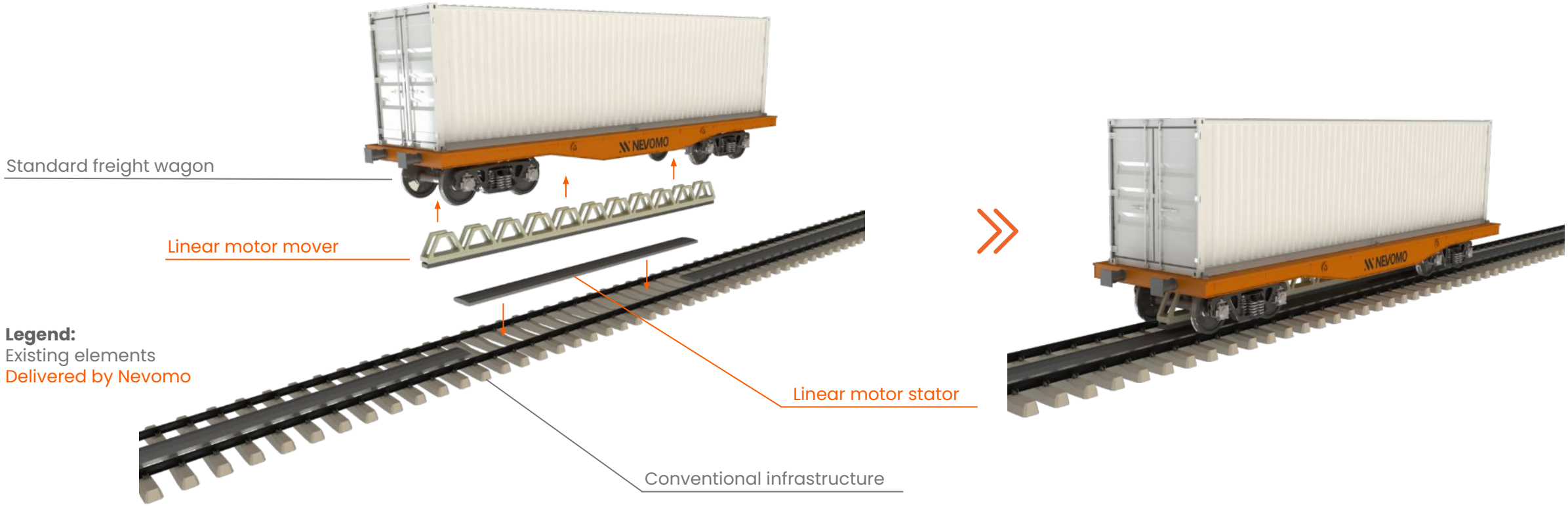
Limited wheel use

For low-speed rolling only

* under evaluation a simplified version of Booster called Slider - not requiring permanent retrofit of existing vehicles

Cargo MagRail Booster

An immediate improvement of efficiency & elimination of bottlenecks by digital and precise acceleration & braking – no locomotives needed anymore



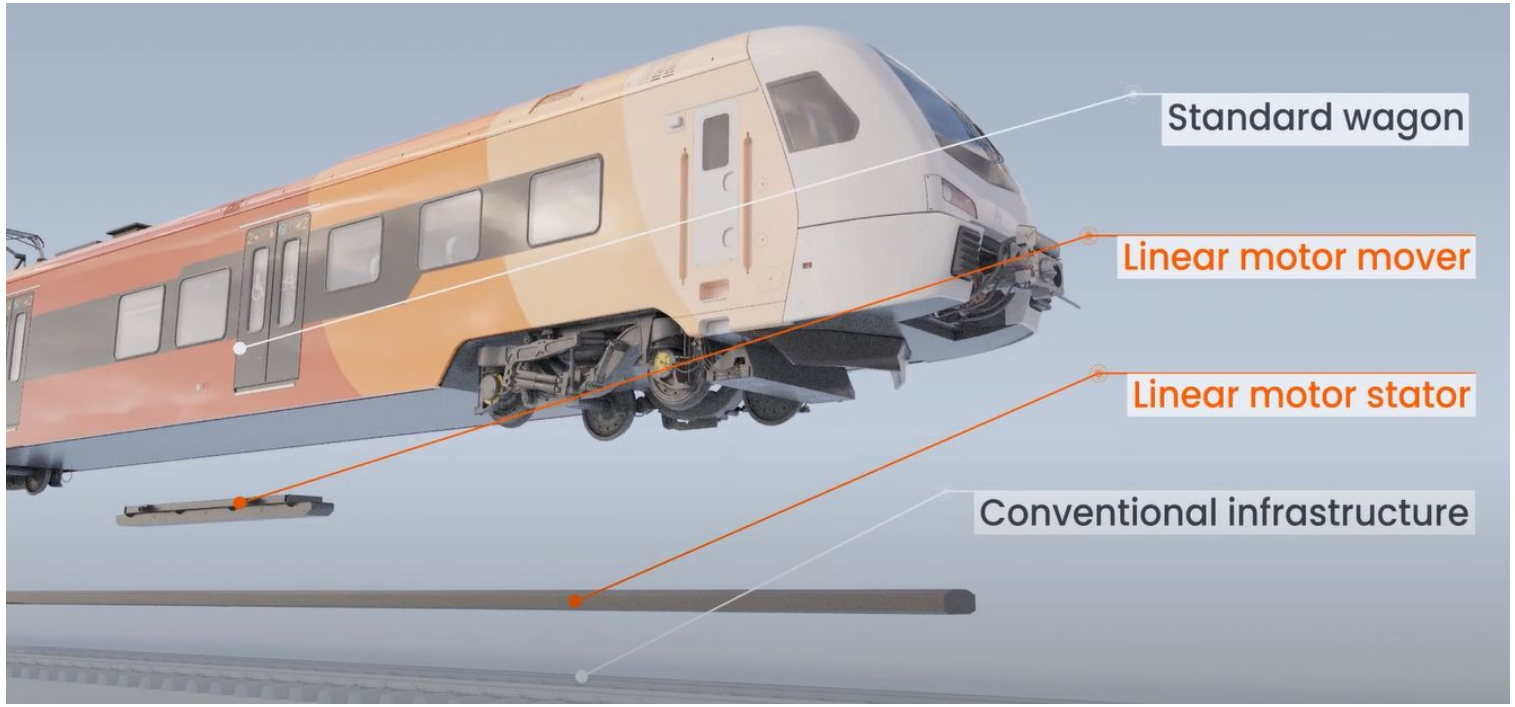
1 Quick **retrofit of existing cars** with **linear motor propulsion**

2 **Enhancement of capabilities** of rail: higher loads, better train dynamics, easy electrification

3 **Use cases**:
- more capacity & flexibility in terminals
- extra capacity on inclines
- electrification of tunnels & ports

Passenger MagRail Booster

An immediate improvement of efficiency by digital and precise acceleration & braking – retrofit of existing fleet for hybrid operations



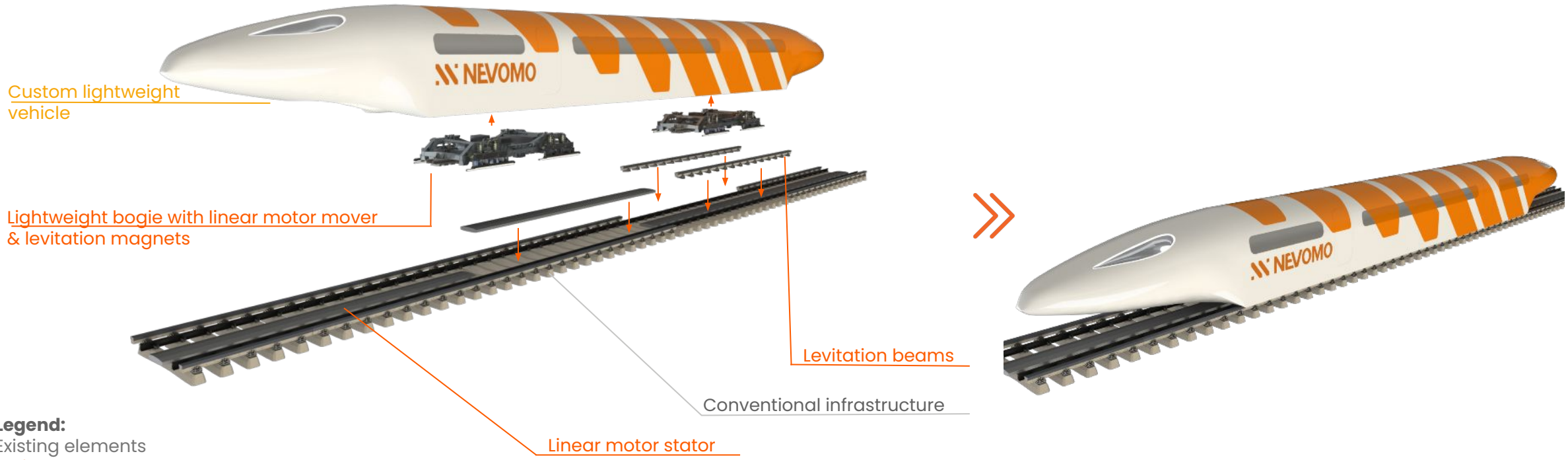
1 Quick **retrofit of existing cars** with **linear motor propulsion**

2 **Enhancement of capabilities** of rail: higher acceleration, precise stopping, easy electrification, hybrid operational mode (e.g. Diesel + MagRail Booster)

3 **Use cases**:
- more capacity & quality in congested urban commuter lines
- electrification of tunnels & lines without catenary

Passenger MagRail

HSR or MagLev speed & lower OPEX on existing infrastructure at a fraction of the cost of building new lines – solution for gaining passengers from air



Legend:
Existing elements
Delivered by Nevomo
Delivered by industrial partners

1 **Specialized MagRail pods***: lighter and dedicated to the MagRail system

2 **Enhancement of capabilities**: high frequency, flexible, automated pod system – enabling on-demand high-speed travel

3 **Use cases**:
- „on-demand", direct, fast intercity services due to smaller pods
- next generation of ultra-high-speed services

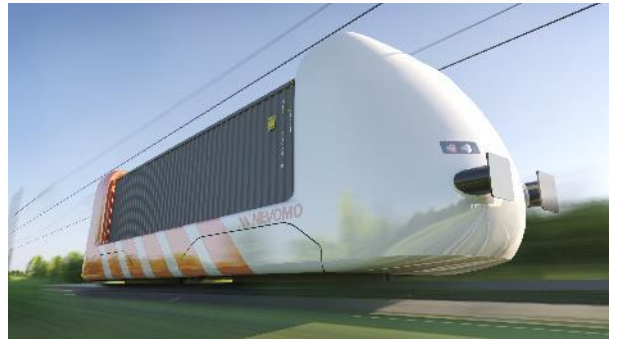
* MagRail pods are newly designed levitating vehicles

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

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

- High-Speed cargo transport (250 – 300 kph) could be floating withinethe existing HSR-traffic to allow for better capacity usage

Benefits:

Capacity ↑ Flexibility ↑ TCO* ↓

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

Nevomo's MagRail will enable railways by adding needed features

Solving railways' challenges with a portfolio of MagRail solutions

MagRail features:

Electrification

Capacity Booster

Flexibility

Velocity

Applications:

- Electrification of lines with issues in classic electrifications (e.g. tunnels)
- Usable for lightweight vehicles, e.g. for line reactivations

- Automated precise stopping at platforms
- Faster acceleration/ deceleration in stations for more capacity

- Dedicated pods operating with high frequency and high flexibility
- No full-trains needed – easy adaptation to demand fluctuations up to on-demand services

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

Benefits:

Capacity ↑ Flexibility ↑ TCO* ↓

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

Our technology is piloted on real infrastructure

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

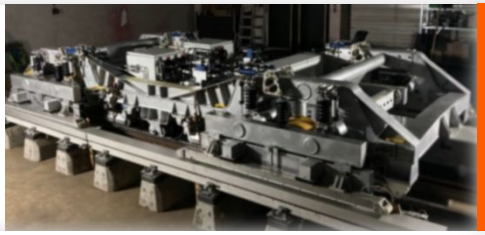
Cooperation with:

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

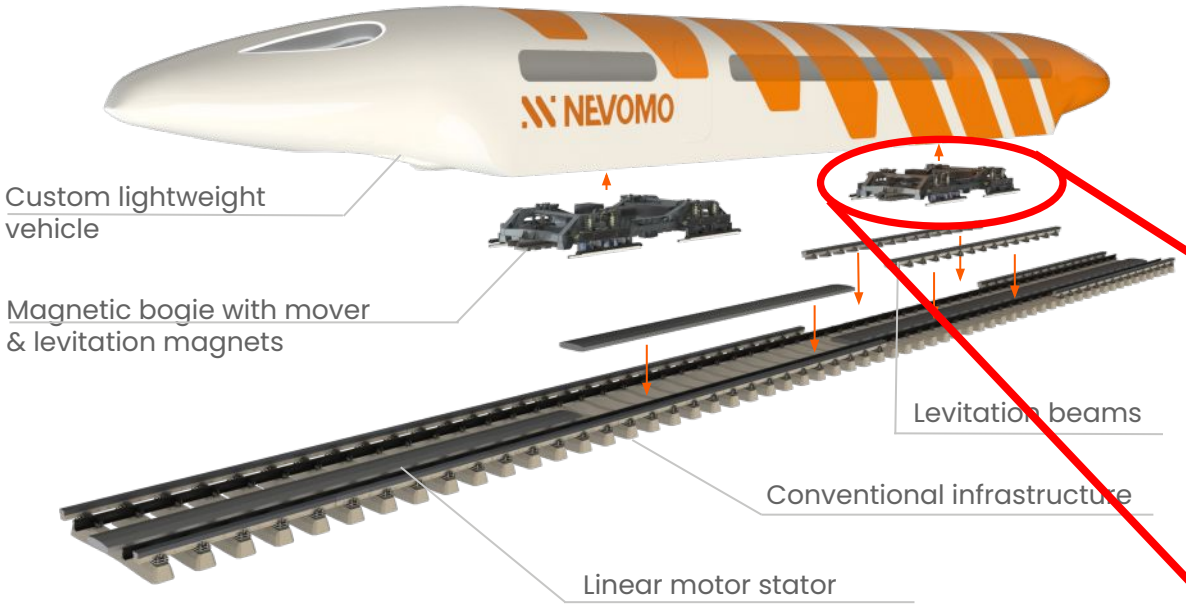
First demonstration
Q4/2019

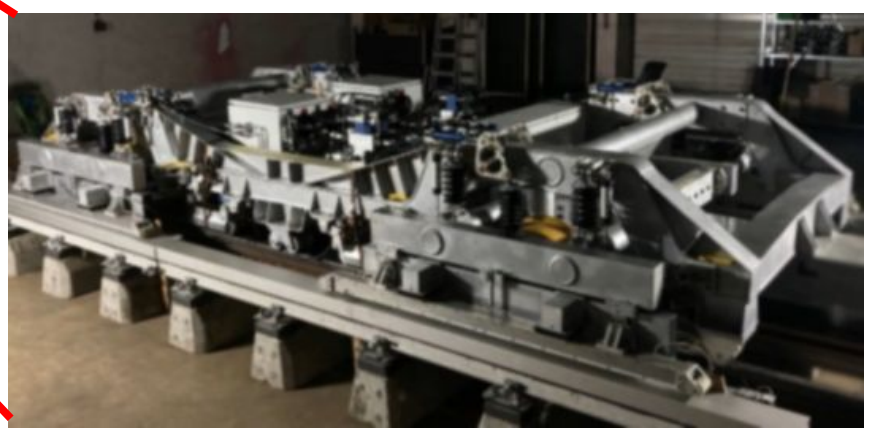
Medium-scale test track
Q1/2021

* €1.2bn EU Research & Innovation program

The mobility gamechanger is happening now

Tests of MagRail are already performed achieving first ever levitation on railway infrastructure





Successful levitation tests

Demonstrated test system is a baseline for industrializing the solutions used and acquiring homologation

TEST RESULTS:

- **Location:**
  Nowa Sarzyna, Poland
- **Technical parameters:**
  Test track length: **720 m**
  Top speed achieved: **130 kph**
  Levitation start speed: **70 kph**
  Levitation height: **20 mm**
  Testing acceleration 0 to 100 kph: **11 s** Max. acceleration 0 to 100 kph: **7 s**
- **Neo-4 vehicle:**
  Total length: **6 m**
  Mass: **2 t**

Boeing 737-800:
0 to 100 kph: 10.3-15.4 s
(depending on load, weather conditions, altitude etc.)

VW Golf VII, 110KM:
0 to 100 kph: 13.2 s

Mercedes AMG GT, 530KM:
0 to 100 kph: 3.8 s

MagRail technology for cargo-retrofitted wagons

Example of an equipped Container wagon from GATX – tests to be started in July

Mover on the wagon

MagRail Booster & MagRail tests were performed

What’s next?

Nevomo will continue to enable the railway system and achieve the MagRail stage around 2030

Booster industrialization (H1’24)

- Enhance the test-track to achieve complete system functionality
- Achieve readiness for pilot implementations and start of homologation

Commercial launch of Booster

- Pilots to start 2024/25
- Show the working tech in commercial railway environment
- Adding additional capabilities over time until full MagRail stage

Homologation Center

- Bigger test facility for high-speed and durability tests
- More than 10km test-circuit to achieve speeds of 500 kph
- Homologation & certification to achieve full MagRail readiness by 2030

Become part of this (r)evolution!

Support in making the shift happen

- **BECOME** our **CLIENT** and be among the first to deploy MagRail
- **BECOME** our **PARTNER** and support us in making it happen
- **BECOME** our **INVESTOR** and participate in this new market opportunity
- **BECOME** our **SUPPORTER** and help with regulation, homologation & certification
- **PREPARE** the railway **FUNDING** for future deployments & include MagRail in TEN-T plans

CONTACT

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