



Vectron

The locomotive from Siemens for Europe
Convegno CIFI
Milano 20/5/2021

Unrestricted © Siemens Mobility 2021

[siemens.com/Vectron](https://www.siemens.com/Vectron)

SIEMENS

Vectron: Creating Corridors



Vectron platform
Full Service

Vectron – figures of a success story

1034 Vectron locomotives sold

More than **390.000.000**

Fleet kilometres on track



Authorised in
20
countries

54 customers



Vectron wins



Fuori Muro



CFI



DBCi



Locoitalia



SBB Cargo Int.



ÖBB



Hupac



Inrail



BLS Cargo



MRCE



ELL



Alpha trains

Orders for > 1000 locomotives from > 54 customers

Why Vectron – Future demands on European rail transportation

Changing
customer structure
→ **Smaller** order sizes

Increasing
customer demands for
more flexibility in terms
of setup and area of
operation

Changing
requirements due to
legislation and
standards

More stringent
requirements regarding
environmental
sustainability



Vectron principle – Genuine flexibility in different performance classes for highly diverse transport tasks

MS locomotive

High power
6.4 MW 200 km/h



AC locomotive

High power
6.4 MW 200 km/h



DC locomotive

Medium power
5.2 / 6 MW 160 km/h



Vectron – Market-oriented flexibility

Continuous production – Standards off-the-shelf



Vectron MS



Vectron AC



Vectron DC



Vectron Dual Mode



Vectron – Market-oriented flexibility

Shortest delivery dates by “manufacturing on stock”

- DB Schenker Rail Polska ordered 23 Vectron DC Locomotives for operation in Poland
- This was the largest order Siemens had received so far for its Vectron locomotive
- Shortest delivery dates by manufacturing on stock:
 - Signature of contract with DB Schenker Rail Polska: **End November 2012**
 - Delivery of first two locomotives already on **December 20, 2012**



Vectron – 7 advantages for your business

- ✓ Market-leading performance
- ✓ Highest availability
- ✓ Borderless mobility
- ✓ Safe investment
- ✓ Long-term cost effectiveness
- ✓ Environmentally compatible sustainability
- ✓ Reliable partnership



Vectron – Market-leading performance – Vectron DC Italy (E191) base locomotive at a glance

Technical data E191

Wheel arrangement	Bo'Bo'
Track gauge	1,435 mm
Dimensions (l x w x h)	18,980 x 3,012 x 4,248 mm
Weight acc. to EN 15528:2015	80 t (also incl. DPM)
Axle load acc. to EN 15528:2015	20 t (also incl. DPM)
Wheel diameter (new/worn)	1,250 mm/1,160 mm
Voltage system	3 kV DC (incl. 1.5 kV DC Ventimiglia area)
Train power supply	3 kV DC
Max. power at the wheel rim	5,200 kW/6,000 kW (option)
Starting tractive effort	320 kN
Max. electr. braking effort	240 kN
Max. speed	160 km/h



Unique network accessibility

- 1.5 kV DC Ventimiglia area
- C3 without restriction
- & D lines with axle load >20 t

Highest flexibility for all transport tasks

- Prepared for 6,000 kW power upgrade
- Prepared for DPM (“last mile”) upgrade
- Prepared for passenger operation (v >160 km/h)

Future proof

- Prepared for ETCS implementation

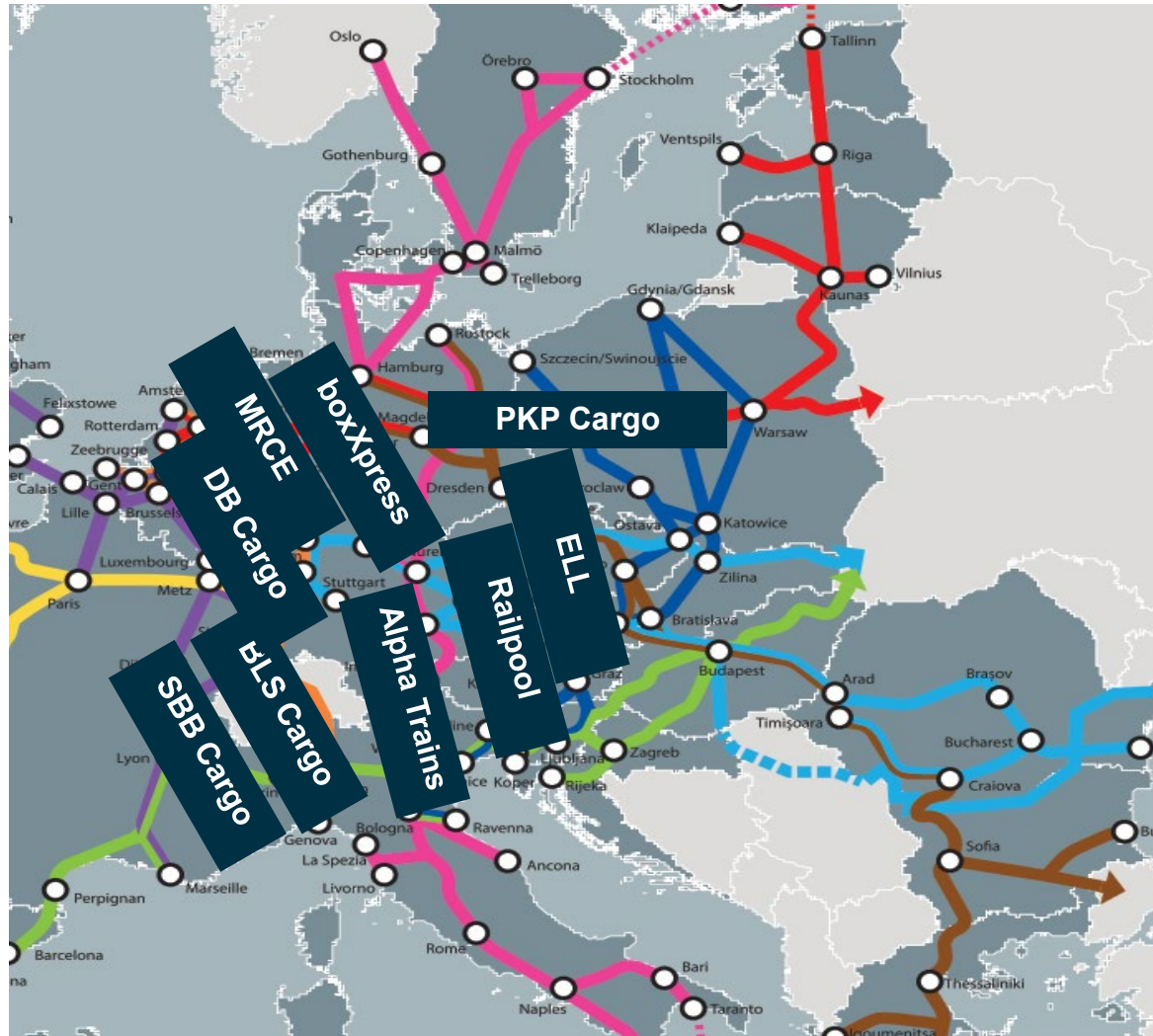
Vectron – References – Vectron MS for Inrail, Italy

Vectron MS

Wheelset arrangement	Bo'Bo'
Voltage systems (kV/Hz)	AC 15/16.7 AC 25/50 DC 3
Power (kW)	Max. 6,400
Starting tractive effort (kN)	300
Maximum speed (km/h)	160
Overall weight (t)	90
Track gauge (mm)	1,435
Numbers built	1
Construction year	2018



Vectron - Locomotives on European corridors



Main Siemens customers using European corridors



Vectron on High Speed lines in Germany

Vectron – Market-leading performance – Universal use possible also for passenger services

Power range 6.0 to 6.4 MW

- **160 km/h as standard** for freight and passenger locomotives
- **200 km/h with the same bogie**

Power range 5.2 MW

160 km/h as standard for freight operations

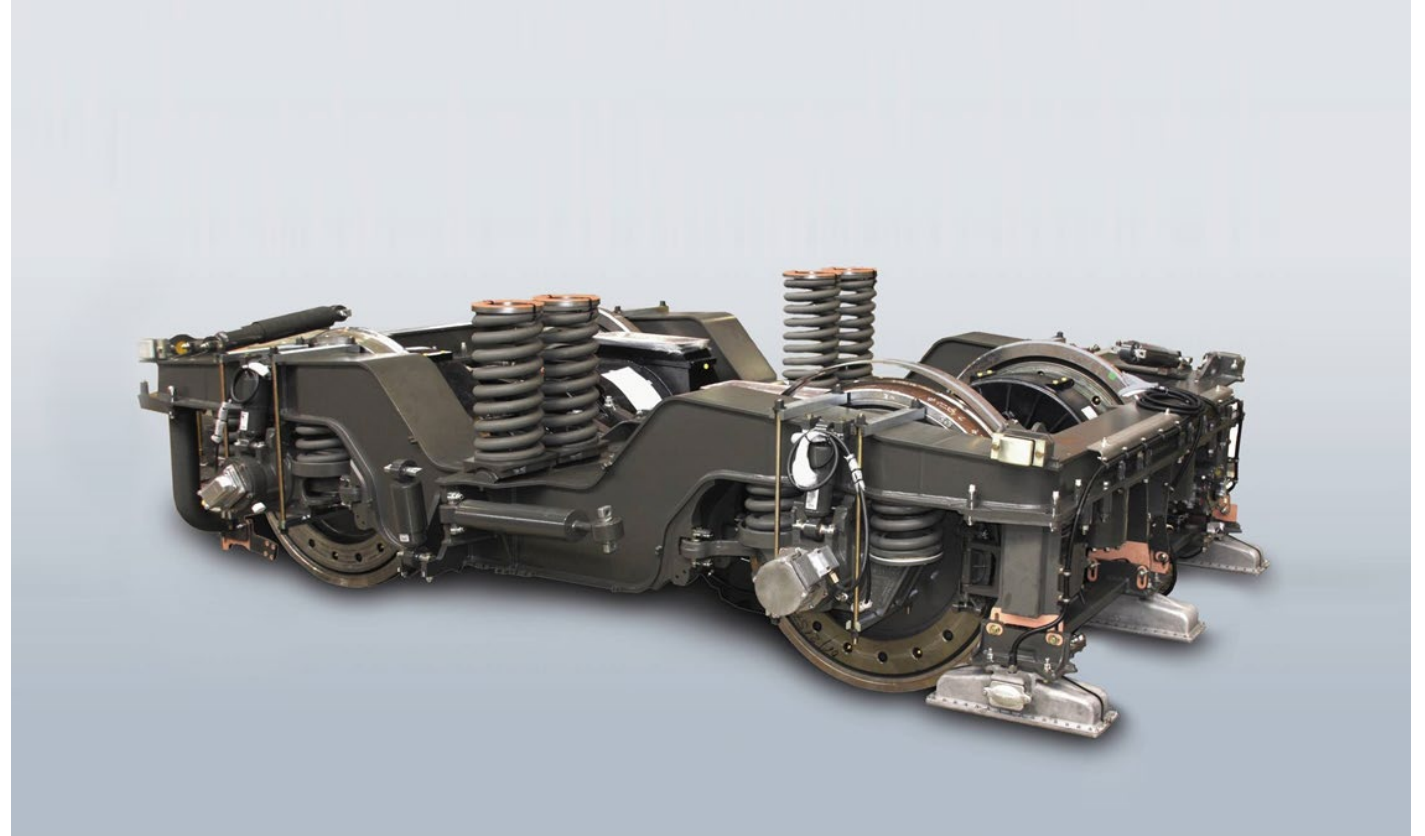
- **Sufficient performance reserves**
operation in critical slots possible
- **Improved efficiency**
operation not in the limit range
- **Easy upgrading for high speed rail**
service possible



Vectron – Safe investment – Only one bogie for freight and passenger services

Maximum speed = 160/200 km/h
for rail freight and intercity services

- Pinion hollow shaft traction
- Wheel disc brake



Well-equipped for new business opportunities – high residual value for financing

Vectron – Highest availability – Overview of measures

Preventive maintenance

Scheduled downtime



- **Inspection intervals**
30,000 km
- **Railcover: Partner workshops**
Shorter transfer times
- **Maintenance-friendly design**
All consumables can be filled externally
- **Railcover** central parts warehouse

Corrective maintenance

Unscheduled downtime



- **Reliability of components**
 - Absorbed glass mat battery
 - Fewer IGBTs
 - Life-time greased blower motor bearings
- **Repair-friendly design**
 - Removable bolted-on front end
 - Lightweight, small phase modules
 - Separate removal of traction motor/drive
- **Redundancy**
 - 75% redundancy in the drive (option)¹
- **Railcover – Helpdesk**
- **Railcover – Mobile technician**
- **Railcover – Partner workshop**
- **Railcover – Central spare parts stock**
- **Susceptibility of components to damage due to external influences**
Roof and underfloor components
> interior



Boost availability = Reduce downtimes

Vectron – Highest availability – Maximization of locomotive service time

Inspection N	25,000 km	↑	30,000 km
Inspection F1	100,000 km	↑	150,000 km
Inspection F2	200,000 km	↑	300,000 km
Inspection F3	400,000 km	↑	600,000 km
Overhaul R1	1,000,000 km	↑	1,200,000 km
Overhaul R2	2,000,000 km	↑	2,400,000 km

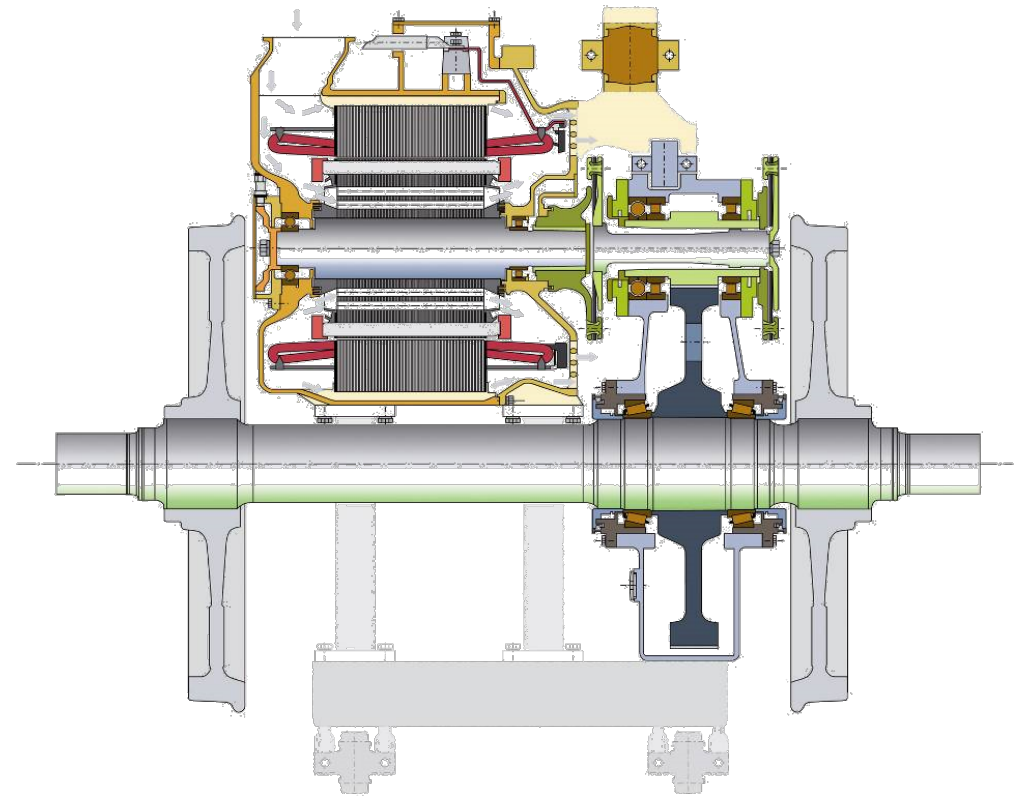
Saving of 40 – 50 depot transfers¹ for preventive maintenance over 30 years

¹ Distance covered 200,000 km or 250,000 per year

Vectron – Highest availability – Preventive/corrective – Maintenance-friendly design

Traction motor and drive system
can be removed separately

Traction motor and drive system linked
by bolted steel multiple-disk clutch



Easy and fast removability of components

Vectron – Borderless mobility – Mixed multiple unit operation to boost flexibility

Multiple unit operation capability
with all other series (Siemens + others)

Same type (Vectron – Vectron)

Vectron – other locomotives made by Siemens

Vectron – locomotives made by others

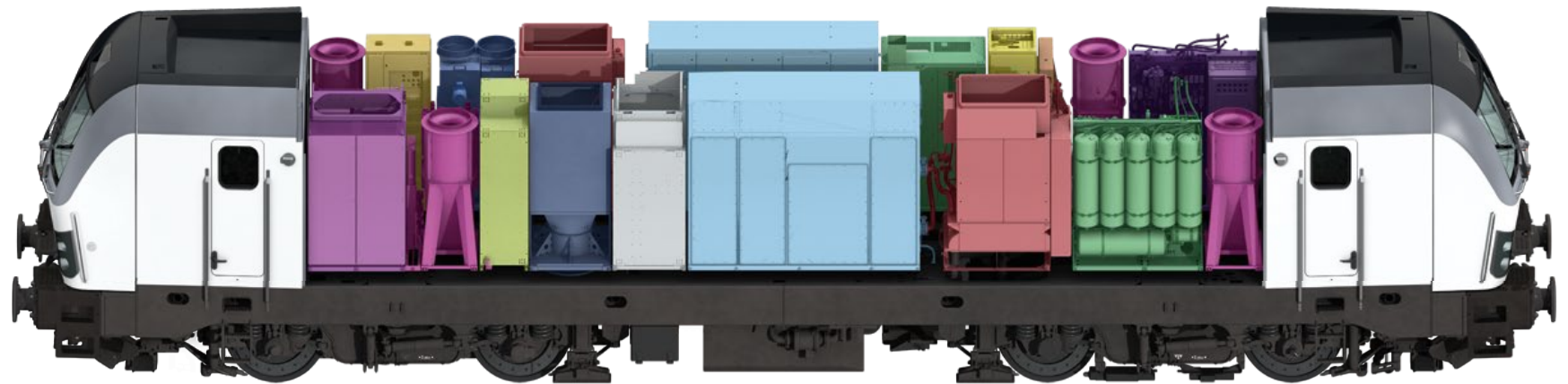
- Europe-wide flexibility thanks to unique multiple unit capability
- For example, Vectron can be used on the Brenner Pass route with all essential Austrian Federal Railways (ÖBB) vehicles

















Vectron – Safe investment – Genuine modularity in all performance classes

Machine room layout

Vectron MS
high power

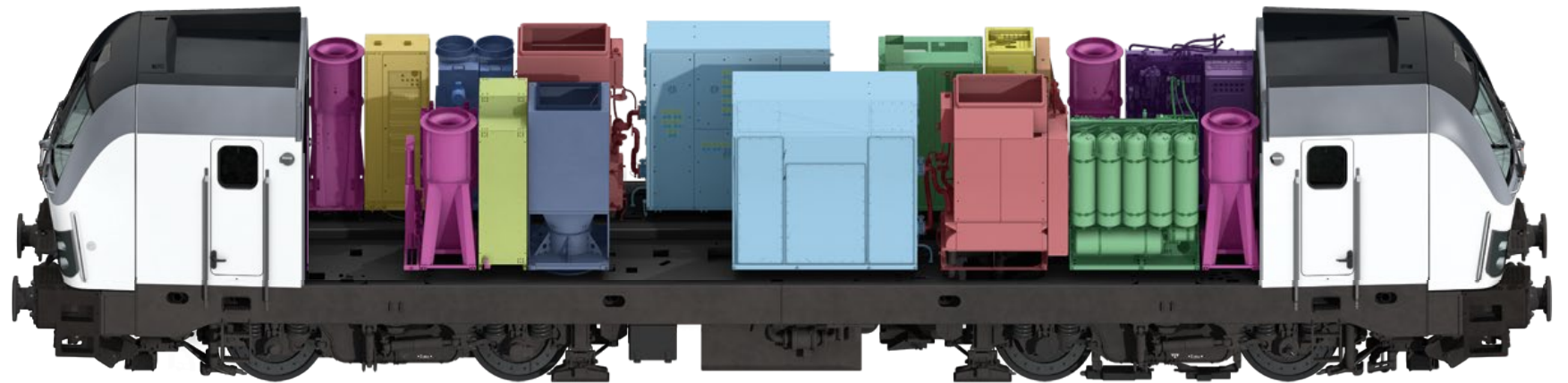


- | | | |
|--|---|---|
|  Fire extinguishing system |  Compressed air equipment rack |  Train protection cabinet 1/2 |
|  Traction converter |  Brake rack |  Train protection cabinet 3 |
|  Oil and water cooler |  Dynamic brake resistor | |
|  High-voltage DC equip. cabinet |  Low-voltage equipment cabinet | |
|  Traction motor blower |  Auxiliary equipment rack | |
|  Auxiliary transformer rack |  High-voltage AC equipment cabinet | |

Vectron – Safe investment – Genuine modularity in all performance classes

Machine room layout

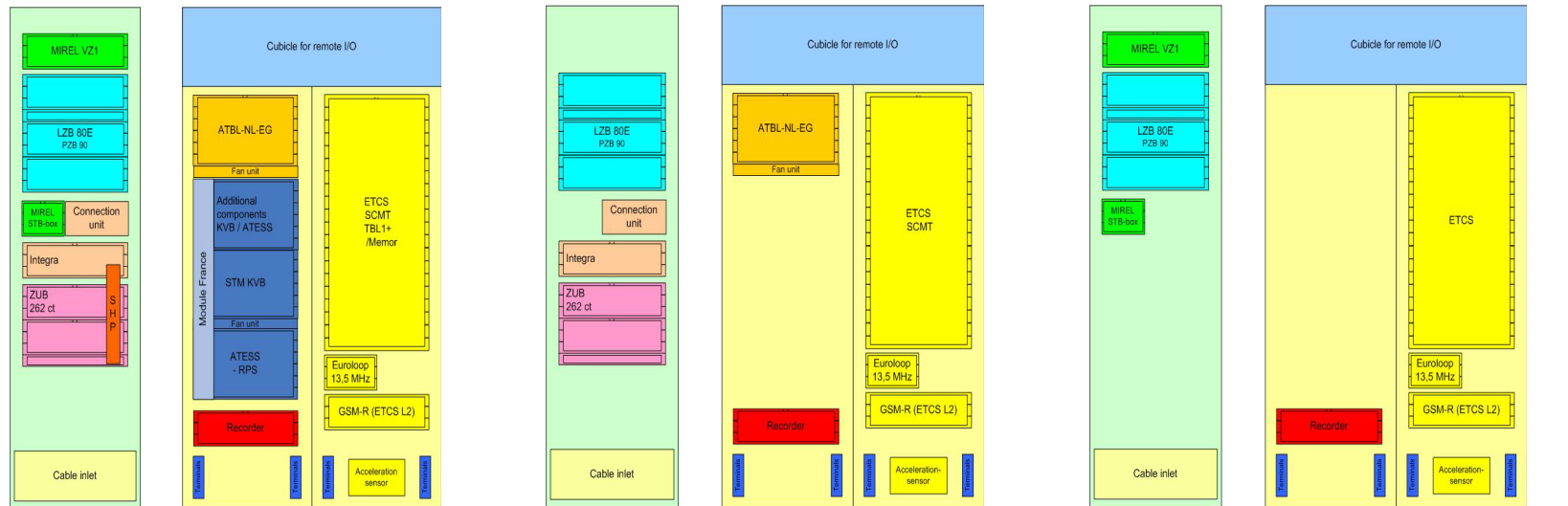
Vectron DC
medium power



- Fire extinguishing system
- Traction converter
- Oil and water cooler
- High-voltage DC equip. cabinet
- Traction motor blower
- Auxiliary transformer rack
- Compressed air equipment rack
- Brake rack
- Dynamic brake resistor
- Low-voltage equipment cabinet
- Auxiliary equipment rack
- Train protection cabinet 3

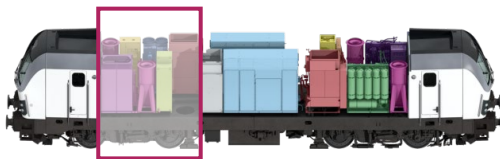
Vectron – Safe investment – Genuine flexibility for Europe-wide travel

Fixed slots for each train protection system in Central Europe



D – A – CH – I – NL

D – A – H – RO – BG – SK – CZ



Genuine flexibility in the long-term and increased locomotive residual value

Vectron – Safe investment – Retrofit, upgrade, convert

Vectron

One name –
one concept

You ordered **Vectron**, but forgot something

No problem → **Retrofit**

You ordered **Vectron**, but requirements have increased

No problem → **Upgrade**

You ordered **Vectron**, but the duty has changed

No problem → **Convert**



Future proof – That means a low starting price won't spoil your future prospects

Vectron – Safe investment – Retrofitting – Ready-made extensions

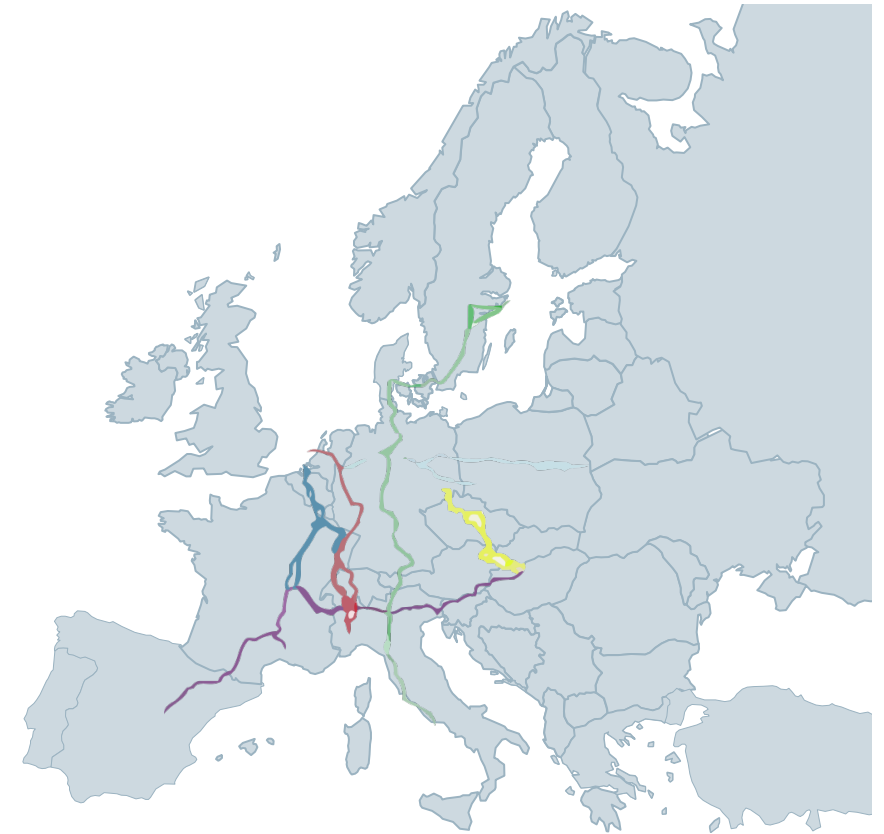
There's more to the Vectron – even for later use

ETCS → Only when it has to travel on ETCS routes

200 km/h → Only when it has to run at high speed

Active yaw damper → Only if tight curves have to be negotiated frequently

... → ...



Security for the future – Enter at a low price and make further investments only when necessary

New certificate: first authorization according to the IV Railway Package

SIEMENS

Vectron News

Customer information | Siemens Mobility | Locomotives | May 14, 2021

www.mobility.siemens.com > > vectron

New EC Certificate for Vectron issued

In April 2021, a new EC Certificate (EC Type Examination Certificate) has been issued for the Vectron locomotives. The document certifies the conformity of newly built locomotives with the currently valid version of the Technical Specifications for Interoperability (TSI) of Rolling Stock:

- TSI 'rolling stock – locomotives and passenger rolling stock' subsystem of the rail system in the European Union (TSI LOC&PAS 1302/2014 incl. Amendments 2016/919, 2018/868, 2019/776, and 2020/387)
- TSI 'rolling stock – noise' of the rail system in the European Union (TSI NOI 1304/2014 incl. Amendment 2019/774)
- TSI 'safety in railway tunnels' of the railway system of the European Union (TSI SRT 1303/2014 incl. Amendment 2019/776)
- TSI accessibility of the Union's rail system for persons with disabilities and persons with reduced mobility (TSI PRM 1300/2014 incl. Amendment 2019/772).



Vectron Status

The Vectron has received the first authorizations according to the 4th Railway Package. The new EC Certificate will be an inherent part for the future homologations of the Vectron locomotives.

Contact:

Alessandro Lopalco

+39 335 202657

alessandro.lopalco@siemens.com

Vectron – Long-term cost effectiveness – Fewer costs thanks to higher load hauled

Savings example

Goods train in Germany; **Vectron** (1,800 t train) vs. other electric loco (1,620 t train) = **+10%**



- 240,000 km covered
- Speed: 80 km/h
- Period considered: 30 years (without energy consideration)
- Calculation: With Vectron, fewer trips/slots/personnel/locos needed for the same transportation performance

Achieved saving

>4 million euros per locomotive
(without energy saving)

Route costs: 2.8 m Locomotive drivers: 0.5 m

Maintenance: 0.7 m Miscellaneous: ...

Thanks to higher loads hauled, the next locomotive is already financed

Vectron – Long-term cost effectiveness – Minimizing LCC – extremely low energy costs

Vectron energy saving potentials

- Up to 3% higher efficiency of the traction system
- Up to 20% energy saving thanks to energy consumption display for energy saving driving
- Up to 30% energy saving thanks to feedback of braking energy to the network, for auxiliaries and train power supply

Saving from 3 % efficiency

€ 514,000

Saving with 23 % feedback¹

Approx. € 3.9 m

Example: Goods train

Towing capacity:	1,800 t	Topography:	Up to 10 ‰ gradient
Average speed:	65 km/h	Energy costs over 30 years:	€ 17,141,000



Every kWh saved on the locomotive means a saving of up to 3 kWh in primary energy and a corresponding reduction in CO₂ emission²

Vectron – Long-term cost effectiveness – Minimizing LCC – Extremely low energy costs

Increased electric braking effort 240 kN

Electric braking effort usual in Europe: 150 kN

In various countries, up to 240 kN permitted

- Use of the pneumatic brake can be dispensed with on steep downgrades (e.g. in the Alps)
- Less wear on brake pads and brake discs of the locomotive
- Additionally gained braking energy can be fed back into the network



Energy and cost saving by additional feedback
Reduced noise and dust

Vectron – Environmentally compatible sustainability

Environmentally compatible manufacture

- Energy saving production facilities
- Environmentally compatible materials (e.g. water-based paint systems)



Environmentally friendly operation

- Use of environmentally compatible fuels, consumables and coolants
- Converters with environmentally friendly water cooling
- Biologically degradable ester as transformer coolant
- Wheel flange lubricator grease is biodegradable
- Residue-free fire extinguishing gas acc. to the Kyoto protocol



Noise emission

- Less than limits of TSI Noise
- Low-noise braking to standstill with disk brakes



Vectron – Environmentally compatible sustainability – A theme under the attention of the market

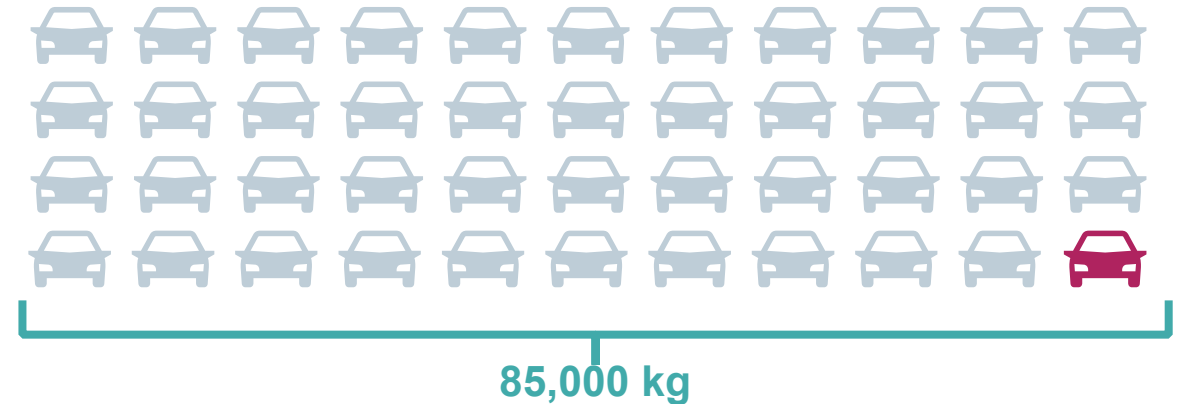
Sustainability ...

... in the manufacturing phase

- Production Process
- Materials (e.g. paintings)

... and in the use of the locomotive

- Consumables and cooling liquids
- Converter: Cooling liquids
- Transformer: Biodegradable liquid ester
- Flange lubrication: Biodegradable oil
- Anti-Fire system: Extinguish gas
- Noise: RST TSI limits



■ Residual material

Recoverability quota of 98% (Recycling 94%, thermal 4%)

Vectron – Reliable partnership – Siemens – Your strong partner

- For >130 years, **technology and innovation leader** in electrical engineering and mobility
- All important **core competencies** for locomotives and service in-house
- Best Siemens-wide solutions used for our customers
- **Siemens One: Innovative force of Siemens¹**
 - € 4.6 bn R&D investments
 - 40,800 employees in R&D worldwide
 - 42,900 active patents

¹ Figures of FY2020

Unrestricted © Siemens Mobility 2021

Page 30

May 2021



Vectron – Creating Corridors

- **Market-leading performance** – A real workhorse: Vectron can take on any traction task thanks to its superior power and high tractive effort
- **Highest availability** – Vectron is resilient: With 75% redundancy, inspection intervals every 30,000 km and Railcover service concept, it ensures reliable operation
- **Borderless mobility** – Eager for cross-border contacts: As a pan-European team player, Vectron can easily be coupled with other rail vehicles and equipped with nearly all European train control systems
- **Safe investment**– Ready for any eventuality: Quick conversion to meet changing operating requirements in Europe is no problem for Vectron – thanks to its modular design and standard bogie concept both for rail freight and for passenger service
- **Long-term cost effectiveness** – Well worth the money: Vectron gives railway operators greater competitive strength and exceptionally high stability of value
- **Environmentally compatible sustainability** – A balanced energy diet: Vectron’s high efficiency and energy recovery capability ensure sustainable reductions in energy consumption and CO₂ emissions
- **Reliable partnership** – Good breeding: innovation leader Siemens is a long-term reliable partner since decades. More than 1,000 Vectron have been sold to more than 50 customers!





Vectron's extra mile

Vectron – Market-oriented flexibility – Diesel Power Module (DPM) – Capabilities

Increase utilizability of electric locomotives on non-electrified sections of track

- Secondary lines
- Feeder lines
- Non-electrified tracks in terminals

Secure maximum flexibility

- Freedom to operate in case of shunting (locomotive, personnel)
- Traction in case of loss of overhead power



Vectron – Market-oriented flexibility – Diesel Power Module (DPM)

- DPM can be integrated into Vectron
 - **AC**
 - **DC**
- Diesel engine power **180 kW**
- Meets emission standard Stage IIIb
- Usable fuel tank volume 350 liter
- Locomotive can be delivered with DPM
 - As an option package or
 - As a retrofit solution



Diesel Power Module without covers

Vectron – Market-oriented flexibility – Diesel Power Module (DPM) – Technical Data

Power of diesel engine acc. To EU97/IIIB: With integrated pre-heating and aftertreatment	180 kW
Available tractive power at wheel	Approx. 120 kW
Length of rack Mass of rack	Approx. 1.3 m Approx. 1.2 t
Fuel tank volume	Approx. 350 l

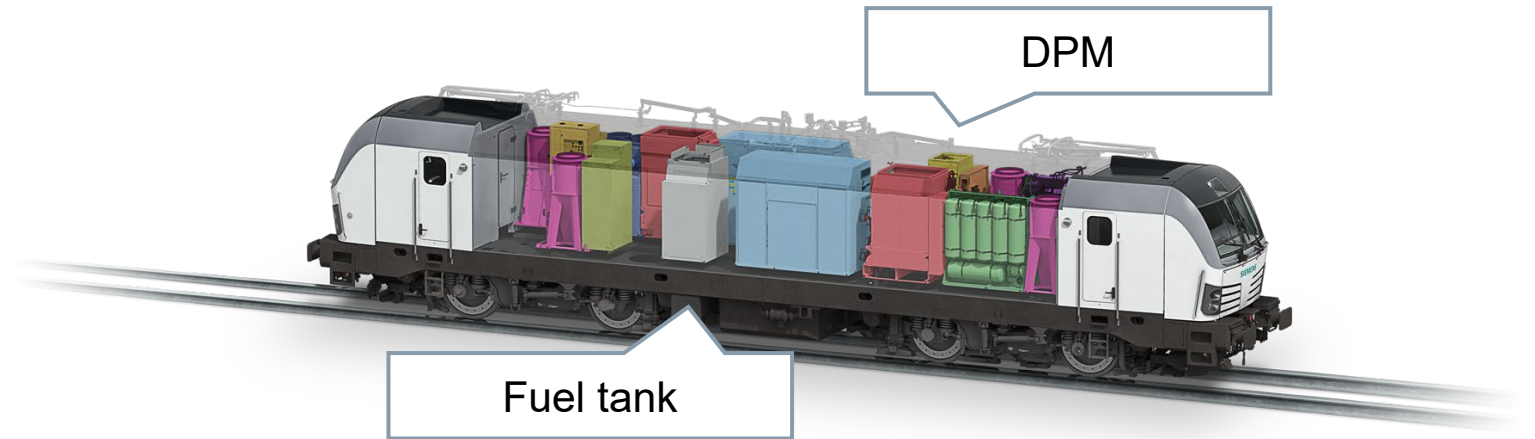
Fuel consumption		
Idle	No demand of power	Approx. 0.7 l/h
Full load	180 kW	Approx. 55 l/h
Partial load	150 kW	Approx. 44 l/h
Partial load	50 kW	Approx. 15 l/h

Operating range		
Single locomotive	60 km/h	Approx. 330 km
With 1,000 t train	Level track, 25 km/h	Approx. 136 km

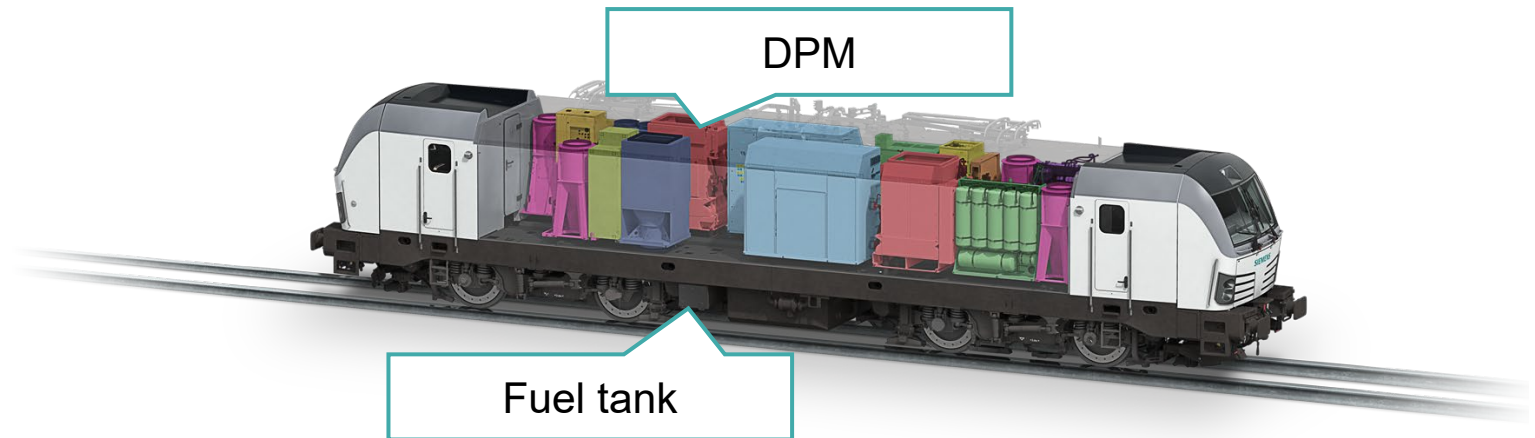


Vectron – Market-oriented flexibility – Diesel Power Module (DPM) – Installation position

Vectron AC

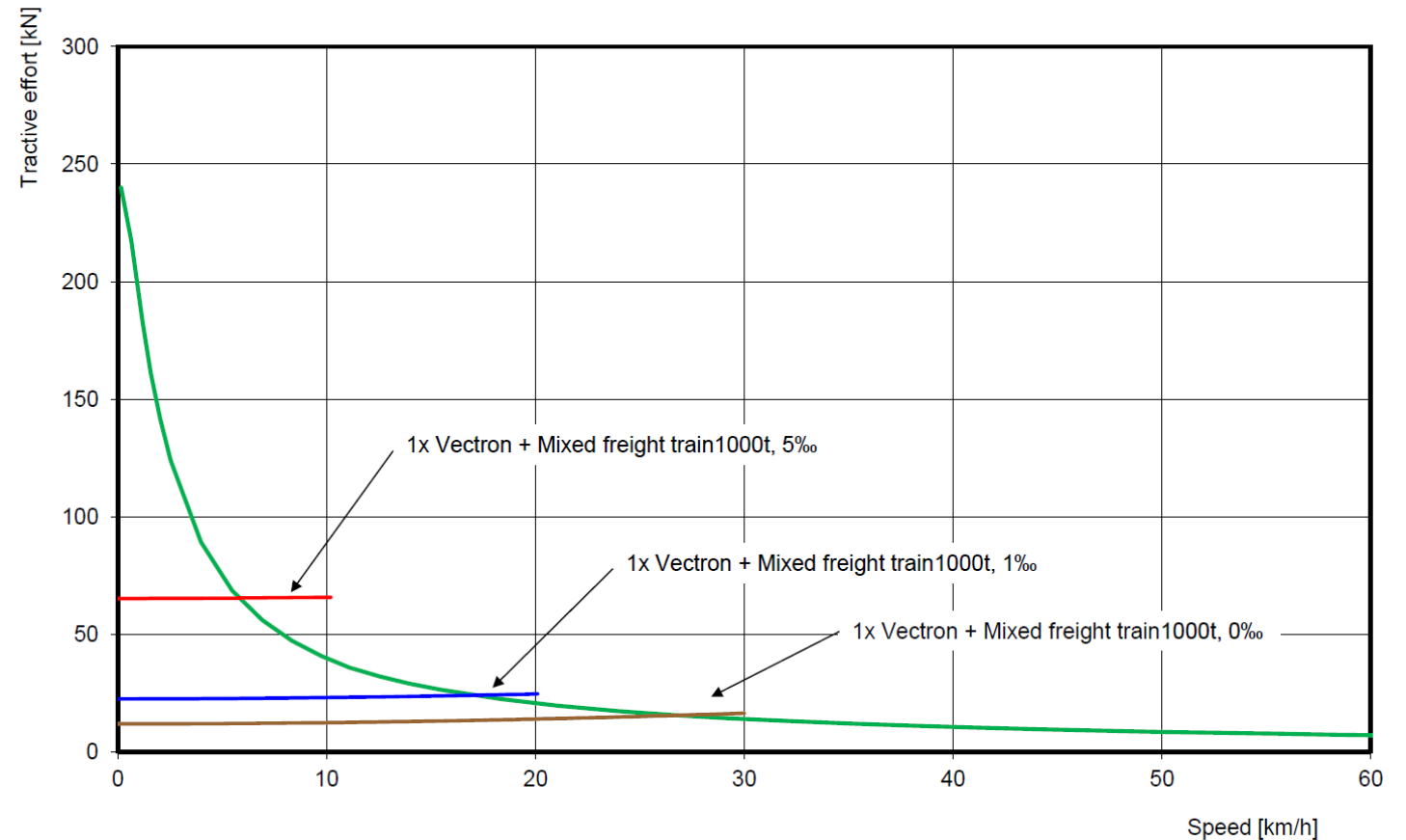


Vectron DC



Vectron – Market-oriented flexibility – Diesel Power Module (DPM) – Tractive effort curve

- **Train resistances**
have been verified by measurements
- **Power**
sufficient to move even heavy trains



A very good performance is achieved with minimum volume and weight

Diesel Power Modul (DPM) – References – 112 Locomotives with a total of 192 DPM



VR Finland: 80 Locos – 160 DPM



Railcare: 7 Locos – 7 DPM



Hector: Rail 18 Locos – 18 DPM



Gysev: 2 Locos – 2 DPM



Inrail: 1 Locos – 1 DPM



Locoitalia: 4 Locos – 4 DPM

Mobility Services

SIMOS® Portfolio – our offerings for you

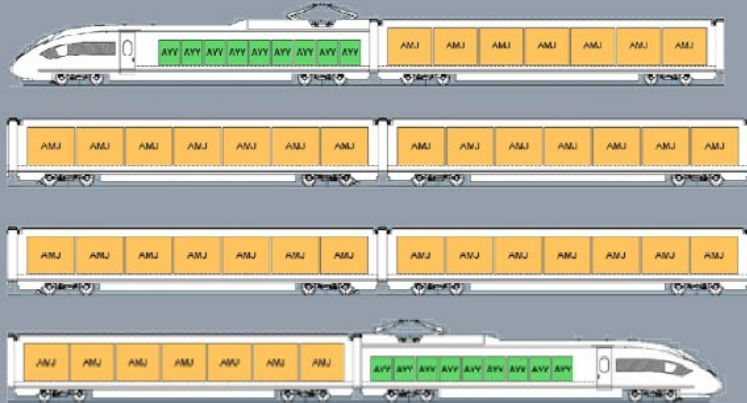


SIMOS® Service Portfolio

Railcover® Service Contracts

*TSSA: Technical Support and Spares Supply Agreement

Velaro Cargo



Maximum speed:	up to 350 km/h
Power supply:	AC 25 kV and 15kV DC 3 kV and 1,5 kV
Length:	200 m
Pay load:	144 t
Capacity:	App. 180 m ² for container or pallets up to 3m height

A high performing freight transport solution was derived from the Velaro for passenger transport. High capacity concerning payload and space are the characteristics of the Velaro CARGO.



Euro CAREX Project

Thank you for your attention



Alessandro Lopalco

Head of ST&BD and Sales RS

Cell. 335 202657

alessandro.Lopalco@siemens.com

siemens.com