FP6-FutuRe
Cost effective regional lines

Europe's Rail

# Regional Rail Rolling Stock

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# Background

Regional railway lines are vital for connecting rural areas and supporting the wider rail network.

Many such lines have been abandoned in recent decades due to high costs.

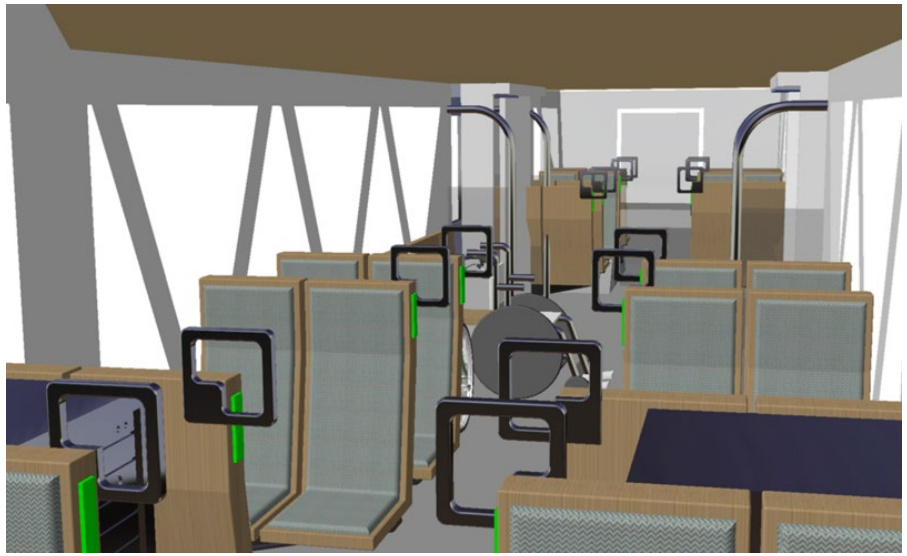


The German railbus (*Uerdinger Schienenbus*) of the 1950s became a huge success and earned the nickname **"Retter der Nebenbahnen"** ("Saviour of the Branch Lines").
What is needed to create a **Schienenbus 2.0**?

From a material science perspective, we could build trains just as simple today, but regulations don't allow it because they prioritize interoperability and safety over cost efficiency, needed especially on low-density lines.

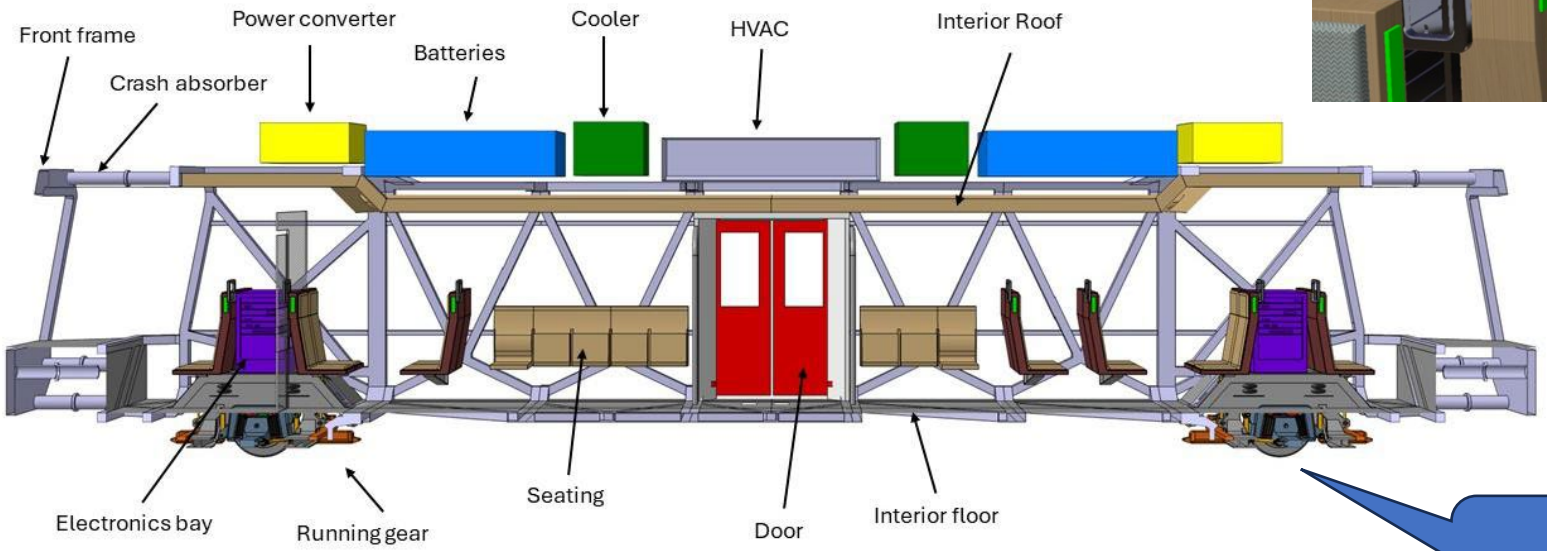
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# Schienenbus 2.0



Lightweight carbody

Battery propulsion




16 m version

Lightweight running gear

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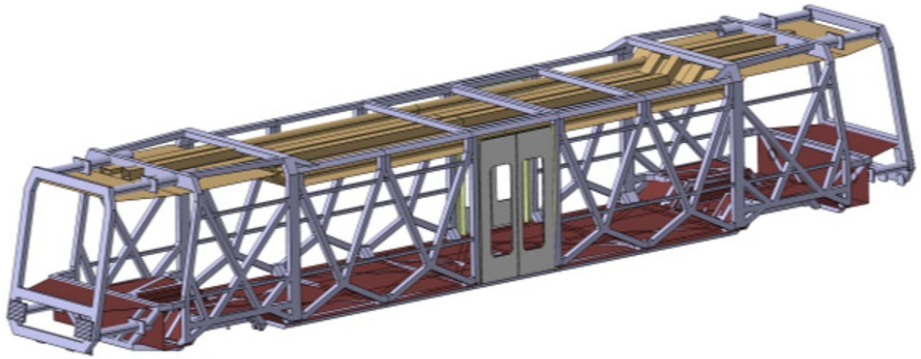
# Lightweight carbody

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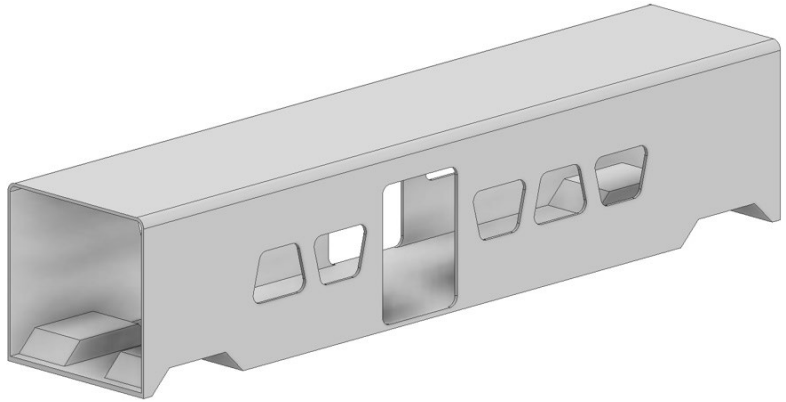
Developing a rail vehicle with low energy use, low cost, and high sustainability requires balancing competing requirements.

The FutuRe project evaluates two carbody concepts in parallel

A topology-optimized welded steel frame, aiming to minimize manufacturing cost while retaining good lightweight performance.

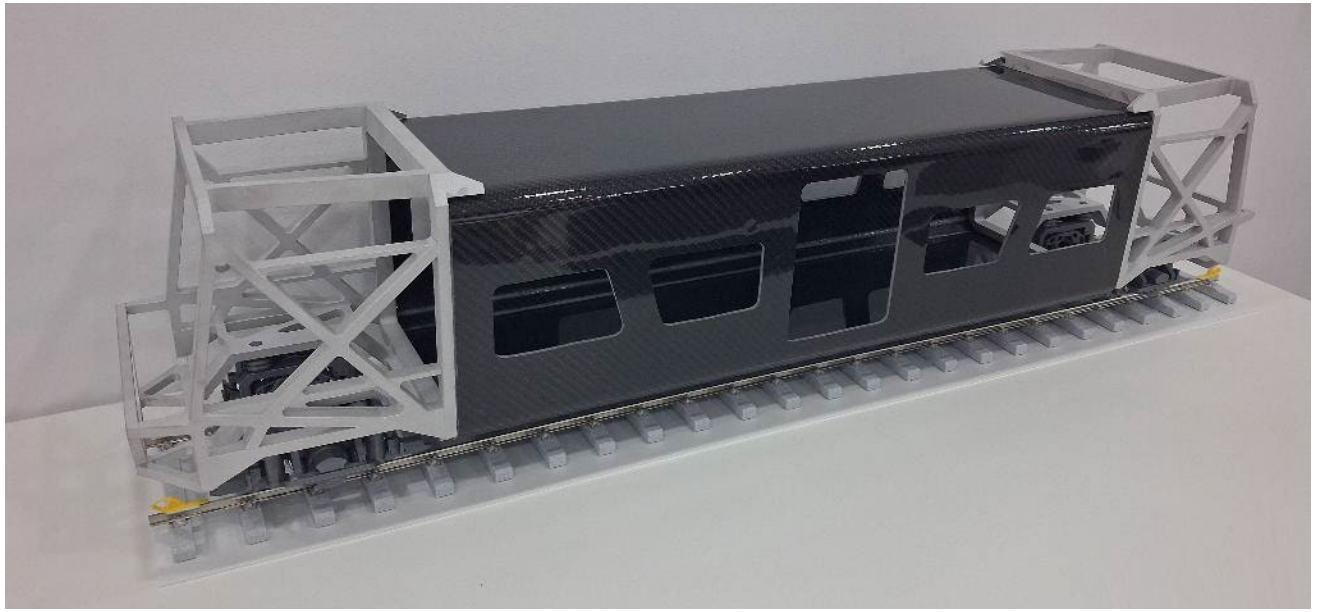


A composite sandwich structure to maximize weight reduction although to a higher manufacturing cost.



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# Lightweight carbody hybrid



Hybrid carbody, topology optimized steel (ends), sandwich composite (middle)
1:16 model displayed at InnoTrans 2026 to show the two concepts

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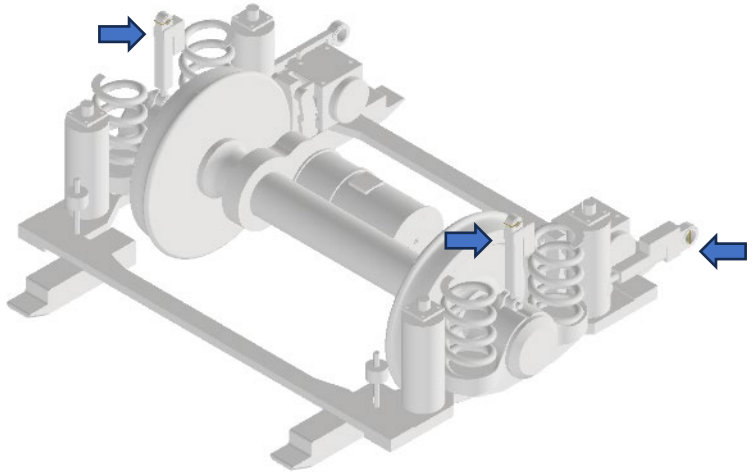
# Running gear

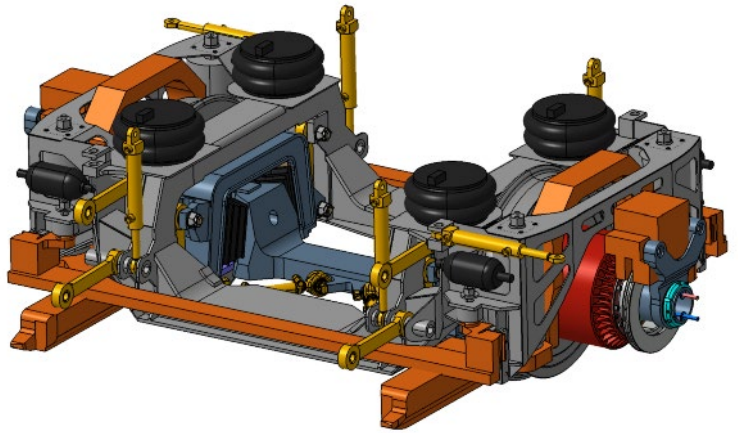
A single axle design allows a larger low floor area and is lighter than a bogie

The FutuRe project evaluates two running gear concepts in parallel

Solid axle between the wheels and just one suspension step. Active suspension added to ensure proper performance.

Independently driven wheels allowing the low floor section to extend over the running gear.



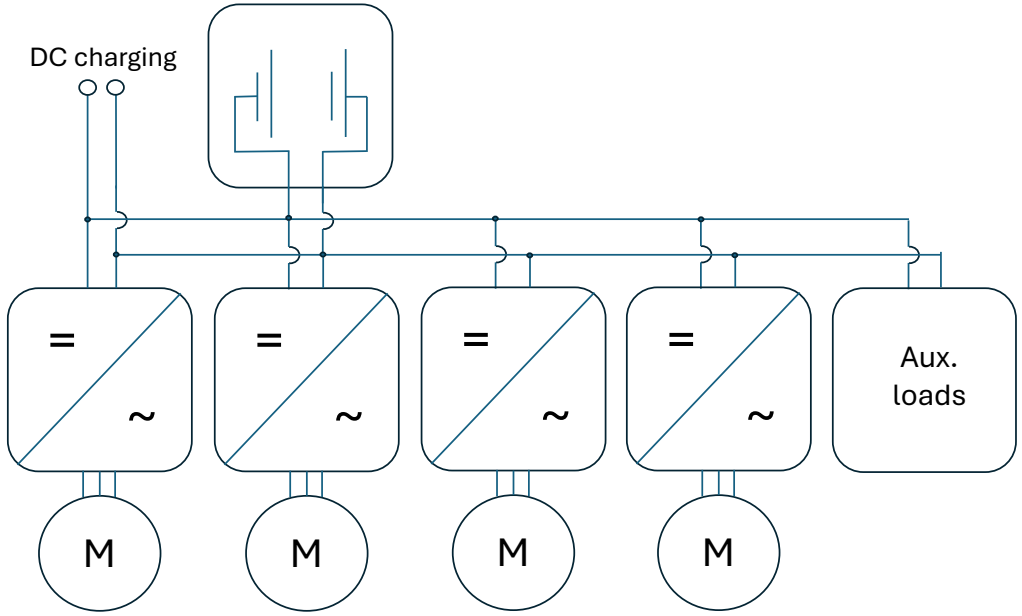


⇦ Active elements replacing passive

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# Battery propulsion

Most low-density rail lines are not electrified. Therefore, since achieving zero emissions at the vehicle is a prerequisite, batteries have become the preferred energy-storage solution.




Adopting solutions from road vehicles has the potential to significantly reduce the weight and cost of the propulsion system.

**Differentiators from conventional BEMU design**

- No charger on the train
- Battery as DC-link (no extra converters)
- Auxiliary loads directly on DC-link (no auxiliary converter)

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# Battery propulsion

**Battery-electric (LFP** (Lithium Iron Phosphate)**)**

- Range exceeds **300 km** with the maximum installable battery capacity (549 kWh).

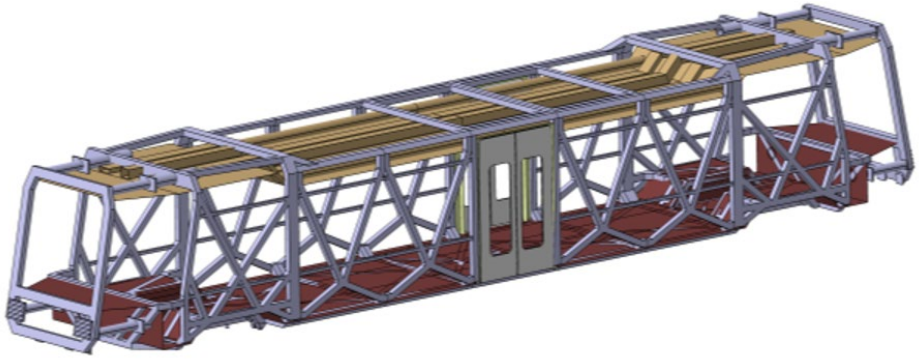
**Hydrogen hybrid (Fuel cell or combustion engine + LTO** (Lithium Titanate Oxide) **battery)**

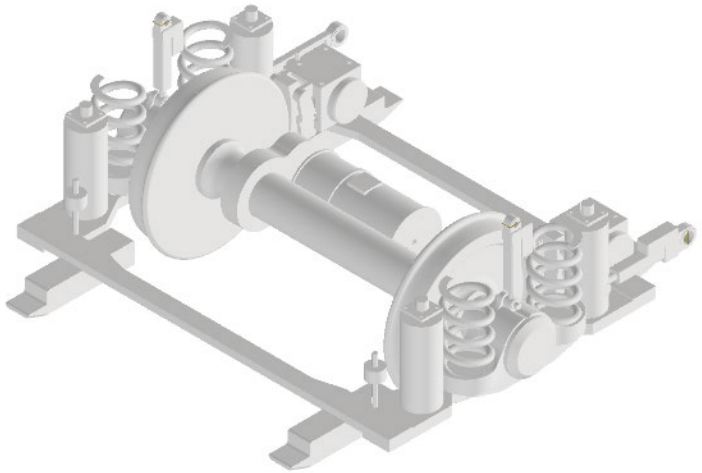
- Even longer range possible.
- Hydrogen system reduces available battery space (66 kWh).
- Requires hydrogen refuelling infrastructure.

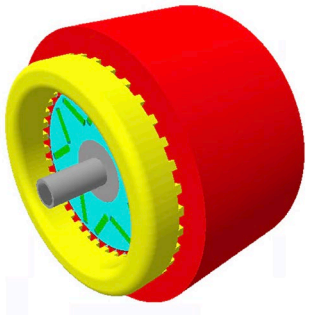
A LFP battery has limited ability to absorb regenerative braking power. Hence, LTO is a better choice when the battery becomes small. The LTO battery is heavier and more expensive.

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# TRL achievement







Conceptual designs of the carbody, running gear, and propulsion system have been developed. CAD models have been created, and analyses and simulations have been conducted to verify performance and validate the design.

TRL 3

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# KPI evidence

| Property | G1 Reference | G1 proposed |
|---|---|---|
| Vehicle type | DMU | BEMU |
| Axels | 6 | 2 |
| Length | 42 m | 16 m |
| Seats | 125 | 40 |




Cost

| KPI | Reference | Target | Achieved |
|---|---|---|---|
| Vehicle cost | 4.0 M€ | -50% | -35% |
| Maintenance cost | 200 k€/year | -50% | -43% |
| Energy cost | 80l/100km diesel<br>1.51 €/km | -50% | -84% |

Weight

| KPI | Reference | Target | Achieved |
|---|---|---|---|
| Vehicle weight | 79 t | -30% | -70% [1, 2)] |
| Body weight | 17.6 t | -60% | -68% [1)] |

1) Carbody in topology-optimized welded steel, composite design would be lighter
2) Running gear with independently driven wheels, solid axle design would be lighter

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# Lessons learned

## Lightweight Carbody

- A topology-optimized steel carbody provides substantial weight reduction, while a composite sandwich design enables further weight savings at increased cost.

## Flexible Zero-Emission Propulsion

- A battery-electric propulsion system based on proven road-vehicle technologies provides the baseline solution, while hydrogen extends range at higher cost.

## Innovative Running Gear

- A single axle design is a must to maximize the low floor area. The solid axle concept gives the lowest weight and cost, when free rotating wheels provide a step-free interior.

## Regional vehicle

- A compact vehicle concept significantly reduces weight and energy cost, while mandatory equipment and battery-electric propulsion prevent a 50% acquisition cost reduction.

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# Where do we go next?

PREFER will transform the most promising concepts into validated technologies through demonstrations.

- Carbody concepts demonstrated through full-scale structural sections
- Running-gear concepts validated through scaled roller-rig and on-track testing
- Battery-electric and hydrogen-assisted propulsion demonstrated in a laboratory environment

PREFER (Pods and Regional Flexible Efficient Rolling Stock) is an EU-funded project over 42 months starting December 1st

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