Sustainable rolling stock for sustainable railways

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ALSTOM

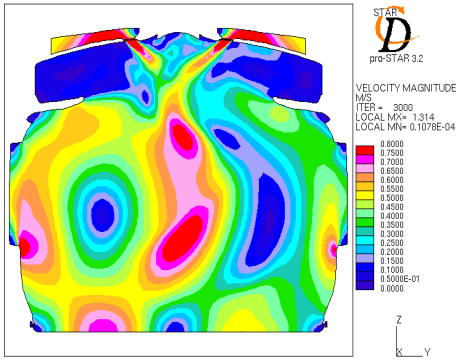
Leading railway evolution through technological innovation

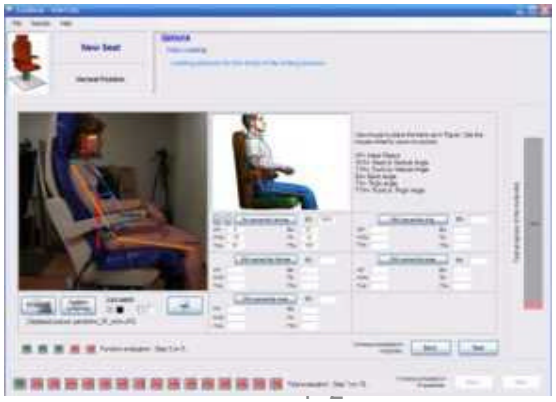
Very well known R&D projects …

Test at very high speed:

- Aerodynamics
- Soundproofing
- Dynamic stability
- Material performance under extreme conditions
- How high speed affects the environment

… whilst others not that notorious





… but that contribute decisively to make true all of the users' needs

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Sustainability in its broadest sense

SAFETY ← **SUSTAINABILITY** → COMFORT

↓

ENVIRONMENTAL ASPECTS

Articulated trainset
Synthesis of the 3 vectors

Safety:

- Rigidity of the trainset. No "accordion" effect in case of derailment

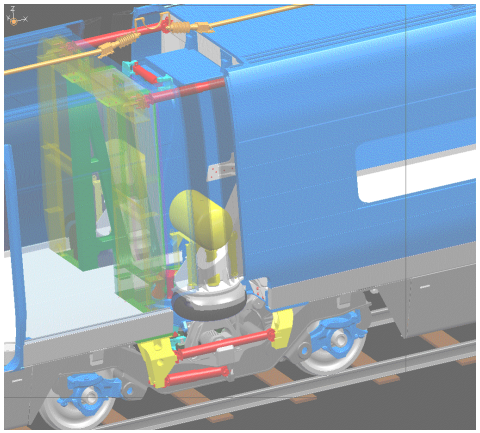
Comfort on board:

- Rolling noise and vibrations are reduced and restricted to the area between cars

Sustainability:

- **Energy consumption:** reducing the number of bogies reduces weight and improves aerodynamic resistance

- **Cost:** fewer bogies means lower maintenance costs (a bogie accounts for 35 to 40% of the cost of maintaining)



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Sustainability
Reducing impact on the environment

98% of easily recyclable materials	Aluminium, steel, copper and glass
Able to produce its own electricity	Up to 8 MW of power feedback into the grid
Aero-acoustics to reduce noise	Same noise at 360 kph than competitors at 300 kph
70 tonnes less than competitor models	15% reduction in energy consumption

Sustainability
Aerodynamics

Less energy consumption than competitors thanks to:

Intensive works on aerodynamic shapes:

- Nose
- Bogie fairings
- Gangways

Sustainability
Energy consumption

15% less energy consumption than competitors

Due to:

- Reduced weight
- Optimized use of regenerative braking
- Reduced number of bogies
- High efficiency of traction drive
- Improved aerodynamics

Sustainability
Traction: permanent magnet motors

- Power/weight ratio: more than 1 kW/kg
- Efficiency ratio: 98%

Increased efficiency

- No need to create magnetic fields

Less losses due to harmonics

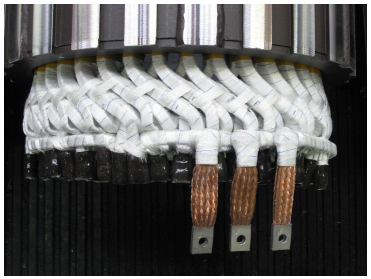
- Pulse Width Modulation (PWM)

Less losses

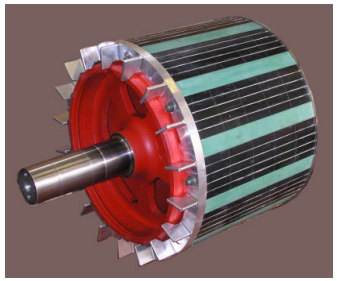
- Stator (increased nb of poles)
- Rotor (low resistivity of magnets)

Less maintenance

- Air self ventilated
- Totally enclosed

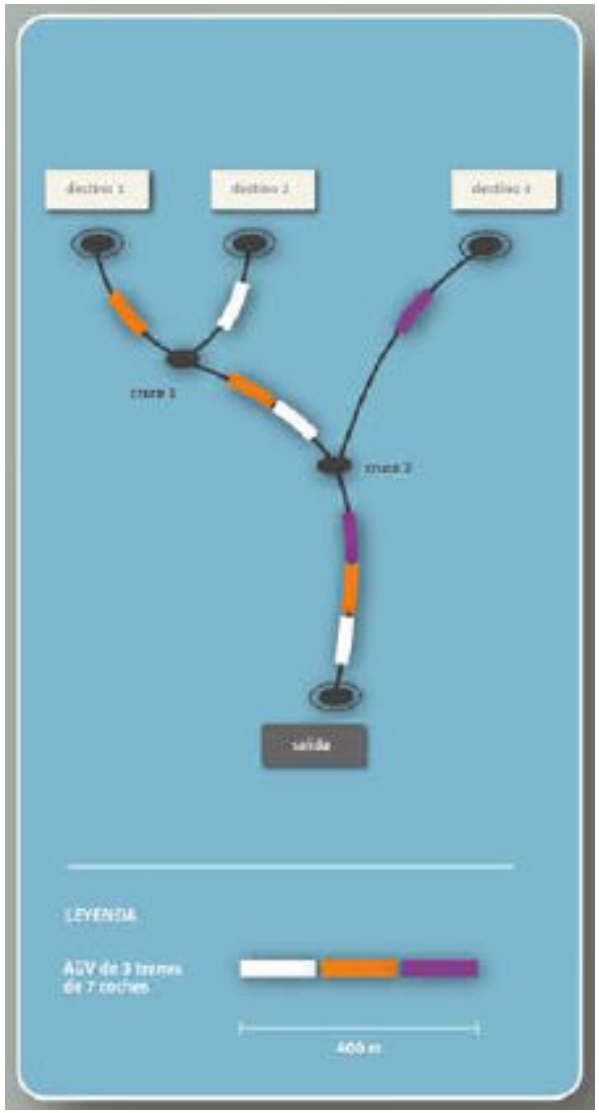


PMM STATOR



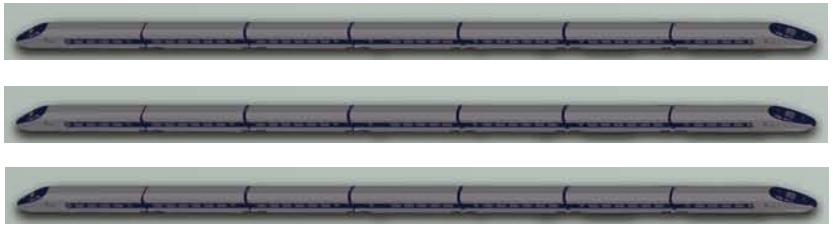
PMM ROTOR

Sustainability
Reducing operational costs

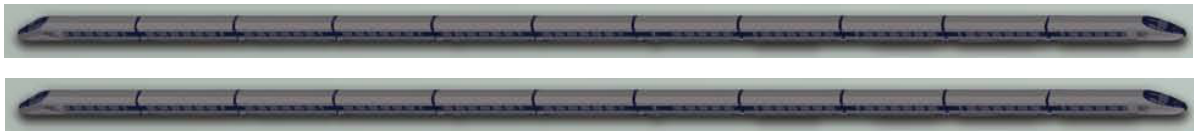


Modularity of trainsets

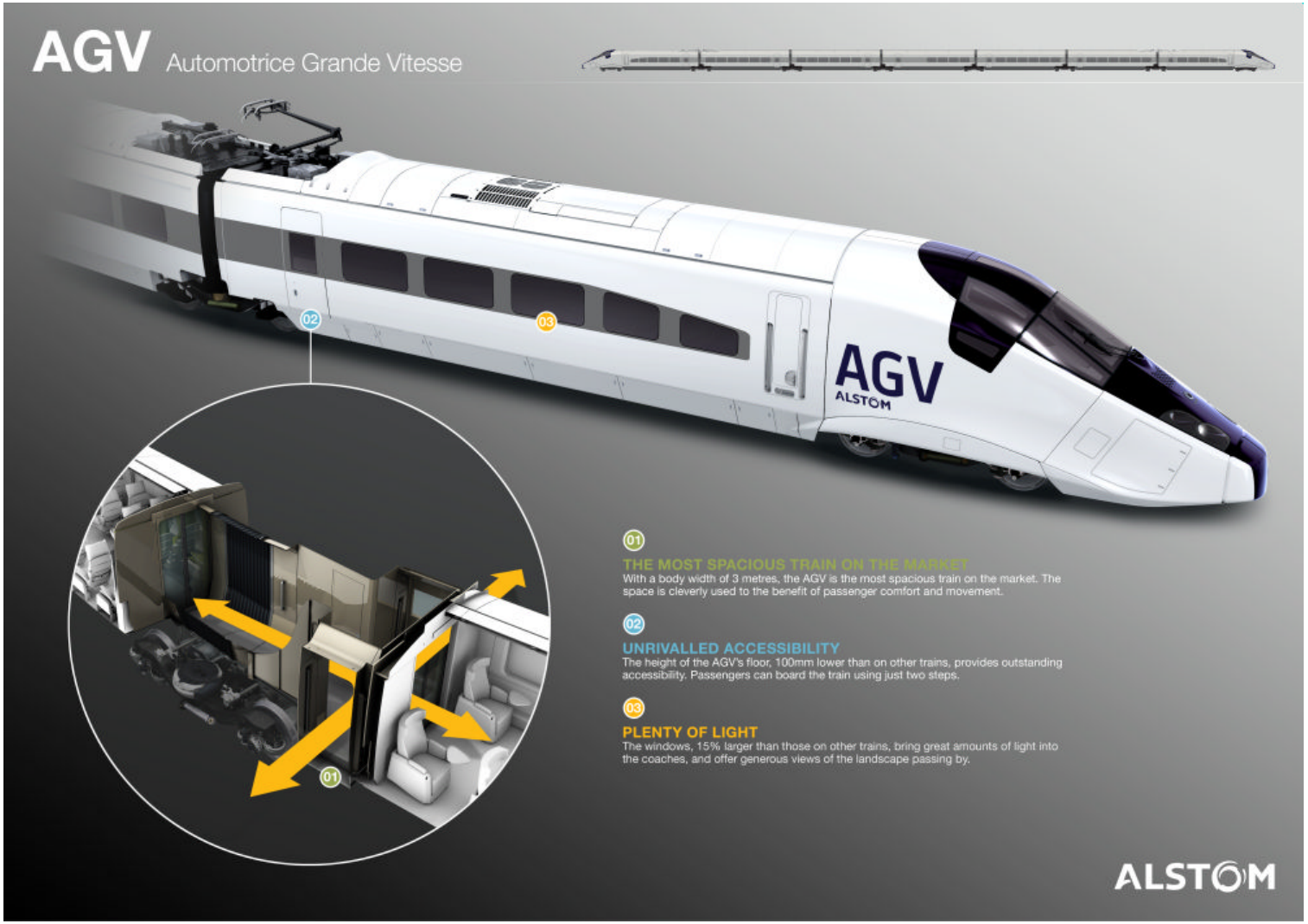
Fine-tuning for trains' circulation, train fleets and railway hubs



2 * AGV7 = 400 m = 3 * AGV11



Sustainability
Global comfort



Sustainability
Spanish commuter trains: CIVIA Platform

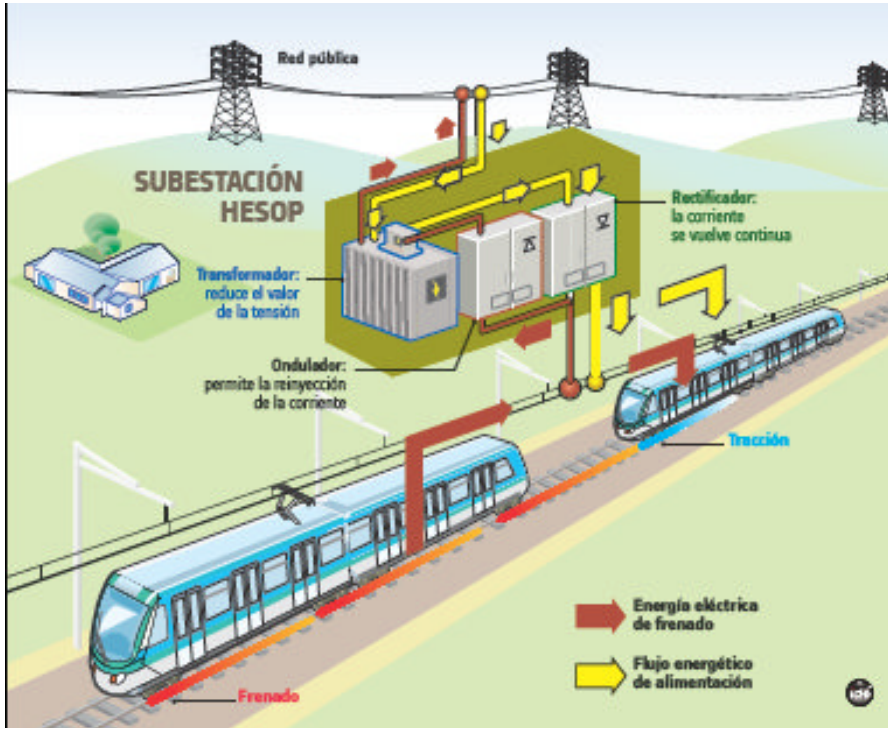
ALSTOM's contribution to RENFE's success story in Commuter trains.

Articulated train, use of alluminium, efficient traction chain,...

- CIVIA I: The first family of the new commuter platform
- CIVIA II: Including fire detection.
- CIVIA III: Meeting passive safety requirements.
- CIVIA IV: Full STI compliance with regards to accesibility.

Sustainability
HESOP reversible substation

Defined by RAILENERGY as « technical leap »



Allows full recovery of braking energy

Returns enery upstream: real “green energy”

Brake resistors and short circuit brakers can be avoided in given configurations

Application to commuters, metros, tramways

Sustainability
APS: Aesthetic power supply

Catenaryless tramway

Allows running into city centers where for different reasons superstructure cannot be considered:

- Bridges
- Sharp turns
- Aestetically protected environments

Total autonomy independent of:

- Interstation length
- Slope
- Power of auxiliaries

Alstom
Innovation for enhanced sustainability

Great brands don’t just happen,
they’re made.