



RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



Gröna Tåget

(Eng: Green Train)

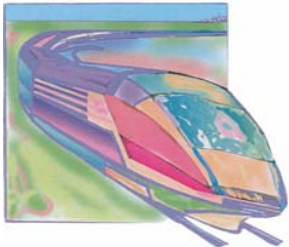
Overview and Technical Aspects

Evert Andersson, professor

Programme coordinator - Technology

everta@kth.se

evertan@telia.com





RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



Background

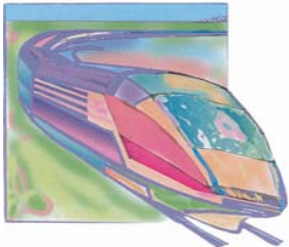
Current Swedish **12-year plan** (2004-2015)

- Heavy rail investment program (11 billion Euro)
- Capacity enhancements
- Upgrading of existing lines
- High-speed links & freight corridors.

Still, on most lines high-speed trains will **share tracks with heavy freight trains** (axle load to up to 25 metric tonnes).

A new generation of long-distance trains is foreseen to be needed and introduced within in the next 5 – 10 years.

Other Nordic countries (Denmark, Finland, Norway) have similar needs, possibly later.





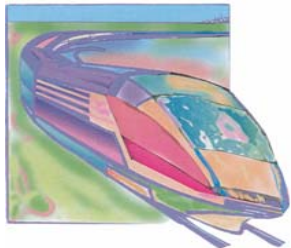
RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



Why not simply use a train from continental Europe?

- Sweden has a **modest population density** with major cities and regions located some 300 – 600 km apart. There is a great need for efficient and sustainable passenger transportation.
- Trains for introduction within 5 – 10 years are yet not developed.
- We should be able to influence train development and European standardisation.
- Sweden is one of the 6 - 8 countries worldwide, having the ability of developing trains for speeds above 200 km/h.
- European standardisation (TSI, EN) is lacking some important requirements for Swedish (Nordic) conditions.





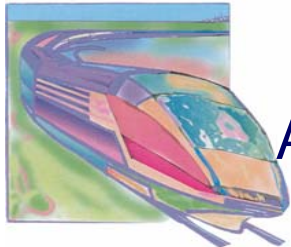
RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



Additional requirements to European standards

- **Mixed traffic** with heavy freight trains, as well as **frost upheaval** would produce larger track defects. Requires **track-friendly trains** (low track deterioration, smooth ride on non-perfect track)
- The **modest population density**, and varying traffic demands, requires **flexible trains** (3 – 12 cars). This means at least two pantographs (current collectors) at short distance.
- Reliable operation under harsh **winter conditions**.
- Requirements on **economic efficiency** is high.
- Requirements for **disabled passengers** are high (low entrances and/or convenient lift facilities).



All this is **compliant to required European standard**, but is not specified in TSI and EN.



RAILWAY GROUP

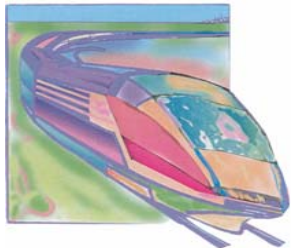
Centre for Research
and Education
in Railway Engineering



Higher performance for next generation

Desired features for Swedish (Nordic) conditions

- **Short travelling time** (on upgraded and new infrastructure); top speed **250 km/h or higher**. **Tilting carbody** is needed.
- Improved **passenger comfort** (seating and working ability, noise & ride, pressure tightness, reduced motion sickness).
- **Space-efficient, flexible** and attractive **interiors**.
- Improved **environmental performance** (energy, noise):
 - **Energy** consumption (per seat-km) should be reduced.
 - No higher **noise level** at higher speeds (cf. 200 km/h).



Opportunity (according to proposed EN):

- The Swedish (and Nordic) rail network allows **wider trains** than continental Europe (in Sweden approx 0.55 m). Important for economic efficiency !



RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering

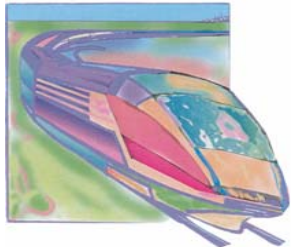


Next generation high-speed trains

Finally

- **Reduced cost** (per seat-km) by 20 – 30 %, as to compete successfully with low-cost airlines, and for increased market share.

All this requires advanced technical research and development, and also research on economic and passenger issues.





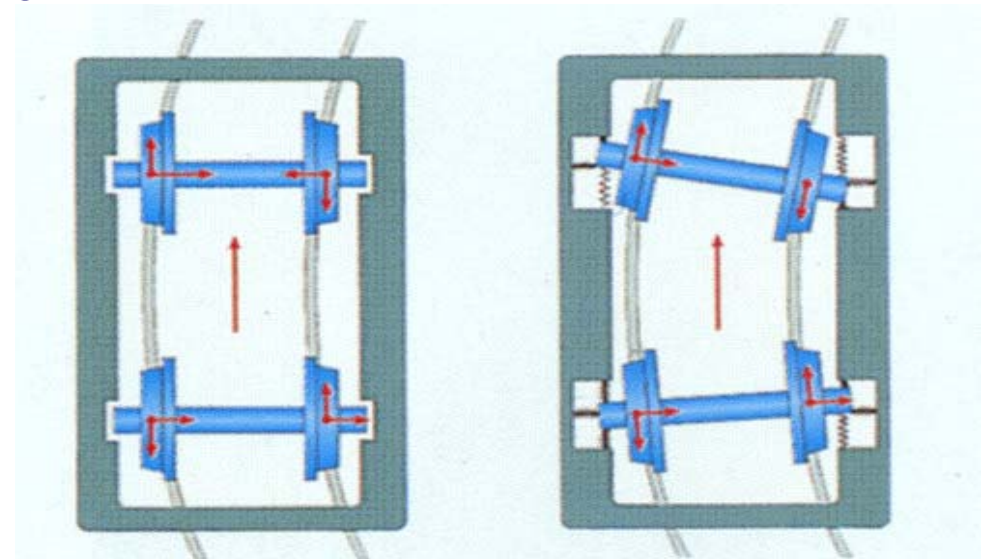
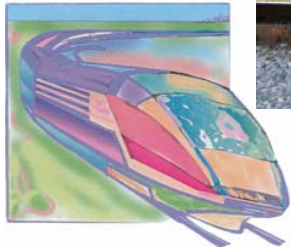
RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



2005 – 2008 particular focus on

- **Track-friendly bogies** (passive self-steering + mechatronic)
Track forces + running stability
measured by instrumented wheels
- **Ride qualities** on non-perfect track (active lateral suspension)
Simulation, hardware and testing.





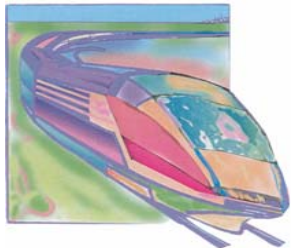
RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



Further 2006 – 2008

- **Noise reduction (external + internal)**
- **Current collection**
(improved pantographs on existing overhead catenary)
- **Aerodynamics**
- **Winter climate protection** at high-speed operation.





RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



Step 1 & 2 testing.

Testing 2006 – 2008: Modified "Regina" wide-body EMU train



**STEP 1
2006-07**

Improved radial steered bogies

Bogie noise shield

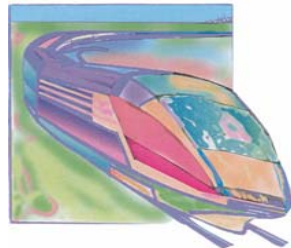


**STEP 2
2007-08**

Modified existing radial
steered bogies with
Active Lateral Suspension

Mechatronic bogies
based on existing bogies

Bogie noise shield



Source: Bombardier



RAILWAY GROUP

Centre for Research
and Education
in Railway Engineering



Further research & development until 2010

- **Carbody tilt** systems performance & measures to **reduce motion sickness**.
- **Permanent magnet motor drives**.
- Reductions of **energy consumption**.
- Studies on **market demands**,
 - **performance** requirements (speed, cant deficiency, power),
 - possible **train concepts**,
 - **cost & revenue** analysis,
 - **capacity** in mixed rail traffic (high speed and heavy freight).
- **Attractive passenger facilities** (interiors).
- Considerations of the **European standard**.
- Development of appropriate **specifications**.

