Next generation trains
Shift2Rail perspectives

Energy efficiency of future trains, 4/10/2017

Giorgio Travaini, Head of Research & Innovation, S2R JU
The S2R Joint Undertaking has been created in June 2014 to play a major role in rail-related research and innovation, ensuring coordination among projects and providing all stakeholders with relevant and available information on projects funded across Europe. It shall also manage all rail-focused research and innovation actions co-funded by the Union.

Council Regulation (EU) No 642/2014 of 16 June 2014 (S2R Regulation)

It reached autonomy in May 2016, it is now fully operational.
PUBLIC-PRIVATE PARTNERSHIP & INI PLATFORM FOR RAILWAY
WORKING TOGETHER
RIVE INNOVATION
Y 2024
From TRL0 to TRL6/7

Technology Demonstrator (TDs)
Projects specifying, developing and demonstrating a specific technology resulting in a lab tested and/or simulated prototype.

Integrated Technology Demonstrators (ITDs)
Projects integrating/combining TD prototypes at system level (lab and on-site) and testing performance.

System Platform Demonstrators (SPDs)
Assessment of the whole systems performance based on the results of TDs and ITDs. SPDs bring S2R innovative solutions to a technology maturity level for a new generation of railway system.

RAILWAY SYSTEM OF THE FUTURE
Energy-related Activities: S2R

**Energy**
- Work Area 5.1 Energy: 1,8M€
  - (FINE1, OPEUS projects)

**Energy and sustainability**
- (CCA)

**Smart energy**
- (IP3 Infra)

**Energy – (IP1 rolling stock)**
- TD1.1 Traction: 70M€
- TD1.2 TCMS: 44M€
- TD1.3 Carbodyshell: 26M€
- TD1.6 Doors: 10M€
  - (PINTA, Connecta, Pivot, Safe4Rail, Mat4Rail, RUN2Rail, Roll2Rail projects)

**TD3.9 Smart Power Supply**: 7,1M€
- TD3.0 Smart Metering: 7.4M€
  - (In2Stempo, In2Dreams, In2Rail projects)

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The PINTA project aims address two key topics: Development of concepts towards the next generation of traction systems and management of wheel/rail adhesion.

- Line capacity increase through weight, volume, Energy and noise savings of Traction equipment
- Operational reliability increase via higher reliability/availability
- Traction & Brakes systems LCC reduction
- Improvement of braking degradation limit in poor adhesion condition
- Improvement of the overall train safety
• Develop energy savings solutions – example of foreseen optimisation possibilities with Sic in traction

- Lower converter losses
- Higher switching frequencies for reduced harmonic losses in motors/transformers as well as reduced noise
- Simplified cooling (active → passive)
- Reduced cooling noise
- Less maintenance
- Reduced auxiliary power consumption
- Increase of output power and reduced volume and weight of converter equipment
- Increases possibilities to optimize motor and transformer design for lower weight
- Easier to fit on vehicle
Expected Impact

Improve S2R KPIs at Traction/Adhesion levels

– LCC

• [...] Reduction in traction energy consumption (Usage of more energy efficient technologies, significant weight reduction, evaluation of technologies for potential hybrid traction, traction auxiliaries optimisation, etc.)

<table>
<thead>
<tr>
<th>Application</th>
<th>Data type</th>
<th>LCC reduction</th>
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<tbody>
<tr>
<td>Tramway</td>
<td>Average</td>
<td>-12%</td>
</tr>
<tr>
<td>Metro</td>
<td>Average</td>
<td>-15%</td>
</tr>
<tr>
<td>Sub-urban</td>
<td>Average</td>
<td>-17%</td>
</tr>
<tr>
<td>Regional</td>
<td>Average</td>
<td>-15%</td>
</tr>
<tr>
<td>High Speed</td>
<td>Average</td>
<td>-14%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Average</strong></td>
<td><strong>-15%</strong></td>
</tr>
</tbody>
</table>
FINE1 = Future Improvements Noise & Energy

- Energy quantification methodology
- Gathering of sub-level KPIs
- Quantification of energy improvements (kWh and €) gained in Shift2Rail (KPI generation)
- Interface to external energy groups, normative groups
- Strategic view on energy
WHAT’S GOING ON

Around 50 PROJECTS ONGOING

MAAP STRATEGIC REVIEW

S2R MID TERM EVALUATION

R&I 2018 AND BEYOND

DEMOS PLANS

STANDARDS’ ROADMAP

R&I BEYOND 2020
USER FIRST: User Centric Mobility as a Service
#Shift2Rail

**WHAT & WHY**

- **user vision**
  - easy, personalised and integrated mobility

- **Strategic goals**
  - clustered around issues of carbon, cost, customer and capacity

- **market needs**
  - market segments and needs e.g. SPDs

- **capabilities**
  - linking the goals with the specific R&I programmes

- **investment programmes in new capabilities**
  - portfolio of significant programmes e.g. Shift2Rail

- **investment projects**
  - Shift2Rail projects, Solutions catalogue
Efficient and reliable R&I delivery...

An ecosystem for rail R&I delivery based on effective collaboration, the provision of greater technology demonstration capability (including virtual and physical testing) and the efficient integration of technology into the railways. This removes barriers to the adoption of new technology and decreases time to market.
...opening up new Capabilities coming from emerging technologies or concepts.

- BIG DATA, CLOUD, IOT
- INTEROPERABLE AND AUTONOMOUS PASSENGER OR FREIGHT TRAINS
- DIGITAL AND SERVICE ORIENTED (RAILWAY 4.0)
- PARADIGM SHIFTS FOR RAILWAY
- MACHINE TO MACHINE COMMUNICATION
- REAL TIME INTEGRATED AND AUTOMATED TRAFFIC MANAGEMENT
- FULL RAILWAY IT ECOSYSTEM AND CONNECTED BUSINESS MODELS
- ZERO EMISSION RAILWAY SYSTEM
- ARTIFICIAL INTELLIGENCE
Backups
# Shift2Rail

**Integrated Programme:**
- Consistent Delivery Oriented

### S2R Programme:
- Long-term needs and socio-economic research
- Smart materials and processes
- System integration, safety and interoperability
- Energy and sustainability
- Human capital

### IP 1:
- Cost-efficient and reliable trains, including high capacity trains and high speed trains

### IP 2:
- Advanced Traffic Management & Control Systems

### IP 3:
- Cost-efficient, sustainable and reliable High Capacity Infrastructure

### IP 4:
- IT Solutions for Attractive Railway Services

### IP 5:
- Technologies for Sustainable & Attractive European Freight

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PROGRAMME FINANCIALS

Values as at 1 Sept 2016 in Million EUR

Programme € M967
- Railway Sector Net Contribution € M517
- S2R Co-fin (H2020) € M450

IPs/CCA € M777
- IP1 € M225
- IP2 € M195
- IP3 € M153
- IP4 € M86
- IP5 € M83
- CCA € M35
- IKAA € M163
- Other € M27
To develop a simulation methodology and accompanying modelling tool to evaluate, improve and optimise the energy consumption of rail systems with a particular focus on in-vehicle innovation.
Thank you

*imagine, together we make it...*