Railenergy

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RAILENERGY

Project General presentation

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UIC / Macroplan

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Railenergy Facts & Figures

- Integrated Project co-funded by the EU under the 6th Framework Programme
- 27 partners across the EU
- Project start: 01 September 2006
- Duration: 4 years
- Budget: €14.7M (€8M EC grant)

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Railenergy Partnership

UNIFE
uic
D'APPOLONIA engineering consulting company
IZT
SIEMENS
ALSTOM | ANSALDOBREDA
BOMBARDIER
BANVERKET
RFI
TRENITALIA
EUROLUM
Faiveley S.A.
saft
TRANSTECHNIK
Rail Cargo Austria Ein Unternehmen der ÖBB
ENOTRAC
emkamatik
Engineering – Modeling – Calculation – Real Time Simulation for Railways and Electrical Systems
transrail
SCIROIDEA
TRANSPORT SYSTEMS AND INFRASTRUCTURES GROUP
Instituto Superior Técnico
nitel Consorzio Nazionale Interuniversitario per i Trasporti e la Logistica
CORYS Training & Engineering Support Systems
tfk
VUZ
KTH Vetenskap och Konst
FAV

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Railway demands of the future

energy-efficient

cost-effective

comfortable

silent

light

fast

Railenergy Mission Statement

The main objective is to address the energy efficiency of the integrated railway system and to investigate and validate solutions ranging from the introduction of innovative traction technologies, components and layouts to the development of rolling stock, operation and infrastructure management strategies.

The overall objective of Railenergy is to cut the energy consumption in the railway system thus contributing to the reduction of life cycle costs of railway operation and of CO_2 emission. The project target is to achieve a 6% reduction of the specific energy consumption of the rail system by 2020.

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Identification of the Target (1/2)

- The target of 6% in energy saving in 2020 has been elaborated as follows:
  - Savings Potential attributed to key technologues on the basis of existing research and experts' knowledge
  - Progressing them to system wide and fleet wide potential
  - Deployment of 25% at 2020 has been estimated on the basis of investments, innovation cycles and initial condition of the railways (low to medium investment scenario)

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Identification of the Target (2/2)

Domain	Operation	Trackside	Components	Traction	Topologies
efficiency potentials on a subsystem level	energy efficient driving 5-20%, energy efficient time tabling 5-10%	recuperation DC networks 10-20% loss reduction (incl. contact lines) 2-5%	on-board energy storage 5-30% use of waste heat 5-20%	supercond. transf. 40-60% medium freq. transf. 35-55% perm. magnet mot/gen. 4-10%	traction control 10-25% aux power supply 10-30% aux cooling system 5-15%
global contribution	2%	4%	5%	5%	2%
		Deployment in European railways: 25%			
system-wide impact	2%	1%	1,25%	1,25%	0,5%
	Overall target: 6%				

An Integrated Approach

- The 3 largest European networks are spending **€1.75 Billion** on energy (20% increase last year!)
- Inter-relationship of railway sub-systems is highly complex, especially with regard to assessing their consumption of energy
- Therefore, a **fully integrated approach** is the only way to achieve true energy savings
- Generate new validation standards for the energy performance of products and services and contribute to the European harmonisation process

Railenergy Project outputs (1/4)

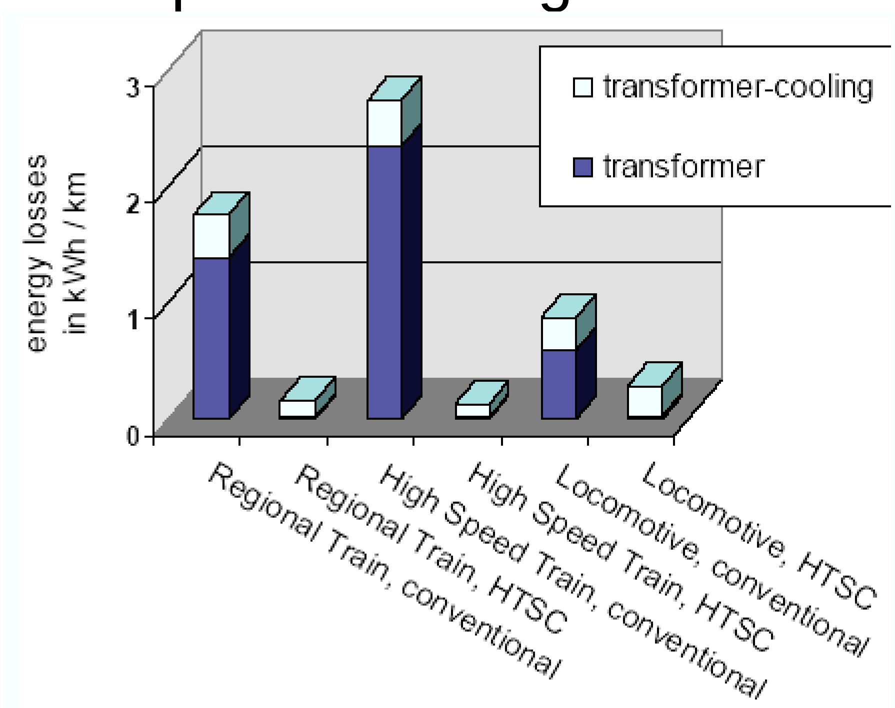
- **Relevant baseline figures and scenarios for selected reference systems**
- **A system-based concept for modelling energy consumption**
- **A common and standardised methodology to determine energy consumption by rail sub-systems and components in the development and procurement phases**
- **An integrated simulation tool for energy consumption and LCC**
- **An integrated railway energy efficiency management approach & decision support tool**

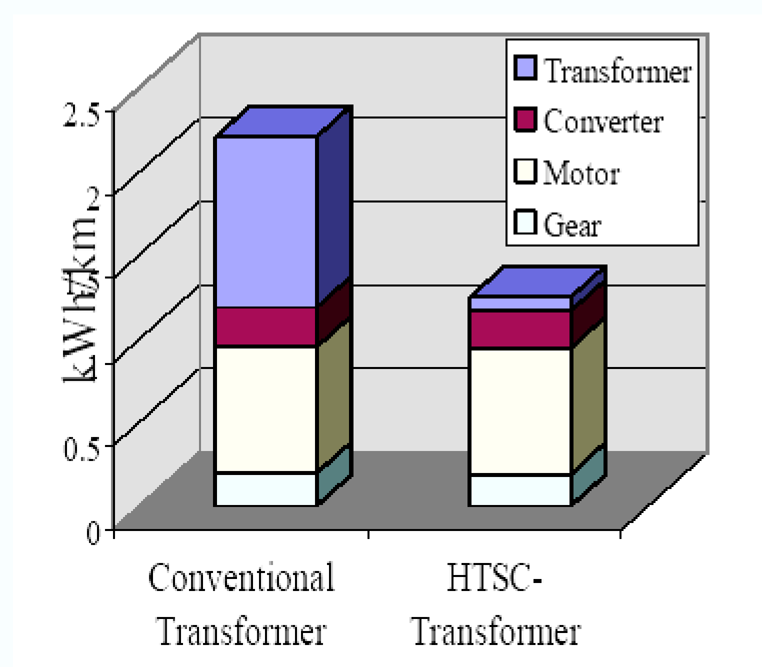
Railenergy Project outputs (2/4)

- Strategic energy efficiency targets for rolling stock, infrastructure and traffic management
- An Energy Management Module which could provide the operator with a diagnostic of their complete installation (main energy flows, and their distribution, power peaks and mean, links with energy contract subscription, real time and statistics…)
- New validated energy efficiency-oriented railway technologies for trackside and on-board sub-systems and equipment, developed in compliance with the new integrated approach
- Refined best practices for Railway Operators and Infrastructure Managers
- Strategies for incentives, pricing, and policies

Railenergy Project outputs (3/4)

- New innovative components could significantly reduce energy losses of traction systems
- one example: to substitute conventional transformers by superconducting or medium frequency components:





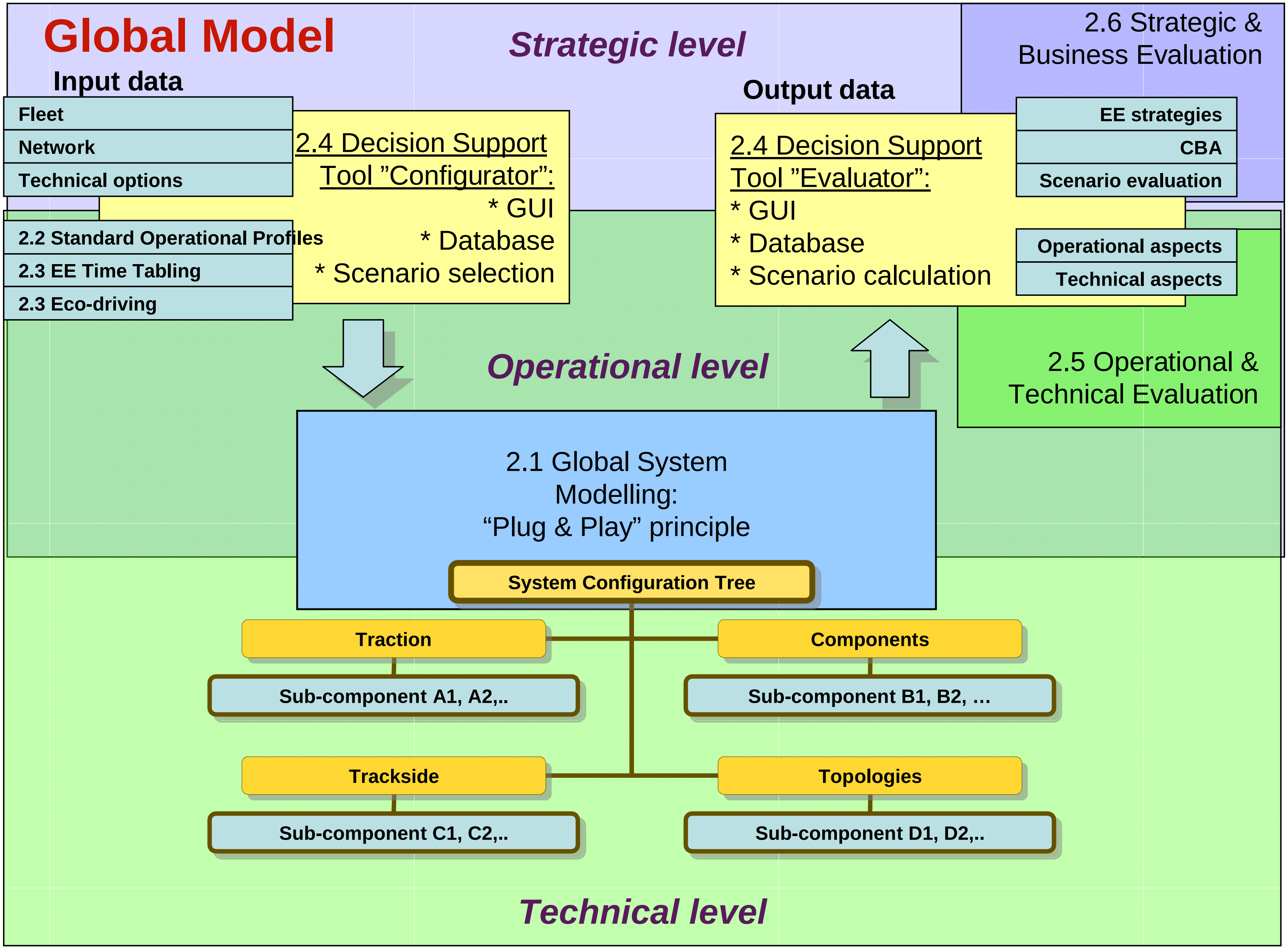
Railenergy Project outputs (4/4)

Integrated approach:

Railenergy will develop the *Railenergy Global Model* supported by the *Decision Support Tool*

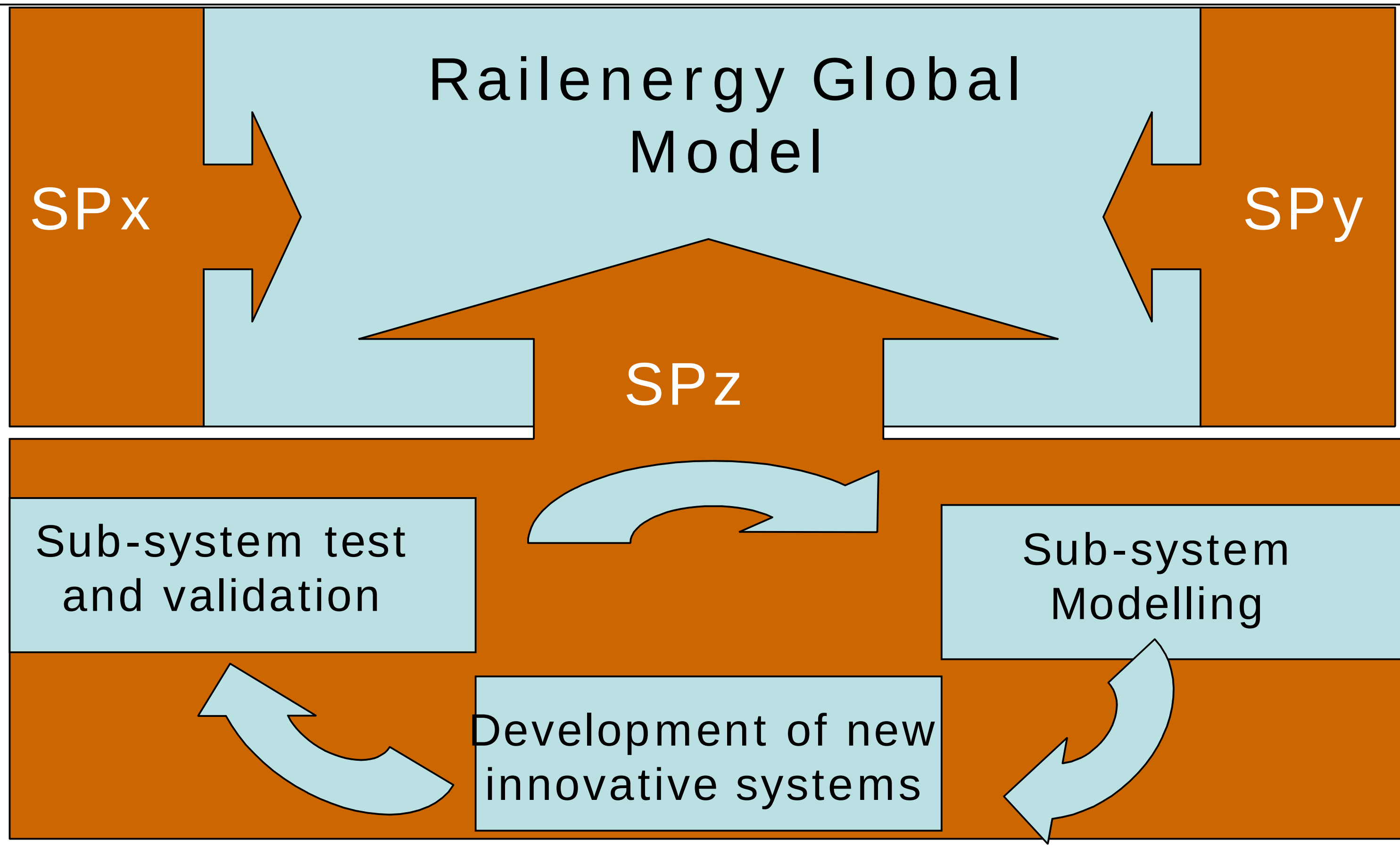
Features of Railenergy Model

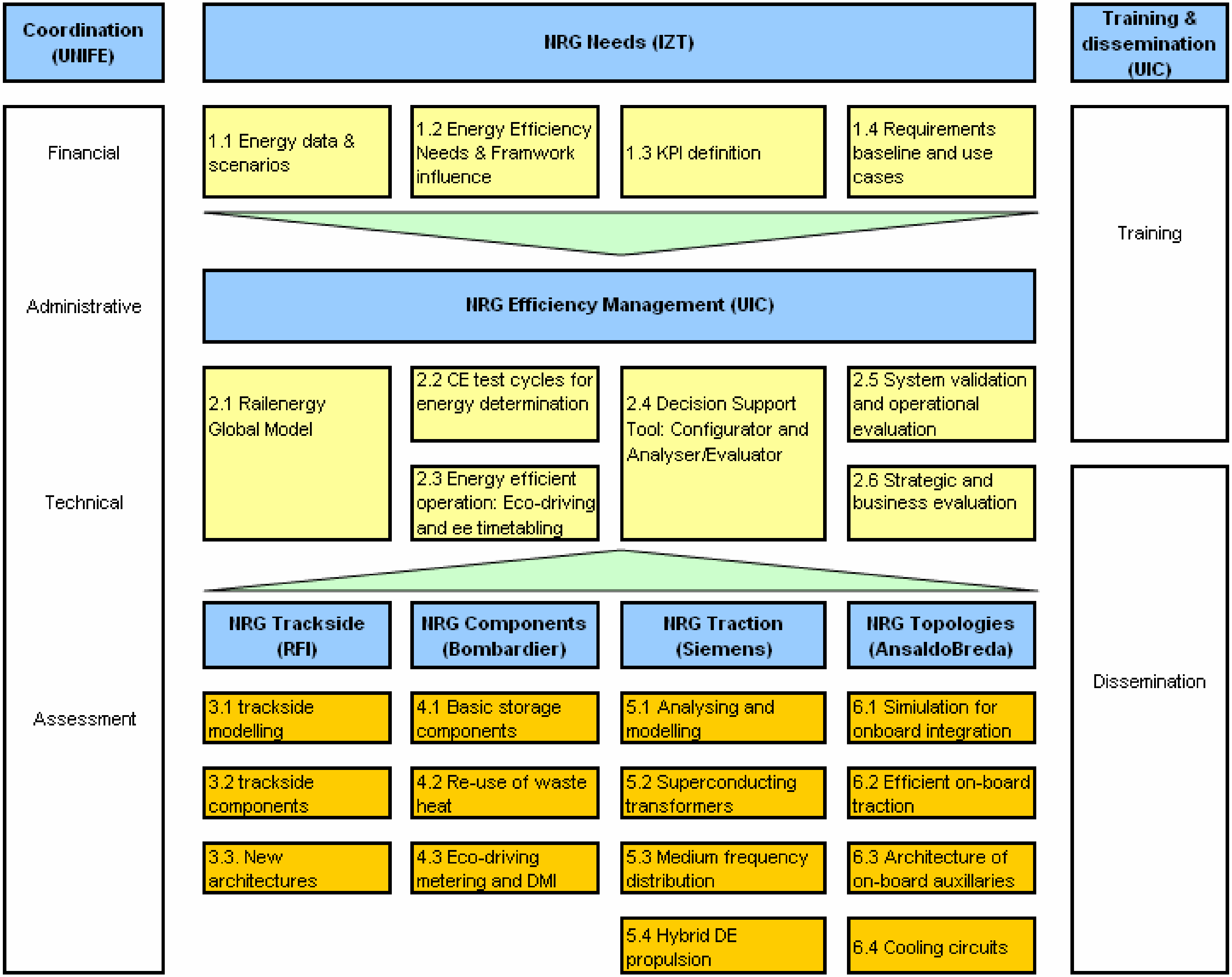
- Open architecture for the whole sector
- Ability to break a global target into manageable units
- Assist in developm. of new energy-friendly hardw. and control syst.
- Help select the best combination of solutions for energy cost saving (during design, procurement and operation phases)
- Specific modules to assess the contribution of any new technical solution developed within Railenergy
- The ability to convert all test or simulation results into a common unit for measurement of Life Cycle Cost
- Support investment decisions
- “WHAT-IF” function to accommodate new technology options and different load profiles



Global Model
Strategic level
2.6 Strategic & Business Evaluation
Input data
Fleet
Network
Technical options
2.4 Decision Support Tool "Configurator":
* GUI
* Database
* Scenario selection
2.2 Standard Operational Profiles
2.3 EE Time Tabling
2.3 Eco-driving
Output data
2.4 Decision Support Tool "Evaluator":
* GUI
* Database
* Scenario calculation
EE strategies
CBA
Scenario evaluation
Operational aspects
Technical aspects
Operational level
2.5 Operational & Technical Evaluation
2.1 Global System Modelling:
"Plug & Play" principle
System Configuration Tree
Traction
Components
Sub-component A1, A2,..
Sub-component B1, B2, …
Trackside
Topologies
Sub-component C1, C2,..
Sub-component D1, D2,..
Technical level

‘Plug & Play’ Principle for new development




Coordination (UNIFE)
NRG Needs (IZT)
Training & dissemination (UIC)
Financial
Administrative
Technical
Assessment
1.1 Energy data & scenarios
1.2 Energy Efficiency Needs & Framwork influence
1.3 KPI definition
1.4 Requirements baseline and use cases
NRG Efficiency Management (UIC)
2.1 Railenergy Global Model
2.2 CE test cycles for energy determination
2.3 Energy efficient operation: Eco-driving and ee timetabling
2.4 Decision Support Tool: Configurator and Analyser/Evaluator
2.5 System validation and operational evaluation
2.6 Strategic and business evaluation
Training
Dissemination
NRG Trackside (RFI)
NRG Components (Bombardier)
NRG Traction (Siemens)
NRG Topologies (AnsaldoBreda)
3.1 trackside modelling
3.2 trackside components
3.3. New architectures
4.1 Basic storage components
4.2 Re-use of waste heat
4.3 Eco-driving metering and DMI
5.1 Analysing and modelling
5.2 Superconducting transformers
5.3 Medium frequency distribution
5.4 Hybrid DE propulsion
6.1 Simiulation for onboard integration
6.2 Efficient on-board traction
6.3 Architecture of on-board auxillaries
6.4 Cooling circuits

Validation and Prototypes

Domain	Output	Level of Implementation
Integrated Energy Efficiency Management	Railenergy Global Model	Software Prototype
	Decision Support Tool	Software Prototype
	Harmonised energy consumption determination for rolling stock	Contribution to Standards
Operation	Energy Efficient Time Tabling	Software Prototype
	Real Time Drive Optimiser	Physical Prototype
Components	Eco-driving Metering and DMI	Physical Prototype mounted on board of the driver's cab
Traction	Cooling system for superconducting transformer	Physical Lab Prototype
	Medium Frequency Transformer	Physical Lab Prototype
	Permanent Magnet Motor	Physical Lab Prototype
Topologies	Traction control system	Software Lab Prototype
	Auxiliary Power Supply	Physical Lab Prototype

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Examples of how the Railenergy solutions will be tested against real oper. conditions on existing lines.

Example1: Passenger Traffic in International Routes

Scenario description

- High speed passenger train;
- Two countries;
- Both countries using AC traction;
- One country using 50 Hz;
- One country using 16 2/3 Hz

SP/WP Coverage

- WP4.3 – Eco-Driving Metering and DMIs
- WP5.2 – Superconducting Transformer
- WP5.3 – Medium Frequency Distribution
- SP6 – NRG-Topologies

Examples of how the Railenergy solutions will be tested against real oper. conditions on existing lines.

Example 2: International Route with Mixed Traffic

Scenario description

- Mixed traffic (passengers and freight);
- International traffic (at least two countries);
- One country using DC traction;
- One country using AC traction;
- Domestic freight traffic scenario is a subset of the whole Demonstration Scenario.

SP/WP Coverage

- WP4.3 – Eco-Driving Metering and DMIs
- WP5.2 – Superconducting Transformer
- WP5.3 – Medium Frequency Distribution
- WP5.4 – Diesel-Electrical Mutliple Units
- SP6 – NRG-Topologies

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Examples of how the Railenergy solutions will be tested against real oper. conditions on existing lines.

Example 3: Passenger Transport on Regional Services

Scenario description

- Passenger transport on regional lines
- Frequent stops

SP/WP Coverage

- WP3.2 – Trackside components for existing systems
- WP4.1 – Basic Storage Components
- WP4.2 – Re-use of Waste Heat
- WP5.4 – Diesel-Electrical Mutliple Units
- SP6 – NRG-Topologies

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Outlook for the future

The exploitation of the Railenergy results among railway operators, infrastructure managers and manufacturers will be realised along the following main axes of management decisions:

- **Design and procurement**

Investment decision support for the design, production (suppliers' side), and procurement (customers' perspective)

- **Optimisation of operation**

Energy efficiency optimisation of the daily train operation

- **Harmonised communication**

The creation and use of a harmonised language for energy efficiency within the railway sector will be of major value for enhancing the applicability of the solutions at hand.