



## **Intermediate results**

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**11th UIC Sustainability Conference**

**Madrid**

**June 17th 2010**

**Mads Bergendorff**

**Macroplan Consulting**

## Presentation overview

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### Latest results of the project

- Simulation and evaluation concept
- First simulation results
- Strategic assessment reports
- Railenergy Calculator

### How can you get involved already now?

- The new TecRec 100\_001: “Specification and verification of energy consumption for railway rolling stock”

How to measure & analyse energy in railway systems?

- **Common simulation methodology**
- **First UIC/UNIFE TecRec (100\_001)**

How to define, browse & collect energy data?

- **Railenergy KPIs**
- **UIC energy & CO<sub>2</sub> database**

How to benchmark energy performance?

- **Railenergy performance baseline**
- **Ranking of saving potentials**
- **Technology Assessment Reports**

How to compare & prioritise different measures?

- **Cost-benefit & effectiveness**
- **Decision Support Tool**
- **Market readiness**

How to save energy costs?

- **LCC screening**
- **In/out of service view**

How to plan strategically your fleet procurement & refurbishment?

- **Strategic Assessment Reports**
- **Practical check lists for professionals**



## Simulation & evaluation concept

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The Railenergy is evaluating the performance of promising technologies and operational in four main steps:

1. Performing simulations of pre-selected use cases
2. Aligning the commercial multi train simulators using one common simulation input database format
3. Measuring the resulting energy consumption using agreed Key Performance Indicators (KPI)
4. Extrapolating and transferring results to increase coverage and usability of Railenergy simulations



## Demonstration scenarios & use cases

Railenergy Technology Matrix	Demonstration scenes and use cases											
	DS 1		DS 2					DS 3				
	1.1	1.2	2.1 A		2.1 B	2.1C	2.2	3.1	3.2	3.3	3.4	3.5
Rail service type	High speed		Intercity		Freight	Mixed intercity & freight		Regional			Intercity	
Country	France	Germany	Austria			Italy	France	Sweden	Netherlands		United King-dom	
Energy supply type	25 kV AC 50 Hz	15 kV AC 16.7 Hz	15 kV AC 16.7 Hz			3 kV DC	Diesel	15kV AC 16.7 Hz	1.5 kV DC		Diesel	
Rolling stock configuration	EMU	EMU	Loco	EMU	Loco	Loco / EMU	Loco	DMU	EMU	EMU		DMU

# Railenergy



<u>Railway domain</u>	<u>Technologies and measures</u>
<b>Management</b>	Eco-driving
	Parked train management
<b>Infrastructure</b>	DC Reversible substation
	Real-time power management
	2x 1.5 kV DC Traction system
	Asymmetrical system
	Parallel substation
	Reduced line impedances
	Increased line voltage (4kV)
<b>Onboard components</b>	Trackside energy storage unit
	On-board energy storage technologies
<b>Onboard traction</b>	Re-use of waste heat
	Superconducting transformers and inductances for railway traction
	Medium frequency energy distribution
<b>Onboard optimization</b>	Innovative hybrid diesel electric propulsion
	New control tech. to reduce converter energy consumption during coasting
	Active filtering tech. to reduce Input passive filter (reactors) losses
	Reuse of converters energy loss
	Medium voltage loads management

## Commercial multi-train simulators used

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- Sidytrac
  - Elbas
  - ECOtranz (diesel only)
  - Fabel
  - MOTORS
- Siemens
  - Alstom
  - Bombardier
  - Enotrac
  - Sciroidea



## Agreed Key Performance Indicators

### Energy performance on railway system level

#### ➤ KPIs for the operation of rolling stock

- KPI 1: Final Energy consumption per traction effort (kWh/gross tkm)
- KPI 2: Final Energy consumption per offered traffic (kWh/seat km)
- KPI 3: Primary Energy consumption per traffic output (KJ/Pkm~tkm)
- KPI 4: Final Energy consumption per traffic output (kWh/Pkm~tkm)
- KPI 5: Share of energy consumption for parked trains (%)
- KPI 6: Systemwide realised energy recuperation rate (%)

#### ➤ KPI for the operation of railway infrastructure

- KPI 7: Efficiency of the railway distribution grid (%)



## Technology Potential Tables (TPT)

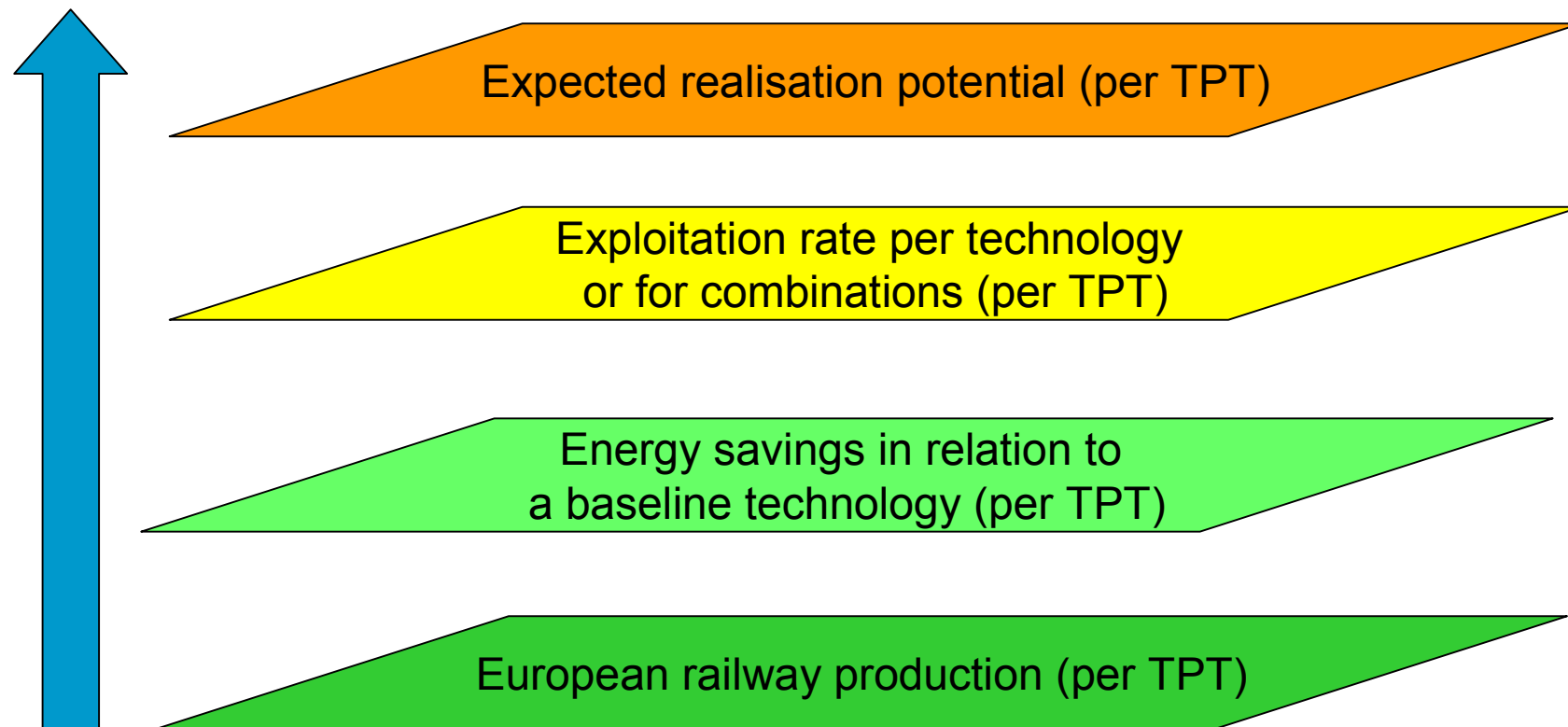
- A TPT table is created for each Railenergy technology to extrapolate simulation results from use cases to a general European situation taking into account the actual technology baseline.
- These values will apply for all relevant combinations of energy supply and service types.
- The TPT tables can always be updated with latest knowledge and represent a transparent structured approach

Railenergy technologies	Example: Reversible DC substation				
Network / Service type	suburban	regional	intercity	high-speed	freight mainline
DC 1.5 kV					
DC 3 kV	← -10,0%	-3,5%	-5,0%		→ -2,0%
AC 15 kV 16 2/3Hz					
AC 25 kV 50 Hz					
Not electrified (diesel)					

DC Traction		Simulated values are marked in green			
Railenergy Technology Potential Table					
Energy supply type / Service type	suburban	regional	intercity	freight mainline	
DC 1.5 kV and 3 kV					
Reversible DC substation	-10,0%	-6,9%	-5,0%	-2,0%	
Real time management	-6,0%	-2,0%	-1,0%		
2x 1.5 kV DC Traction System	-3,3%	-3,3%	-3,3%	-3,3%	
Reduced line impedance	-3,0%	-4,0%		-4,0%	
Trackside Energy Storage Unit	-5,0%	-5,0%	-5,0%	-5,0%	
On-board energy storage technology	10,0%	6,0%	3,0%		
New control tech. to reduce converter energy consumption during vehicle coasting	-3,5%	1,2% (loco), 3,5% (EMU)	1,0%		
Active filtering tech. to reduce Input passive filter (reactors) losses	-1,0%	-1,0%	-1,0%		
Reuse of converters energy loss	-0,5%	-0,5%	-0,5%		
MV Loads management	-0,5%	-0,5%	-0,5%		
Eco-driving	-15,0%	-10,0%	-9,6%		
Parked train management	-3%-8%	-3%-8%	-3%-8%		



## Strategic assessment approach





# Structuring of Strategic Assessment Reports

Railenergy technologies					
Network / Service type	suburban	regional	intercity	high-speed	freight mainline
	1. DC EMU	2A. DC EMU/Loco		3. AC EMU & Loco (including DC mode)	2B. DC Loco
	4. AC EMU	5A. AC EMU/Loco			5B. AC Loco
	6. DMU	7A. DMU/Loco			7B. Diesel Loco



## Strategic Assessment Reports

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### European situation today for the actual railway segment

- Two approaches: New procurement vs. refurbishment projects

### Assessment Methodology

#### Technical Performance

- Simulation and evaluation results (Technology Potentials)
- Technology assessment reports including time to market

#### Economic Performance

- LCC calculations

#### Strategic Assessment

- Pro's and cons' of implementation
- Three scenarios (ambition levels)

#### Recommendations

- Saving potentials for this railway segment
- Promising measures and combinations - ranked
- Main trends for this railway segment exploitation actions

# Railenergy Calculator

START

## General information

Welcome to the Railenergy calculator! This is....

You can fill in some basic information about yourself first in order to save and redo the inquiry. Short explanation here.... Read our FAQ or help file or????  
Happy inquiring!

## Create new inquiry

My name:

Company:

My inquiry name: \*

Date:

go to step 2

## Open examples and your saved inquiries

Example / Name	Energy supply type	Service type	Date
 <a href="#">Example a</a>			03.04.2009
 <a href="#">Example abc</a>			03.04.2009
 <a href="#">Example ab</a>			03.04.2009
 <a href="#">My personal inquiry xyz</a>			24.06.2010

## Login

email address

password

sign in

> password forgotten?

> register now

you can save your inquiry anytime later in the calculation process



- 1 Start
- 2 Scope and targets
- 3 Current setup
  - Yearly traffic production
  - Out of service consumption
- 4 Energy saving potentials
- 5 Energy mix and CO2
- 6 Energy and CO2 results
- 7 Economic framework
  - Life cycle costs
- 8 Economic results
- 9 Sensitivity analysis



## Railenergy Calculator

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### What is the Railenergy Calculator?

- Web-based screening tool to assist the rail industry to align their energy calculations and common understanding
- A "business to business" tool based on a uniform calculation methodology
- Analysis & prediction of energy savings, CO<sub>2</sub> emissions and LCC of saving strategies

### What is the tool NOT?

- The Railenergy Calculator is NOT a comparison tool between modes like Ecotransit and Ecopassenger.



## Railenergy Calculator

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### When should the Railenergy Calculator be used?

- For preparing and supporting railway management investment decisions for energy efficiency solutions during new procurement and upgrade/refurbishment

### Who will be the likely users of the Railenergy Calculator?

- Technical, procurement, strategy and management personnel from:
  - Railway operators, leasing companies and infrastructure managers
  - Railway manufacturers (system integrators and sub-suppliers)
  - Rail traffic authorities & agencies for rail service procurement
  - Consultants and academia supporting the industry players



## Railenergy Calculator

- Step 1: Start
- Step 2: Scope and targets
- Step 3: Current setup
- Step 4: Energy saving potentials
- Step 5: Energy mix and CO2
- Step 6: Energy and CO2 results
- Step 7: Economic framework(LCC)
- Step 8: Economic results
- Step 9: Sensitivity analysis

A screenshot of the Railenergy website interface. A large red rectangular overlay is centered on the page, containing white text. The text reads: "The Railenergy Calculator is part of the Railenergy website." and "The tool and the website will be available early November 2010." The background shows a web page with a navigation menu on the left, a login form at the top right, and a table of data at the bottom. The table has two rows: "Example.ab" with date "03.04.2009" and "My personal inquiry.xlsx" with date "24.06.2010".

**The Railenergy Calculator is part of the Railenergy website.**

**The tool and the website will be available early November 2010.**



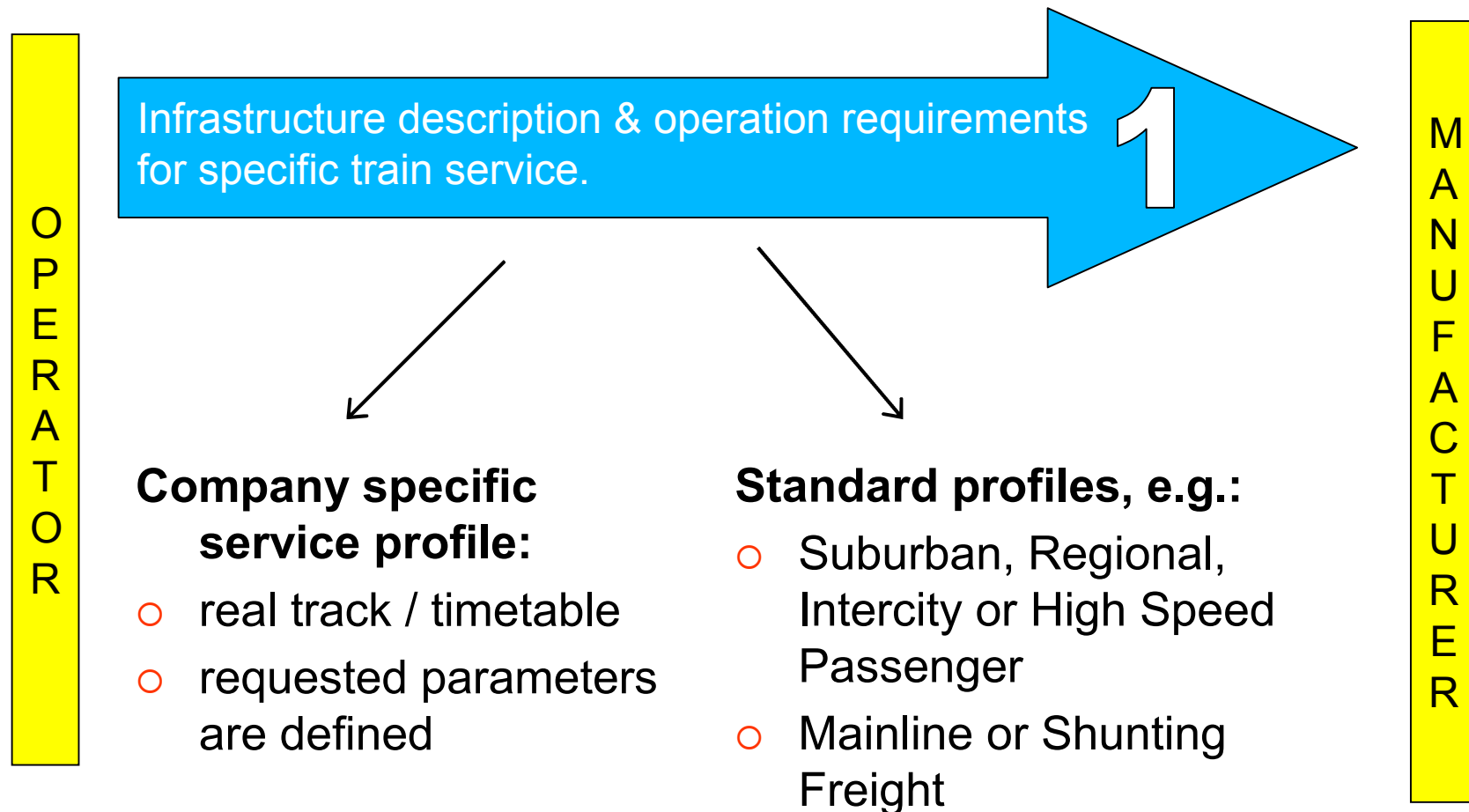
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## Specification and verification of energy consumption for railway rolling stock



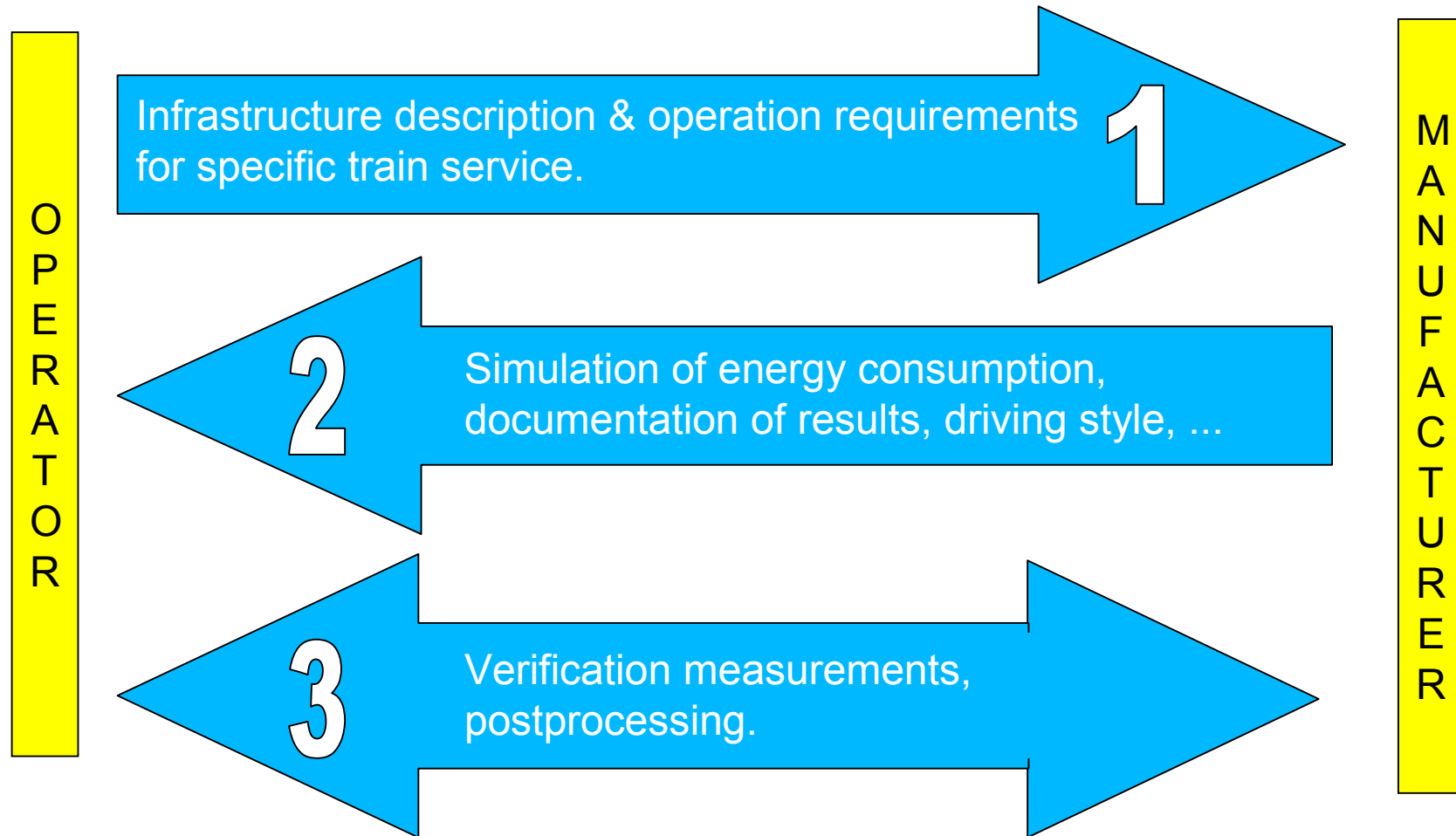
# Railenergy

## Specification and verification of energy consumption for railway rolling stock



# Railenergy

## Specification and verification of energy consumption for railway rolling stock



TecRec introduction:  
Enno Wiebe (UIC)



### Questions for the operators:

- Which railway companies are planning to buy or renew their rolling stock in the next period?
- Please could you request the TecRec 100\_001 to be used?
- Could the companies report on their experiences with the application of the TecRec 100\_001?
- UIC would compile a list of potential users to increase the knowledge exchange
- A revision workshop for the TecRec 100\_001 is foreseen for Spring 2011 – more information will be announced!

## Forthcoming Railenergy events 2010

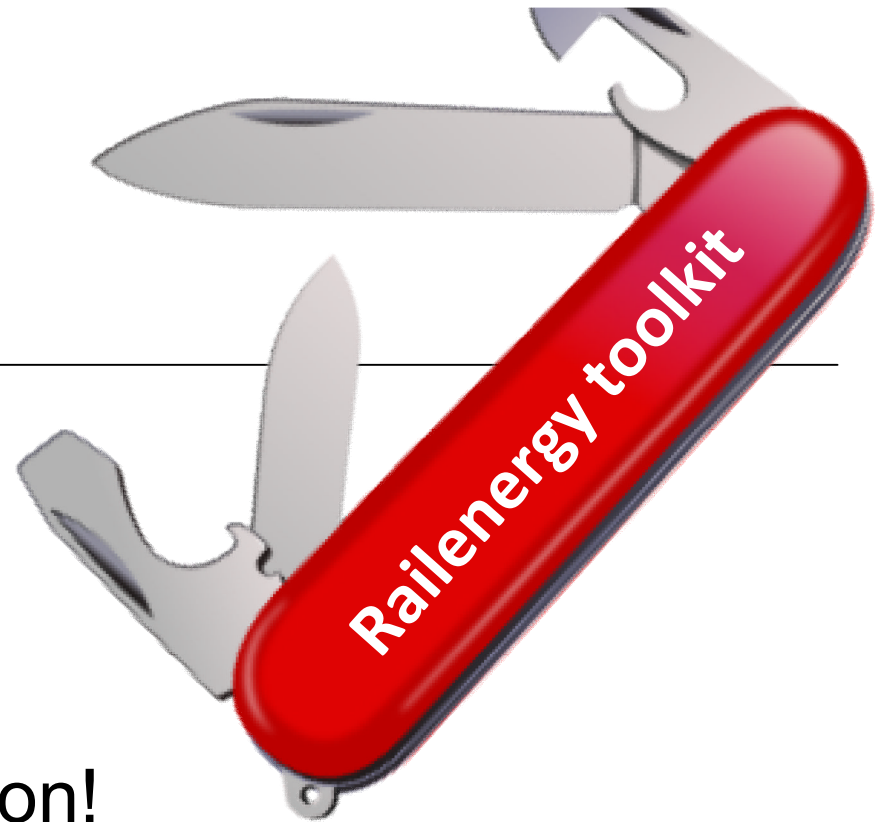
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- End August Draft “Strategic Assessment Reports” to be circulated to UIC & UNIFE members
- September 8<sup>th</sup> Strategic Assessment Workshop for UIC & UNIFE members (Brussels)
- September 22-24<sup>th</sup> Presentation at Innotrans (UNIFE stand)
- Early November **Railenergy website launch**
- November 25<sup>th</sup> **Final Conference - open for all (Brussels)**

# Railenergy

So don't forget your...

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Thank you for your attention!

Further questions can be directed to  
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Mads Bergendorff ([mads@macroplan.dk](mailto:mads@macroplan.dk))