

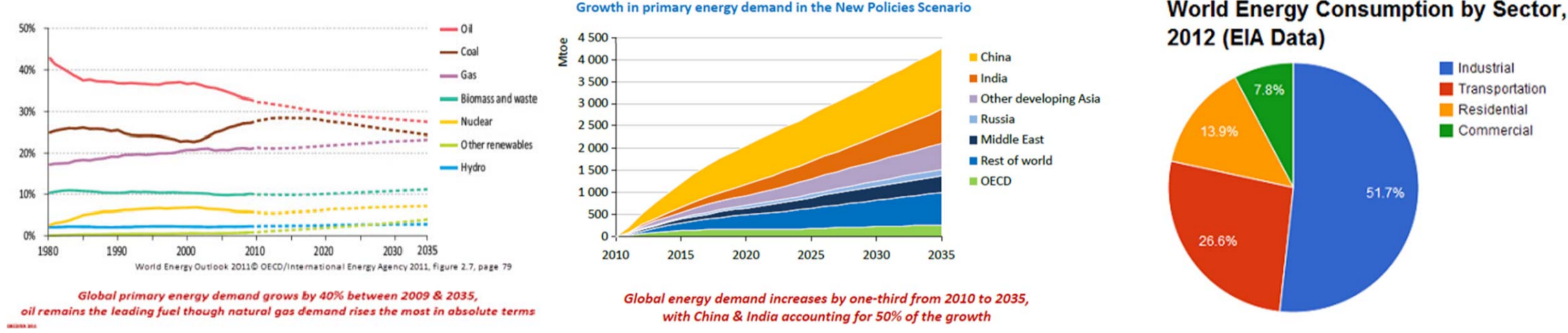


# Energy Efficient Strategies for Freight Rail Operations

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## Introduction:

Energy efficiency in transport systems is a huge challenge around the world. Why?



75-80% of the world total energy production is made by fossil fuels. Forecast for 2035 shows almost the same share.

Forecast for 2035 shows an increase of 40% of the energy requests. The increase of energy request is mainly due to BRICS countries growth.

Transport takes nearly 1/3 of the world total energy production

Energy costs and pollution will relentlessly rise ...

## Motivation:

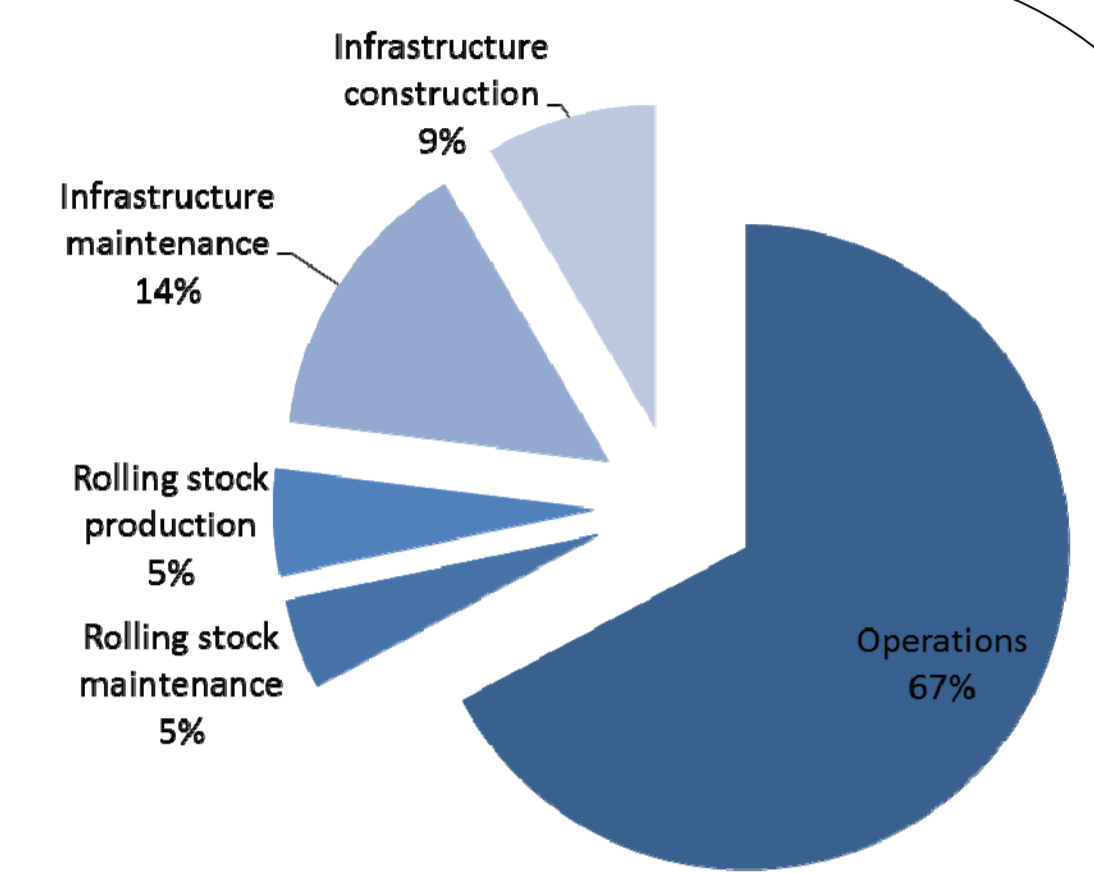
We focus on energy efficient strategies for freight rail because:

- Energy efficiency in rail freight has not been deeply investigated so far.
- Improving rail freight operations would lead to a modal shift from road to rail .

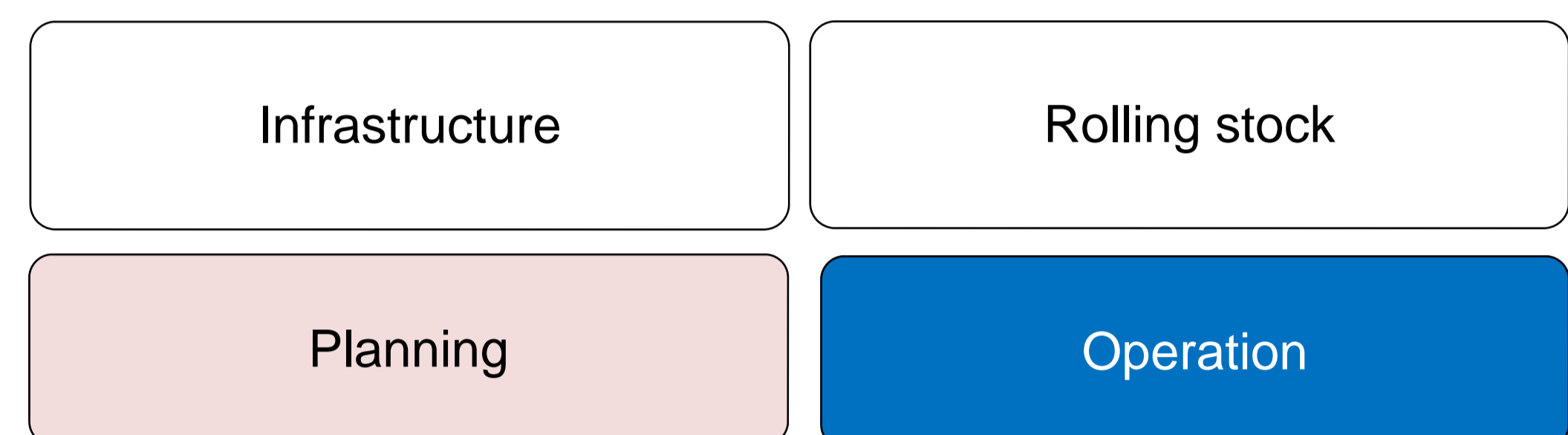
## Energy consumption in rail freight:

From Swiss data:

- The largest part of the energy consumption is used for operation purposes.
- But there is also a significant use of energy for maintenance and construction



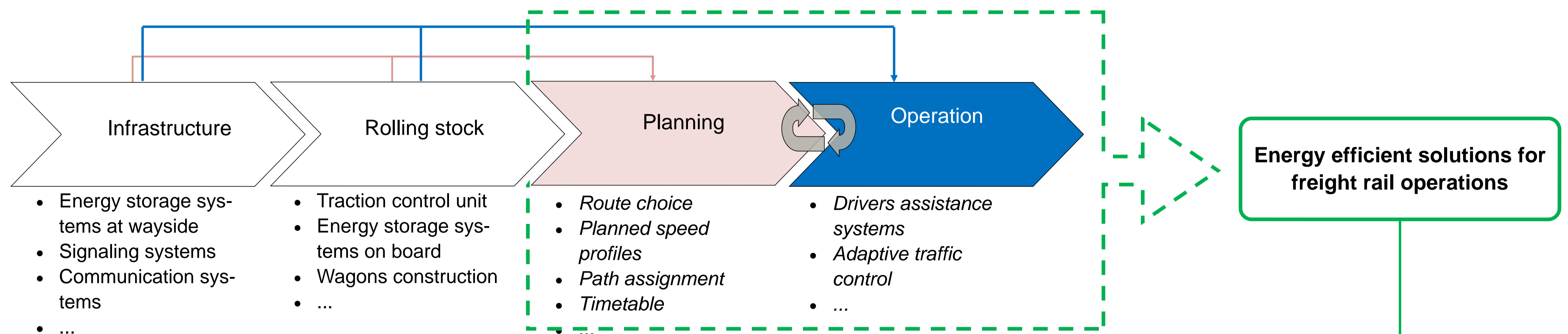
## Key factors for energy efficiency implementation



From a global point of view, there will be positive effects in Modal Shift :

- The measures in energy efficiency increase the quality of rail freight and reduce the operational costs.
- Thus the energy efficiency improves the competitiveness of rail freight.
- Additional global energy savings can be achieved by modal shift from road to rail.

## Planning and Operation interactions with the other rail subsystems for improving energy efficiency



## Energy efficient solutions for freight rail operations:

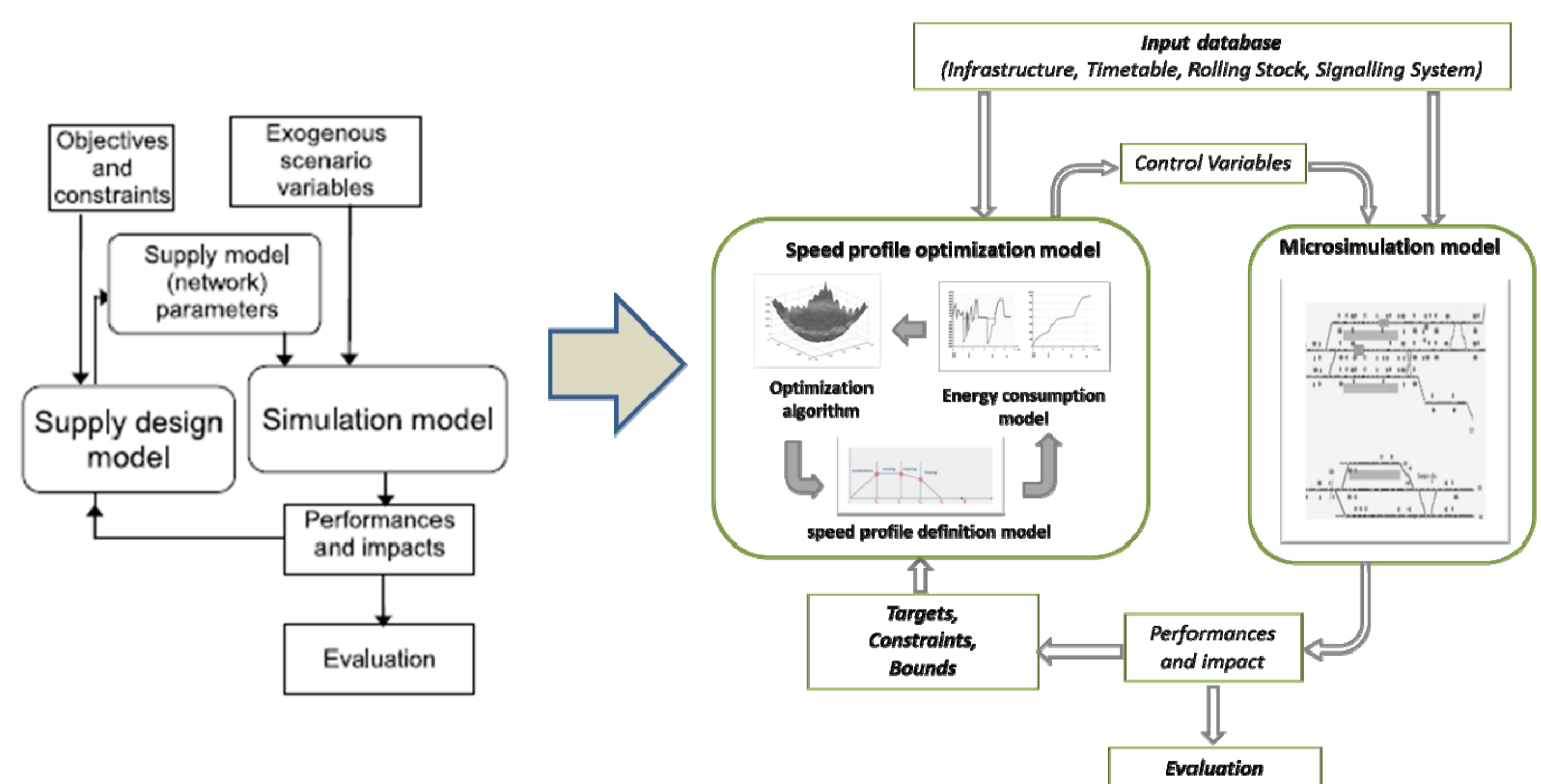
Optimization of freight rail services strictly depends on the chosen level of control and on how energy efficiency is intended (energy efficient strategy).

	Energy consumption reduction	Energy recovered and reused	Optimal use of power supply
<b>Multiple trains view</b>	<b>Solutions:</b> <ul style="list-style-type: none"> <li>• Anticipating train control (unplanned stops reduction)</li> <li>• Departure rescheduling (green wave corridor)</li> <li>• ...</li> </ul>	<b>Solutions:</b> <ul style="list-style-type: none"> <li>• Use of energy storage systems at electric substations</li> <li>• Energy transmission between different trains/to the public grid</li> <li>• ...</li> </ul>	<b>Solutions:</b> <ul style="list-style-type: none"> <li>• Use of energy storage systems at electric substations</li> <li>• Rescheduling during low demand hours</li> <li>• ...</li> </ul>
<b>Single train view</b>	<b>Solutions:</b> <ul style="list-style-type: none"> <li>• Acceleration and/or speed reduction</li> <li>• Coasting phase introduction</li> <li>• ...</li> </ul>	<b>Solutions:</b> <ul style="list-style-type: none"> <li>• Use of energy storage system on board</li> <li>• ...</li> </ul>	<b>Solutions:</b> <ul style="list-style-type: none"> <li>• Auxiliary systems supply (on board energy management system)</li> <li>• ...</li> </ul>

## Our approach:

A bi-level simulation-based framework for the evaluation of energy efficient solutions that consider both the rail traffic conditions and the single vehicle motion.

The proposed framework will be developed on the basis of the "What to" approach for supply design modeling. The figure on the right shows the framework based on the "what to" approach and specialized for speed profiles optimization.



## Expected results:

- Definition of a framework for the analysis and the evaluation of energy efficiency in rail freight
- Definition of a simulation-based optimization tool for the evaluation of different energy efficient solutions
- Definition of a cost-effectiveness evaluation model
- Definition of KPIs on energy related capacity utilization
- Definition and implementation of simulating scenarios, related to different operating conditions, for energy efficient solution evaluation.
- Evaluation of energy efficient strategies for freight train operation, their effectiveness and their effects on the rail traffic

## Schedule of the project:

WP	Year	2014		2015				2016	
		3rd	4th	1st	2nd	3rd	4th	1st	2nd
WP1 State of the Art									
WP2 Definition of the framework									
WP3 Definition of a tool for energy efficient operation of freight trains									
WP4 "Proof of concept"									
WP 5 Cost-Effectiveness Evaluation model with KPI									
Final Report									