Environmental impact assessment of rail freight intermodality in Belgium using the Life Cycle Assessment (LCA) methodology

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Introduction

Intermodal freight transport consists in the shifting of road transport in long distances to others modes of transport with improved environmental performance such as rail and inland waterways transport. In our research, we have carried out the LCA of rail, inland waterways and road freight transport independently. Moreover, we have studied the environmental impacts related to intermodal freight transport.

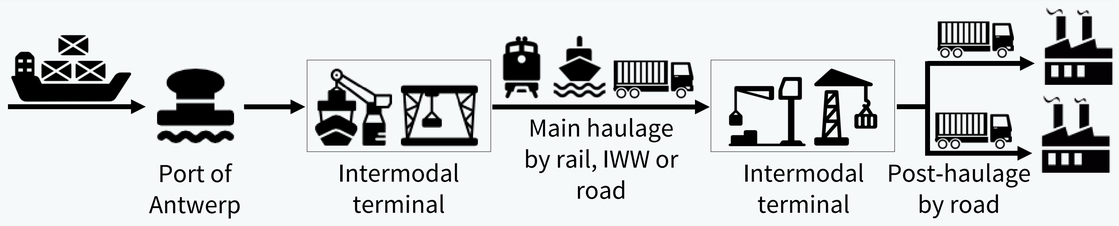
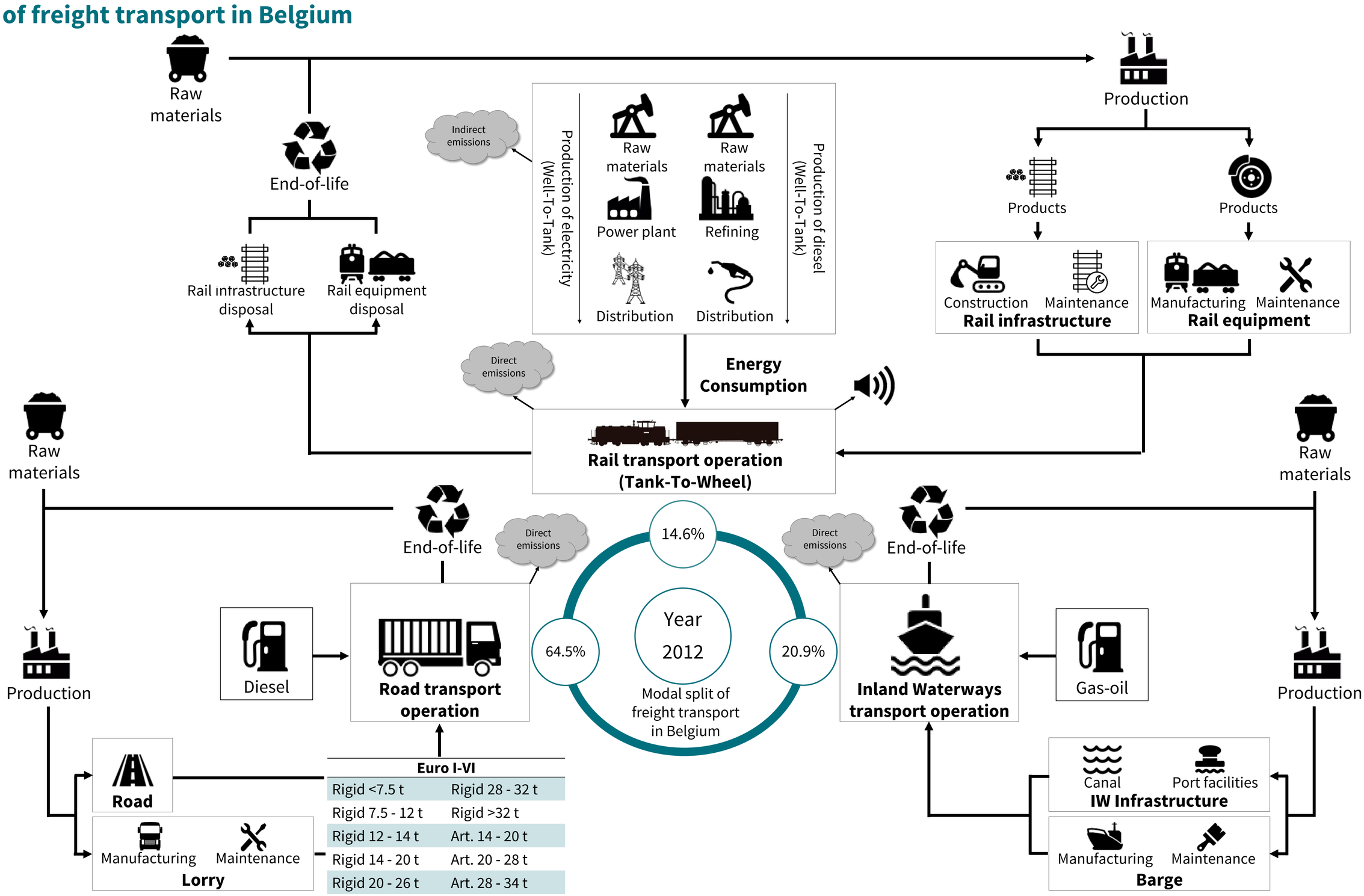


Figure 1. Example of intermodal freight transport system

LCA of freight transport in Belgium



Euro I-VI	
Rigid <7.5 t	Rigid 28 - 32 t
Rigid 7.5 - 12 t	Rigid >32 t
Rigid 12 - 14 t	Art. 14 - 20 t
Rigid 14 - 20 t	Art. 20 - 28 t
Rigid 20 - 26 t	Art. 28 - 34 t
Rigid 26 - 28 t	Art. 34 - 40 t

Figure 2. Inland freight transport system boundaries

LCA of freight transport in three Belgian scenarios in the year 2030

- We have analysed how the increase of rail freight transport as a result of the possible development of the intermodal rail freight transport affects the environmental impacts of the modal split of inland freight transport in Belgium. For this, we have studied an increase of rail demand of 133%, 64% or 10% for a best, medium and worst case scenarios by 2030 considering as reference year 2012.

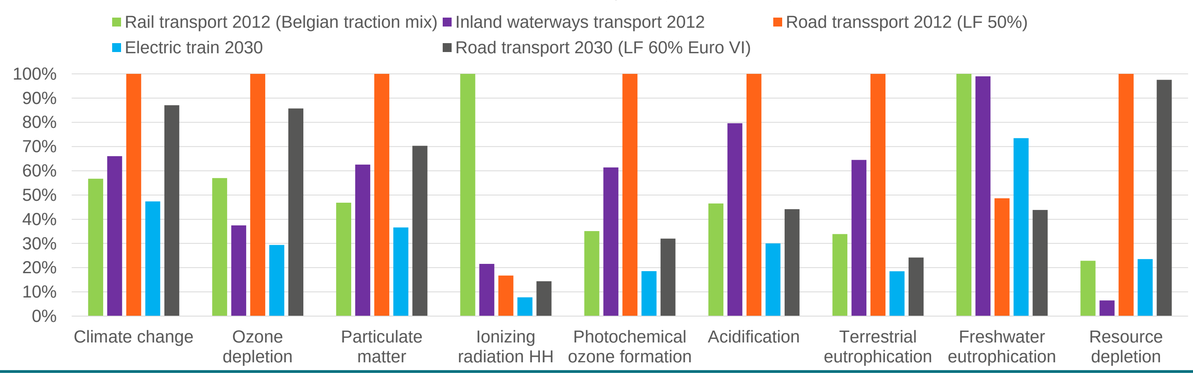
Modal split (%)	Year 2012	Scenarios in the year 2030		
		Best	Medium	Worst
Railway	14.6	20	16.8	14
Inland waterways	20.9	20.9	20.9	20.9
Road	64.5	59.1	62.3	65

- For 2012, the Belgian traction mix includes 86% of electric trains and 14% of diesel trains, and an average road transport with a 50% of load factor has been considered. For 2030, the process inland waterways transport remains the same than 2012, the rail freight transport will be performed by electric traction and the average road transport will improve to a load factor of 60% and the main engine technology will be the Euro VI.

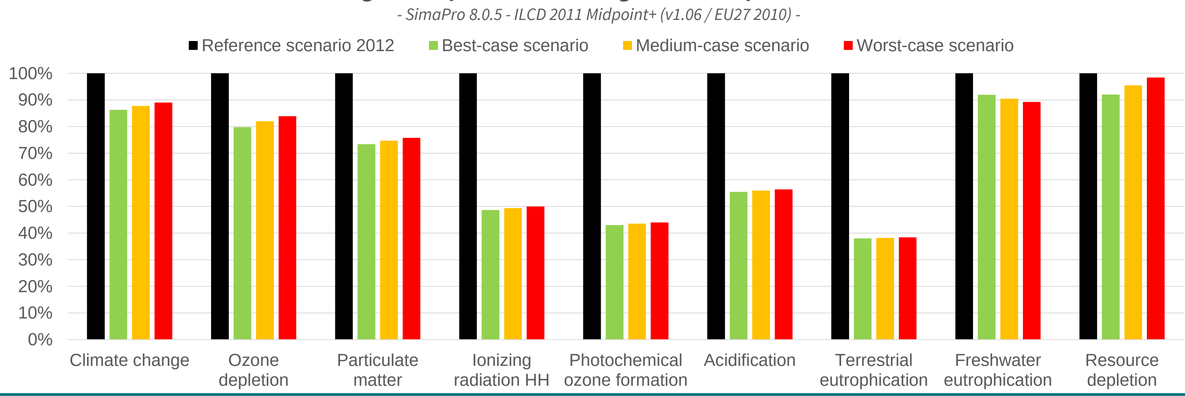
- The electricity supply mix of Belgium for 2030 has been estimated considering a scenario in which all the all targets for CO_2 emission reduction have been achieved and nuclear power is no longer used [1]. The Belgian traction mix of 2012 presents the maximum impact on the indicator ionizing radiation due to the use of nuclear power in the electricity production in Belgium.

- Road transport is the main contributor in all the scenarios to the total impact on all the environmental impact indicators. The reference scenario of the year 2012 shows the maximum impact in all the environmental impact indicators due to the great influence of the average road transport process with a load factor of 50%. This process has the highest energy consumption and exhaust emissions of the transport processes considered in the study. The Euro VI technology influences on the indicators particulate matter, photochemical ozone formation, acidification and terrestrial eutrophication due to the lower exhaust emissions in comparison with the other engine technologies on NO_X, $PM_{2.5}$, and NMVOC.

LCIA of 1 tkm of freight transported by the transport processes used in the scenarios
- SimaPro 8.0.5 - ILCD 2011 Midpoint+ (v1.06 / EU27 2010) -



LCIA of 1 tkm of freight transported considering the modal split of the different scenarios
- SimaPro 8.0.5 - ILCD 2011 Midpoint+ (v1.06 / EU27 2010) -



Conclusions

1. The electricity supply mix plays a fundamental role in the environmental impacts of rail freight transport when using electric traction. Therefore, as the use of electric trains increases in the future, the energy split for the electricity generation will be more important in the environmental impacts of transport.
2. The load factor and emission engine technology are shown as determining factors in the environmental impacts of road transport. Therefore these factors have a strong influence in the environmental impact of the total inland freight transport due to the prominent position of road transport in Belgium.

References [1] Léonard, A., Belboom, S., "Évaluation des impacts environnementaux de la production d'électricité en Belgique par Analyse du Cycle de Vie : Vues du passé, présent et scénarios prospectifs", Rapport final convention ECEB, 2016.