
REFINING INDUSTRIES AND LOW CARBON PROCESSES – A NEED TO INNOVATE

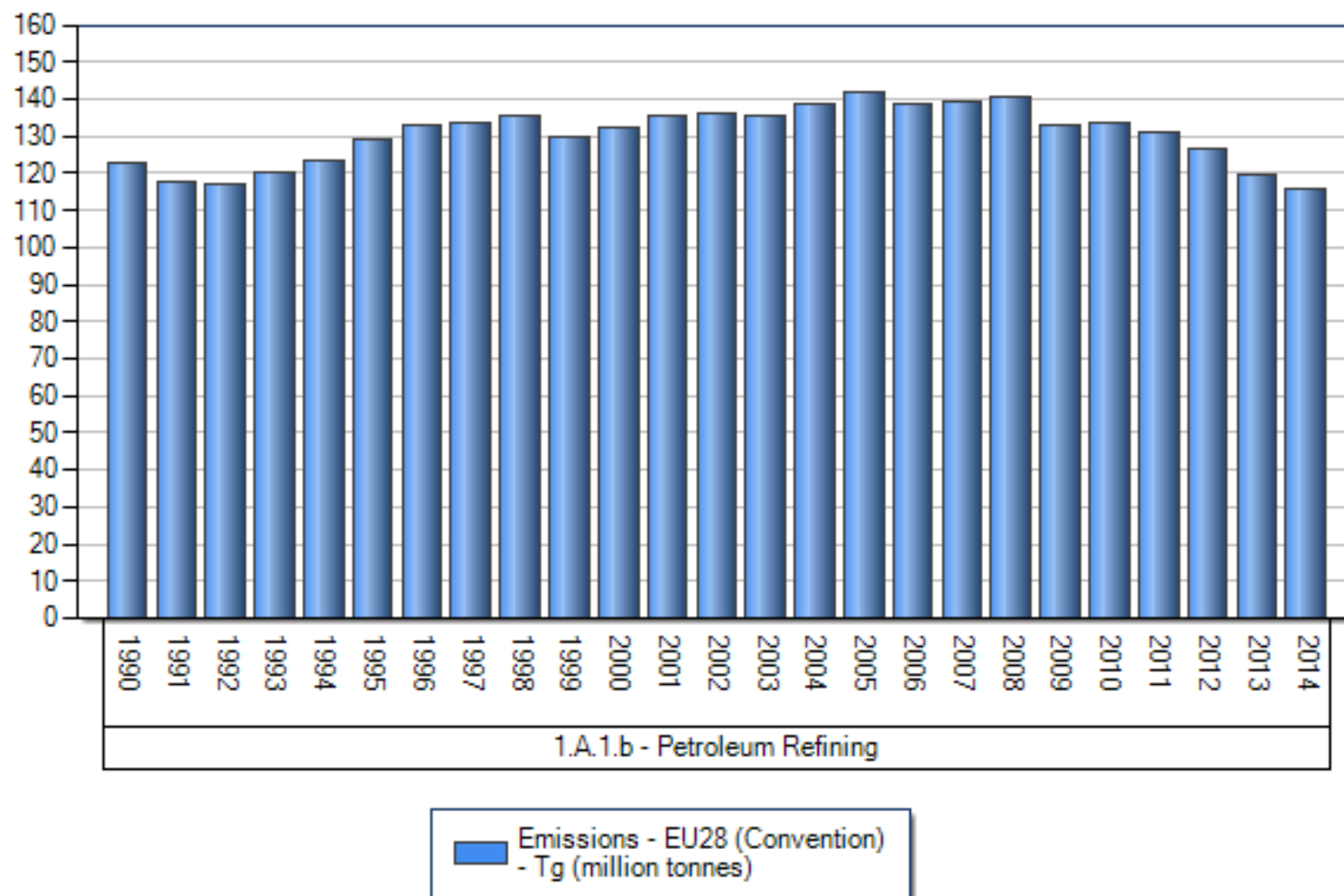
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and

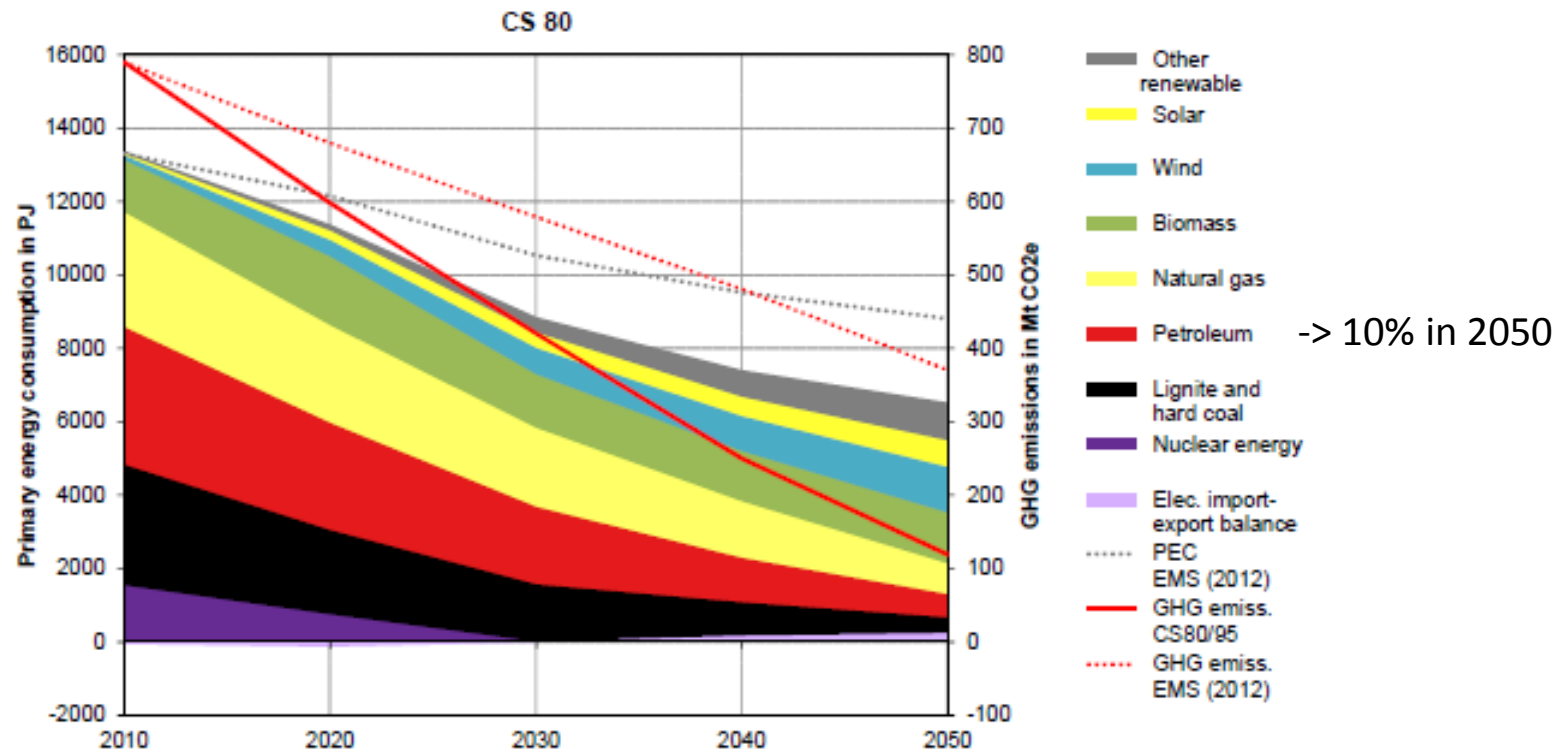
² Utrecht University (Netherlands)

Greenhouse Gas Emissions 1990-2014 (EU28)



Decarbonisation challenge

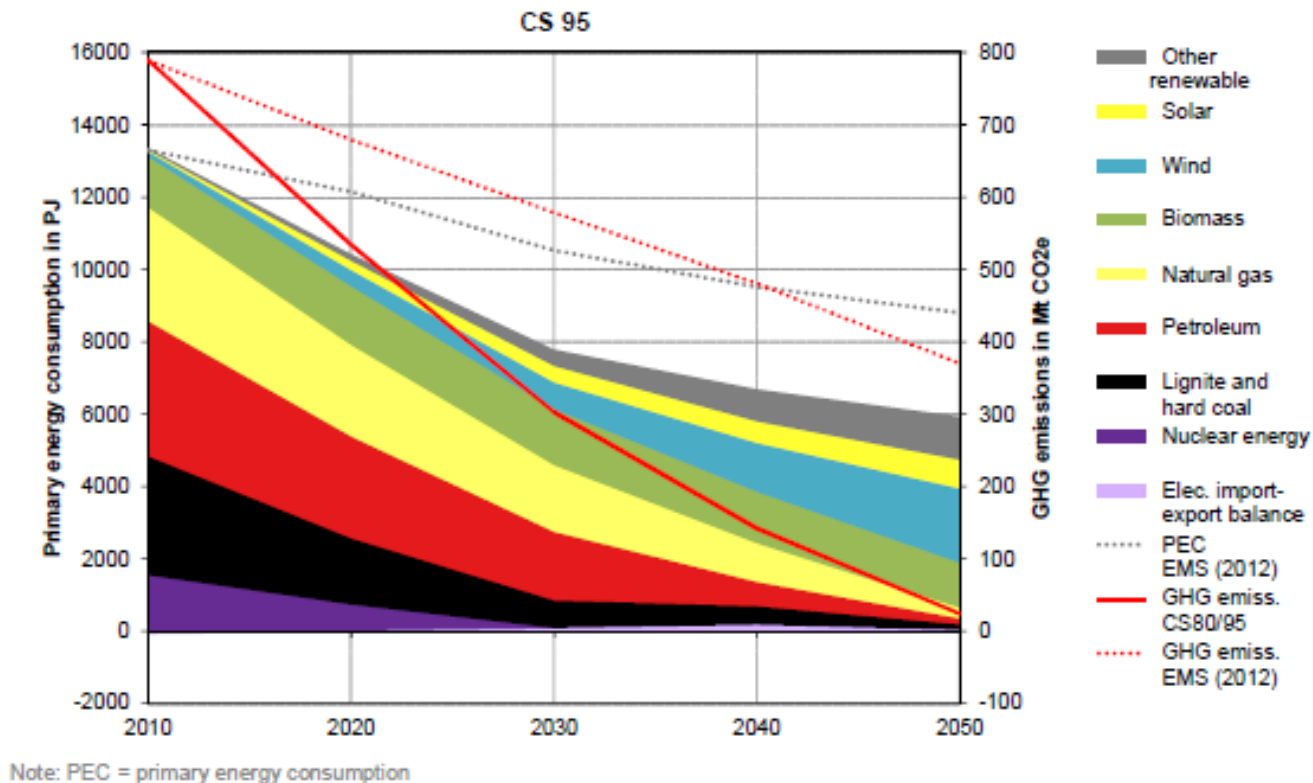
Primary energy consumption in Germany, 2010-2050



To achieve an **emission reduction of 80 %** compared to 1990 levels, demand for petroleum products will have to decrease significantly up to 2050

Decarbonisation challenge

Primary energy consumption in Germany, 2010-2050



To achieve an **emission reduction of 95 %** compared to 1990 levels, demand for petroleum products will have to decrease significantly up to 2050

Structural changes for classical actors ongoing ... more to come



EnBW Energie Baden-Wuerttemberg AG (EBK.DE) - XETRA Ticker: 522000/ISIN: [Zum Portfolio hinzufügen](#) [Gefällt mir](#)
25,40 **+0,15(0.61%)** 4. Jun 17:36



Source:

<http://de.finance.yahoo.com/echarts?s=EBK.DE#symbol=ebk.de;range=my;compare=;indicator=volume;charttype=area;crosshair=on;ohlcvvalues=0;logscale=off;source=undefined;>

Research Paper

Paul Stevens

Energy, Environment and Resources | May 2016

International Oil Companies The Death of the Old Business Model

Source: Chatham House 2016

<https://www.chathamhouse.org/sites/files/>

[chathamhouse/publications/research/2016-05-05-international-oil-companies-stevens.pdf](https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-05-05-international-oil-companies-stevens.pdf)

Double challenge for Refineries

- Quite some refineries (17 out of 100 since 2008) have been closed in Europe in the past years: <https://www.fuelseurope.eu/dataroom/static-graphs>, while their utilization rate has also decreased (indicating that more closure might well come);
- There is pressure on the continued use of fossil fuels in transport see for example:
 - IEA WEO 2016, 450 scenario, for OECD Europe: share of oil in transport decreasing from 89% (2020) to 52% (2040; with further 18% electricity and 23% biofuels and 7% other fuels
 - In the Commission's low carbon roadmap, emissions from the transport sector will significantly decrease between now and 2050 (https://ec.europa.eu/clima/policies/strategies/2050_en)
- Electric vehicles: Structural shift from gasoline car to electric mobility. On the future energy sources for transport, many options are open; see for example : <http://www.shell.com/energy-and-innovation/the-energy-future/future-transport.html>
- Pressure to insulate houses and shift to heat pumps and solar heating/cooling
- Pressure from investor side on fossil-fuel based investments



Pressure to decarbonize production processes



Pressure to replace the products



Strong need for innovation

Mitigation options in basic materials industries

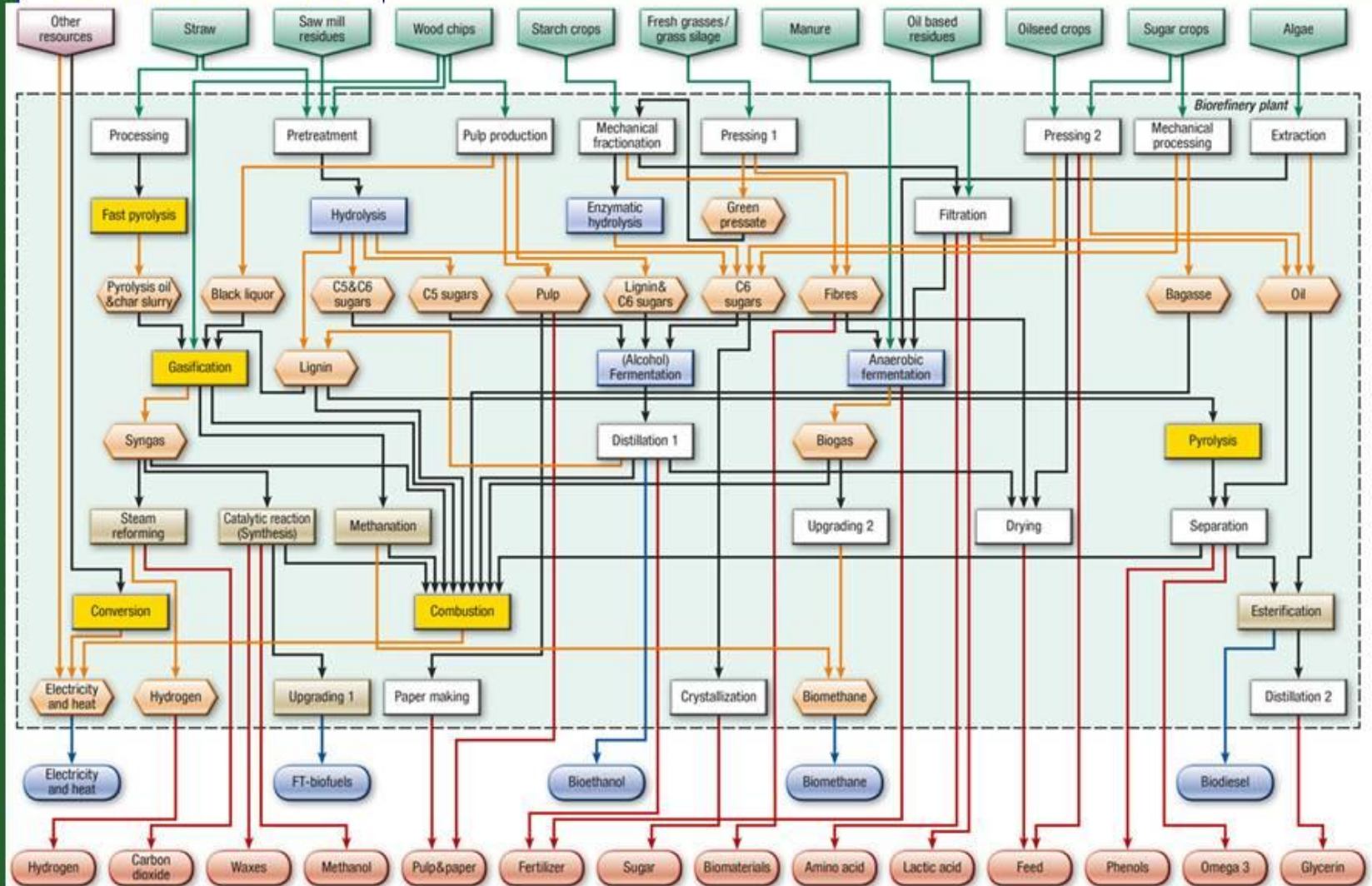
	Clusters of mitigation options	Technology Readiness Level TRL
Materials industry	Integrated process improvement - Energy Efficiency (modernization and replacement) - Reduction in process-related emissions	
	Fuel switch - towards renewable energy sources (e.g. based on hydrogen) - towards decarbonized electricity (indirect emissions)	
	End-of-pipe (Carbon Capture and Storage CCS/ Carbon Capture and Use CCU)	
	Recycling and re-use (innovative recycling processes)	
downstream	Material efficiency (in production and downstream)	
	Material substitution (downstream)	



Possible innovation concepts

- Carbon Capture and Storage
- Gas-to-liquids technologies – transformation of synthetic crude
- Renewable hydrogen/carbon (electrolysis/syngas):
production of hydrocarbons (methane, methanol, Fischer-Tropsch-naptha)
for replacing the fossil feedstock (mainly naphta or ethane) in the
petrochemical industry
- Biorefining
- ...

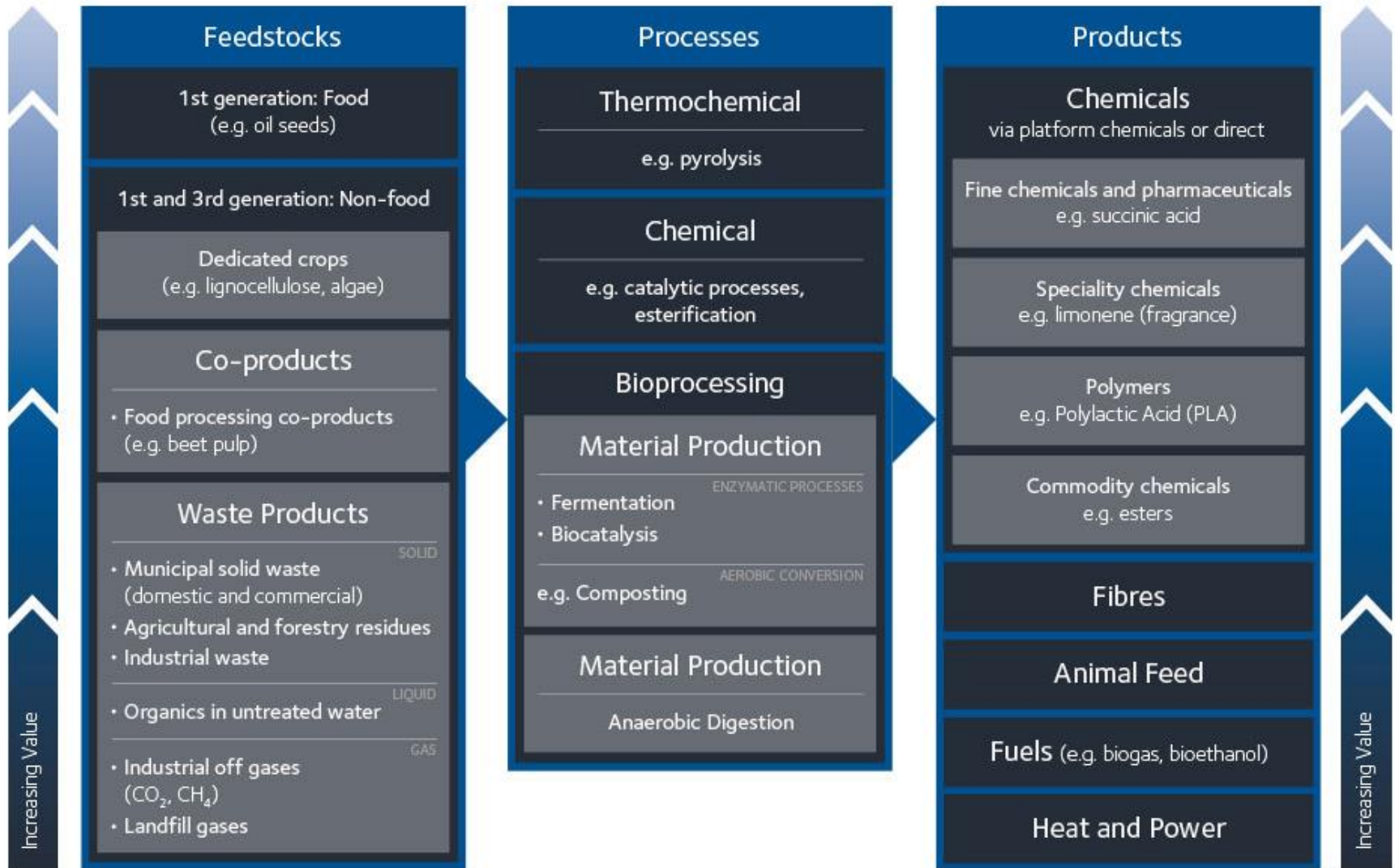
Task 42 Biorefining



Source: Joanneum Research, Austria

Source: <http://www.iea-bioenergy.task42-biorefineries.com/en/ieabiorefinery/Factsheets.htm>

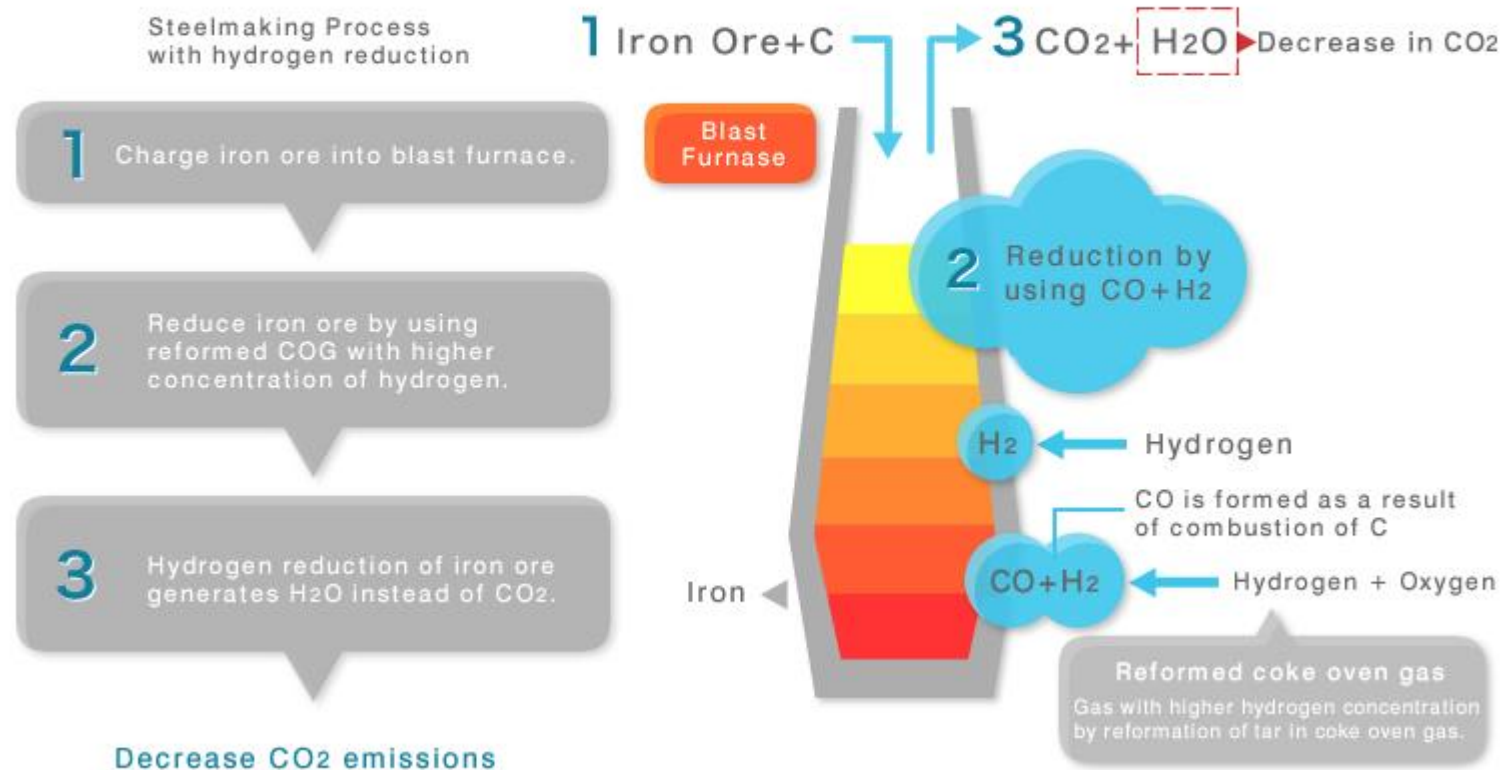
Feedstock, product, process



Example from Iron/Steel Sector

Hydrogen-based Reduction of Iron Ores

'Hydrogen reduction of iron ore generates H_2O instead of CO_2 , leading to decrease in CO_2 emissions.



Backup

Biorefinery example

Integration of pulp production with other manufacturing processes utilising biomass as raw material

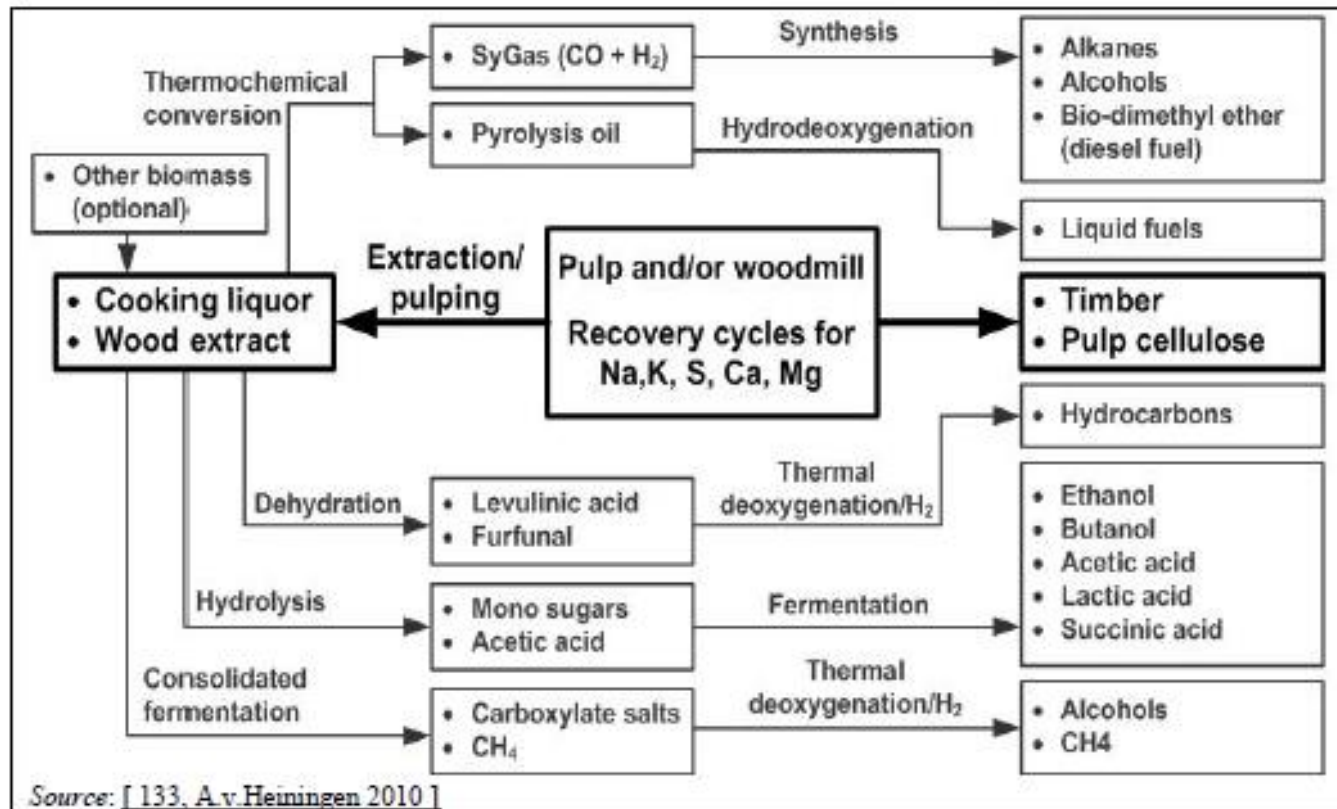


Figure 3.87: Forest biorefinery pathways

Biorefinery concepts

Four relevant features: platforms, products, feedstocks, processes

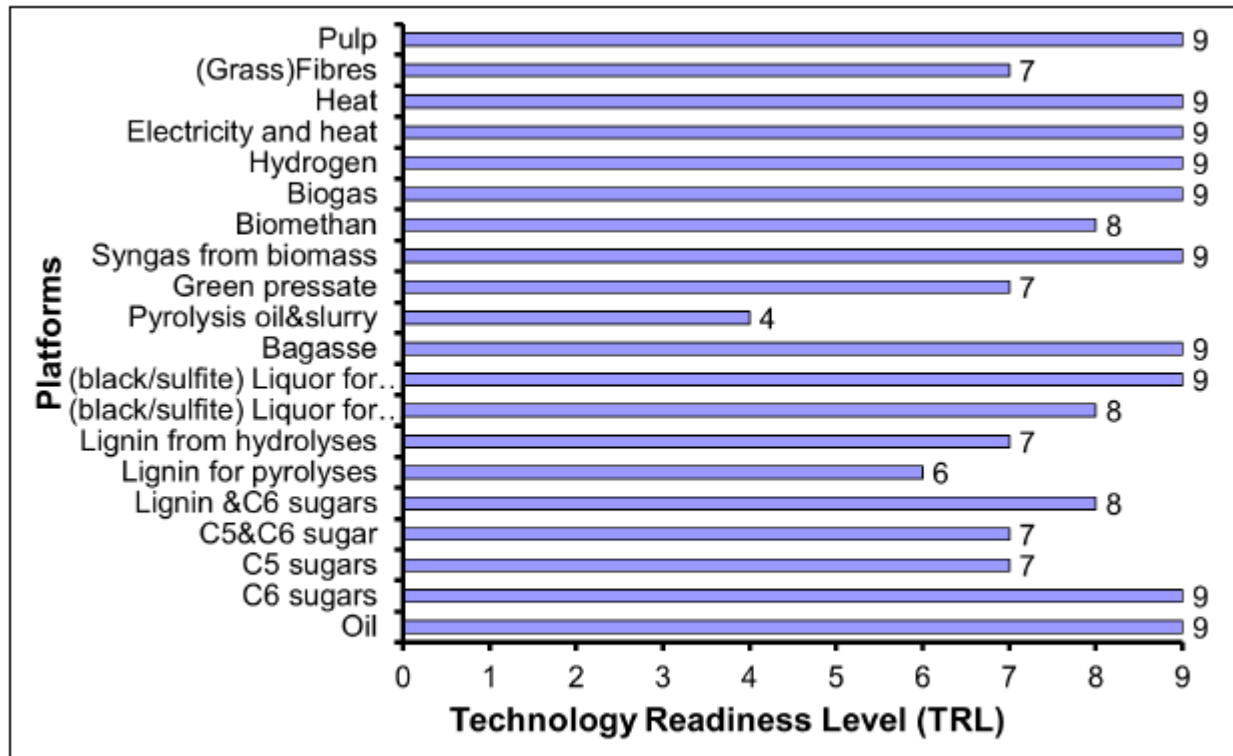


Figure 7: Technology Readiness Level of platforms

Biorefinery concepts

Four relevant features: platforms, products, feedstocks, processes

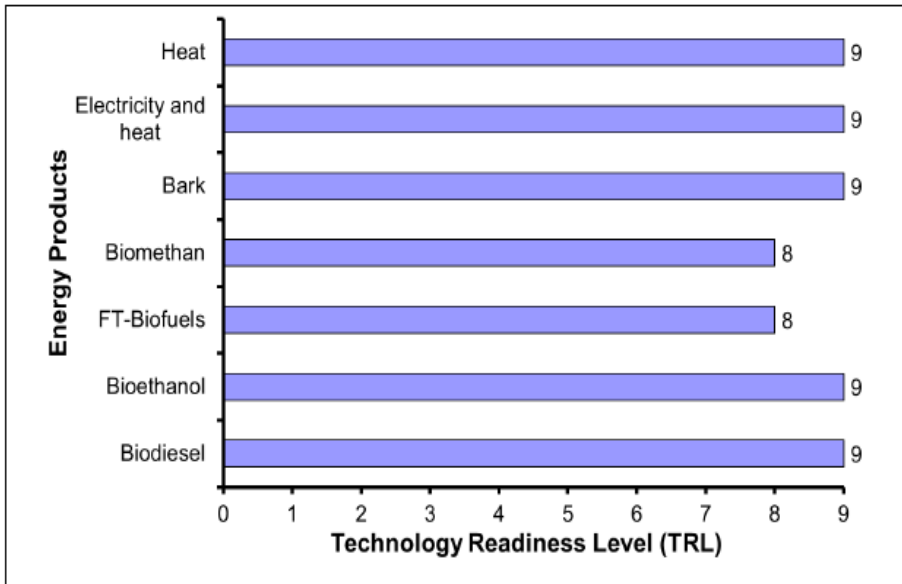


Figure 9: Technology Readiness Level of energy products

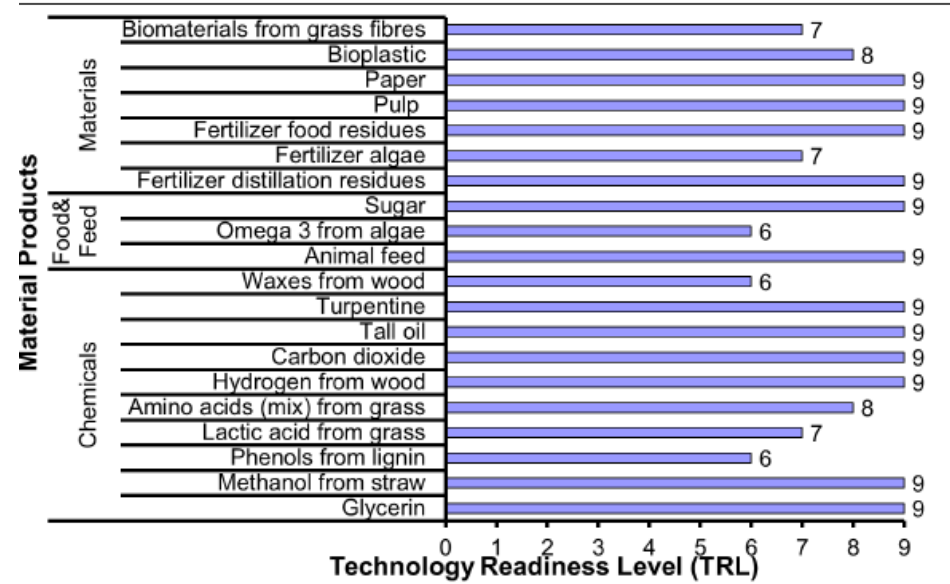


Figure 10: Technology Readiness Level of material products

Biorefinery concepts

Four relevant features: platforms, products, feedstocks, processes

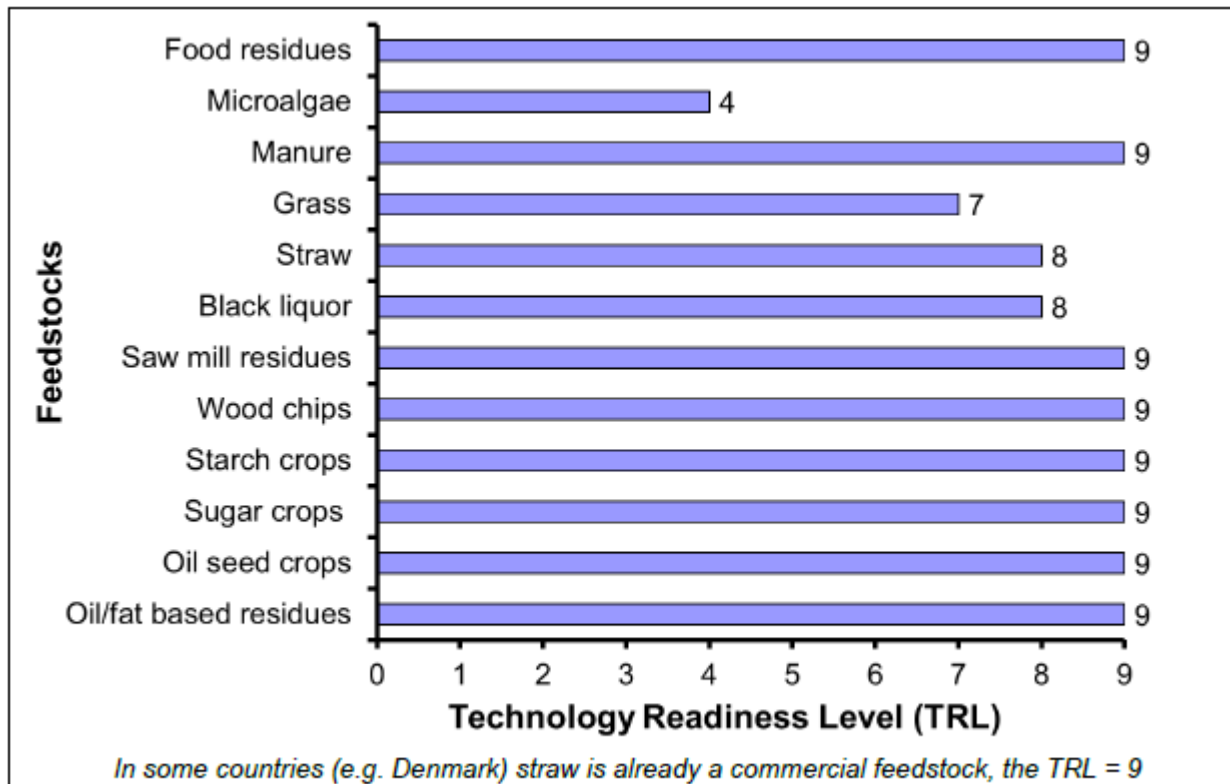


Figure 8: Technology Readiness Level of feedstocks

Biorefinery concepts

Four relevant features: platforms, products, feedstocks, processes (only selected example from a variety of processes)

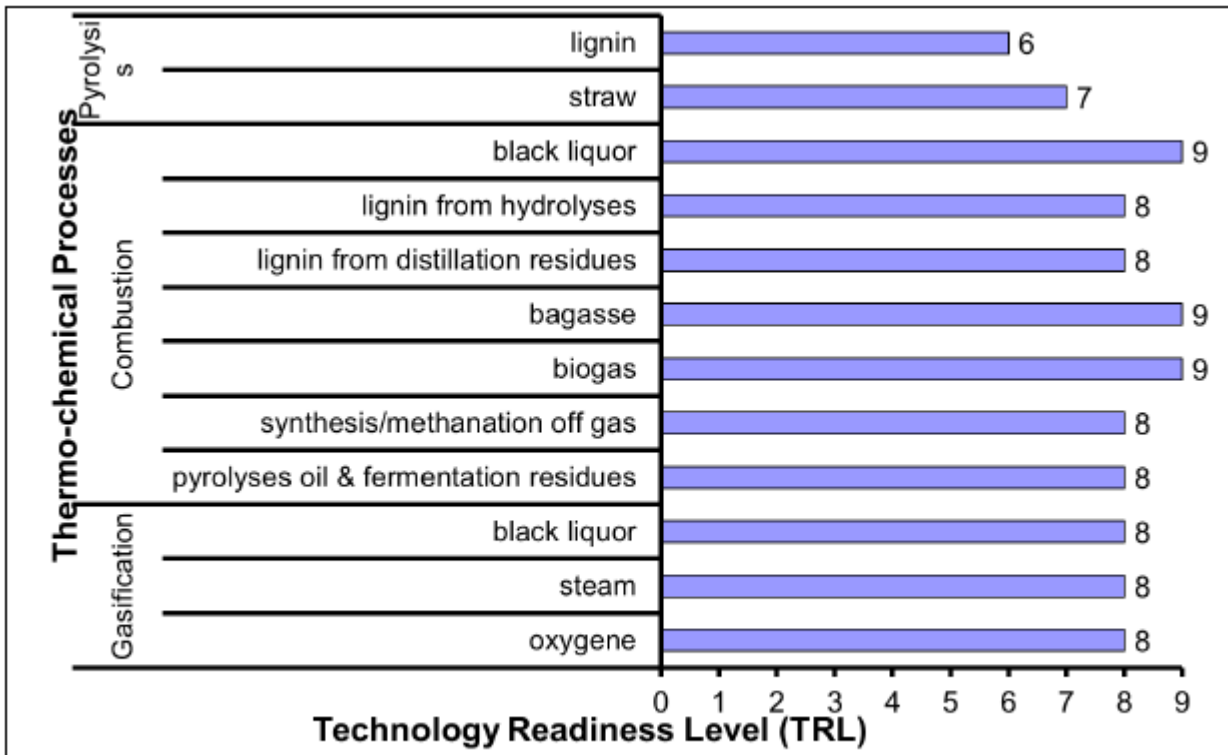


Figure 11: Technology Readiness Level of thermo-chemical processes