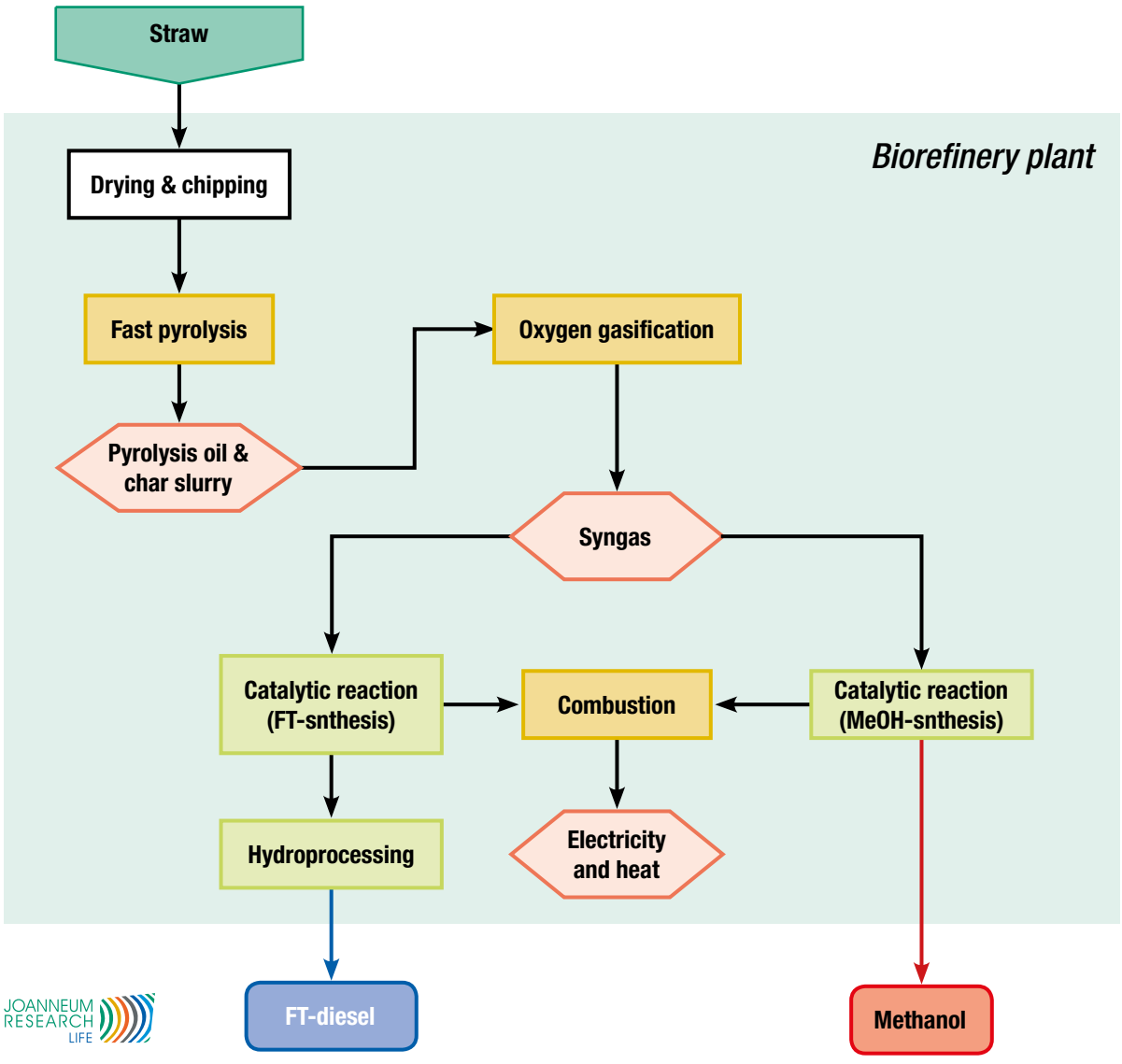
3-platform (pyrolysis oil, syngas, electricity&heat) biorefinery using straw for FT-diesel and methanol with oxygen gasification

Part A: Biorefinery plant

The demonstration scale energy driven "3-platform (pyrolysis oil, syngas, electricity&heat) biorefinery using straw for FT-diesel and methanol with oxygen gasification" converts straw to FT-diesel. In the fast pyrolysis the straw is used to produce pyrolysis oil and char in several decentralized locations close to the origin of the straw supply. The oil and the char are mixed together and are transported as a slurry to one central gasification plant which uses oxygen as gasification medium. In the gasification a syngas (CO and H_2) is produced by using oxygen as a gasification medium. This syngas is then converted to FT-diesel in the FT-synthesis and to methanol in the methanol synthesis. The main difference of the FT- and the methanol synthesis is on pressure, temperature, catalyst and the ratio between CO and H_2 in the synthesis gas, e.g. FT-biofuel: 200 – 250 °C, 20 – 30 bar with Fe and/or Co as a catalyst. The methanol is mainly used as a chemical. Process residues of both processes are used to produce electricity and heat to cover fully the internal demand. After the successful development and demonstration of fast pyrolysis of straw in future further applications and uses for the pyrolysis oil might become interesting, e.g. the direct integration of pyrolysis oil in an existing oil refinery via upgrading to a renewable diesel fuel. In addition the char from pyrolysis can be used to produce other products for chemical industry to substitute fossil based products, e.g. activated char, which is not considered in the assessment here.



JOANNEUM RESEARCH LIFE

IEA Bioenergy Task 42 Biorefining

3-platform (pyrolysis oil, syngas, electricity&heat) biorefinery using straw for FT-diesel and methanol with oxygen gasification

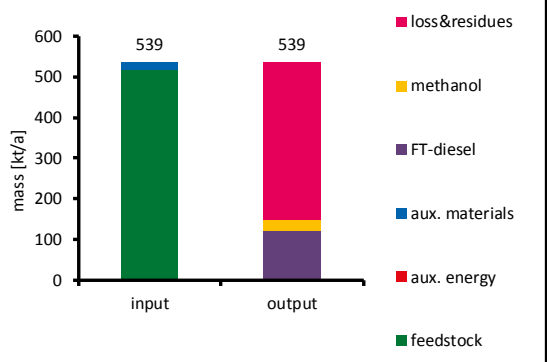
State of technology: commercial 2013
Country: EU 27
Main data sources: BIOGRACE, JOANNEUM RESEARCH

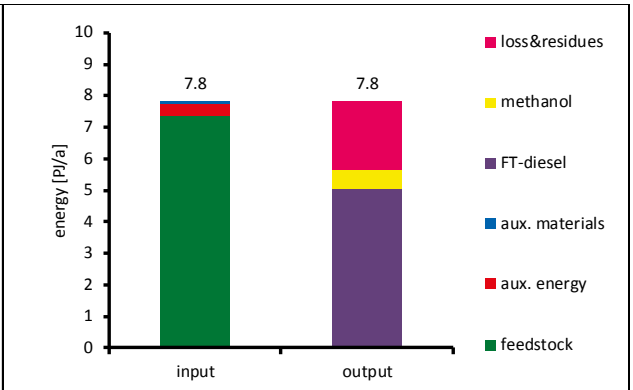
Biorefinery Complexity Index (Products/Platform/Feedstock/Processes): 25 (8/2/3/12)

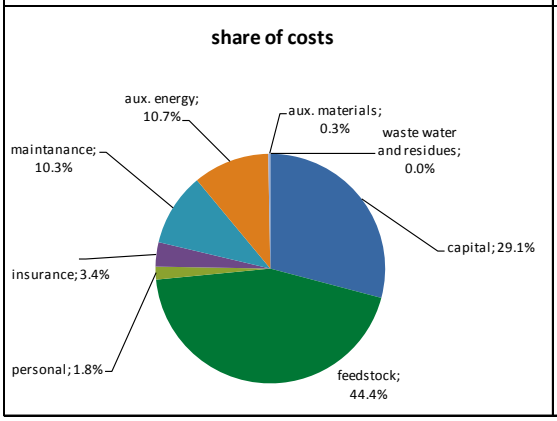
Products		**Auxiliaries (external)**	
FT-diesel	120 [kt/a]	electricity	0.36 [PJ/a]
methanol	30 [kt/a]	heat	0.00 [PJ/a]
		others: various	20.7

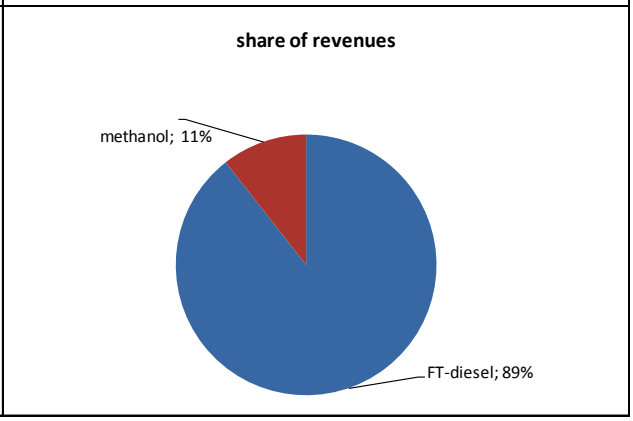
Feedstock	**[kt/a]**	**water [%]**	**Costs**	
straw	518	15.0%	investment costs	255 [Mio €]
			feedstock costs	64 [€/t]
			number of employees	30 [#]

Efficiencies	**mass**	**energy**
input to products	28%	72%
input to transportation biofuel	22%	64%



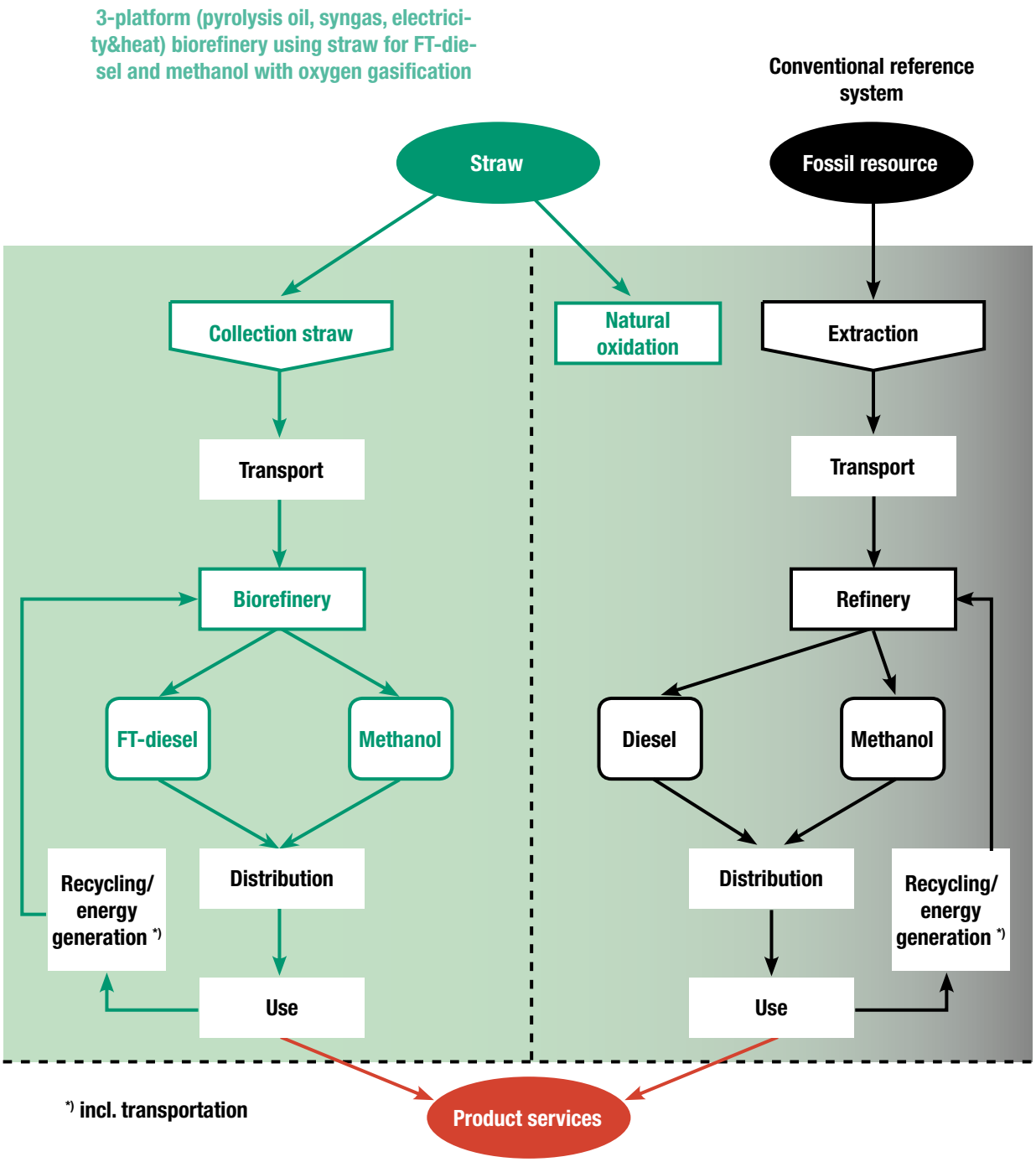






Part B: Value Chain Sustainability Assessment

The method of the sustainability assessment - economic and environmental – is given in Annex 1. The main assumptions and modelling choices are documented in Annex 2. The Annexes are available on the webpage of Task 42: www.iea-bioenergy.task42-biorefineries.com



Whole value chain

Greenhouse gas emissions		**range**	
biorefinery	42	(39 to 48)	[kt CO_2-eq/a]
reference system	449	(420 to 520)	[kt CO_2-eq/a]
saving	-91%	(-84% to -100%)	[%]
Cumulated energy demand			
fossil			
biorefinery	1.0	(1 to 1.2)	[PJ/a]
reference system	5.9	(5.5 to 6.8)	[PJ/a]
saving	-83%	(-77% to -95%)	[%]
total			
biorefinery	8.3	(8 to 9.8)	[PJ/a]
reference system	6.2	(5.8 to 7.2)	[PJ/a]
change	37%	(35% to 43%)	[%]
Agricultural area demand			
feedstock	207,000	(193000 to 238000)	[ha/a]
Costs			
annual costs	74	(69 to 86)	[Mio €/a]
specific costs	496	(460 to 570)	[€/t]
Revenues			
annual revenues	160	(150 to 180)	[Mio €/a]
specific revenues	1,068	(1000 to 1200)	[€/t]