



Wir schaffen Wissen – heute für morgen

## Paul Scherrer Institut Transportation fuels: System analysis for SNG

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IEA Bioenergy Task 33

## Scenario of European Renewable Energy Council (EREC)



RES Type	2007	2020	2030	2050
Wind	8.9	41	72	133.5
Hydro <sup>1</sup>	27.9	33	34.2	38.5
PV	0.5	15.5	48	116
Bioenergy	77.8	175.5	226	359.1
Geothermal (Electricity and H&C)	1.4	9.7	35.5	188
Solar Thermal	0.9	12	70	122
CSP	0.1	3.7	12.1	33.1
Ocean	-	0.4	1.5	14
<b>TOTAL RES (Mtoe)</b>	<b>118</b>	<b>290.8</b>	<b>499.3</b>	<b>1,004.2</b>
<b>Final Energy Consumption</b>				
Eurostat	1,194.9			
NEP				
Moderate Price		1,185		
High Price		1,140		
2030				
Moderate Price			1,175	
High Price			1,124	
2050 Scenario				1,050
2050 Aggressive Efficiency				735*
<b>Total Share of RES (%)</b>		<b>24.5 – 25.5%</b>	<b>42.4% - 44.4%</b>	<b>96% - 137%</b>

<b>Bioenergy</b>		<b>2007</b>	<b>2050</b>
Total	Mtoe	78	359
Electricity	%	11.3	11.9
Heat	%	78.6	59.7
Biofuel	%	10.1	28.4
<b>Total</b>	<b>%</b>	<b>100.0</b>	<b>100.0</b>

Published in April 2010

		Road/passengers			Road/freight			Rail	Water			Air
		short	med	long	short	med	long		inland	short-sea shipping	maritime	
Electric	BEV	■			■			■				
	HFC	■	■		■			■	■			
	Grid	■			■			■				
Biofuels (liquid)		■	■	■	■	■	■	■	■	■	■	■
Synthetic fuels		■	■	■	■	■	■	■	■	■	■	■
Methane	CNG	■	■	■	■	■						
	CBG	■	■	■	■	■						
	LNG	■	■	■	■	■	■	■	■	■	■	
LPG		■		■	■	■	■		■	■		

**Electric:** Battery Electric Vehicle (**BEV**), Hydrogen Fuel Cell (**HFC**)

**Methane:** Compressed Natural Gas (**CNG**), Compressed Biogas (**CBG**), Liquefied Natural Gas (**LNG**)

**LPG:** Liquefied Petrol Gas

[http://ec.europa.eu/transport/urban/vehicles/directive/doc/2011\\_01\\_25\\_future\\_transport\\_fuels\\_report.pdf](http://ec.europa.eu/transport/urban/vehicles/directive/doc/2011_01_25_future_transport_fuels_report.pdf)

Estimate of European Renewable Energy Council (EREC), April 2010

Transport Fuel Demand [Mtoe]		2007	2020	2030	2050
Biofuels production		7.88	34	44.5	102
Total Transport Fuel Demand					
Eurostat		377			
NEP	Moderate Price		390		
	High Price		374		
2030	Moderate Price			390	
	High Price			369	
2050	Scenario				148.6*
	Aggressive Efficiency				104**
Total Share of RES-T		2%	8.7% - 9%	11.4% - 12%	68.6% - 98%

Source: EREC

\* the strong decrease of fuel demand in the transport sector is due to the shift of transport fuel usage towards electrification.

\*\* setting an energy efficiency target of about 30% against the "2050 Scenario"

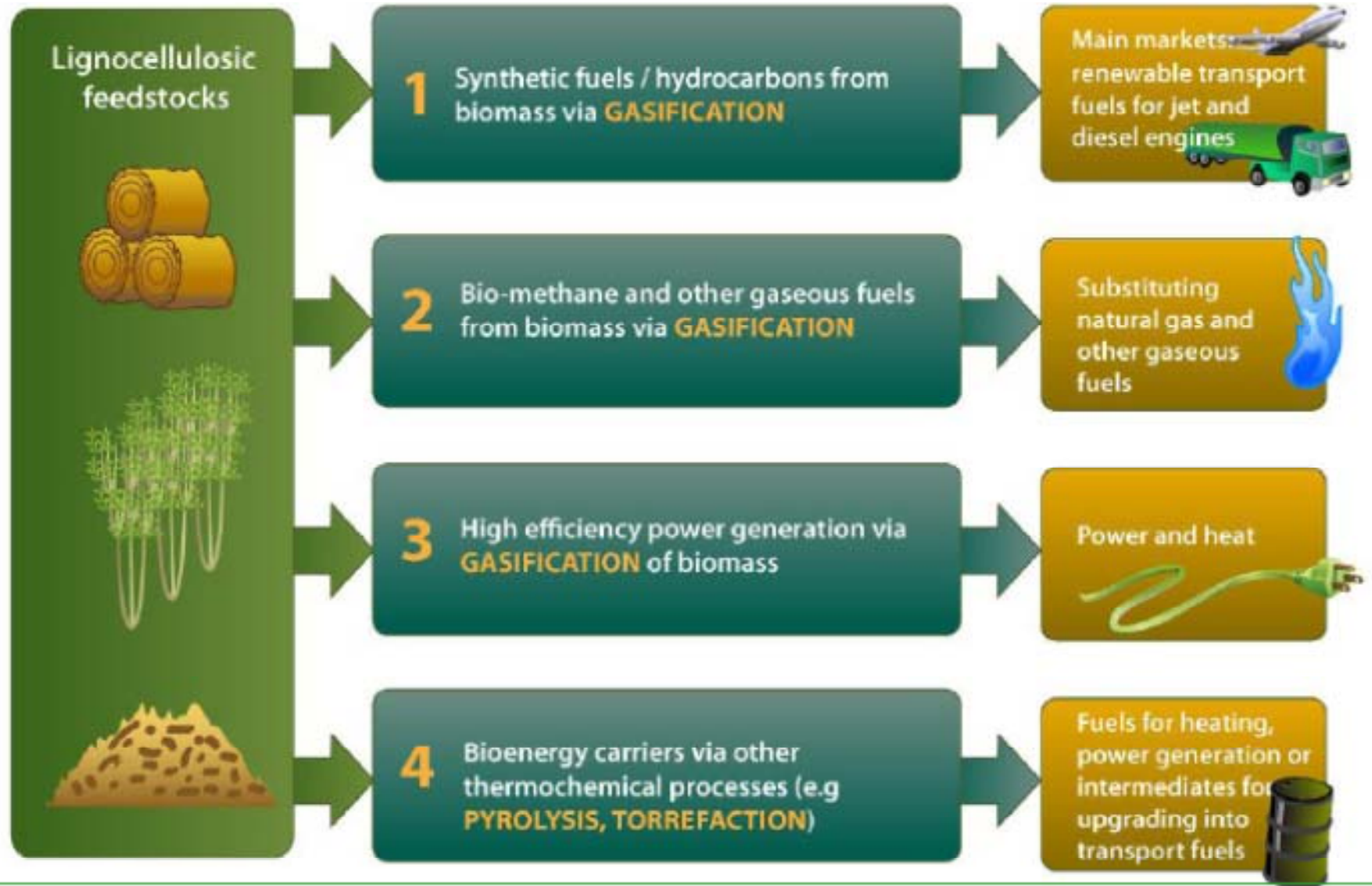


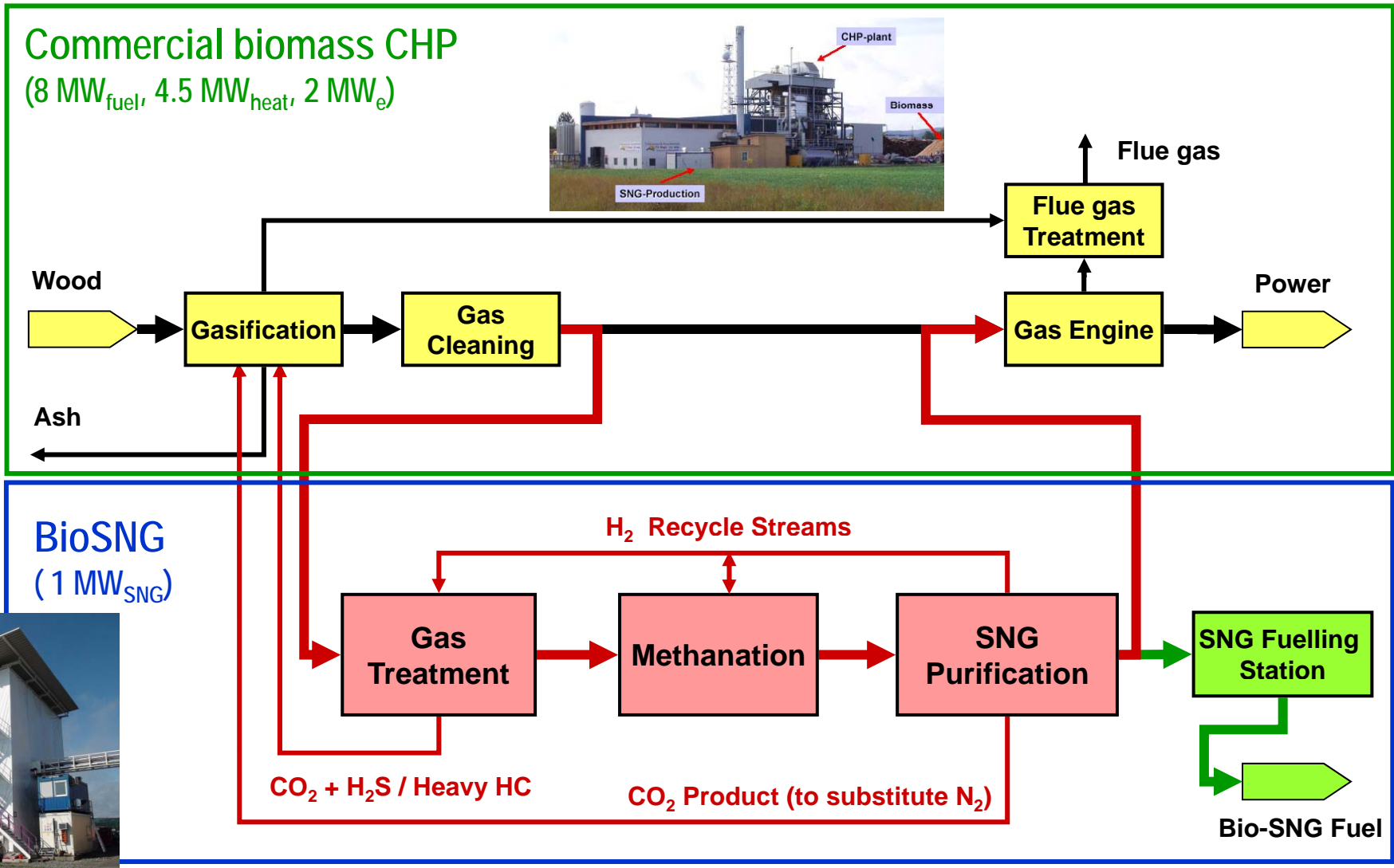
## Motivation

- Funding latest stages of industrial development of innovative advanced bioenergy value chains is a considerable challenge: new tool and approach such as European Industrial Initiative (EII) are urgently needed.

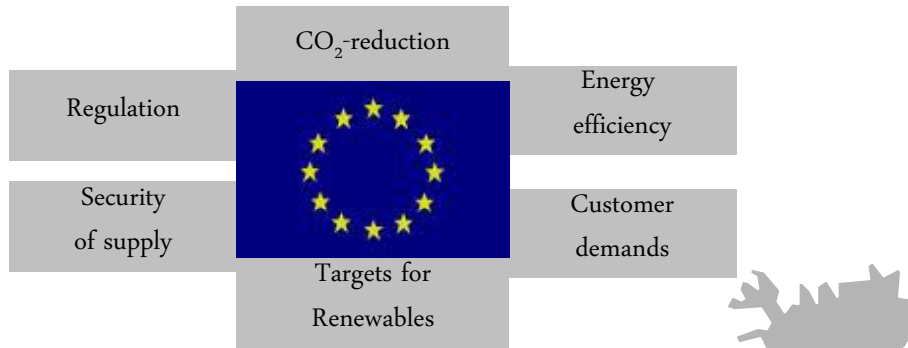
## Objectives

- Enabling commercial availability of advanced bioenergy at large scale by 2020, including **advanced biofuels covering up to 4 % of EU transportation energy needs by 2020**
- Strengthening EU world technology leadership for renewable transport fuels, in particular for diesel and jet engines, serving the fastest growing area of transport fuels in the world.





# A sustainable gas system



- ~10% renewable methane in 2030
- corresponds to 55 billion m<sup>3</sup>/year methane (550 TWh/year = 70 GW<sub>SNG</sub>)
- investment volume of + 60 billion €

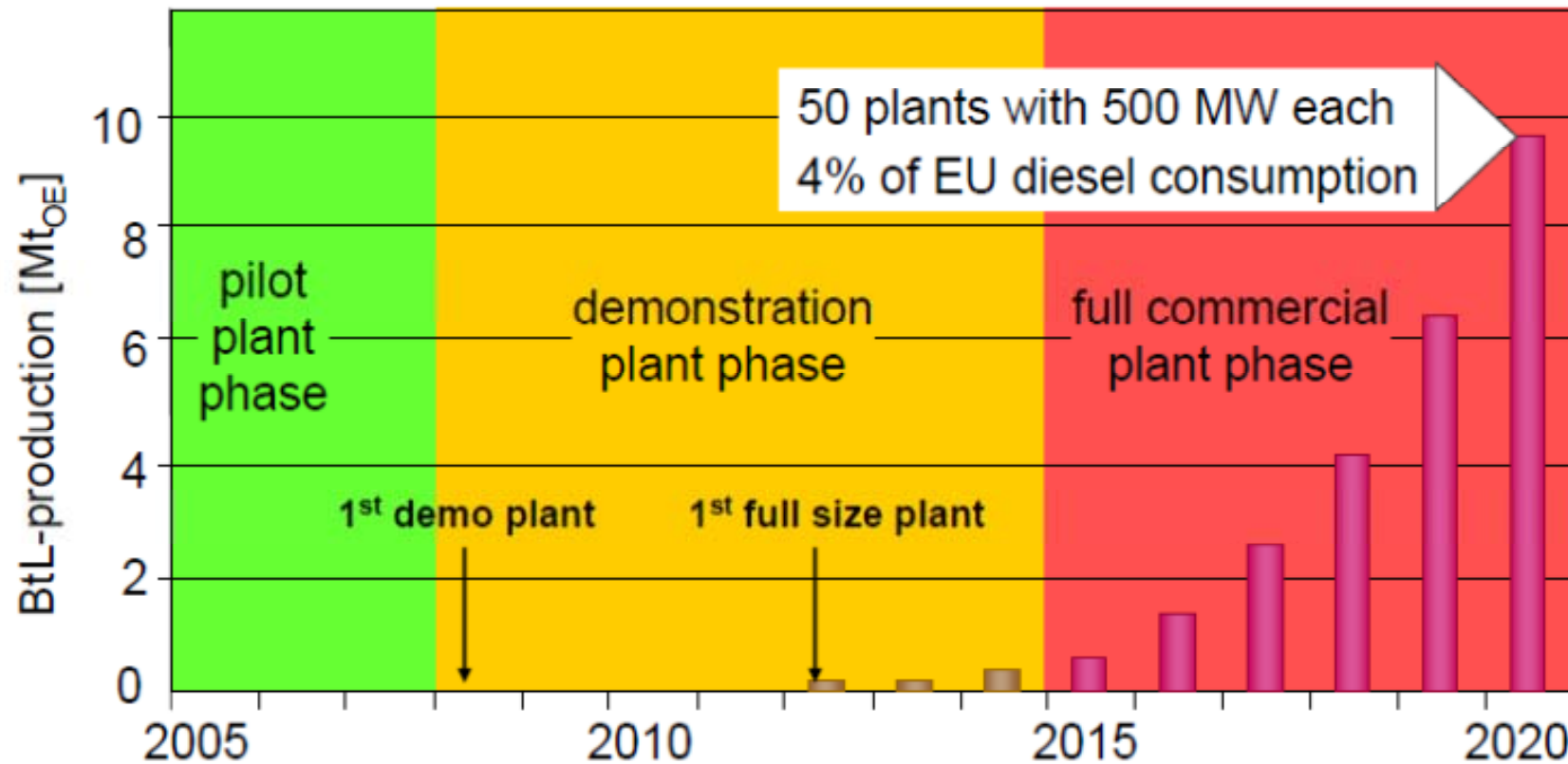




# Example of suggested marked implementation

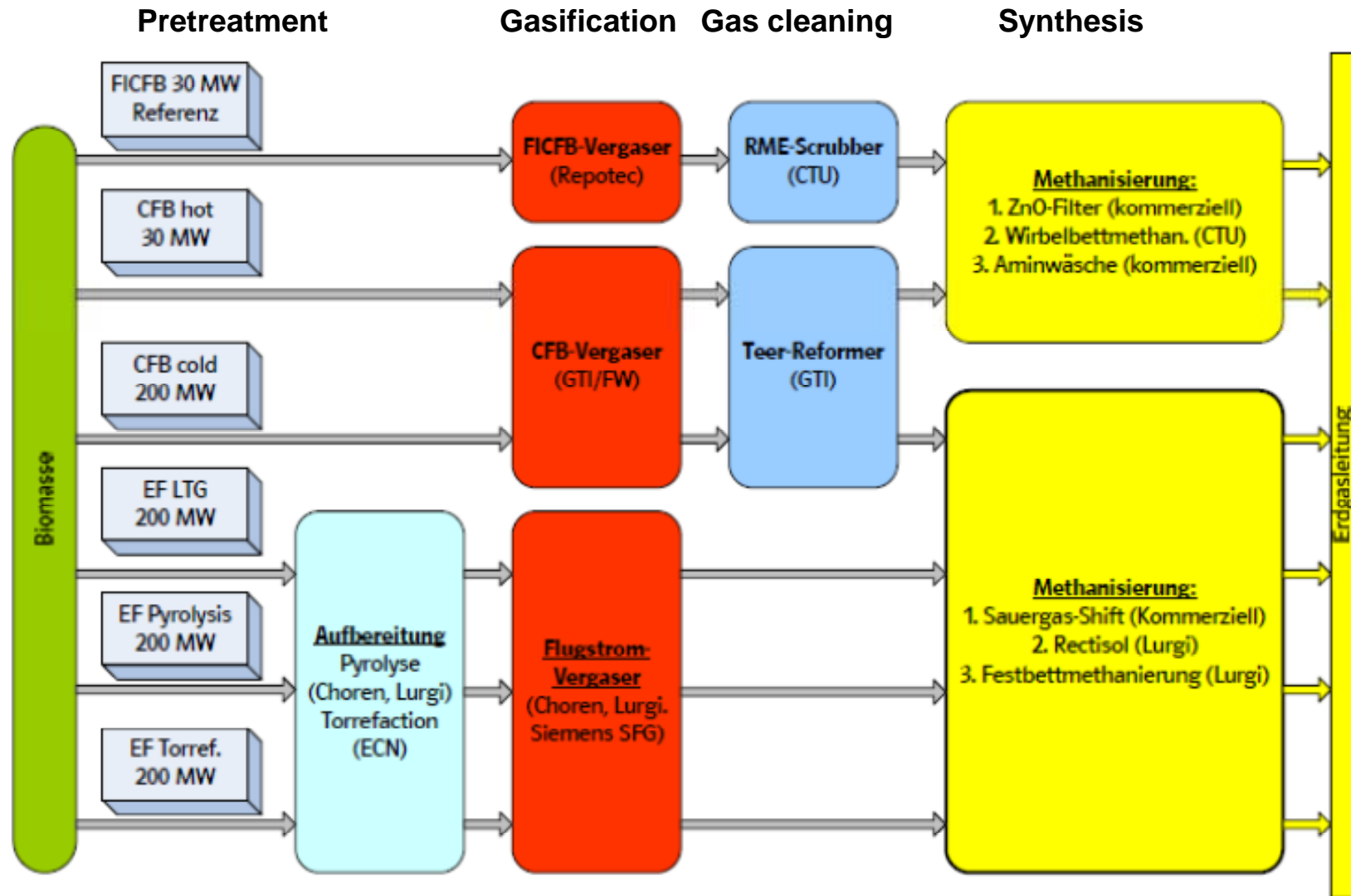
EIBI target: Advanced biofuels covering up to 4 % of EU transportation energy needs by 2020

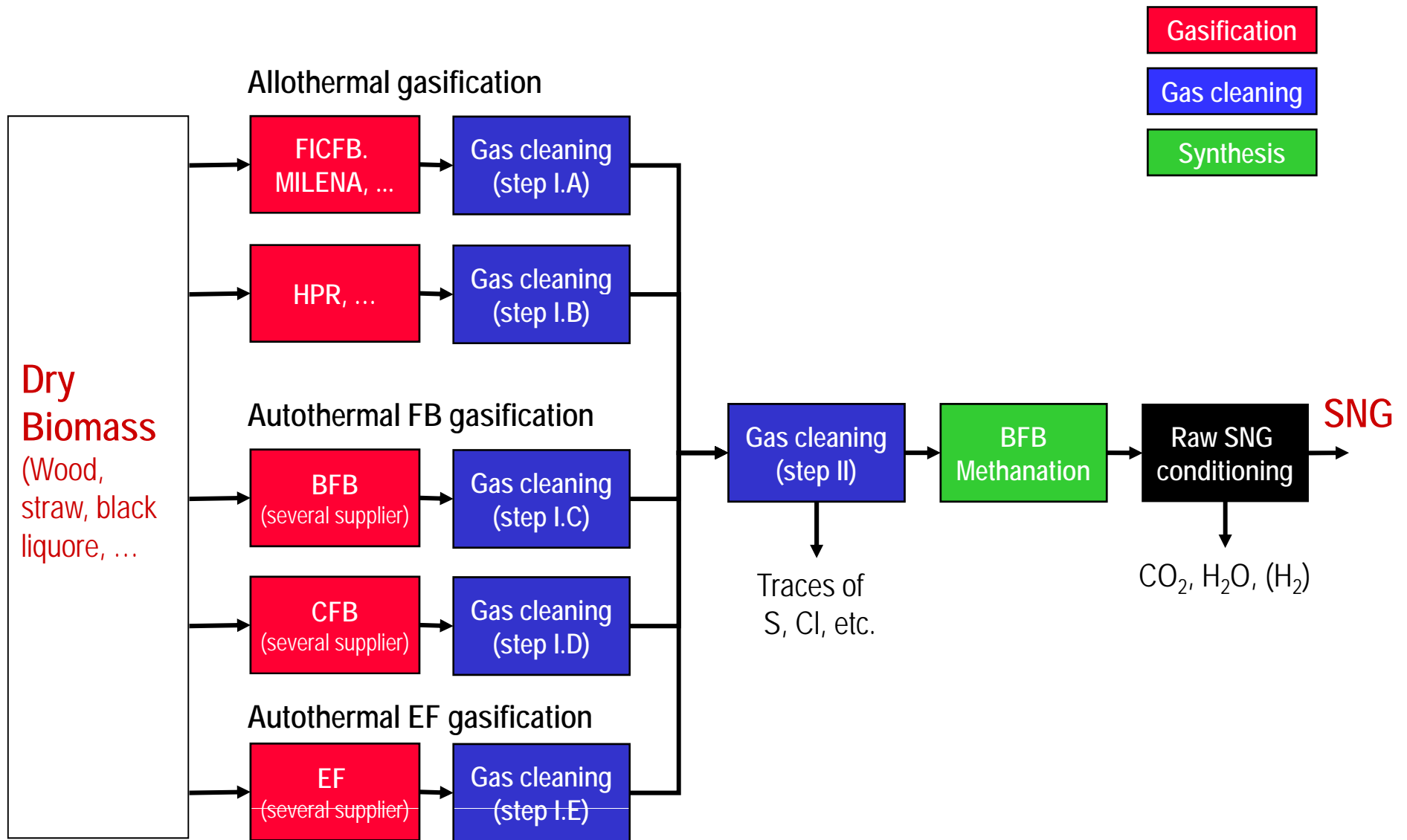
4 % = 13.6 Mtoe = 20 GW<sub>biofuel</sub>



Example: 500 MW or 1 Mt biomass input (= Choren Σ-Plant), 200,000 t/a BtL-fuel = 0.1% EU-diesel demand

→ under optimal conditions, 50 BtL-plants cover 4 % of EC-diesel demand in 2020!





		2007	2020	2030	2050
Biofuels production	Mtoe	7.88	34	44.5	102
	PJ	330	1424	1863	4271
	TWh	92	395	518	1186
	GW	11.5	49.4	64.7	148.3
	h/a	8000	8000	8000	8000
	% advanced biofuel		4	4	4
	Mtoe advanced biofuels		13.6	17.8	40.8
	GW advanced biofuels		19.8	25.9	59.3
Biomethane	% share biomethane			10	
	TWh			550	
	GW			70	
	Investment Billion €			60	
	billion m <sup>3</sup> SNG/year			55	

- There is room for all good technologies
- Supply chain of biomass?
- Supply chain for technology vendors?