



Current Status of Advanced Biofuel Demonstrations in EU

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Prepared by Dina Bacovsky

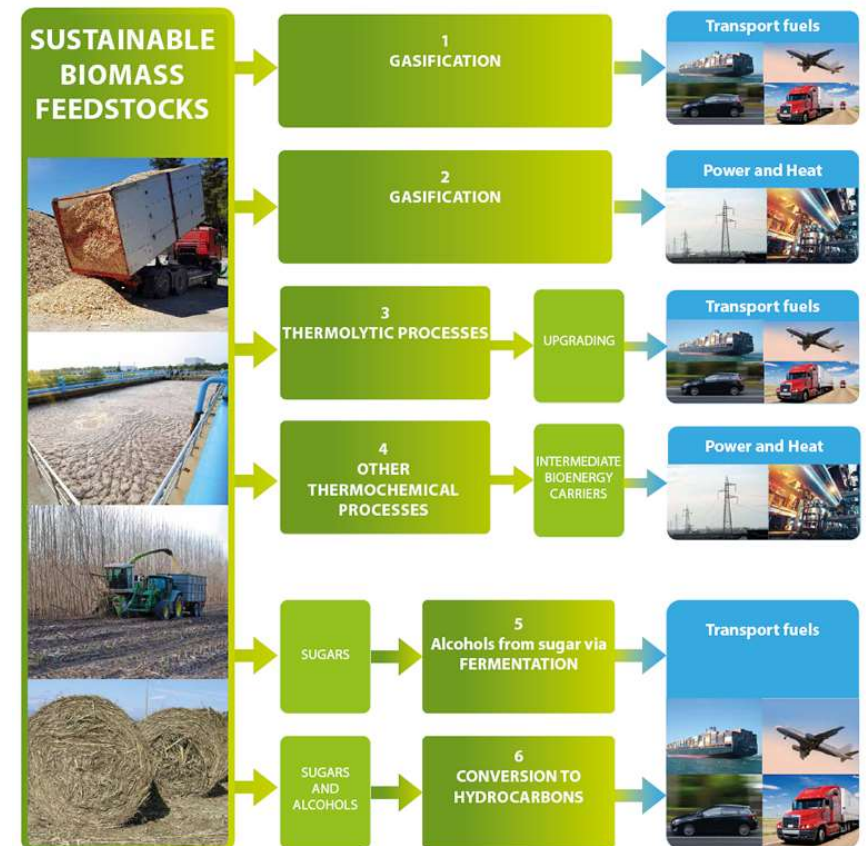


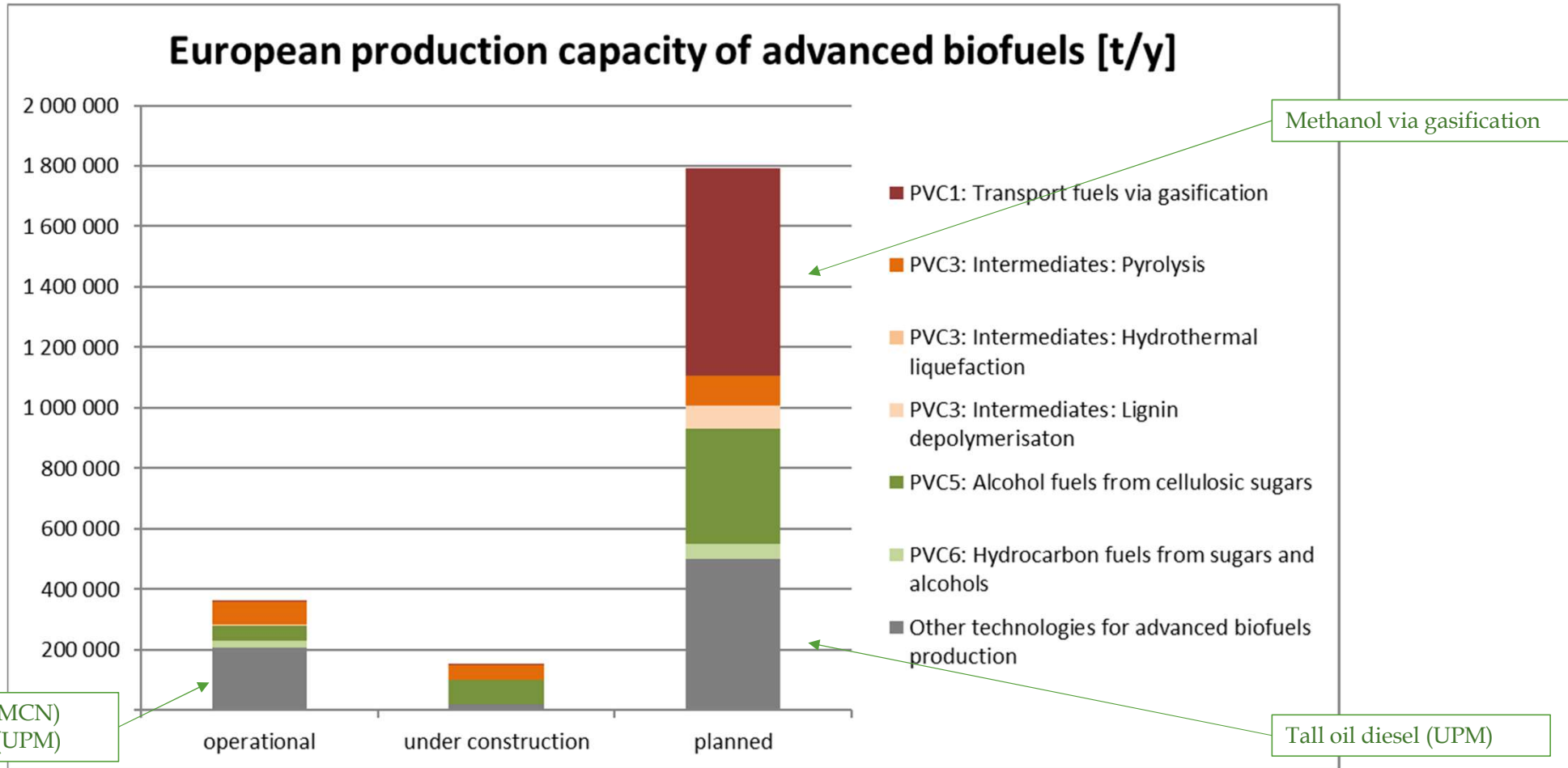
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WG 2 Publication on Advanced Biofuels Demonstrations

Focused on Transport Biofuels

- PVC1: Transport fuels via gasification
- PVC3: Transport fuels via pyrolytic and thermolytic conversion
 - Pyrolysis to bioliquid intermediates
 - Hydrothermal liquefaction (HTO) to bioliquid intermediates
 - Ligning to bioliquid intermediates
- PVC5: Alcohol fuels from cellulosic sugars
- PVC6: Hydrocarbon fuels from sugars and alcohols
- Other technologies to produce advanced biofuels and recycled carbon fuels

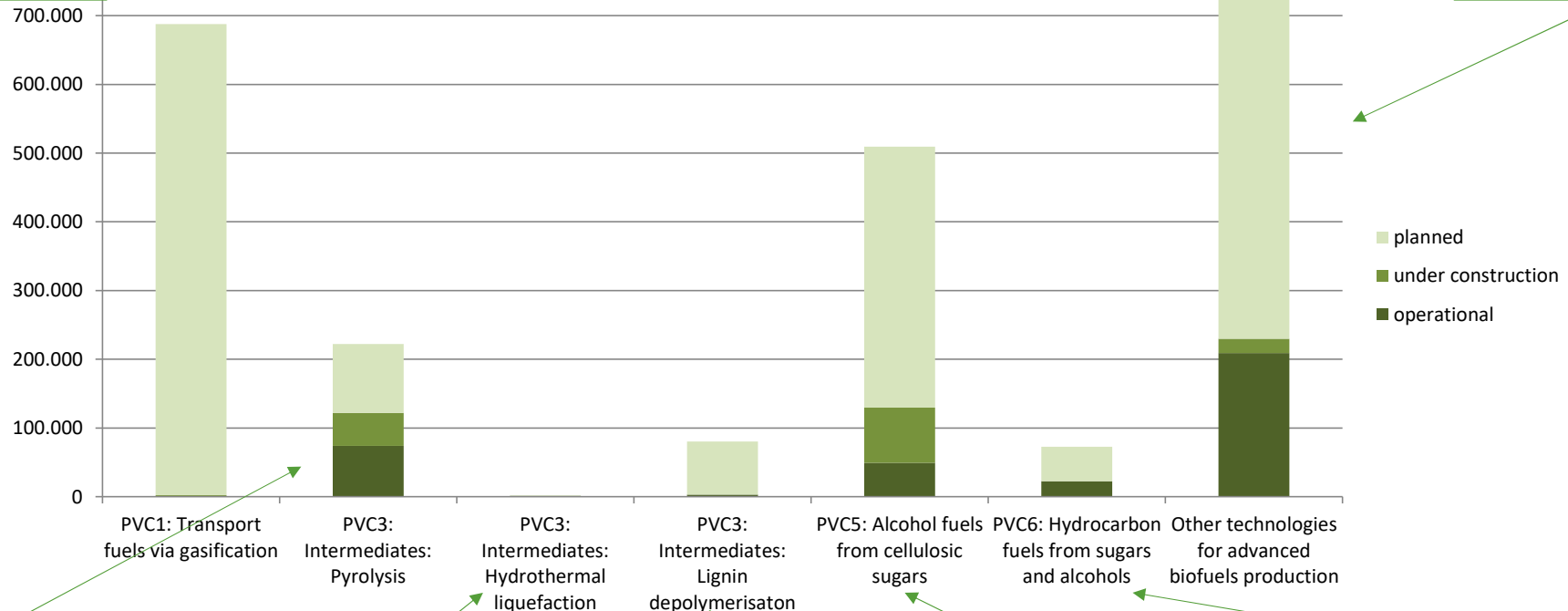




European production capacity of advanced biofuels [t/y]

3 large methanol productions planned
- W2C JV
- Enerkem and Suez
- VaermlandsMethanol

UPM
St1
BioMCN
ArcelorMittal
SödraCell



BTG-BTL:
1 operational facility
2 facilities under construction

Silva Green Fuel

RenFuel

3 main technology providers:
- Clariant
- SEKAB
- St1

Global Bioenergies
Ekobenz
IBN-One



ETIP *Bioenergy*

European Technology and Innovation Platform

Project Partners



www.etipbioenergy.eu



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Transport Fuels via Gasification

Table 1: Operational gasification facilities

Company	Country	City	TRL	Start-up year	Installed capacity [t/y]	Product
Karlsruhe Institute of Technology (KIT) bioliq	Germany	Eggenstein-Leopoldshafen	TRL 6-7	2014	608	DME

Table 2: Under construction gasification facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]	Product
Advanced Biofuels Solutions* GoGreenGas	United Kingdom	Swindon	TRL 8	2020	1 500	SNG
Total** BioTfuel demo	France	Dunkirk	TRL 6-7	2020	Not available	FT liquids

* Advanced Biofuels Solutions acquired the project from Go Green Fuels Ltd

** Facility is currently under commissioning; each step of the full pathway is being demonstrated at the necessary scale, thus the FT-liquids production is lab scale only

Table 1: Planned gasification facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]	Product
Joint Venture of Air Liquide, Nouryon, Enkerm, Port of Rotterdam and Shell W2C	Netherlands	Rotterdam	TRL 8	2022	220 000	methanol
Enkerm and Suez Ecoplanta Molecular Recycling Solutions	Spain	El Morell	TRL 8	2022	265 000	methanol
VaermlandsMetanol AB Vaermlandsmetanol Hagfors	Sweden	Hagfors	TRL 9		130 000	methanol
formerly Goteborg Energi AB GoBiGas Phase 1 restart	Sweden	Gothenburg	TRL 8		11 200	SNG
Velocys Altalto	United Kingdom	Immingham	TRL 8		58 000	jet fuel component
Eni Waste to Hydrogen	Italy	Porto Marghera	TRL 8		not available	hydrogen
TNO Ambigo	Netherlands	Alkmaar	TRL 6-7		1 560	SNG

Pyrolysis to bioliquid intermediates

Table 1: Operational pyrolysis oil production facilities

Company	Country	City	TRL	Start-up year	Installed capacity [t/y]
Twence Hengelo	Netherlands	Enschede	TRL 9	2015	24 000
Fortum Fortum Joensuu	Finland	Joensuu	TRL 6-7	2013	50 000
Karlsruhe Institute of Technology (KIT)* bioliq	Germany	Eggenstein-Leopoldshafen	TRL 6-7	2013	24 000

* Same facility as in **Fehler! Verweisquelle konnte nicht gefunden werden.**; the facility has a fast pyrolysis step (mentioned here) which is followed by gasification of the pyrolysis oil (mentioned in **Fehler! Verweisquelle konnte nicht gefunden werden.**)

Table 1: Under construction pyrolysis oil production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]
Green Fuel Nordic	Finland	Lieksa	TRL 9	2020	24 000
Pyrocell (JV of Setra and Preem)	Sweden	Gavle	TRL 9	2021	24 000

Table 2: Planned pyrolysis oil production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]
Biozin	Norway	Amlı	TRL 8	2022	100 000
Susteen technologies TCR500	Germany		TRL 6-7	2020	

Hydrothermal liquefaction (HTL) to bioliquid intermediates

Table 1: Under construction bio-oil production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]
Silva Green Fuel (JV of Statkraft and Sodra)	Norway	Tofte	TRL 6-7	2021	1 400

Lignin to bioliquid intermediates

Table 1: Operational bio-oil production facilities

Company	Country	City	TRL	Start-up year	Installed capacity [t/y]
RenFuel Bäckhammar	Sweden	Bäckhammar	TRL 6-7	2016	3 200

Table 2: Planned bio-oil production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]
RenFuel Vallvik	Sweden	Vallvik	TRL 8	2021	77 000

Alcohol fuels from cellulosic sugars

Table 1: Operational fermentative alcohol production facilities

Company	Country	City	TRL	Start-up year	Installed capacity [t/y]
Borregaard* Industries ChemCell Ethanol	Norway	Sarpsborg	TRL 9	1938	15 800
Domsjoe Fabriker	Sweden	Ornskoldsvik	TRL 8	1940	19 000
St1 Cellulonix Kajaani	Finland	Kajaani	TRL 6-7	2017	8 000
Chempolis Ltd. Biorefining Plant	Finland	Oulu	TRL 6-7	2008	5 000
Clariant sunliquid	Germany	Straubing	TRL 6-7	2012	1 000
IFP Futurol	France	Bucy-Le-Long	TRL 6-7	2016	350
SEKAB Biorefinery Demo Plant	Sweden	Ornskoldsvik	TRL 8	2004	160
Borregaard* BALI Biorefinery Demo	Norway	Sarpsborg	TRL 6-7	2012	110

*Borregaard uses spent sulphite liquor from pulping processes as feedstock

Table 1: Under construction fermentative alcohol production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]
Clariant Romania	Romania	Podari	TRL 8	2021	50 000
AustroCel Hallein*	Austria	Hallein	TRL 8	2020	30 000

*AustroCel Hallein uses spent sulphite liquor as feedstock, just like Borregaard

Table 2: Planned fermentative alcohol production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]
Enviral* Leopoldov Site	Slovakia	Leopoldov	TRL 9		50 000
ORLEN Poludnie (part of ORLEN GROUP)* Jedlicze Site	Poland	Jedlicze	TRL 9		25 000
INA	Croatia	Sisak	TRL 8		55 000
St1 Cellulonix Kajaani 2	Finland	Kajaani	TRL 8	2024	40 000
St1 Cellulonix Pietarsaari	Finland	Pietarsaari	TRL 8	2024	40 000
St1 Cellulonix Follum	Norway	Ringerike	TRL 8	2024	40 000
Versalis (former Beta Renewables/Biochemtex facility) Crescentino restart	Italy	Crescentino	TRL 8	2020	40 000
Sainc Energy Limited Cordoba	Spain	Villaralto	TRL 8	2020	25 000
Kanteleen Voima** Nordfuel biorefinery	Finland	Haapavesi	TRL 6-7	2021	65 000

*Enviral and ORLEN both license Clariant's sunliquid technology

** The Nordfuel project is based on SEKAB's CelluApp technology

Hydrocarbon fuels from sugars and alcohols

Table 1: Operational hydrocarbon fuel production facilities

Company	Country	City	TRL	Start-up year	Installed capacity [t/y]
Global Bioenergies Isobutene demo	Germany	Leuna	TRL 6-7	2017	100
Ekobenz Bogumilow plant	Poland	Kleszczow	TRL 8	2019	22 500

Table 2: Planned hydrocarbon fuel production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]
IBN-One (JV of Cristal Union and Global Bioenergies) Isobutene commercial	France		TRL 8		50 000

Other technologies to produce advanced biofuels and recycled carbon fuels

Table 1: Operational production facilities

Company	Country	City	TRL	Start-up year	Installed capacity [t/y]	Product
UPM Biofuels	Finland	Lappeenranta	TRL 8	2015	130 000	HVO
St1 Etanolix Hamina	Finland	Hamina	TRL 9	2008	1 000	ethanol
St1 Etanolix Vantaa	Finland	Vantaa	TRL 9	2009	1 000	ethanol
St1 Etanolix Lahti	Finland	Lahti	TRL 9	2009	1 000	ethanol
St1 Etanolix Jokioinen	Finland	Jokioinen	TRL 9	2011	7 000	ethanol
St1 Etanolix Gothenburg	Sweden	Gothenburg	TRL 9	2015	4 000	ethanol
BioMCN BioMCN commercial	Netherlands	Farmsum	TRL 8	2009	65 000	methanol

Table 1: Under construction production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]	Products
ArcelorMittal Ghent Steelanol	Belgium	Ghent	TRL 9	2020	16 000	ethanol
Södra Cell Södra methanol	Sweden	Monsteraas	TRL 9	2020	5 000	methanol

Table 2: Planned production facilities

Company	Country	City	TRL	Start-up year	Planned capacity [t/y]	Products
UPM Biofuels*	Finland	Kotka	TRL 8		500 000	HVO

* Not all feedstock used for the stated production capacity may be Annex IX Part A feedstock