

# Country report Sweden

IEA Task 33 meeting



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# Swedish biomass gasification projects - current status

Cortus WoodRoll 500 kW  
Demonstration  
**Operational**

Rottneros, planned  
100 000 t/a methanol  
NER 300-rejection 2014

Värmlandsmetanol AB  
100 000 t/a methanol  
Planned

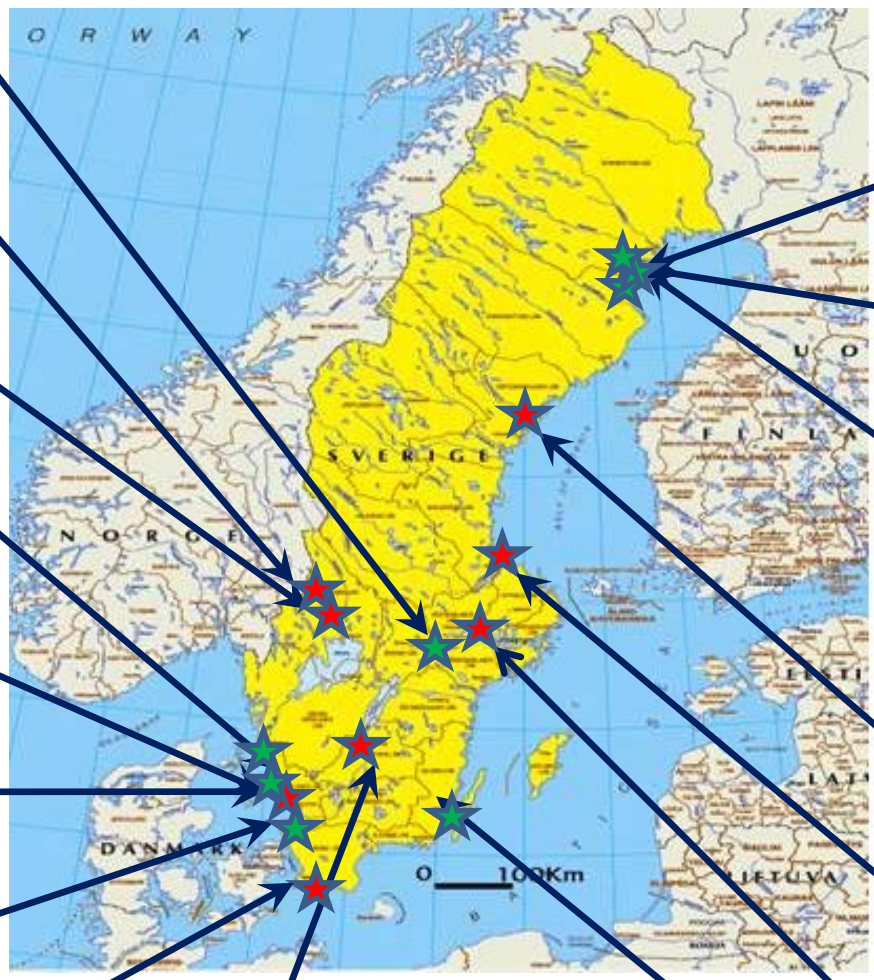
GoBiGas  
20 MW SNG Mothball  
Scale-up NER300 2012

Chalmers CIBG  
4 MW pilot

Värö 25 MW CFB  
Lime kiln gasifier, stopped  
2014

Höganäs  
Cortus WoodRoll 6 MW  
Demonstration in **2020**

E.ON Bio2G  
Planned 200 MW SNG  
NER 300 2014



MEVA  
1.2 MW<sub>el</sub> CHP  
In operation

RISE 1 MW  
PEGB pilot  
Operational R&D

LTU Biosyngas 3 MW BL  
EF pilot + DME/MeOH  
Mothball

Domsjö  
Chemrec demonstration  
Cancelled 2012

Vallvik Biofuel  
NER 300-rejection 2012

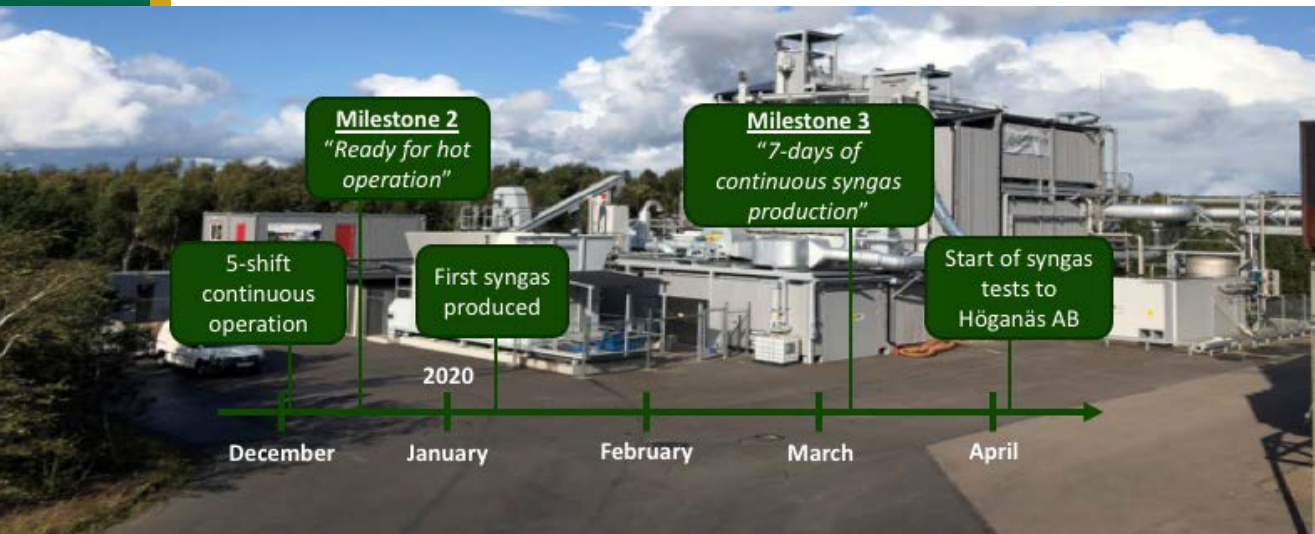
Västerås  
Waste gasification CHP  
Stopped 2010

Värname  
18 MW IGCC  
Stopped 2000, 2010

Emåmejeriet  
40 kW CHP 2015

# Cortus WoodRoll® at Höganäs

- **Cortus 6 MW WoodRoll® gasifier** at the **Höganäs steel plant** (officially inaugurated in June 2018)



Photos: [www.cortus.se](http://www.cortus.se)



# Cortus WoodRoll® & Engie (Fr)

- Biomass-to-hydrogen project in Bordeaux, France
- An order from **Engie Cofely** worth 135 000 € to carry out an **Advanced Feasibility Study** of a plant for hydrogen and CO<sub>2</sub> production



# Cortus WoodRoll® in Mariposa (US)

- Biomass-to-electricity project in Mariposa
- Now in the BioMAT\* queue - an important first step in obtaining a Power Purchase Agreement
- Reversed auction procedure - may get the highest feed-in tariff (\$199,97/MWh) guaranteed in 20 years



\* Bioenergy Feed-in Tariff Program, [https://www.cpuc.ca.gov/SB\\_1122/](https://www.cpuc.ca.gov/SB_1122/)

# MEVA CHP-plant in Hortlax



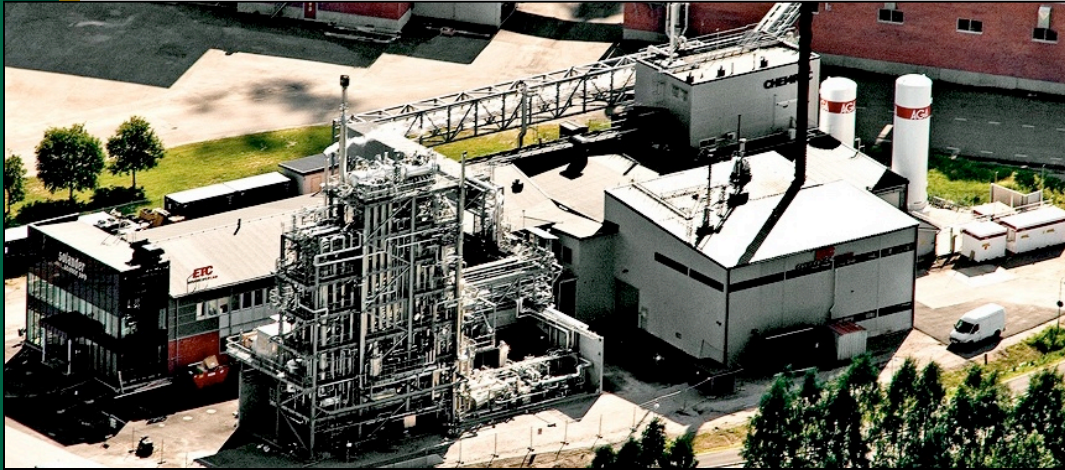
- **Entrained flow cyclone gasifier** emanated from research at Luleå University of Technology
- Energy outputs 1.2 Mw<sub>el</sub> and 2.4 MW<sub>th</sub>
- **Small fraction fuels** (sawdust, wood fibers and agricultural residues)
- **Applications:** CHP, fossil process gas replacements and industrial drying processes
- Working on cutting costs – in particular for gas cleaning



# Commercial initiatives under development



# LTU Green Fuels



Pilot BL gasification	Pilot methanol + DME	Field testing
3 MW, 20 t DS/d	4 t/d methanol/DME	Volvo Trucks DME
>28 000 h since 2005	>12 000 h since 2011	8 trucks, >1 500 000 km
Recovery of cooking chemicals without difficulties		DME and methanol in industrial applications
Opportunities for exp. campaigns 24/7, high availability		

# LTU Green Fuels

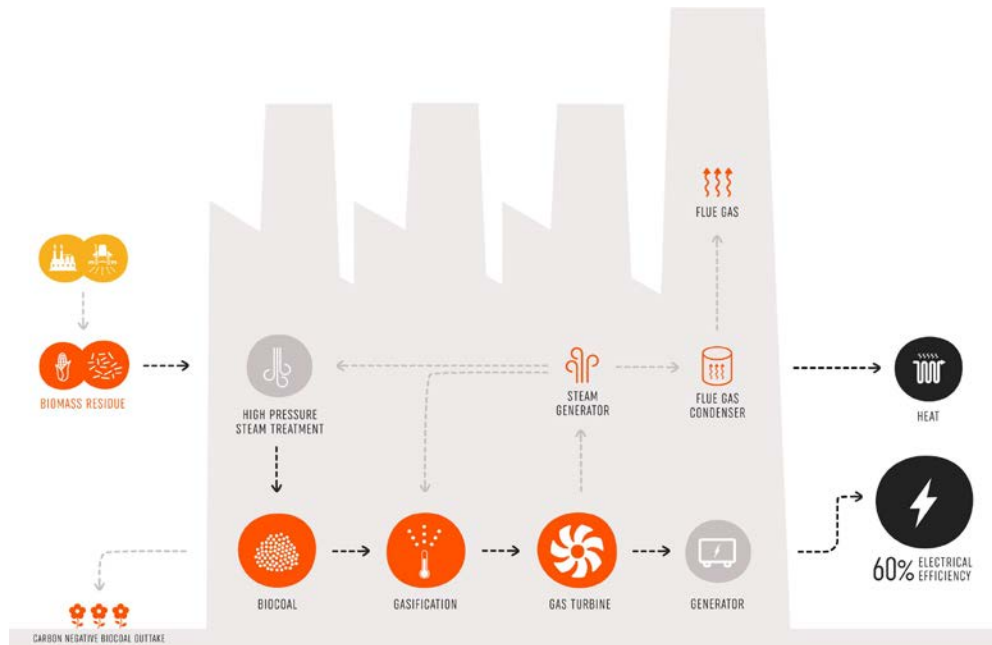
The screenshot shows the website for Luleå University of Technology. The top navigation bar includes 'LULEÅ UNIVERSITY OF TECHNOLOGY', 'EDUCATION', 'RESEARCH', 'MEET THE UNIVERSITY', and a search icon. A left sidebar menu lists: 'Energy Engineering', 'News', 'Research areas', 'Project archives', 'Third-cycle qualification', 'Publications', 'Postgraduate studies', 'Laboratories and equipment', and 'Contact us'. The main content area features a large image of an airplane in flight with the caption 'Wants to produce and test bio jet fuels on Swedish forest-based residue'. Below the image is the article title 'Researchers want to test-fly Swedish bio jet fuel 2021', published on 14 November 2018. The article text states: 'Luleå University of Technology has been granted funding by the Swedish Energy Agency for a preparatory study, and hopefully, within a few years, they can test to produce bio jet fuel on Swedish forest-based residues - and test-fly it on commercial flights in Sweden. The preliminary study will facilitate and risk minimize a first commercial plant for the production of aviation bio jet fuel on Swedish forest-based residues.' A small box on the right titled 'Ongoing projects about bio jet fuel' mentions that the university is part of several projects concerning the development of bio jet fuel in Sweden, signed in a Letter of Intent (LOI) in May 2018 with Sida, KLM, SkyNRG, and Forest.

<https://www.ltu.se/research/subjects/Energiteknik/Nyheter-och-aktuellt/Forskare-vill-testflyga-svenskt-biobransle-2021-1.181623?l=en>

# Phoenix Biopower



- The Biomass-fired TopCycle - the BTC - high-pressure steam treatment and entrained flow gasification
- Gas turbine for power generation
- Aiming at electrical efficiency of up to 60 %



# Plagazi®

- The Plagazi® process aims at hydrogen production from MSW, Auto Shredder Residue (ASR), car tires, Refuse Derived Fuel (RDF), industrial waste, wood chips or mixtures thereof
- Conceptual design for a waste-to-energy plasma gasification plant (40 tons per hour = 350,000 tons waste per annum)
- Plasma technology (Westinghouse Plasma) with three cleaning stages
- Company status unclear

# Research activities

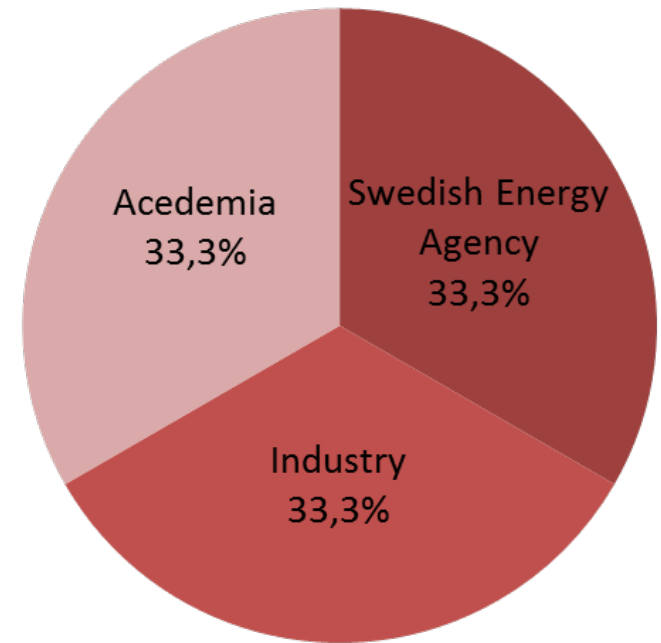


# Ongoing Swedish Gasification-related R&D Programs

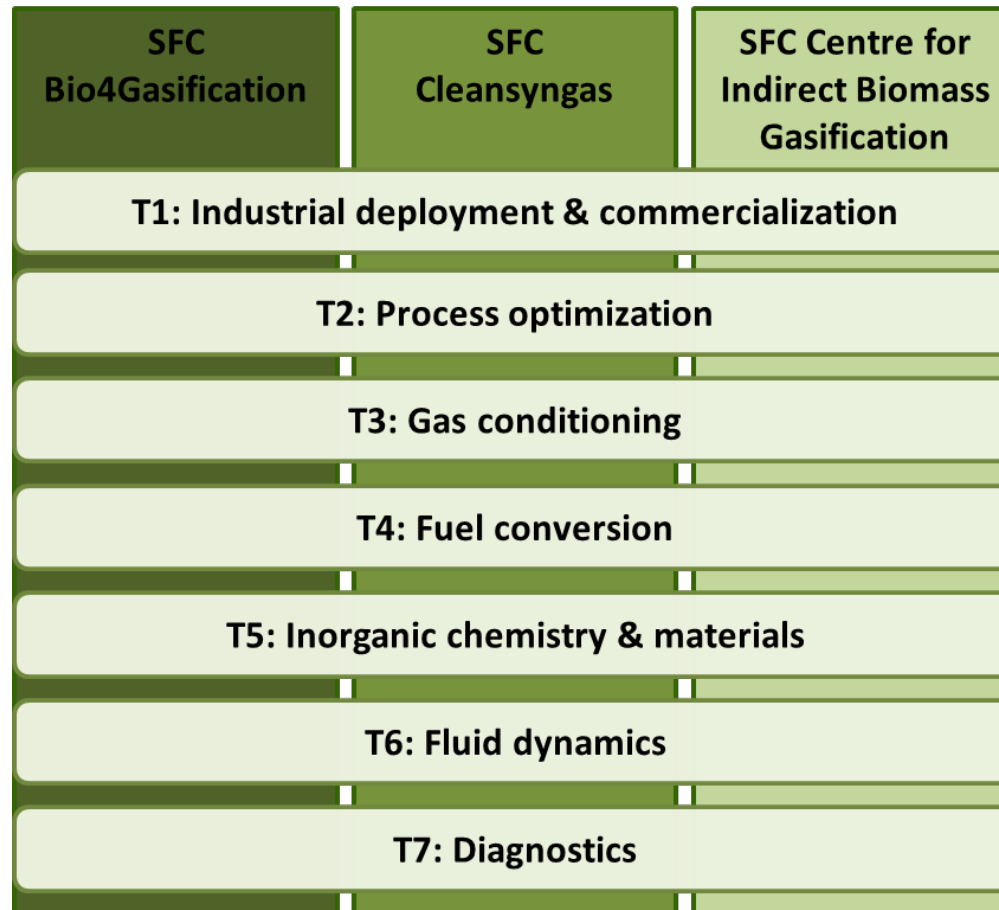
- **Swedish Gasification Centre (SFC):** 2011-2021, budget 54 M€
- **Swedish Knowledge Centre for Renewable Transportation Fuels (f<sup>3</sup>):** New phase 2018-2021, budget 3.3 M€
- **Swedish Energy Agency's biofuel program:** Ongoing 2017-21. Both thermal and biochemical conversion, budget 18 M€
- **SEBRA (CHP):** 2016-19, budget 6 M€
- **Biofuels for Sweden 2030:** 2017-20, budget 0.6 M€

# Swedish Gasification Centre (SFC)

- Strengthen and coordinate Swedish gasification R&D and foster a new generation of gasification competence in Swedish academy and industry
- 10 years - budget 54 M€
- In total, 20 companies, 8 universities and one research institute
- 25-30 senior researchers and 30-35 PhD students (>20% funding from SFC)
- Produced >35 PhDs and >360 journal and conference publications (2012-2018)
- [www.sfc-sweden.se](http://www.sfc-sweden.se)



# Swedish Gasification Centre (SFC)



# Research projects

## Bio4Gasification

- Development of laser diagnostics for gasification environments. Project leader: Per-Erik Bengtsson, Lund University
- Application of Laser Diagnostics in Pilot Gasifiers. Project leader: Florian Schmidt, Umeå University
- Process control and optimization of gasifiers. Project leader: Henrik Wiinikka, RISE ETC
- Ash formation and transport. Project leader: Markus Broström, Umeå University
- Slag properties and material interactions. Project leader: Dan Boström, Umeå University
- Slag build-up and containment protection. Project leader: Rainer Backman, Umeå University
- CFD modeling of entrained flow gasifiers. Project leader: Gunnar Hellström, Luleå University of Technology
- CFD modeling of raw syngas conversion. Project leader: Rikard Gebart, Luleå University of Technology
- Fuel conversion in entrained flow gasifiers. Project leader: Kentaro Umeki, Luleå University of Technology
- Verification and optimization of industrial and pilot scale gasification systems. Project leader: Fredrik Weiland, RISE ETC

## Cleansyngas

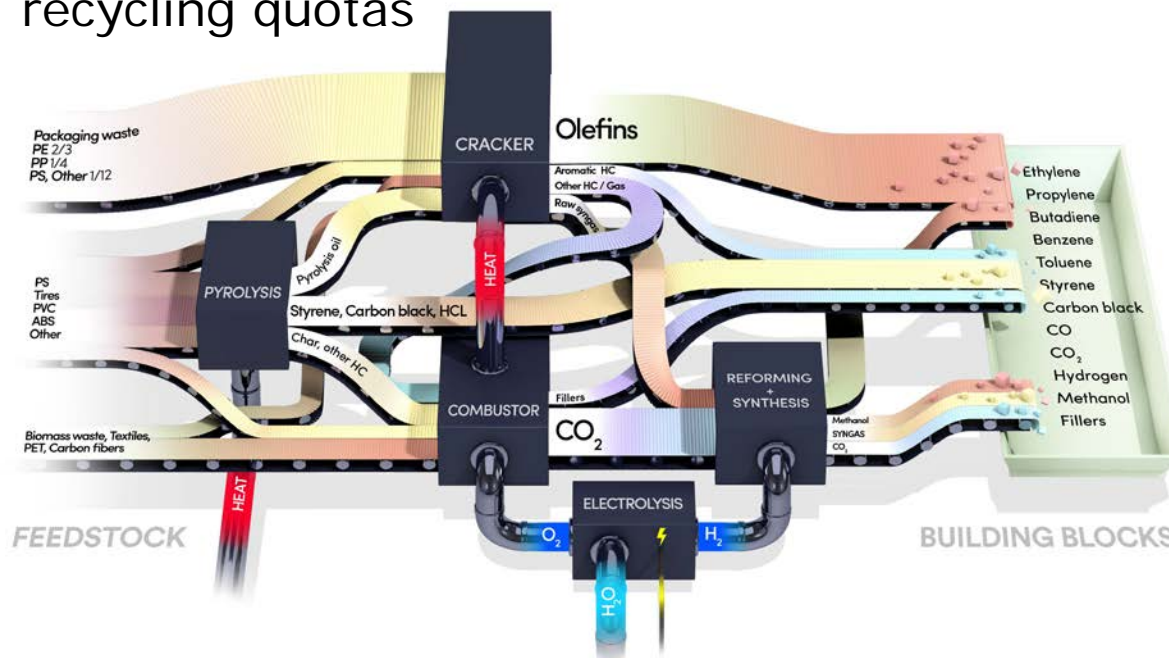
- Pressurized fluidized bed gasification. Project leader: Klas Engvall, Royal Institute of Technology KTH
- Char conversion. Project leader: Weihong Wang, Royal Institute of Technology KTH
- Catalytic conversion processes. Project leader: Efthymios Kantarelis, Royal Institute of Technology KTH
- Removal of impurities. Project leader: Matthäus Bähler, Royal Institute of Technology KTH

## Centre for Indirect Biomass Gasification (CIGB)

- Process optimization, large scale experiments and development of analytical methods. Project leader: Martin Seemann, Chalmers
- Mass transfer phenomena connected to fuel conversion and gas cleaning. Project leader: Henrik Ström, Chalmers
- Fluid dynamics and fuel conversion. Project leader: David Pallarès, Chalmers
- Organic chemistry and fuel conversion. Project leader: Teresa Berdugo Vilches, Chalmers
- Inorganic chemistry and fuel conversion. Project leader: Pavleta Knutsson, Chalmers

# Transformation of an existing petrochemical cluster into a thermochemical recycling plant for 100% recovery of plastics

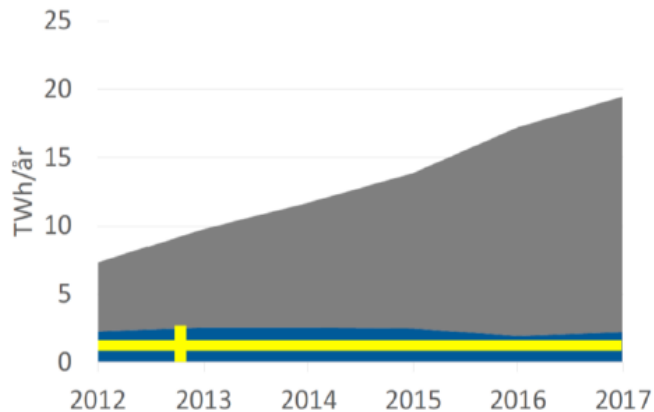
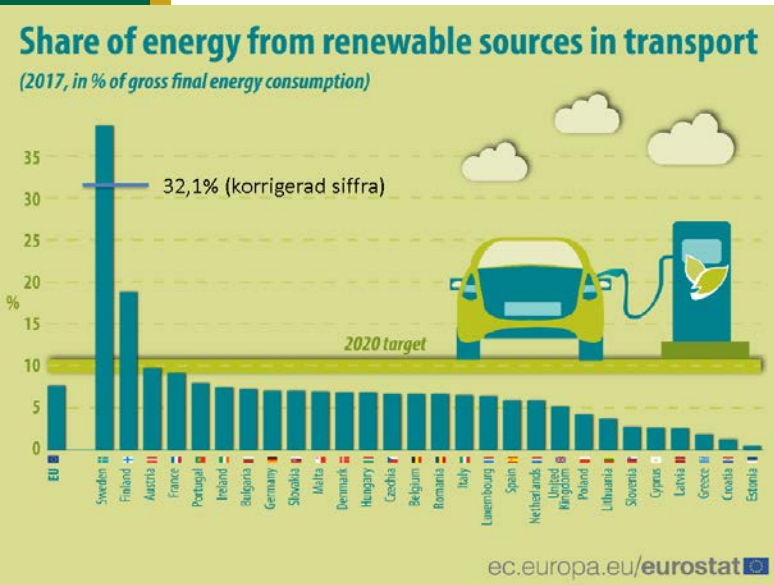
- Fully or partially replacement of fossil virgin feedstock by plastic waste results in economic advantages
- Electrification or oxy-combustion and CCS only justified if a value is assigned to the CO<sub>2</sub> savings, increased share of biogenic carbon in plastic products and/or increasing recycling quotas



Thunman H., et.al (2019). Circular use of plastics-transformation of existing petrochemical clusters into thermochemical recycling plants with 100% plastics recovery, Sustainable Materials and Technologies 22  
<https://doi.org/10.1016/j.susmat.2019.e00124>.



# Recent SFC position paper



- Calls for new effective policy instruments to promote domestic advanced biofuels production via gasification
- Contract for Difference (CfD) for the first large-scale production facility
- Governmental investment support
- Introduction of a blending quota for advanced biofuels

*Thanks!*

IEA Bioenergy



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