

# IEA Task 33 Meeting Trondheim, Norway 2016-05-24

## Country Update Sweden



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# Swedish Politics

The policy is to adhere to the EC policies

A labour-green minority government supported by a leftist party took over governing power from liberal-conservative 4-party coalition in October 2014 following a general election.

The new government has formed a "broad" parliamentary energy commission with main focus on electrical power, to report in late 2017.

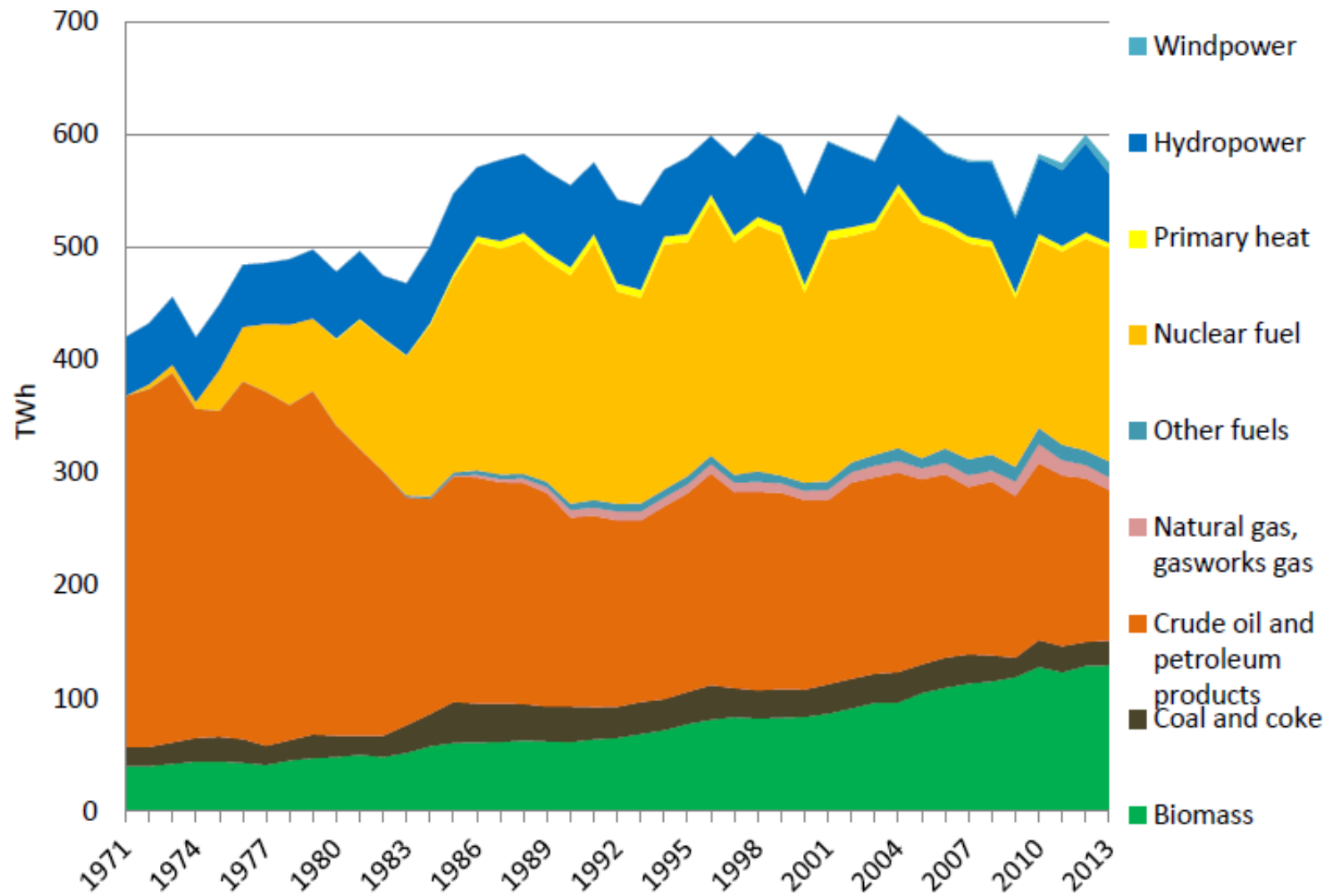
Transport biofuels tax exemption retained with modifications to 2017, due to discussion on state aid with the EC.

Decision on any replacement of nuclear power plants is postponed beyond the mandate period of four years.

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# Swedish Energy System





## Swedish Politics

- Planning and investment decisions on reactors were taken in the 1960's
- Referendum to phase out reactors by 2010 in 1981
- The reactor program of 12 plants fully attained in 1985
- The two reactors at Barsebäck were closed in 1999 and 2005
- The reactor development law (SFS1984:3) was revoked in 2012
- Up to 10 new replacement reactors on present sites??????

Decision on any replacement of nuclear power plants is postponed beyond the mandate period of four years.

New tax on nuclear power to finance decommissioning.

Vattenfall in April 2015 announced the premature stop of two reactors in 2018 and 2020 for "commercial reasons", and EON has in September decided to phase out yet two reactors due to post-Fukushima investments and taxes



# RE Promotion Green Certificates

<b>2002 datum</b>	<b>6.7 TWh</b>
<b>2002 target</b>	<b>+ 10 TWh 2010</b>
<b>2006 target</b>	<b>+ 17 TWh 2016</b>
<b>2009 target</b>	<b>+ 25 TWh 2020</b>

## 2012 SE+NO common target

<b>SE</b>	<b>+ 13.2 TWh 2020</b> to meet previous target
<b>NO</b>	<b>+ 13.2 TWh 2020</b>

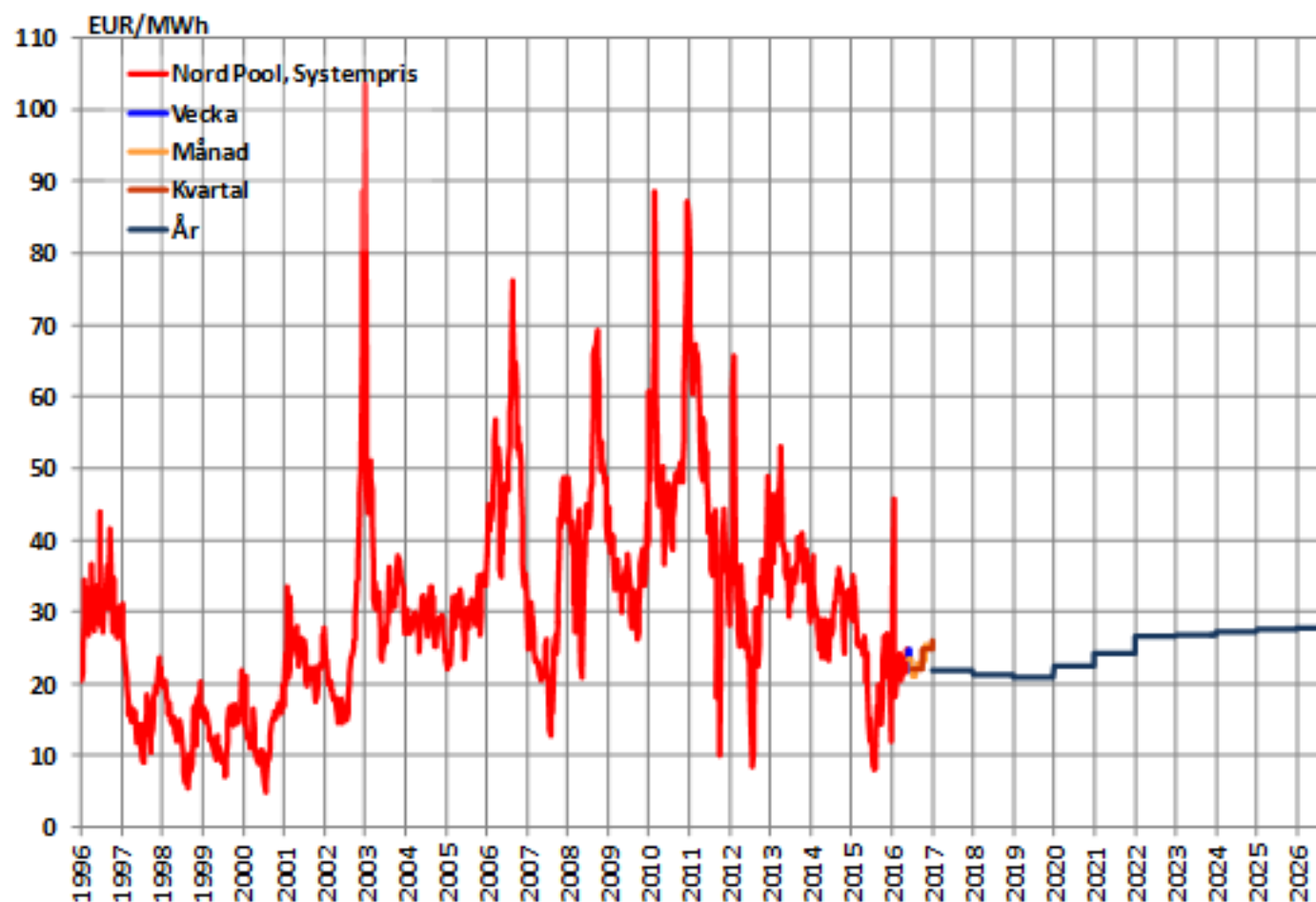
## Decision on October 22 2015

**SE target                      Increase 25 TWh to 30 TWh 2020**

□ Kontrollstation för elcertifikatsystemet 2015. ER 2014:04. Energimyndigheten 2014



# Noordpool spot



Källa: Nord Pool Spot, Nasdaq/OMX Commodities, Svensk Energi





# RE Certificates 2006-2014





# Renewable transport fuels

- **Present situation**

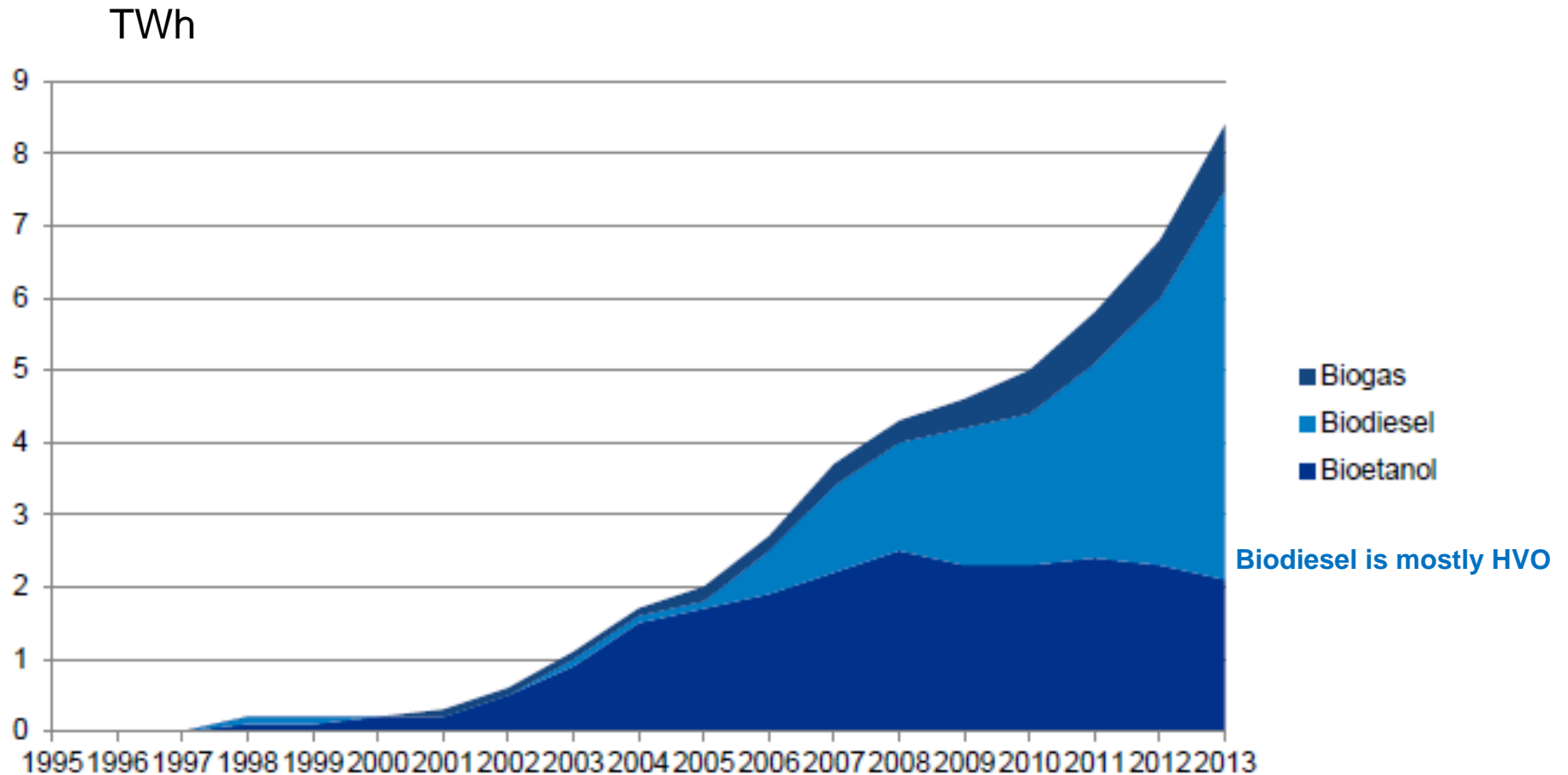
- 15.6 % RE transport fuels in 2013
- 5.9 % of all vehicles predominant RE fuels
- Energy taxes levied on low-level blends in gasoline and diesel as of 2013 to comply with EU state aid rules, but no CO<sub>2</sub> tax.
- Tax exemptions retained for high-level blends or neat fuels (e.g. E85, B100, CBG, but also for HVO < 15 % in diesel)
- Sustainability criteria to qualify as RE fuel and for tax exemptions
- Parliamentary commission on fossil-free vehicle traffic was reported December 16, 2013.
  - Proposal for a price guarantee for second generation biofuels?





# Renewable Transport Fuels

15.6 % RE transport fuels in 2013





# Renewable transport fuel taxation 2015

Fuel type	Usage	Energy tax reduction %	CO2 tax reduction %	Notes
Ethanol ETBE	Low blend-in	89	100	Max. 5 % blend (10 % 2016)
Ethanol, Other biofuel	High blend-in	100	100	E85, ED95  No fossil component
FAME	Low blend-in	8	100	Max. 5 % blend
FAME	High blend-in	44	100	
HVO		100	100	
Biogas		100	100	To 2020

**2016 taxes not defined yet as the potential  
“over-compensation” must be assessed**



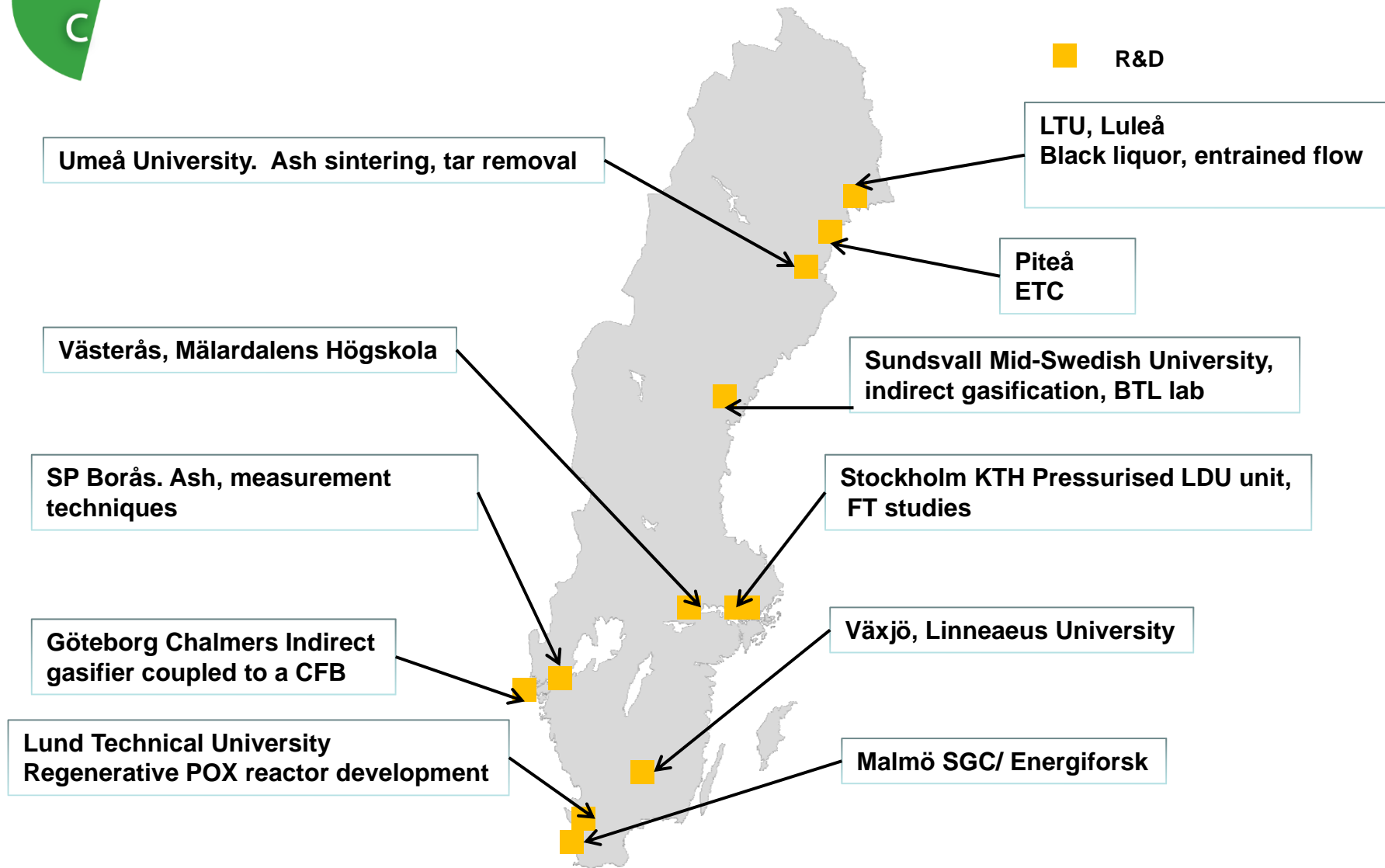
# Renewable transport fuels

## Future plans

- Quota obligation proposal was withdrawn for governance reasons in early 2014
  - Increase of energy tax on low-level blends and also CO<sub>2</sub> tax resulting from state aid consultations with the EC
  - Tax exemption retained until 2017 to conclude the EC discussion, a new package expected to be decided in parliament to be in force by 2018.
  - All options on the table
    - tax exemptions
    - quota obligation
    - GHG reduction obligation
    - the FFF committee proposal to guarantee price relation to fossil fuel
    - Other?
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# Biomass Gasification R&D Sweden





# Swedish Research Program

**SFC – Separate slide**

**LTU-Biosyngas centre- Separate slide**

**Energy gas program- Separate slide**

**f<sup>3</sup>- 65 million SEK, of which a part is a joint program of 44 MSEK, “Renewable transport fuels” 50% from energy agency**

**Thermochemical conversion- Biomass including lignin Gasification, HTL, HTC, Pyrolysis, Hydrogenation, 80 MSEK 2015-2019 (40 MSEK in first call)**



# Swedish Gasification Centre (SFC)



**CDGB - Centre for Direct Gasification of Biomass**

**CIGB – Centre for Indirect Gasification of Biomass**

**B4G – Biomass for Gasification, Entrained Flow Centre**

Academies Chalmers, Gothenburg Univ., KTH, Linneaeus Univ., Luleå Technical Univ., Lund Univ., Mid-Swedish Univ., Mälardalen Univ., Umeå Univ.

Companies E.ON, Metso, Göteborg Energi, Fortum, Mälarenergi, Cortus, Nynas, Eskilstuna Energi och Miljö, Nordkalk

**2013-2017 activity, 58 MSEK/year**

**2017- being planned**



# LTU Biosyngas program

- **The LTU Green Fuels (Luleå Technical University) has bought the Chemrec pilot plant and the bio-DME plant.**
- **Operating staff and some key Chemrec staff hired**
- **LTU Biosyngas program, approx. 160 MSEK, 2014-2016**
- **Objectives:**
  - DME fuel for truck tests, other test activities
  - Catalytic gasification of liquids
  - Develop to solid fuel gasification
  - Gas cleaning developments
  - Development of catalytic synthesis reactions

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# Energiforsk *fka* Swedish Gas Centre

**Four energi research organisations  
where merged to Energiforsk in January 2015**

(Värmeforsk, Svenskt Gascentrum, Elforsk, Framsyn)

## ”Energy gas program”

New project period 80 MSEK, 9 M€ for 2013-2015.

A dozen projects approved in December 2014

### • ***International Gasification Seminar***

Annual since 2007, Gothenburg 2013, Malmö 2014,

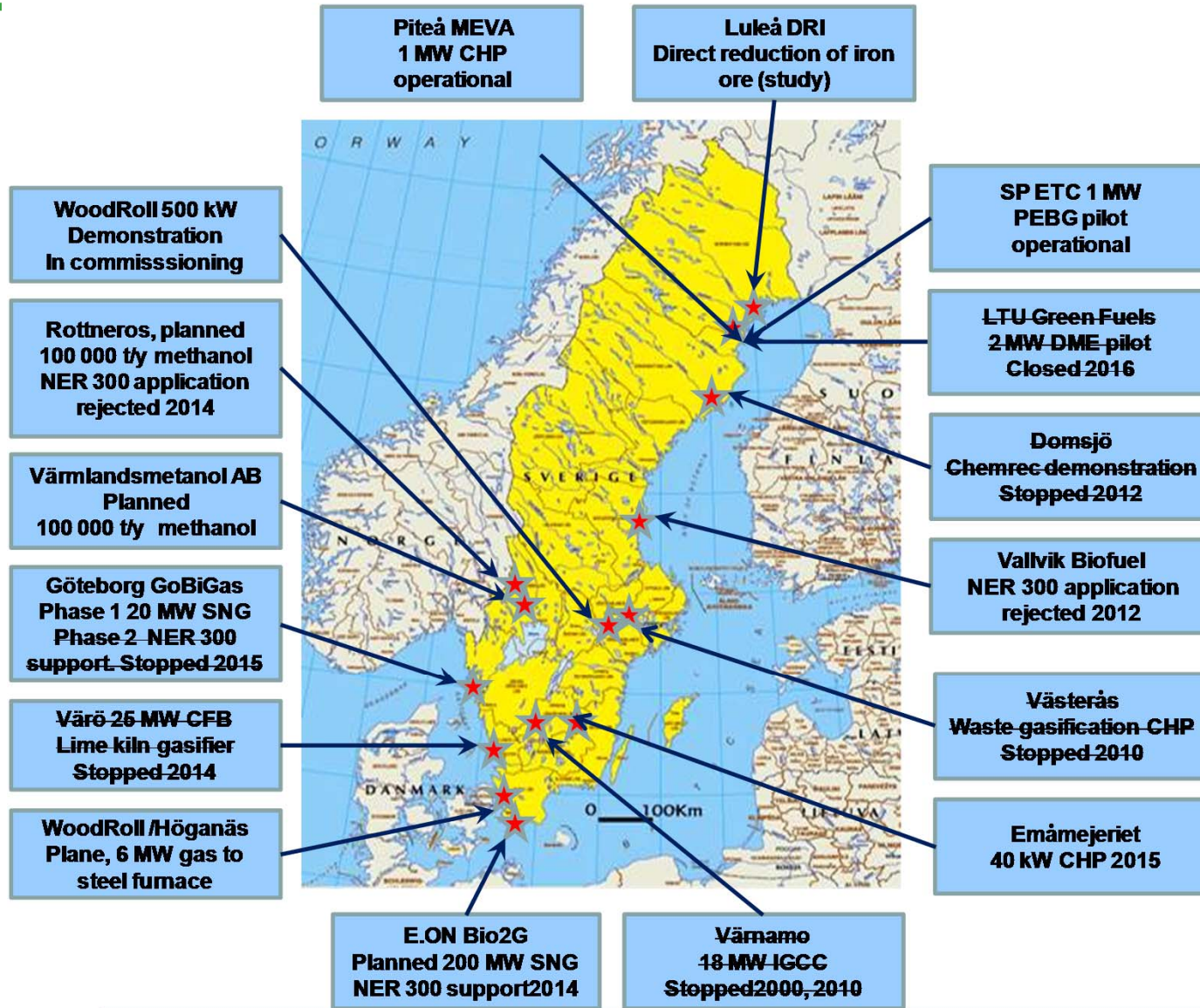
**Stockholm Oct. 2016**







# Biomass Gasification Developments 2010-

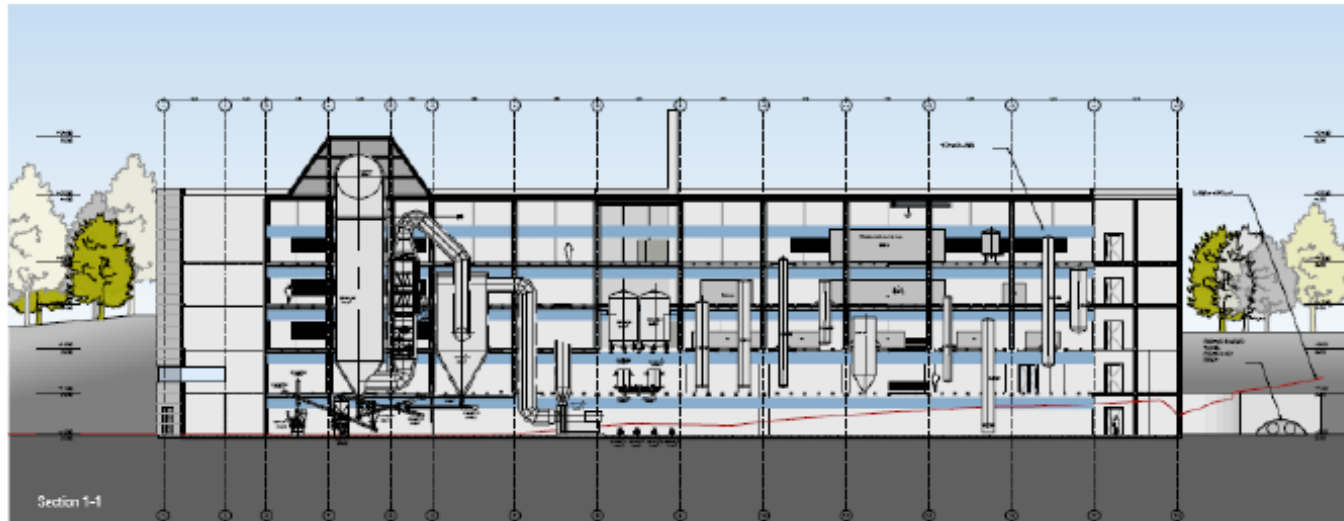




# Biomass to SNG: GOBIGAS

## GoBiGas – phase 1

Production:		Consumption:	
Bio-SNG	20 MW	Fuel (pellets)	32 MW
District heating	4 MW	Electricity	2,5 MW
Heat to heat pumps	8 MW	RME (bio-oil)	0,5 MW



 Göteborg Energi



# Biomass to SNG: GOBIGAS

## GoBiGas – step by step

- **Performance goals:**

- Biomass to biomethane 65 - 70%
- Energy efficiency > 90%

- **Phase 1:**

- Demonstration plant
- Evaluation, R&D programme
- 20 MW generating 160 GWh/year
- In operation early 2013
- Allothermal (in-direct) gasification

- **Phase 2:**

- 80-100 MW generating 640-800 GWh/year
- In operation after evaluation of Phase 1
- Technology not yet chosen



**Official start-up  
October 28, 2013.**









# Biomass to SNG: GOBIGAS

## Current status May 2016.

- Plant operation approx. 3 000 hours
- MCR load proven on pellets
- Gas quality good, bio-methane quality better (rel. to design spec.)
- Pellets are very clean and generates certain specific issues.
- Bed material activation has been a learning experience
  
- SNG product for extended periods since August 2015
- 80 % of design capacity
- 900 hours continuous run in August-September
- Continuous run November to February 30 GWh SNG
- Efficiency close to target, 72 % GHG reduction at this capacity factor
- Present situation is finding and overcoming bottlenecks limiting capacity or limiting duration
- Chip handling system installed and commissioned



# Biomass to SNG: GOBIGAS

## Future goals and plans for 2016

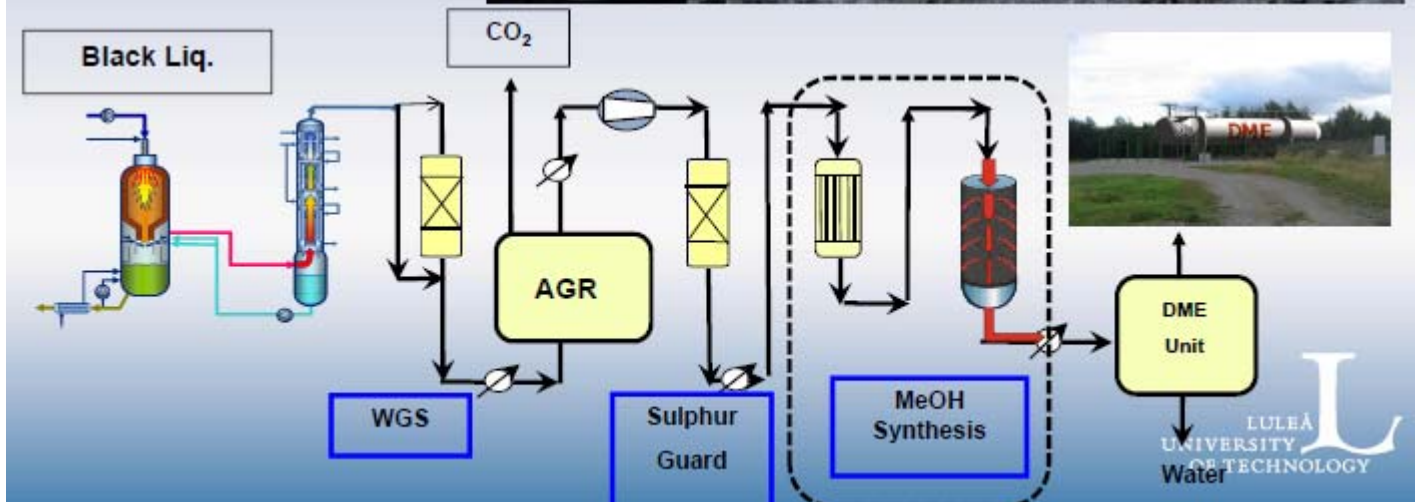
- Switch from pellets to chips in March 2016
- Complete system commissioning (chips to product) on-going
- Limited operation this far on chips
- Initial issue with chip quality  
too high / too varying chip moisture
- But good hopes
- Improved economy on chips

**However, the City Council decided to discontinue plans for Phase II in December 2016, and the future of the Phase I plant after the evaluation phase uncertain**

# LTU Biosyngas program

## Black Liquor to Green DME Demo

- Gasifier >23 000 h
- DME plant >8 000 h
- New MeOH technology



**Program ends in May and no additional funding secured or in discussion  
Mothballing or demolition decision is pending**



# Other Projects

## Other projects, no known development

- Bio2G, EON 300 MW SNG, S. Sweden
- Värmlandsmetanol, 100 000 tpa methanol, Värmland  
(New IPO on-going, 1.5 Million €)
- Rottneros biorefinery, 150- 200 000 tpa methanol, Värmland





# Cortus Wood Roll

Saxlund International / Opcon AB	Torkapparater AB	KTH Royal Institute of Technology	Sandvik Heating Technology AB – Kanthal	ÅF	Calderys AB	Siemens
Saxlund International / Opcon delivers biofuels feeding equipment to the WoodRoll® process	Torkapparater delivers dryer and pyrolysis equipment to the WoodRoll® process	KTH has provided equipments and facilities for Cortus to run tests on over 20 different fuels	Kanthal delivers radiation tube burners for indirect heating to the WoodRoll® process	ÅF provides Computational Fluid Dynamics modeling for system optimization	Calderys delivers refractory materials to the gasification reactor in the WoodRoll® process	Siemens delivers Control systems and instrumentation





# Cortus Wood Roll, Köping

## 500 kW integrated plant

Fully integrated operation has been achieved

Some re-engineering requirements have been identified and are being addressed

Firing pyrolysis gas in gasifier works

Stable product gas composition without any tar

Work with HTAS on catalytic tar treatment in pyrolysis gas





# Cortus Wood Roll, Köping



**KIT Mobile SNG unit to initially tested at the Köping site.  
A project cooperation within KIC Innoenergy.**

## **Prospects:**

- Höganäs 6 MW**
- Forest Energy, Japan 2 MWe 2017 (pot. 20 plants)**
- CHP study in California target 2017**
- LPG replacement in a paper industry dryer**
- 3 units in Italy awaiting new RE support policy decision**





# Cortus Wood Roll

## 6 MW modular design for Höganäs steel





# MEVA Innovation AB

A first unit, 1.2 MWe has started operation at Hortlax, Piteå.  
Target market is co-gen plant, 2-20 MW heat, 1-10 MWe.

VIPP-VORTEX®, Gasification system

**VIPP** Cyclone  
Gasifier

VORTEX INTENSIVE  
POWER PROCESS



VIPP-ECP®, Gas cleaning system

Multistage cleaning

- cyclone
- gas cooling
- RME scrubber
- WESP

Gas engine

Cooperation on specially designed gas engines with supplier Cummins Power Generation Ltd., UK.

**In operation according to company representatives**

