

IEA Task 33 Meeting

Berlin, Germany

2015-10-29

Country Update Sweden

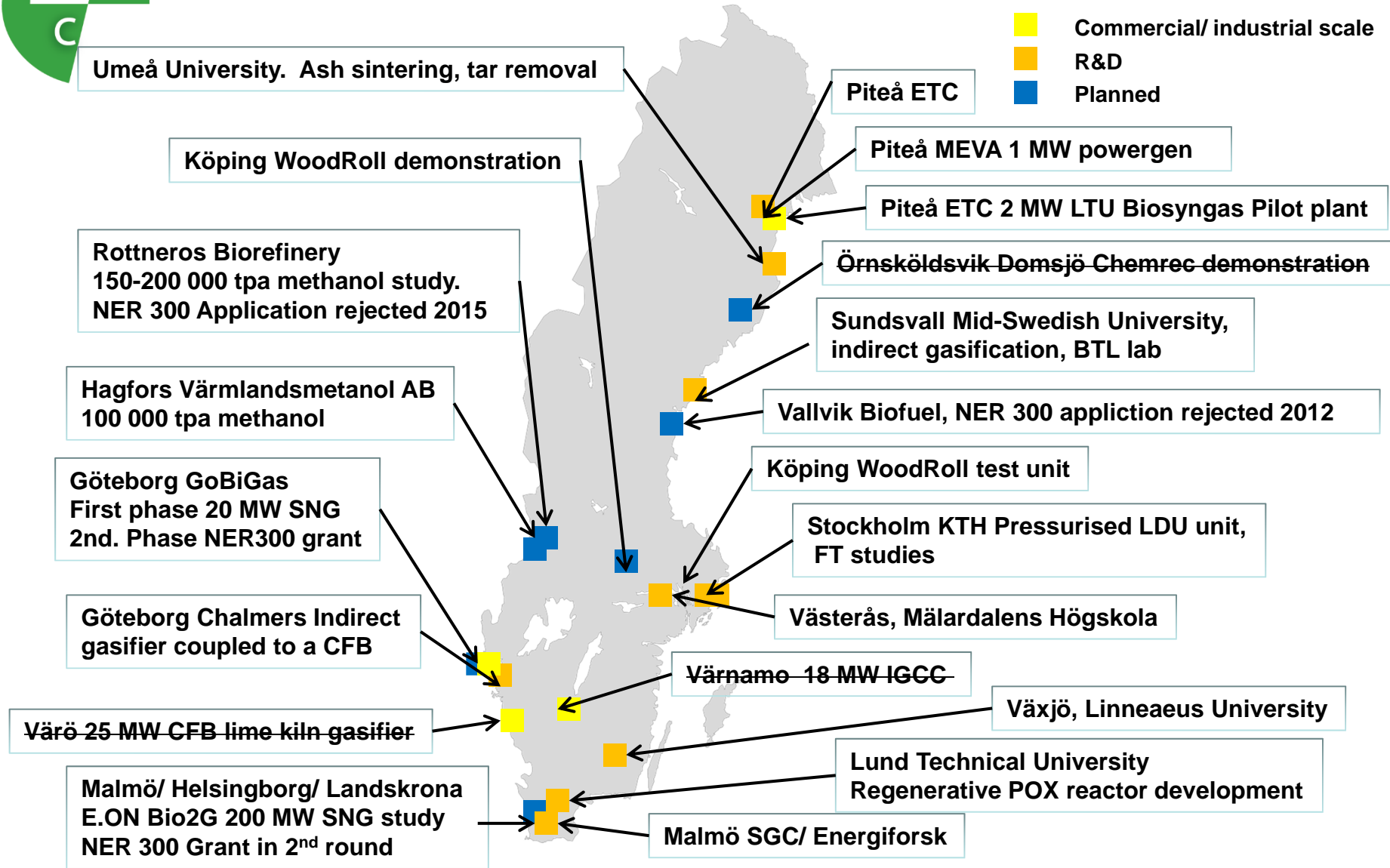


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Biomass Gasification Sweden 2012-2014





Swedish Energy Targets 2020

- Reduce GHG emissions 40 % by 2020 outside ETS sector
 - 20% done (rel. 1990), 30% by flexible mechanisms
 - Continued use of environmental taxation
 - Sweden independent of fossil transport fuels in 2030
- Follow EU ETS policies (now third phase)
- Minimum 50% Renewable Energy 2020
 - RE Certificate prolonged and coordinated with Norway
 - Target increased, +25 TWh rel. 2002
 - Wind power planning 20 TWh land-based+10 TWh sea-based
 - 10% renewable transport fuels
- Energy Savings Plan
 - 20% reduction of energy/GNP ratio by 2020, relative to 2008



Swedish Politics

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.

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

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.

New tax on nuclear power to finance decommissioning.



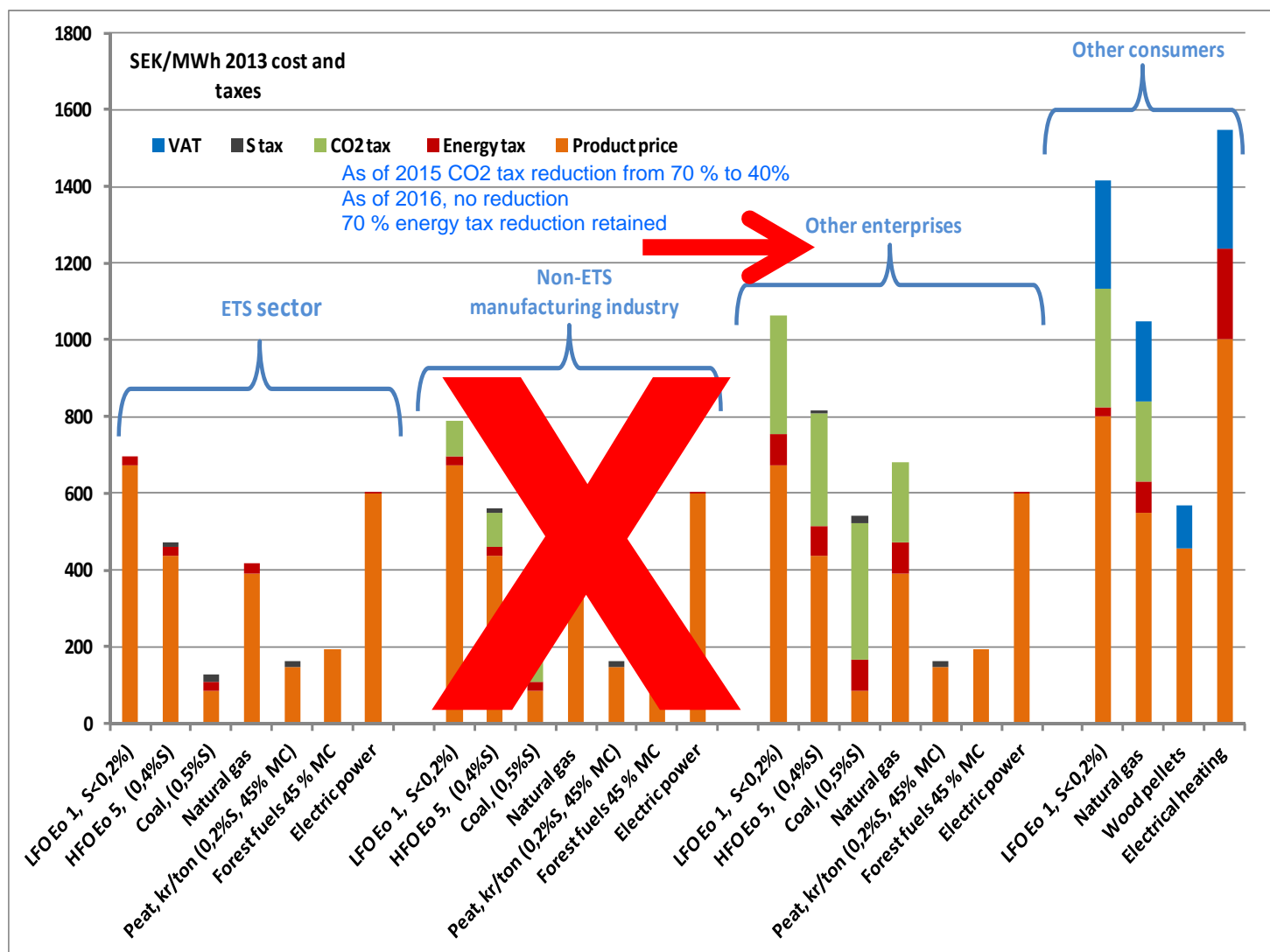
Nuclear Power

• History

- Planning and investment decisions on reactors were taken in the 1960's
- Referendum to phase out reactors by 2010 in 1981
- The reactor development law (SFS1984:3) was put in force prohibiting building of nuclear power plants and the development of novel reactor technologies
- 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- The reactor development law (SFS1984:3) was revoked in 2012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??????
- However, the new government has stopped planning by Vattenfall by an owner's directive in late 2014
- However, 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.

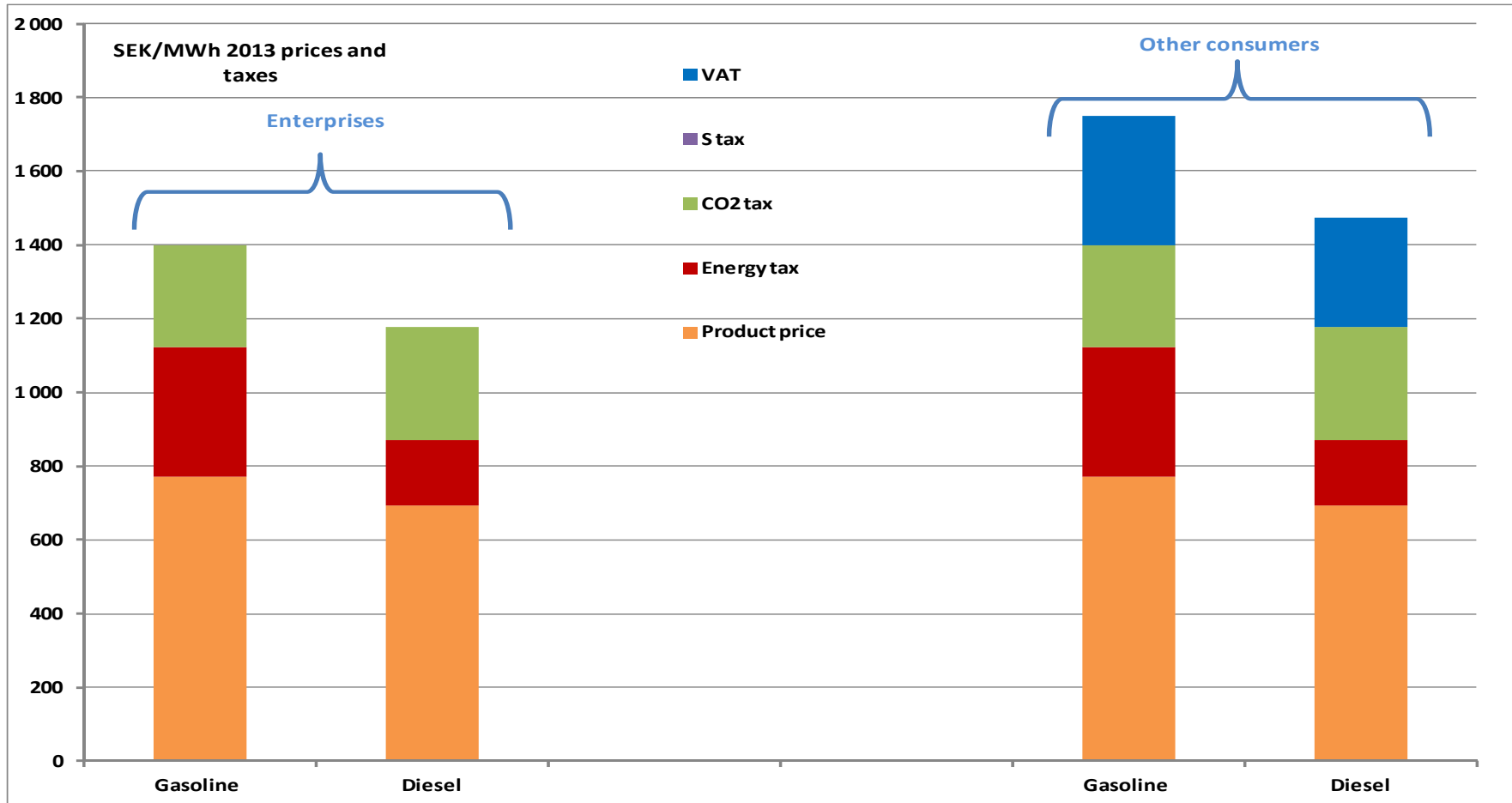


Fuel prices and taxation 2013



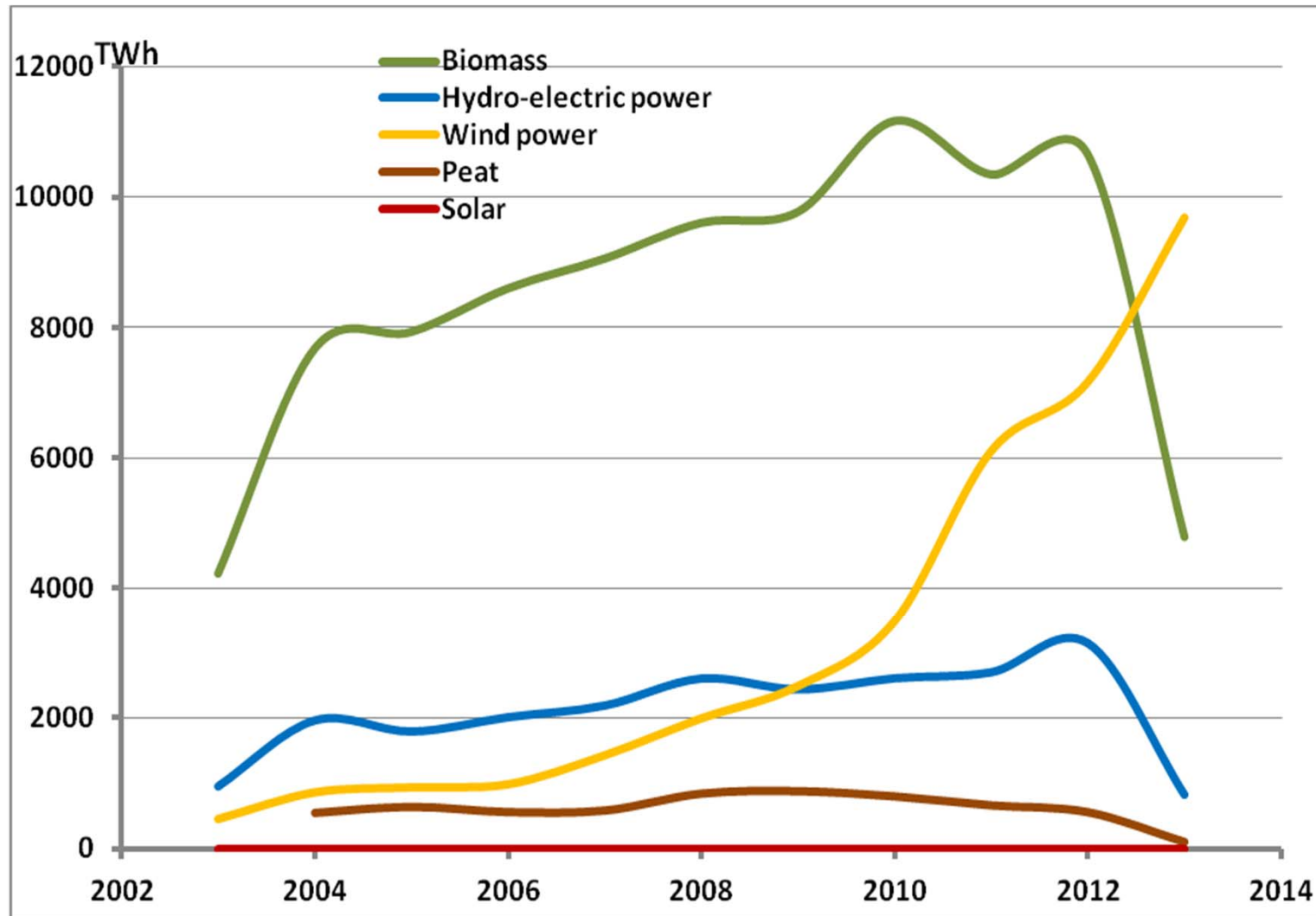


Transport fuel prices and taxation 2013





RE Power production 2002-2013





Green Certificates

2002 datum	6.7 TWh
2002 target	+ 10 TWh 2010
2006 target	+ 17 TWh 2016
2009 target	+ 25 TWh 2020

2012 SE+NO common target

SE	+ 13.2 TWh 2020 to meet previous target
NO	+ 13.2 TWh 2020

Decision on October 22 2015

SE target Increase 25 TWh to 30 TWh 2020

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

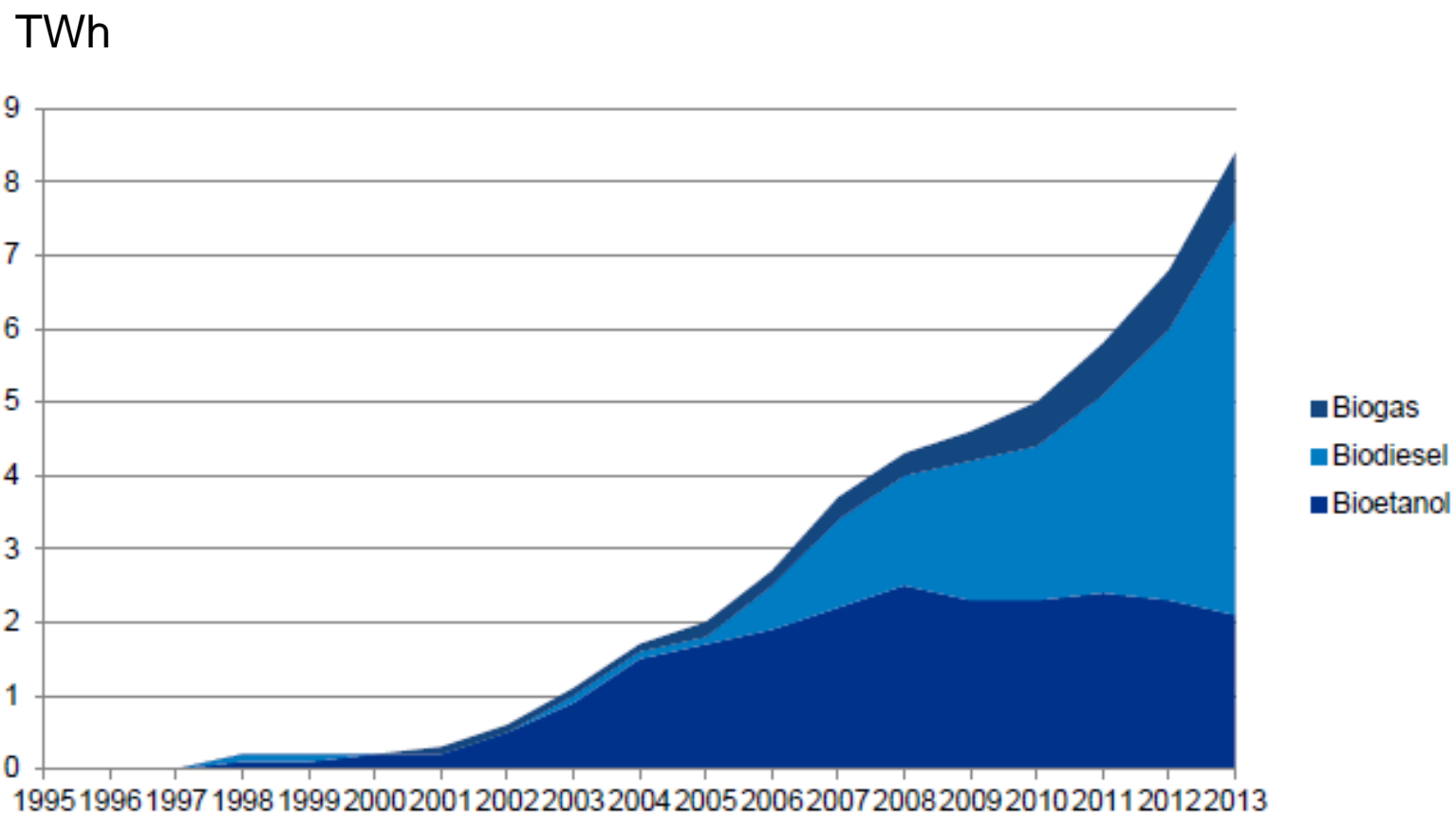


RE Power production 2002-2013





Renewable Transport Fuels





Renewable transport fuels

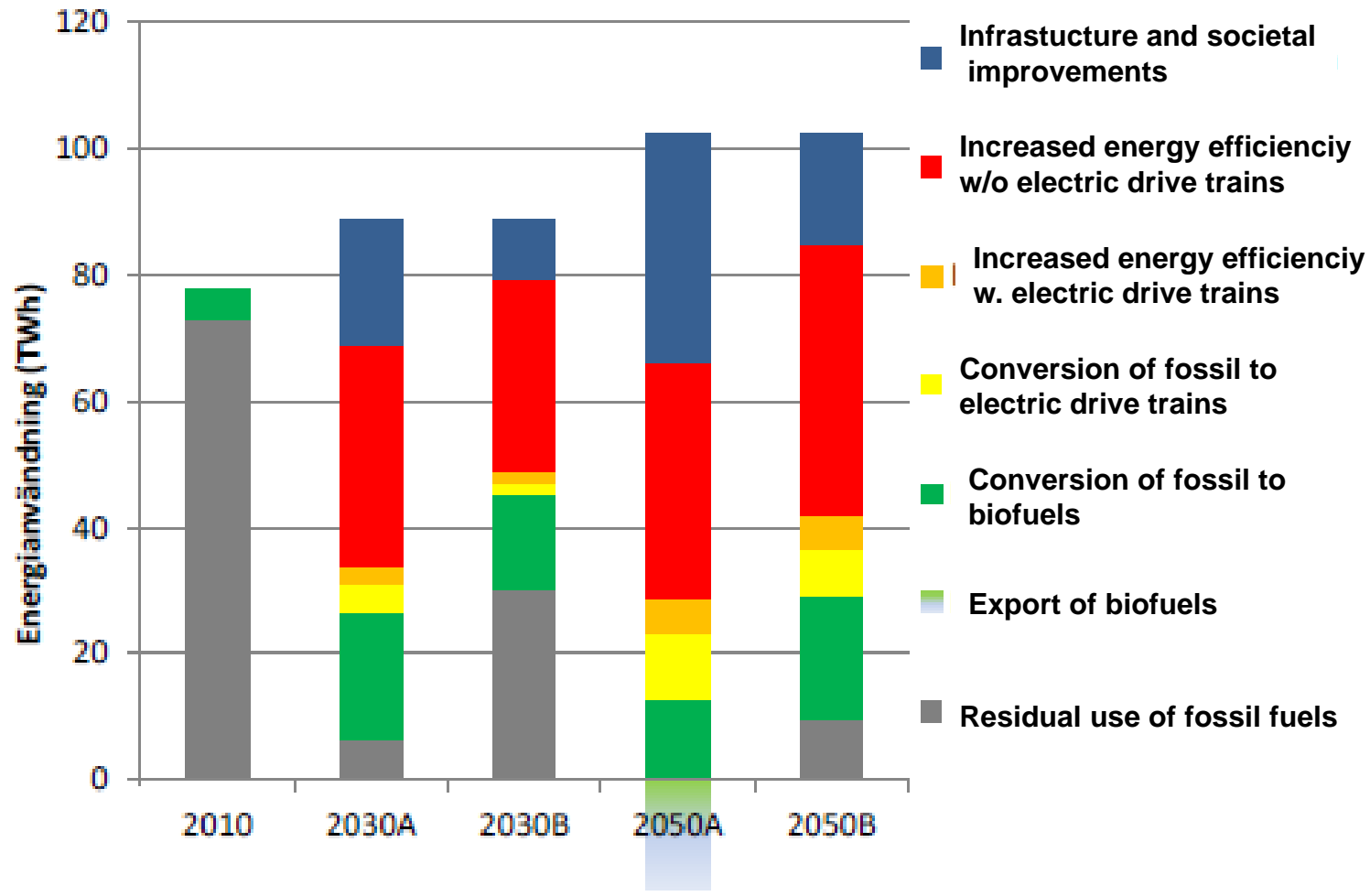
- **Present situation**

- 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 CO₂ 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?



Parliamentary commission on fossil-free vehicle traffic (FFF)

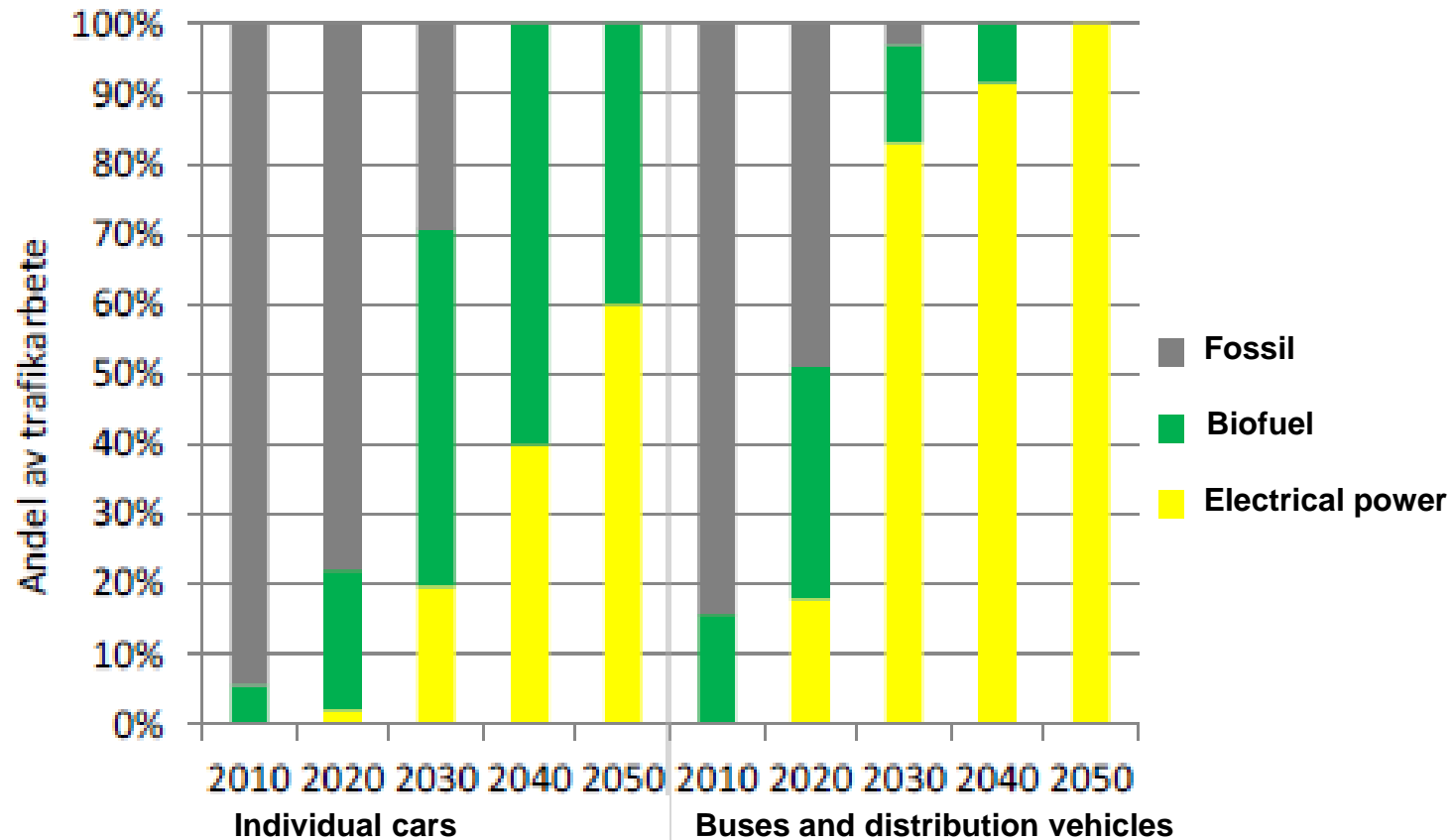
Energy for transports, TWh





Parliamentary commission on fossil-free vehicle traffic (FFF)

Share of transport work %





Tax exemptions and state-aid

The EC view on support by tax exemptions

- cannot make biofuels cheaper than fossil fuels (“over-compensation”).
- cannot apply to new plants (2014)
- cannot be applied to biofuels derived from food crops as of 2020
- cannot be combined with other policy measures such as a quota obligation
- CO2 tax requires differentiation on a fuel basis

SE government actions to avoid issues for enterprises

- More price supervision to avoid over-compensation.
- Stepwise increase in biofuels taxation to avoid over-compensation
- Differentiated taxation for different biofuels depending on type and level of blend-in (even CO2 tax!)
- New tax conditions for new plants (after 2014)
- Proposal for new system in 2017 for implementation 2018



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

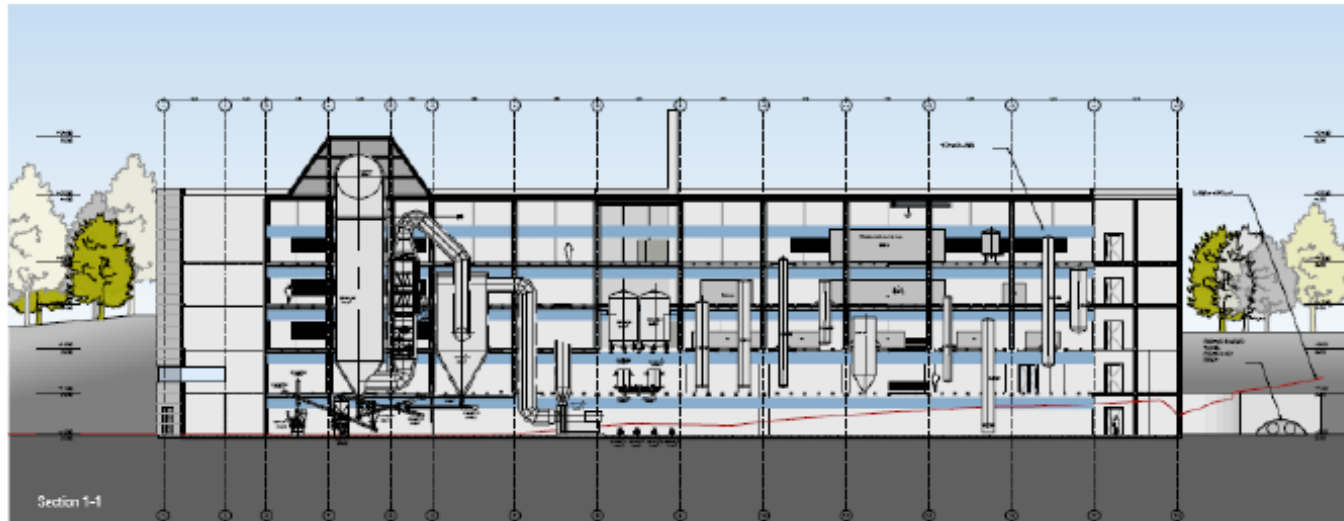
- Quota obligation proposal was withdrawn for governance reasons in early 2014
- Increase of energy tax on low-level blends and also CO₂ tax resulting from state aid consultations with the EC
- Tax exemption retained until 2017 to conclude the EC discussion, a new package expected to be decided in parliament 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?



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.**



Further details in work shop presentation



Biomass to SNG: GOBIGAS

Current status beginning of October 2015.

- Gasifier operation approx. 9 000 hours
- MCR load proven on pellets
- Gas quality (relative to design values) good
- Pellets are very clean and generates certain specific issues.
- Bed material activation has been a learning experience

- SNG product in a longer campaign in December 2014
- In 2015 periods of grid supply (days) on some occasions
- 60-70 % of design capacity
- 900 hours continuous run in August-September at 80 % load
- Biogas quality better than design spec.
- Overall efficiency during the long run close to target
- Present situation is finding and overcoming bottlenecks limiting capacity or limiting duration



Biomass to SNG: GOBIGAS

Future goals and plans for 2015-2016

- Continuous operation period from to December
- Installation of chip feeding equipment on-going
- Expected switch from pellets to chips early 2016
- The second phase is studied technically but still decision requires evaluation of first phase operation and also clarification on policies, commercial conditions etc.



Other Projects

Other projects, no known development

- Bio2G, EON 300 MW SNG, S. Sweden
- Värmlandsmetanol, 100 000 tpa methanol, Värmland
- 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 production of clean syngas from biomass
- ❖ Investing 1 200 000€
- ❖ Six months work will be finalized shortly
- ❖ All safety functions
- ❖ Six screen Siemens control system
- ❖ Remote operation as an overall goal





Cortus Wood Roll, Köping



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



Cortus Wood Roll

6 MW modular design





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 this heating season according to company representatives





Swedish Research Program

SFC – Separate slide

LTU-Biosyngas centre- Separate slide

Energy gas program- Separate slide

f³- 65 million SEK, of which a part is a joint program of 44 MSEK, “Renewable transport fuels” 50% from energy agency

New

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



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

