



# Past, present and future biofuel use in Sweden

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# Outline of presentation

- Biofuel markets in Sweden
- Bioenergy in Sweden
- Biofuel policy in EU/Sweden
- Outlook for 2020/2030

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# Production and use of biofuels 2009 (mln. litres)

Production	Sweden	EU27	USA	Brazil	World
<b>Etanol</b>	<b>174</b>	3599	41403	26103	77024
<b>Biodiesel</b>	<b>116</b>	10016	1914	1608	17884
<b>Gasoline</b>	<b>6055</b>	202950	509818	22860	1235553
<b>Diesel</b>	<b>9098</b>	339723	234904	39088	1414879
<b>Consumption</b>					
<b>Ethanol</b>	<b>389</b>	4480	41775	22823	74341
<b>Biodiesel</b>	<b>205</b>	12221	1195	1567	17560
<b>Gasoline</b>	<b>4756</b>	151027	522060	19218	1256097
<b>Diesel</b>	<b>4068</b>	371133	210708	43871	1410698

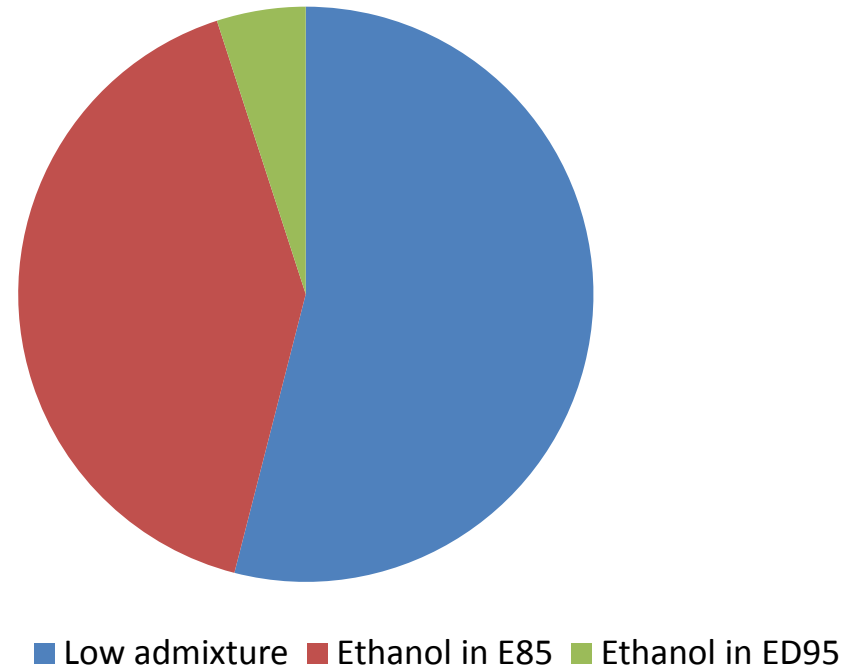
Sources: EurObserver 2010, EBB, ePure, EIA International Energy Statistics, FAPRI 2010, Transportsektorns energianvändning 2010

# Biofuel markets in Sweden

- Small amount of producers in ethanol and biodiesel in Sweden
- Production 2009
  - 174 mln litres ethanol; 116 mln litres biodiesel (**EU27**: 3702 mln litres and 10 245 mln litres)
- Use 2009
  - 389 mln litres of ethanol; 205 mln litres biodiesel (**EU27**: 4480 mln litres and 12 221 mln litres)
- Capacity to produce the use of biofuels in Sweden, but...
- Large import of both fuels and agriculture commodities (and ¼ of the ethanol production is exported)
  - 47% biodiesel import 2010 (EU)
  - 73% ethanol import 2010(EU, Brazil, USA)

# Ethanol production and use in Sweden

- Production:
  - Two ethanol producers in Sweden, of which one is dominating
  - Total production covers around 27% of domestic demand (2010)
  - Small volumes of "2nd generation" is produced (black liquor)
- Use:
  - Low-admixture in petrol (95% of all petrol sold in Sweden contains 5% ethanol)
  - E85, mixture of 85% ethanol and 15% petrol (less ethanol in winter time). Mainly for passenger cars
  - ED95, mainly used as bus fuel

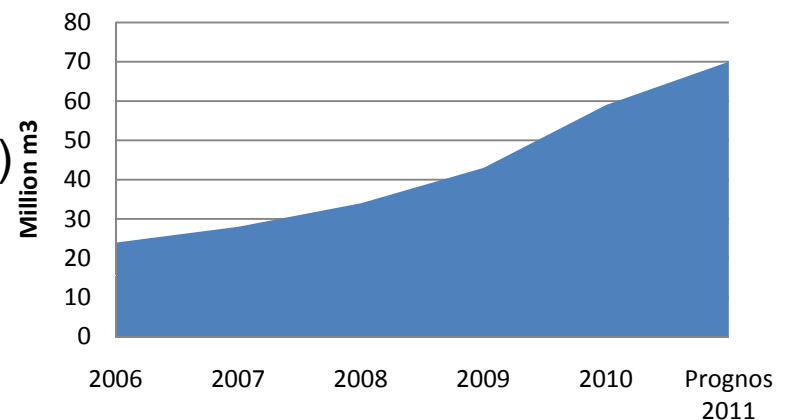


# Biodiesel production and use in Sweden

- Use:
  - Biodiesel (RME) is used as low-admixture in diesel (in average 90 % of the diesel used for transport contains 5% biodiesel). (Low admixture has been permitted since 2006)
  - Very small volumes of "pure" biodiesel on the market so far
  - From April 2011 – hydrogenated vegetable oil (HVO) were introduced on the Swedish market. A biodiesel, but different from RME since it is identical with fossil diesel. Allows for higher admixture in diesel compared to RME (currently the admixture of HVO is around 15% + 5% RME). Present HVO-capacity is 100 000 m<sup>3</sup> (diesel demand is around 5 000 000).
- Production:
  - One major producer and several small-scale producers of RME
  - One producer of HVO
  - Around 50% of demand is imported from other countries (2010)

# Biogas production and use in Sweden

- Production:
  - Around 230 production facilities
  - Most of the biogas for transport (upgraded biogas) is produced from waste.
- Use:
  - Biogas is often sold as "fordonsgas" which is normally a mixture of biogas and natural gas. The average mixture is 65% biogas and 35% natural gas, but there are large variations across the country.
  - 572 GWh were sold 2010
  - Also some LNG and LBG on the market, but so far very small volumes.
  - Around 120 public fuelling stations
  - (most of them in the southern Sweden)





# Future biofuels

- The Agency is financing several large research projects in the field of renewable motor fuels covering the entire chain from cultivation of raw materials for biobased motor fuels to the use of new fuels. Examples of projects:
  - Black liquor gasification in Piteå (paper mill industry). Main focus is to produce DME (dimethylether) which can be used in diesel engines.
  - Gothenburg Biomass Gasification Project. Forest residue will be used to produce biomethane which will be upgraded to natural gas quality.
  - Ethanol demonstration plant in Örnsköldsvik, cellulosic ethanol production. Started up in 2004. Used as a centre for development and as a test bed for research results produced by university departments.
- Research, development, and demonstration projects constitute an important element of long-term development strategy. It takes time for new technology to enter the market!
- **Probably no new fuels on the market before 2020!**

# Land use for biofuels

- 30% of the grains used in production of ethanol were imported 2010 (changes annually)
- Mainly imported rapeseed oil for biodiesel production in Sweden
- Biogas from agriculture is negligible (mostly waste)
- The agricultural products used for biofuel production is today limited and are not considered to change the land use in Sweden
- If the total capacity were reached with Swedish agricultural products: 10% of wheat production, 45% of rapeseed production would be used.
- Today 0.1 Mha (2%) of 2.6 Mha is used for biofuels.
- Future?

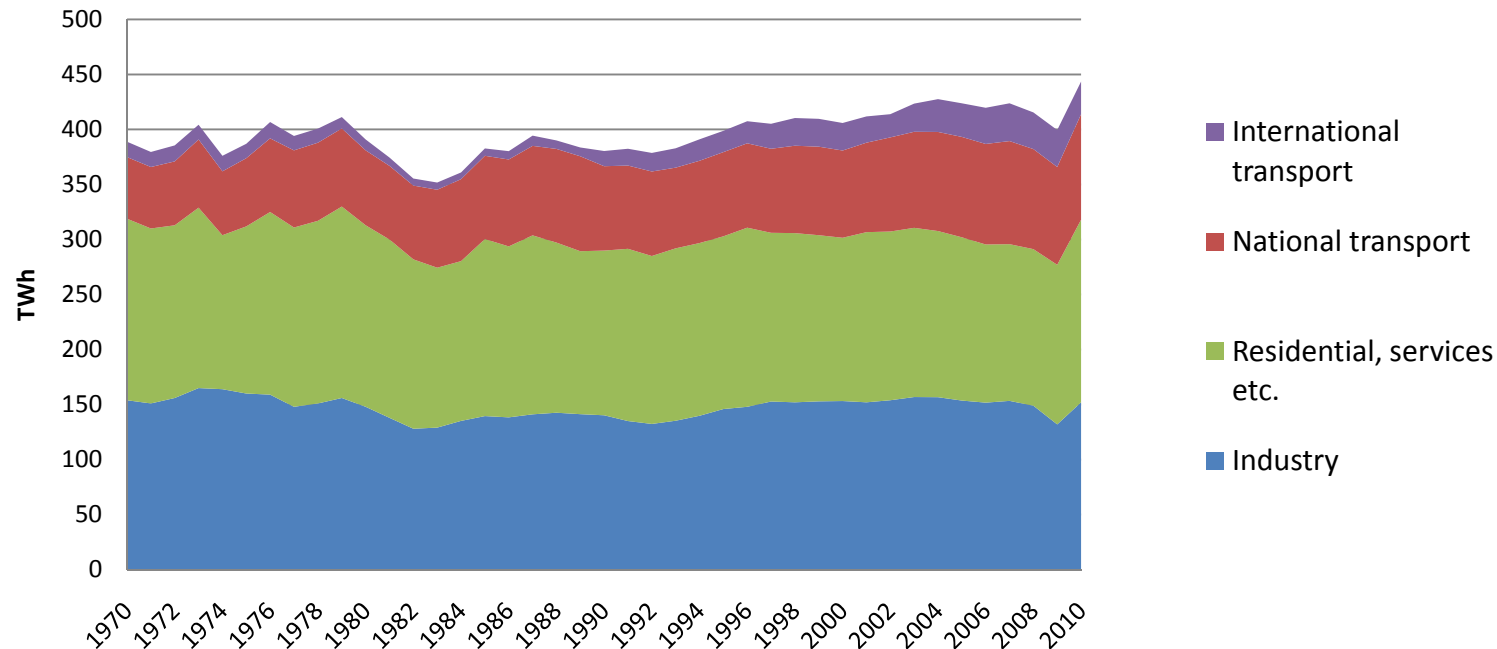
- Demand is driven politically, through policy measures. Biofuels cannot compete with fossil fuels in Sweden today without some kind of support

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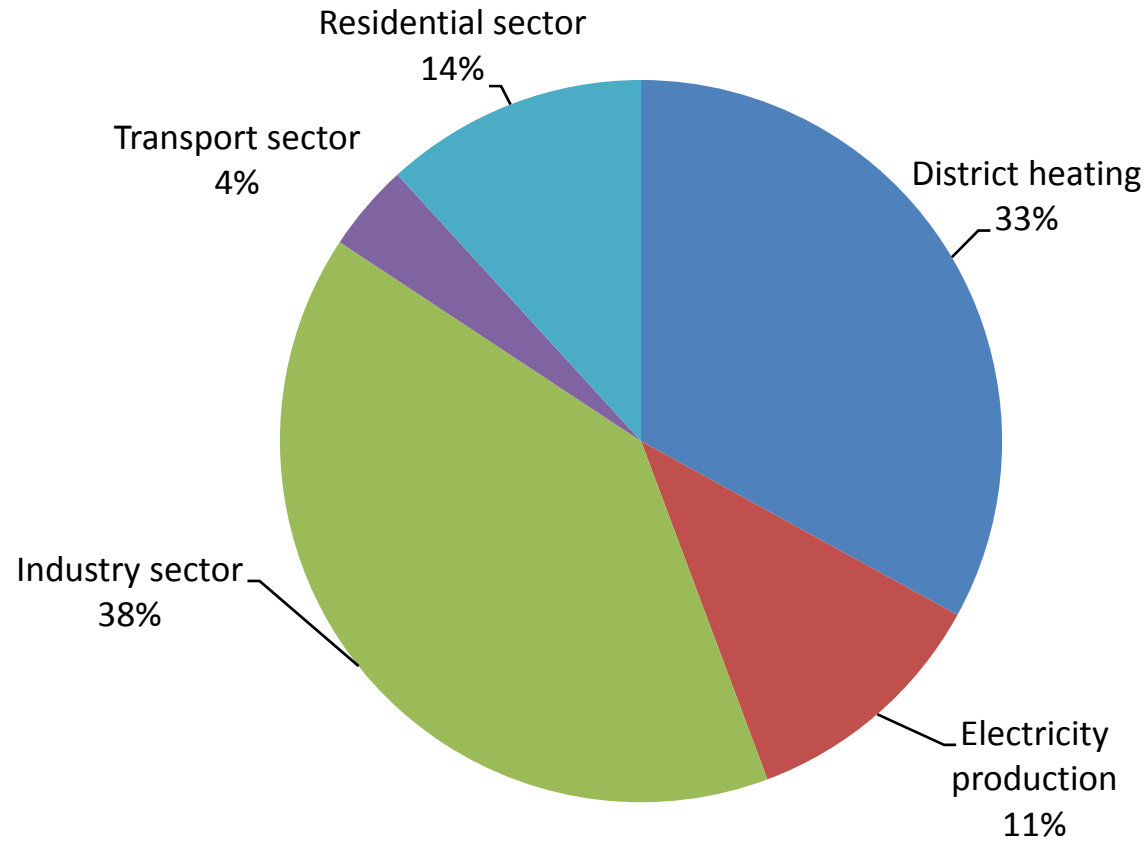
# Energy use in Sweden 1970-2010

(exkluding losses in conversion, transformation and nuclear power)



- End use of energy in industry and housing has been constant (due to large efficiency improvements and changes in energy carrier)
- The transport sector energy use has almost doubled from 56 TWh in 1970 to 96 TWh in 2010 (from 70 to 126 TWh when international transport is included).
- National transport accounts for ~25% of Swedish energy use.

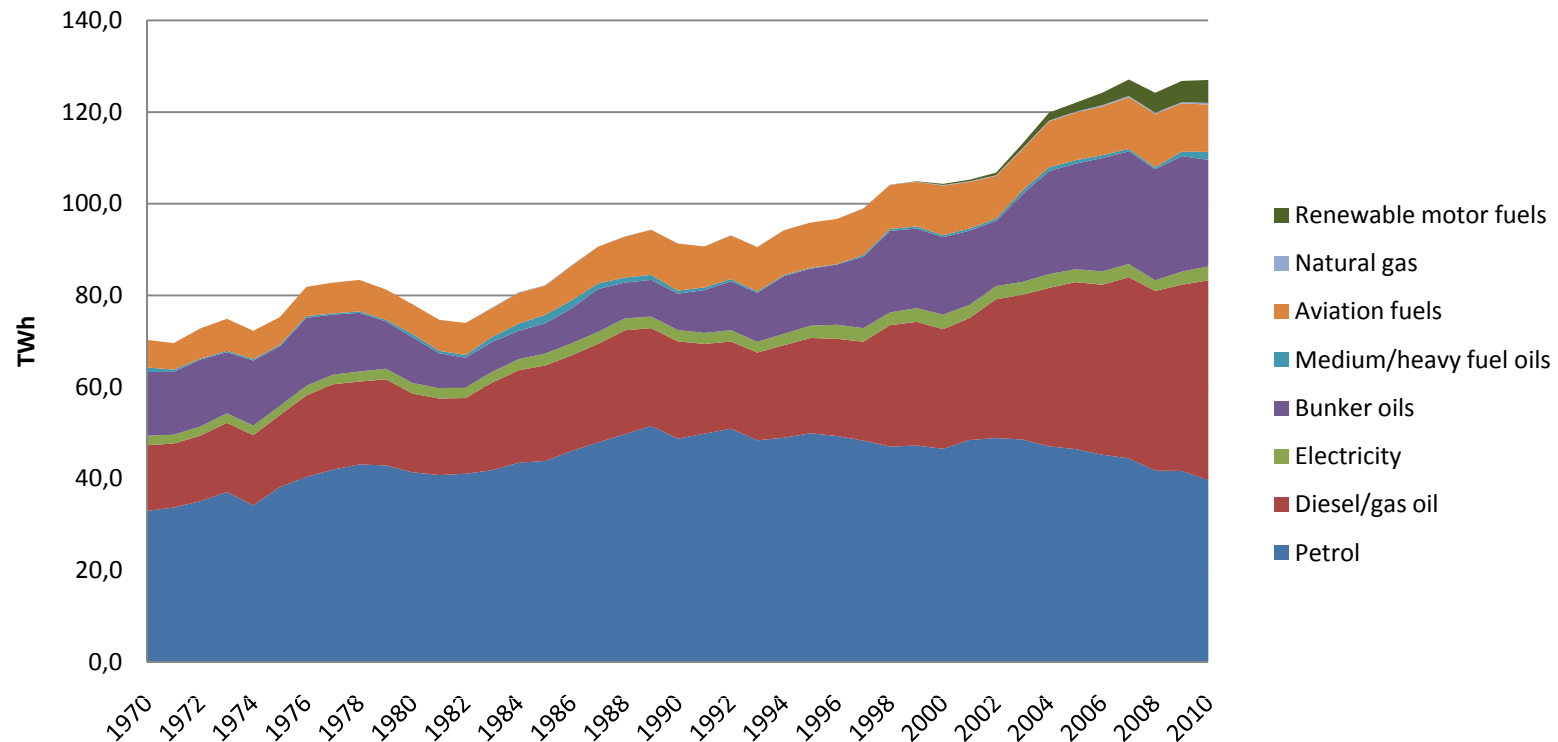
# Use of bioenergy in Sweden (2010)



Total: 141 TWh  
bioenergy

# Transport sector energy use

(including international shipping and aviation)

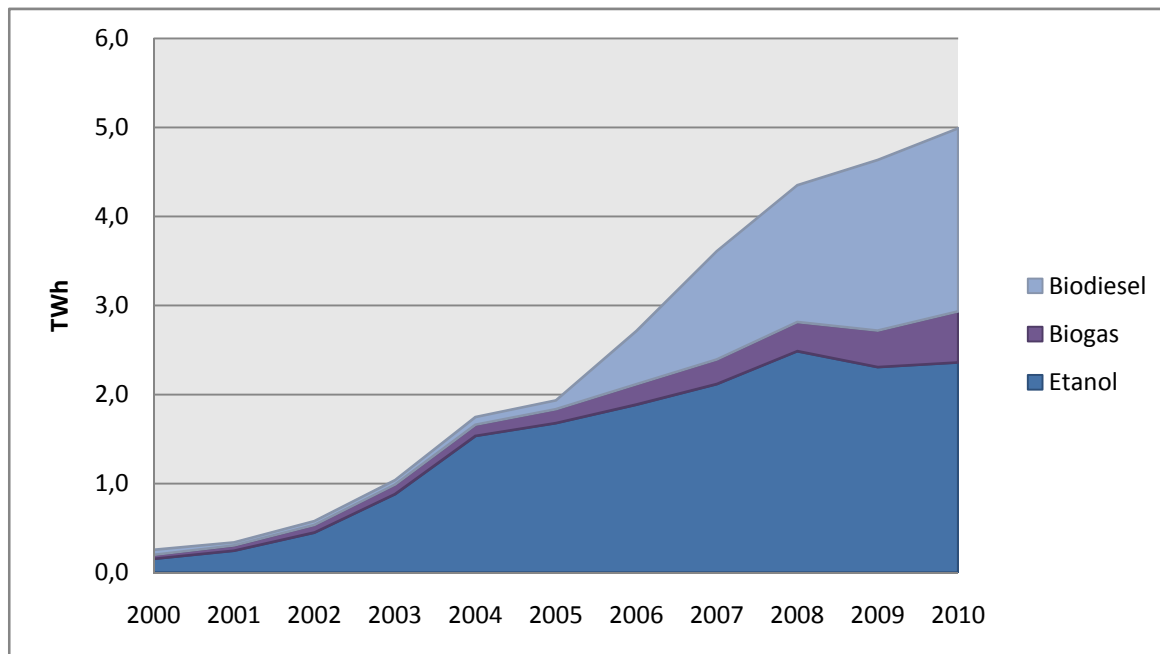


Total increase since 1970: almost 90%

Petrol: 15% decrease since year 2000

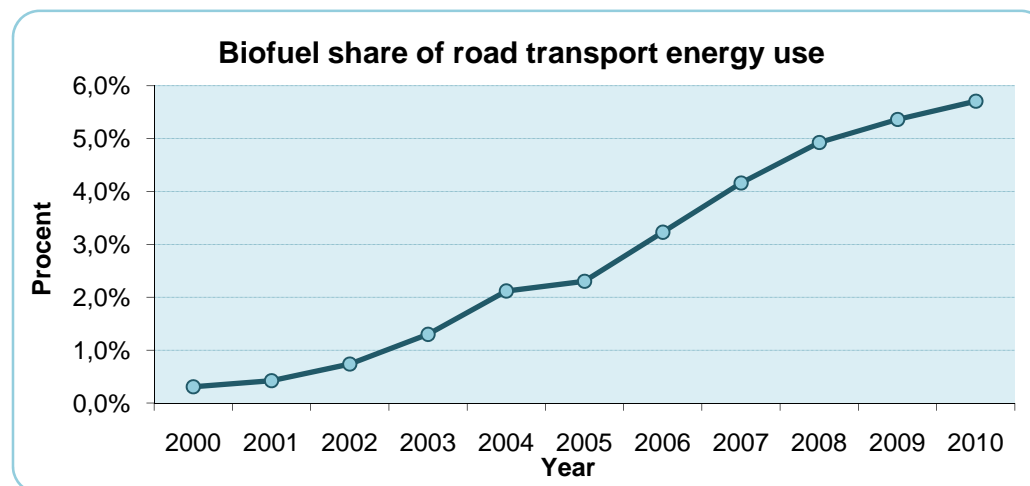
Diesel: more than 50% increase since year 2000

# Biofuel use in Sweden 2000-2010



- Current trend:
- Biodiesel and biogas increases
  - Ethanol levels off

5.7% biofuels share in 2010!  
7.9% renewables total





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# Biofuel policy in EU/Sweden

- International level:
  - Kyoto protocol targets
- EU level:
  - 20-20-20 targets
    - 20% increase in energy efficiency (compared to projections) in 2020
    - 20% less green house gas emissions (compared to 1990) in 2020
    - 20% renewable energy in 2020 (49% for Sweden)
  - **10% renewable energy in transport sector in 2020 (includes renewable electricity)**
- National level:
  - 50% of Sweden's energy use in 2020 will come from renewable energy sources (in line with EU target for Sweden - 49%)
  - In 2030 Sweden will have a vehicle fleet that is independent of fossil energy (not specified further)
  - Sweden's net greenhouse gas emissions will be zero by the middle of this century

# EU directives concerning biofuels

- Renewable directive (2009/28/EC)
  - Sets a binding target of 10% renewable energy in transport by 2020
  - Renewable biofuels need to fulfil sustainability criteria (-35% compared to fossil fuels, - 50% in 2017)
- Fuel quality directive (2009/30/EC)
  - Requires suppliers of motor fuels in the EU to reduce CO<sub>2</sub> emissions by 6% per unit of energy (as seen in a life cycle perspective) in 2020 from the level in 2010
  - Specifies permitted levels of low-admixture additives in motor fuels (10% ethanol or 3% methanol in petrol, 7% biodiesel in diesel)
- Emission performance standards for new passenger cars (regulation EC no. 443/2009)
  - New cars must not, on average, emit more than 130 g CO<sub>2</sub>/km. Applies to 65% of new cars in 2012, 100% in 2015
  - Producer level, not national level

# National policies for biofuels

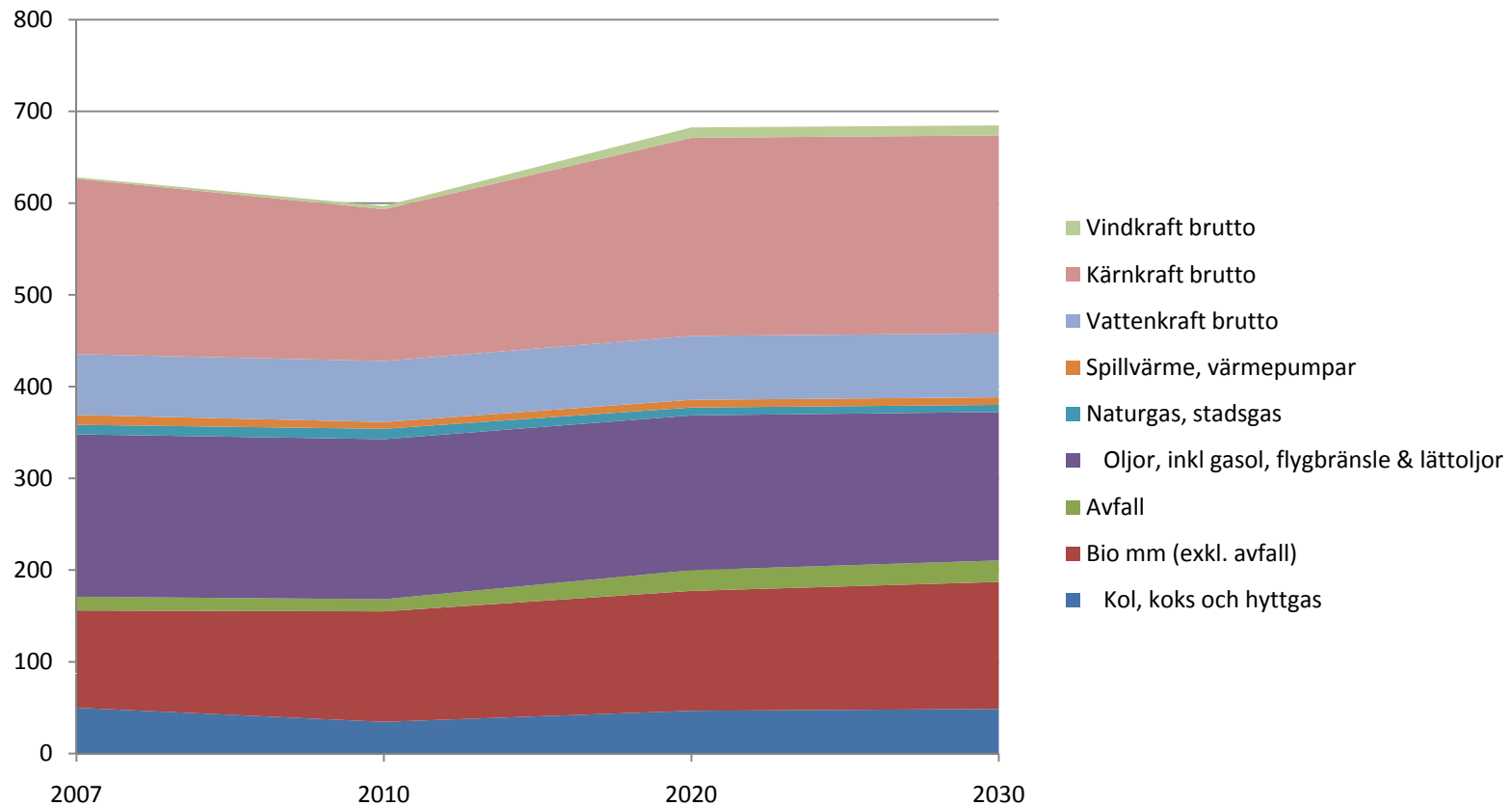
- Tax exemption for biobased motor fuels
  - However, some restriction from 2011 for low-admixture - only up to 6.5% blending in petrol and 5% in diesel is exempted. Additional low-admixture is subject to full tax (= the tax of petrol/diesel).
- Motor vehicle tax based on the vehicle's CO<sub>2</sub> emissions. From 2011 this also applies to light duty vehicles, buses and motor caravans.
  - "Clean vehicles" are exempted from vehicle tax for 5 years.
  - Before July 2009; premium of 10 000 SEK for purchase of clean car
- Law requiring larger petrol stations to sell at least one renewable fuel (since April 2006)
- Cars provided as a benefit to employees are subject to tax. Biofuel driven cars have reduced notional value.
- Public authorities are required to ensure that passenger cars, purchased or leased, are clean vehicles and that light goods vehicles have emission levels less than 230 g CO<sub>2</sub>/km

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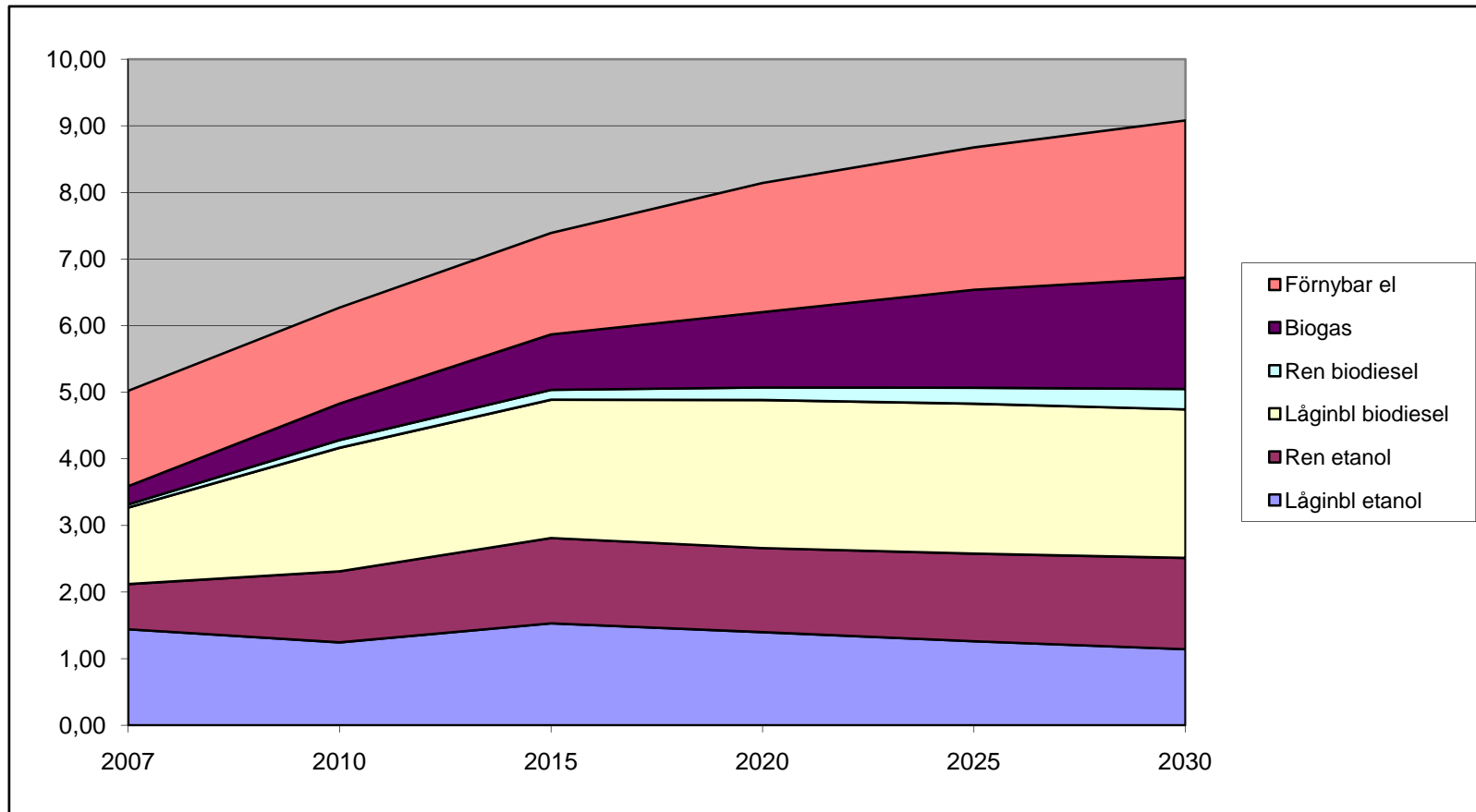
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# Outlook for 2030

## Energy use Main scenario, TWh



# Renewable energy use in transportation 2007-2030 (TWh)



# Renewable energy use in transportation 2007-2030 (TWh)

- *Biofuels, peat and others 121 – 162 TWh*

*By fuel*

- *Ethanol 2,1 - 2,5 TWh*
- *Biodiesel (FAME) 1,2 - 2,5 TWh*
- *Biogas (for transport) 0,0 - 1,7 TWh*
- *Peat 3,5 - 5,1 TWh*
- *Waste 4,1-21 TWh*



## **The use of biofuels will increase to 2030**

- The use of biofuels for transport will raise to 7 TWh in 2030 (3,5 in 2007)
- The largest increase concerns biogas and biodiesel (RME)
- The largest increase regarding biofuels will be wood-fuels (28 TWh until 2030)
- The use of oil and gas will decrease (15 TWh and 2TWh)

# Main conclusions from latest forecast cont.

- 10% target for 2020 will probably be reached in Sweden, but only with a small margin. The renewable share only slightly increasing between 2012 and 2020. (10.7% in 2013)
    - Renewable electricity (for rail transport - not road) makes up a large proportion of the renewable energy for transport. Very slow introduction of electric cars.
    - Low-admixture ethanol and biodiesel will soon be at it's maximum levels (due to restriction in tax exemption)
    - Share of ethanol cars in car sales is decreasing
    - Biogas – potential but may face capacity problems
    - It seems higher oil prices also bring higher biofuel prices. High oil prices is not necessarily the "solution"
    - Biodiesel has problems competing with fossil diesel today
    - Uncertain development of tax exemption
- In simple words: if we want to reach more than 10% renewables in 2020 new measures is likely to be needed

# Publications in the area of biofuels

- Analys av marknaderna för etanol och biodiesel 2011, ER 2011:13 (Analysis of ethanol- and biodiesel markets)
- Energimyndigheten, 2011. Övervakningsrapport avseende skattebefrielse för biodrivmedel år 2010, Dnr 00-11-428.
- Energiläget/Energy in Sweden 2010, ET2010:45
- Transportsektorns energianvändning 2010, ES2011:05 (Transport sector energy use 2010)
- Energiindikatorer 2011, ER2011:12 (Yearly follow-up on the Swedish energy policy targets)
- Produktion och användning av biogas 2009 (Production and use of biogas 2009)
- Fokus III- Transportsektorn, ER2010:07
- Kortsiktsprognoser (Short-term forecasts) – Published every March and August.
- Långsiktsprognos 2010/ Long term forecast 2010.
- [www.energimyndigheten.se](http://www.energimyndigheten.se), webbshop

# Thank you for your attention!

Questions?

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