

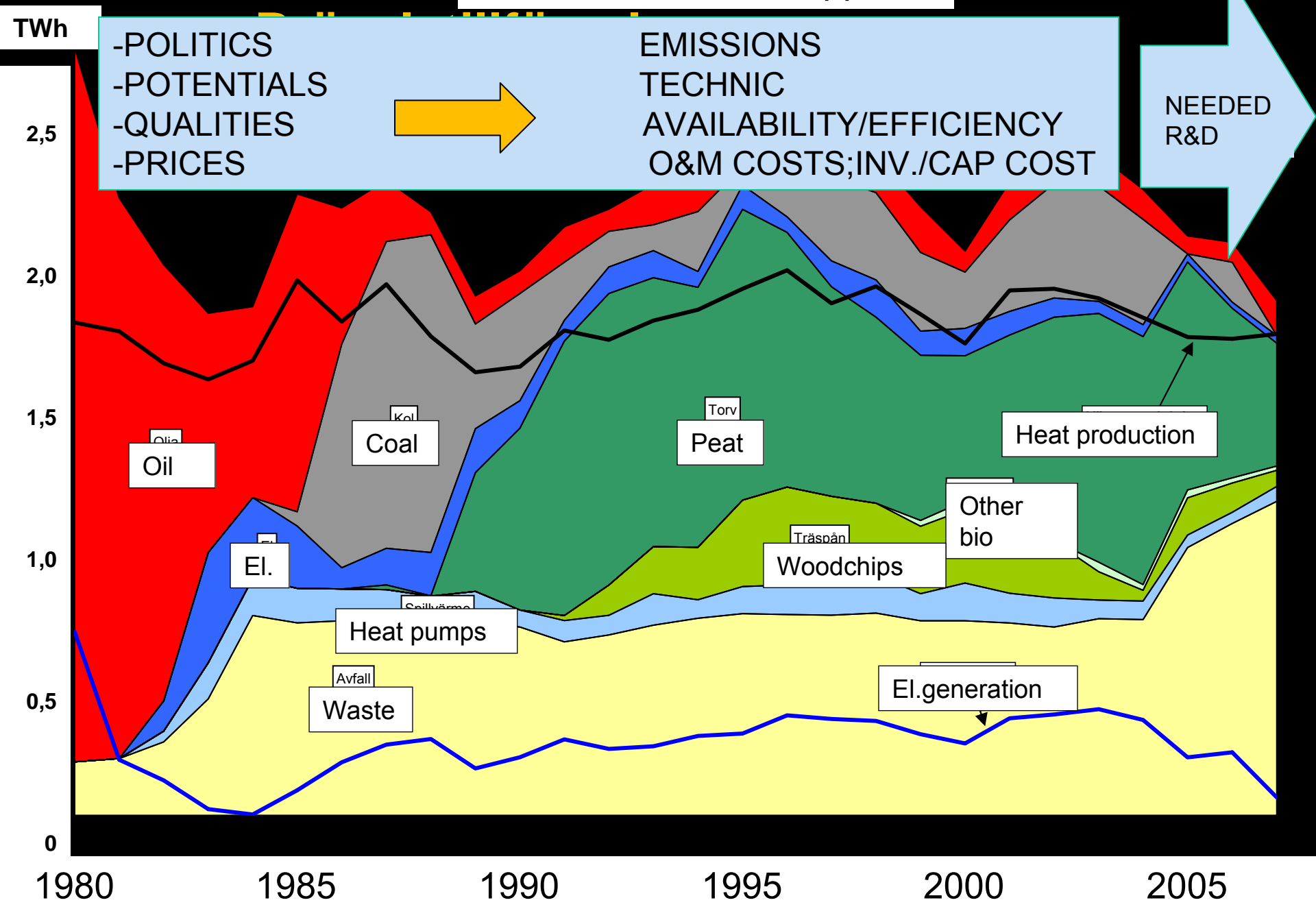
## Biomass in relation to 2020

Hans Nordström, Vattenfall Heat Nordic



- SITUATION TODAY & TOMORROW
- POTENTIALS & QUALITIES
- POLITICS – SUSTAINABILITY ; ECONOMY

# Ex. Fuels Vattenfall Uppsala



-POLITICS  
-POTENTIALS  
-QUALITIES  
-PRICES

EMISSIONS  
TECHNIC  
AVAILABILITY/EFFICIENCY  
O&M COSTS; INV./CAP COST

NEEDED  
R&D

# .....2-3 generations back – sustainability or...?



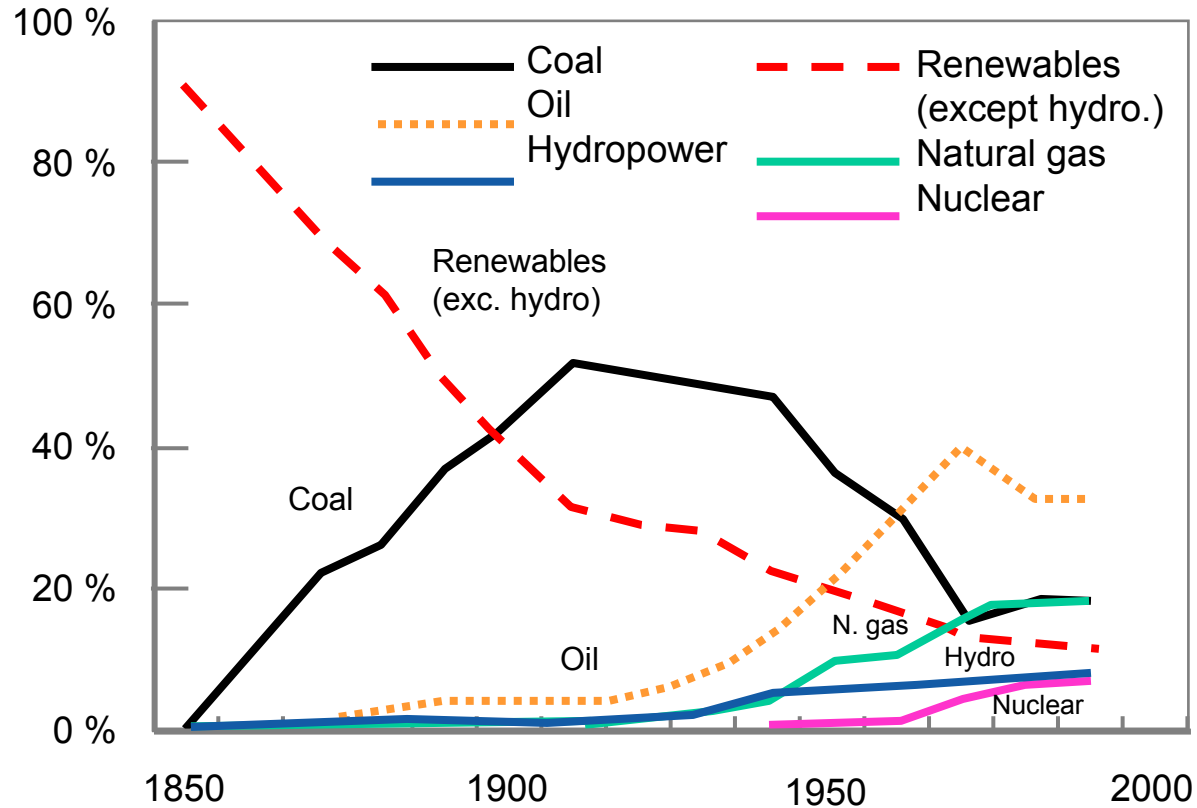
## ..survival of civilisations....

- Friendly neighbours or not.
- Environmental destructions
- Actions against environmental destructions
  - Deforestation !
  
- Easter Island
- Haiti / Dominican Republic
- Iceland
- UK
- Sweden ca 1900 – bio not sustainable...! Go for coal !

# Forest in perspective EU 27

- Forest in UK – park
- Forest in Germany – for pulp & paper
- Forest in East Europe – timber for sawing
- Forest in Southern Europe – deforestation, fires, landerosion etc
- ...and deforestation a global threat

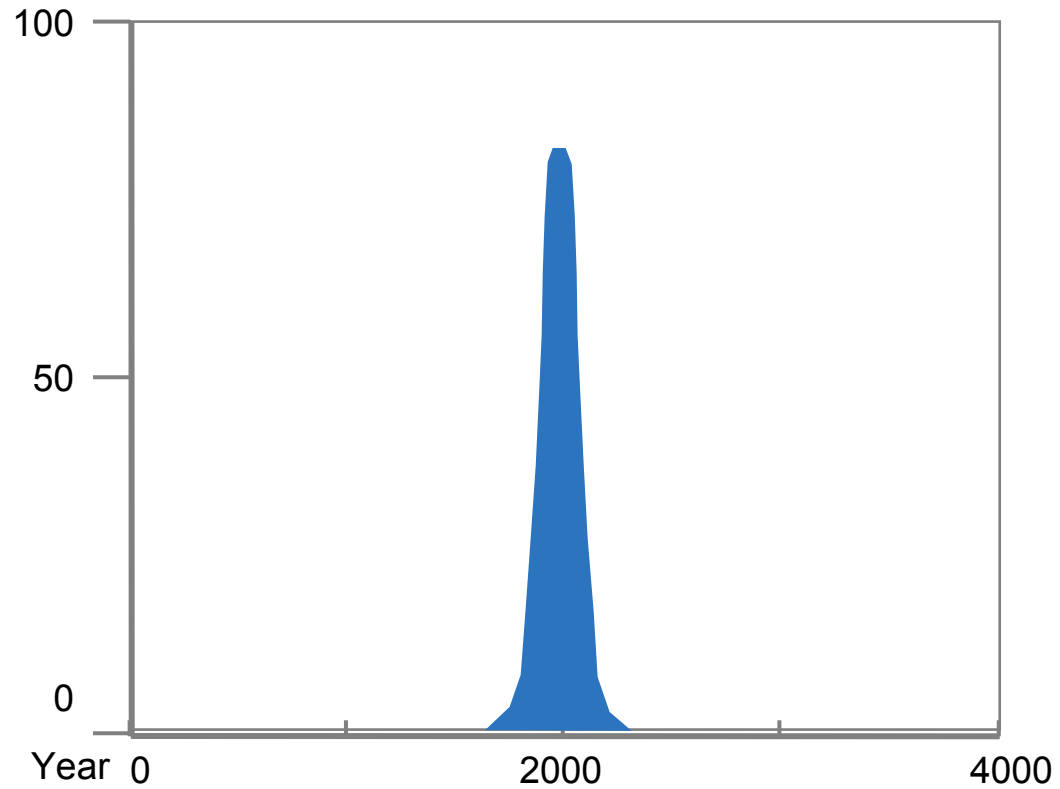
# World primary energy sources



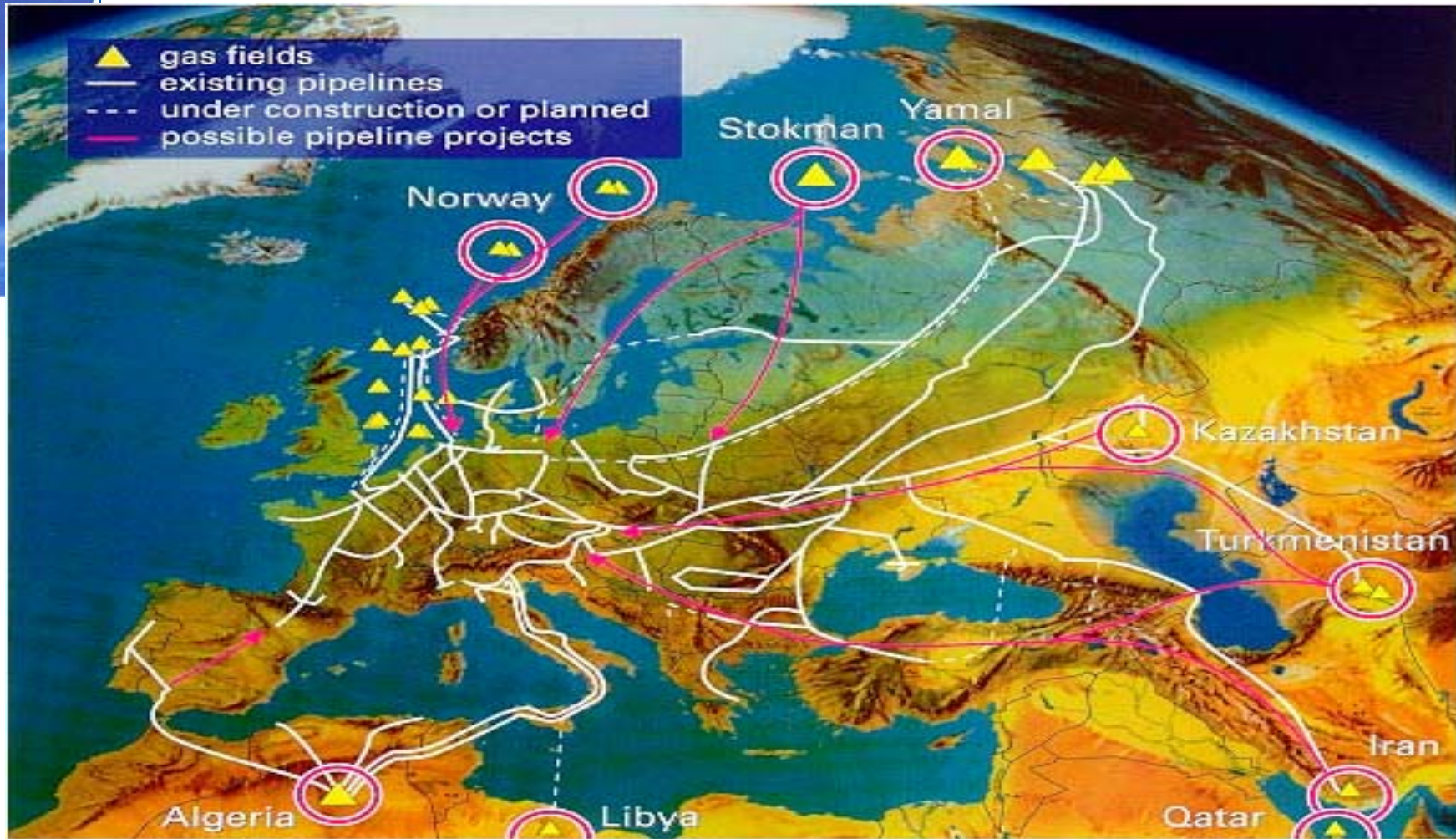
Source: Oil & Gas Science and Technology  
Pierre-René Bauquis

# The oil/fossils age

Yearly production  $10^3$  TWh



## Security of supply is essential....





# Situation in Europe

Fact: High dependence of imported and not sustainable fuels!

Prognosis: Strong increase in use of renewables?

And a long discussion about

- potentials
- politics
- economy
- dependence of import
- existing technic
- new technic
- total sustainability
- etc

**What facts?**  
**What actions ?**

# Climate changes affect us all.....

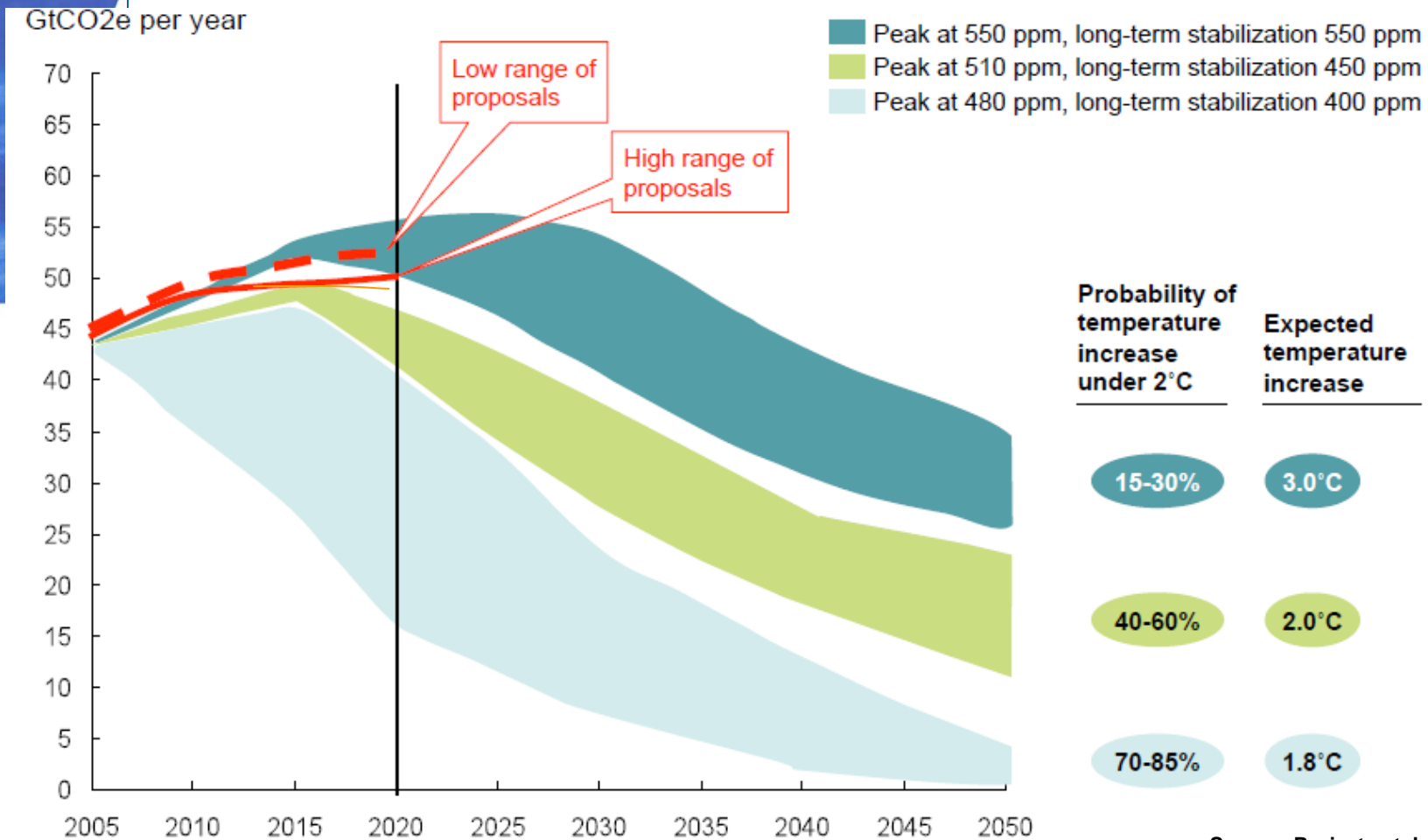


# COP 15 - ..a picture tells more than 1000 words...





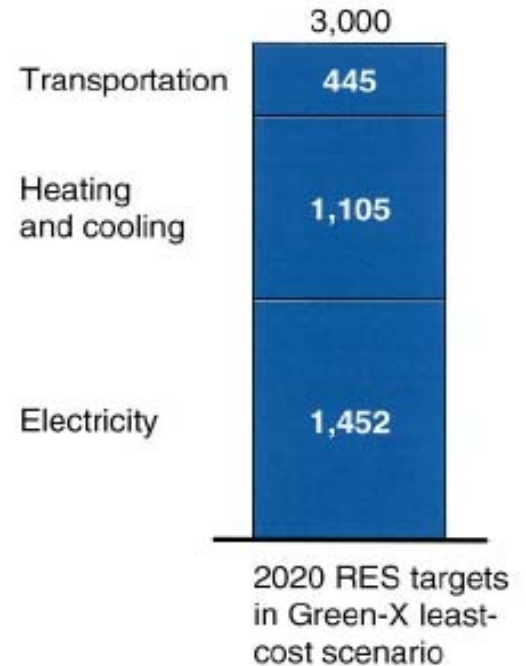
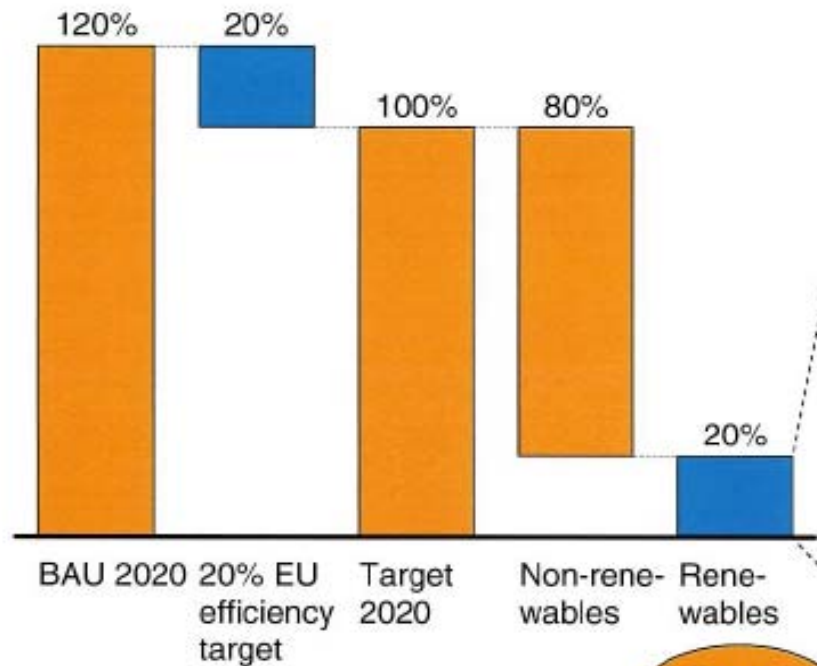
# Current proposals not consistent with 2 °C target



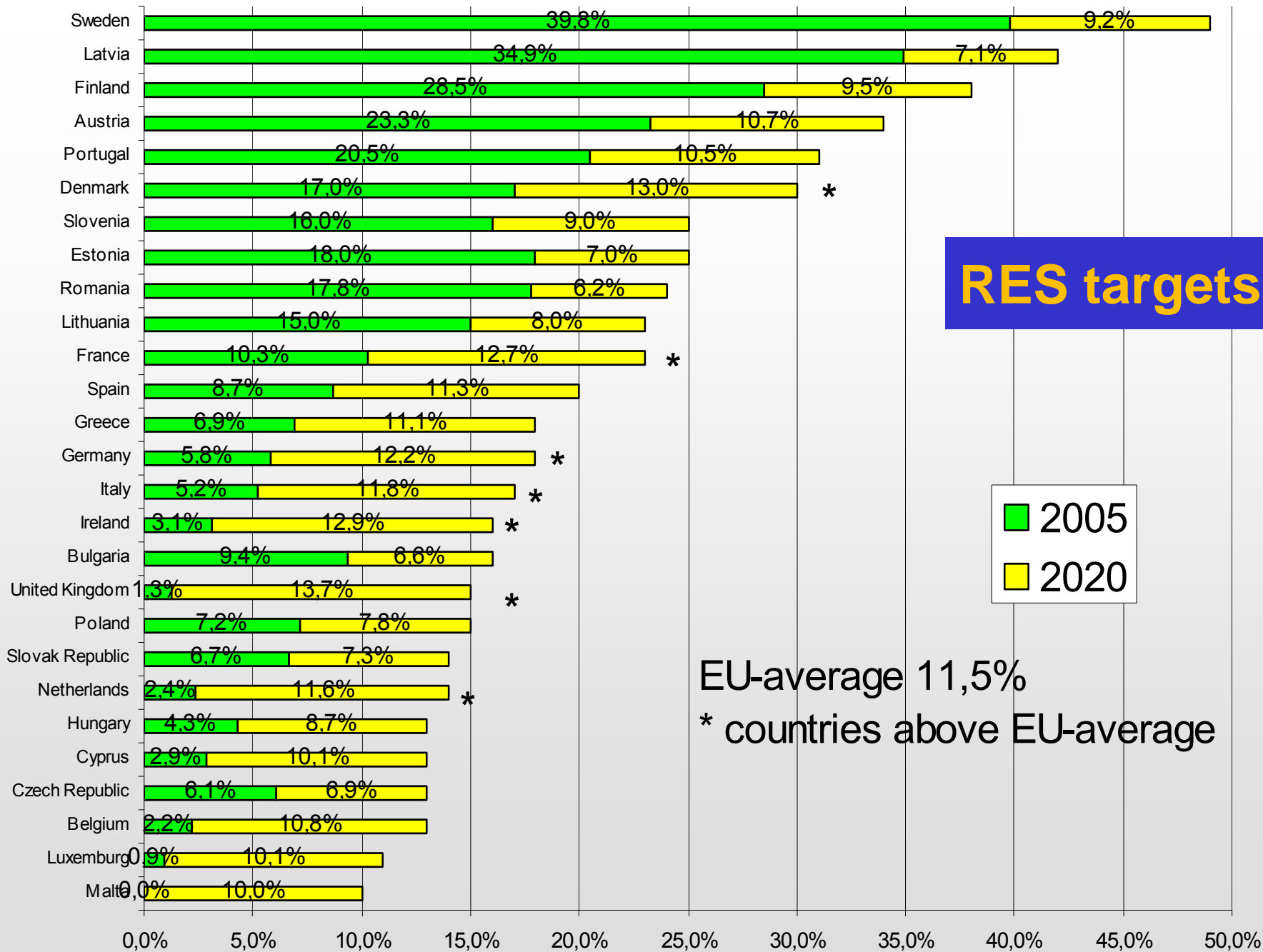
Source: Project catalyst [2009]

# BUT - EU have binding targets...

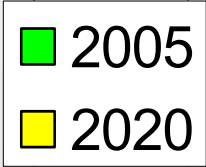
**Final energy consumption EU-25, 2020, TWh**  
100% = 15,000 TWh



Source: EC renewable energy road map; Green-X; McKinsey analysis

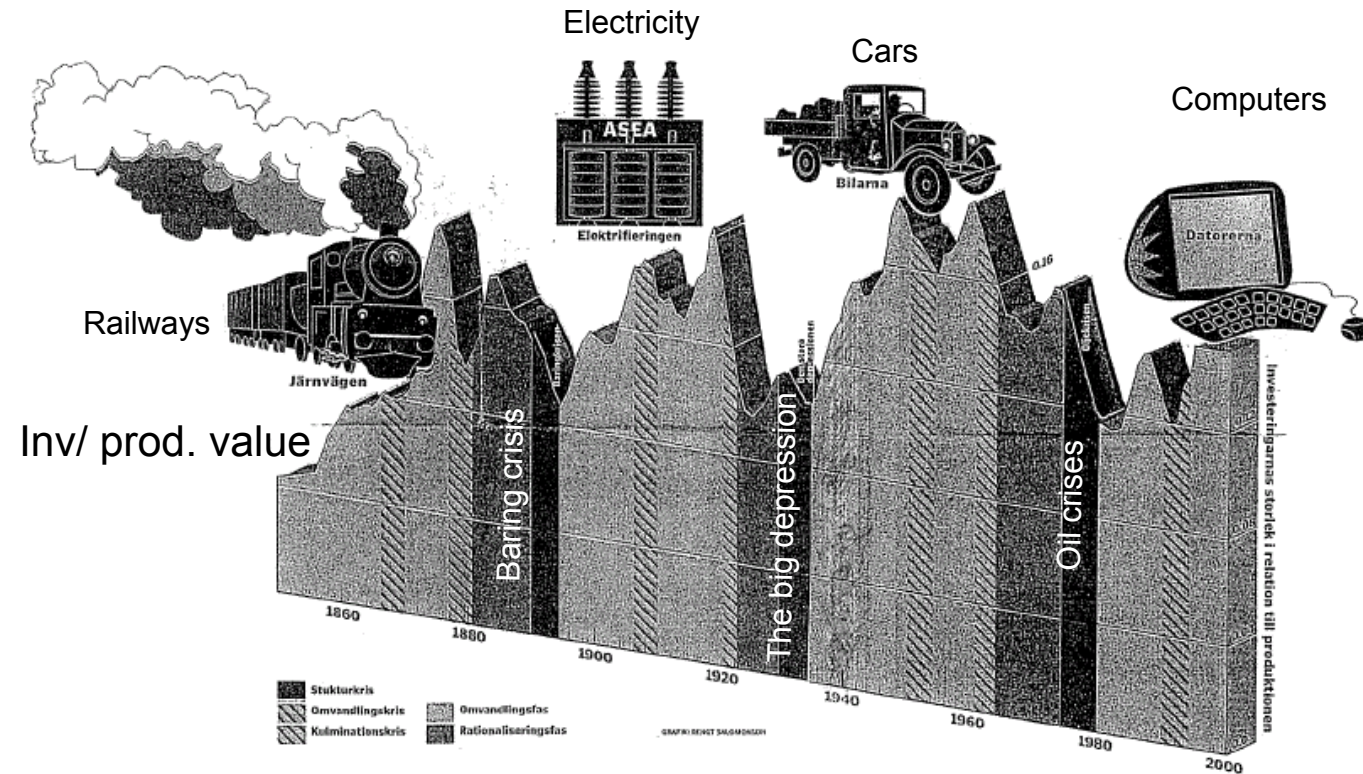


# RES targets



EU-average 11,5%  
 \* countries above EU-average

# ..new important technical steps...?



What next in the technical / economical history...

- Climate
- Security of supply
- Sustainable energy
- Political consensus?

?

Cycles 40-50 years, so far.....

Source:lars.ahnland,svd



**What alternatives do we have...**



# What alternatives do we have....

- Hydro
- Wind
- Solar
- Wave
- Geo
  
- Nuclear
- CCS / fossils
  
- New technic
  
- Bio mass fuels

## What alternatives do we have....

- Hydro – almost done
- Wind – production balance
- Solar – still expensive
- Wave – development
- Geo – geografically / technically limited
  
- Nuclear – politics / security ?
- CCS / fossils – development takes time
  
- New technic
  
- Bio mass fuels

## What alternatives do we have....

- Hydro – almost done
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- Wave – development
- Geo – geografically / technically limited
  
- Nuclear – politics / security ?
- CCS – development takes time
  
- New technic -?
  
- Bio mass fuels – can be produced in most countries
  - known “commercial” technic for conversion
  - only renewable possible to use in existing coal plants

## .. So combustion of bio needed for long time...

**Largest potential of renewables is bio– but limited ! So far !**

- consider competition between energy, pulp and paper, timber and transportation, food etc

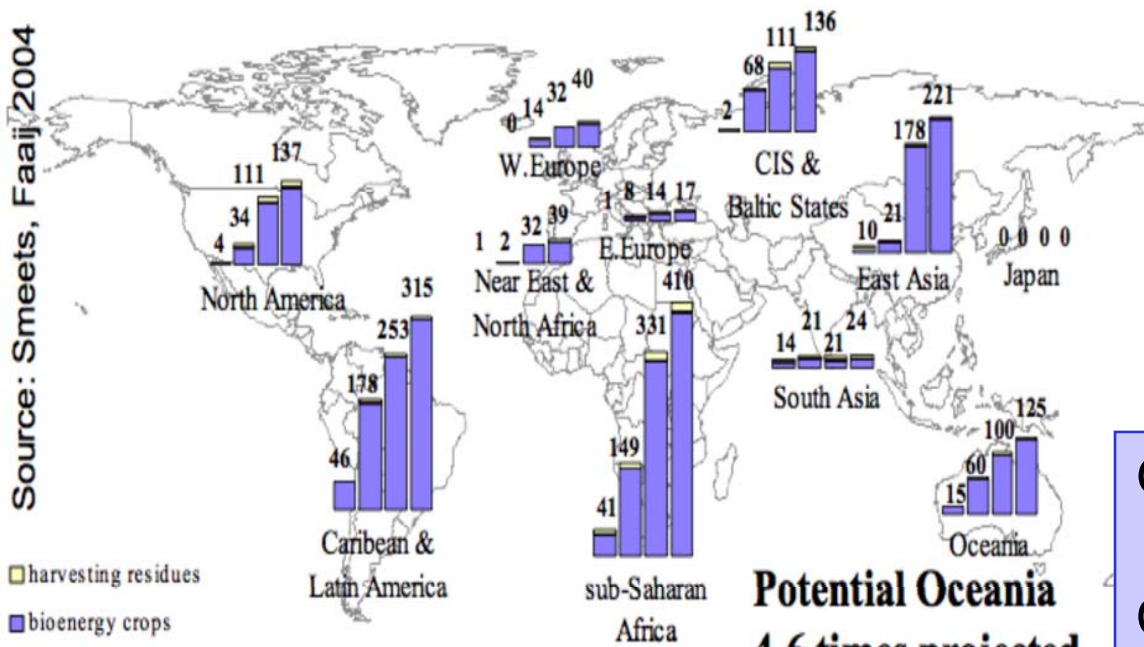
**Many qualities**

- Forest fuels/residues
  - Agricultural fuels/residues
  - Energy crops, biooils etc
  - Waste fuels
  - Peat (not bio but renewable)
  - Others (algae etc)
- Consider all resources!**
- Diversification needed**
- Potential=  $f(\text{price})$**
- Price=  $f(\text{market situation})$**



# Bioenergy production potential in 2050 for different levels of change in agricultural management

Source: Smeets, Faaij 2004



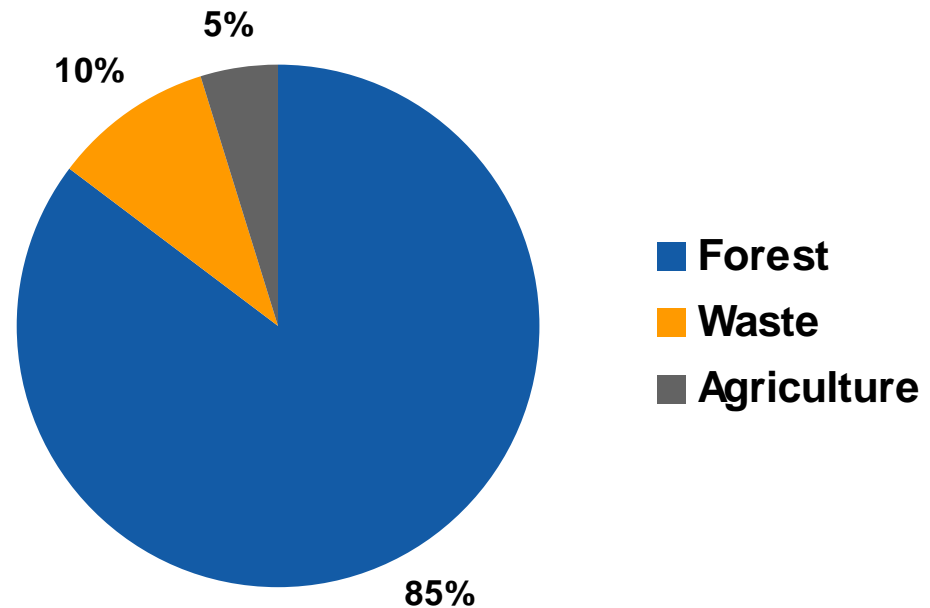
**Potential Oceania  
4-6 times projected  
primary energy use**

Global potential – 1400 EJ/år.  
 Considering limitations 250-500 EJ/år.  
 Global primary energy demand 360 EJ/year.

(..say 100 000 TWh/year)

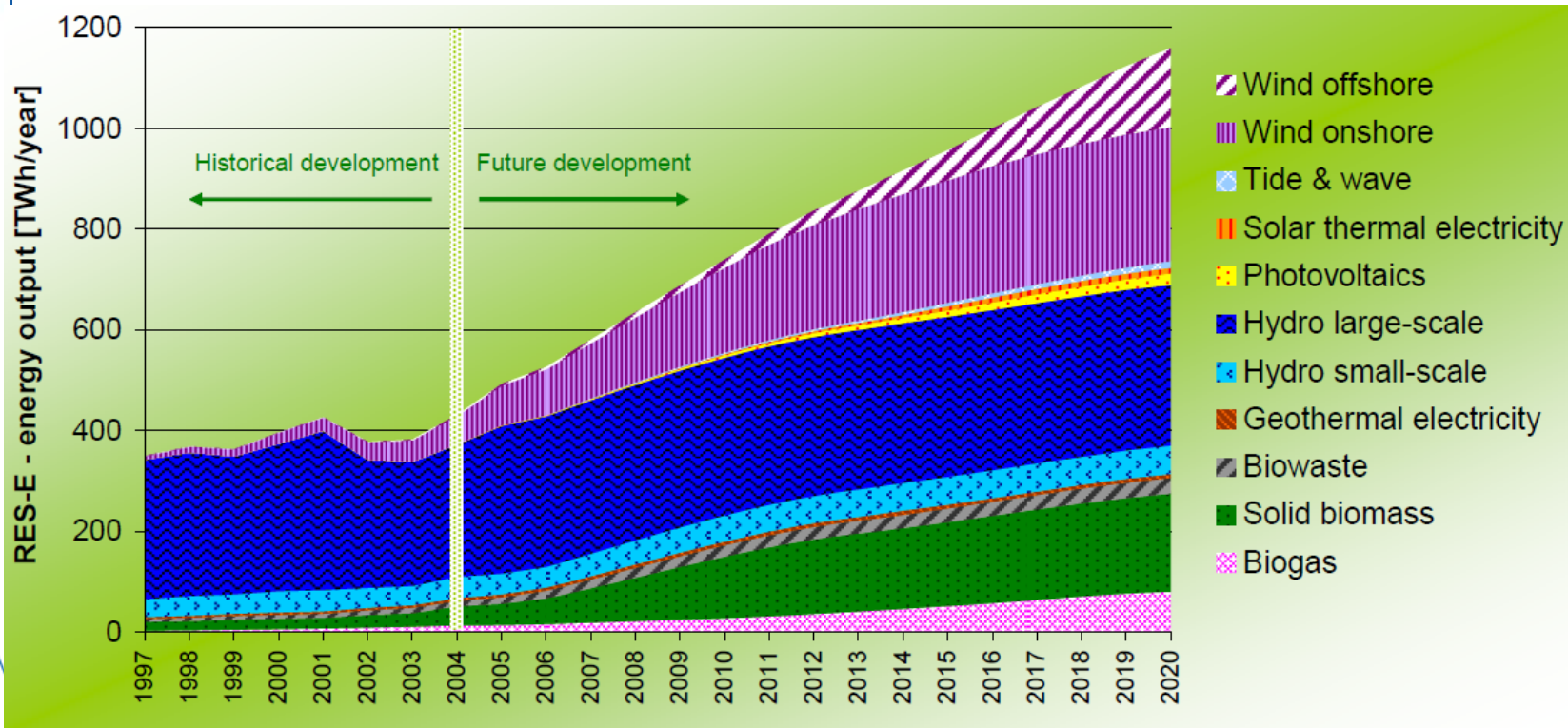
# Forestry is the main source of supply for biomass in Europe

Composition of biomass as energy carrier in EU 25, 2004



Source: European Biomass Association

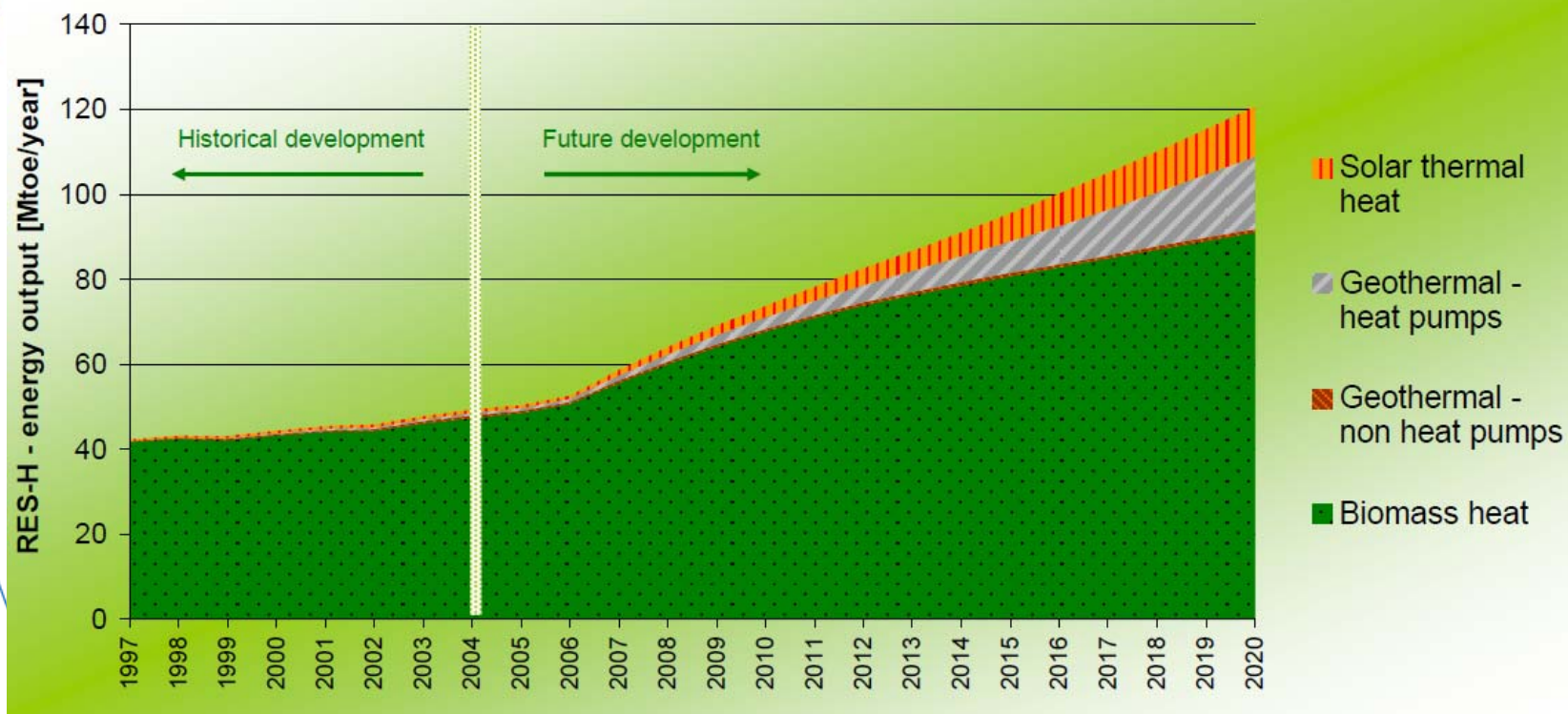
# Electricity from renewables EU 27



Källa: EU Kommissionen 2007



# Heat from renewables EU 27

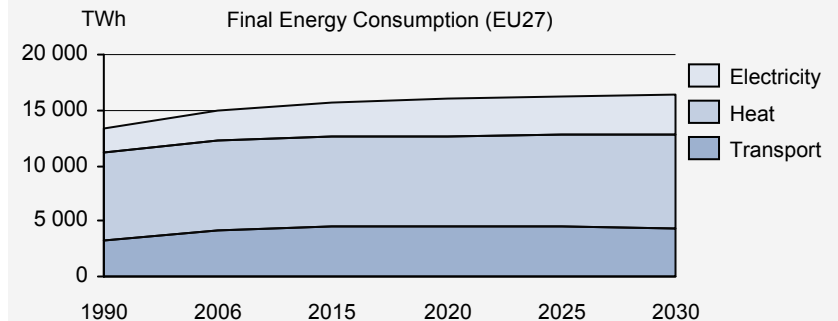


Källa: EU Kommissionen 2007

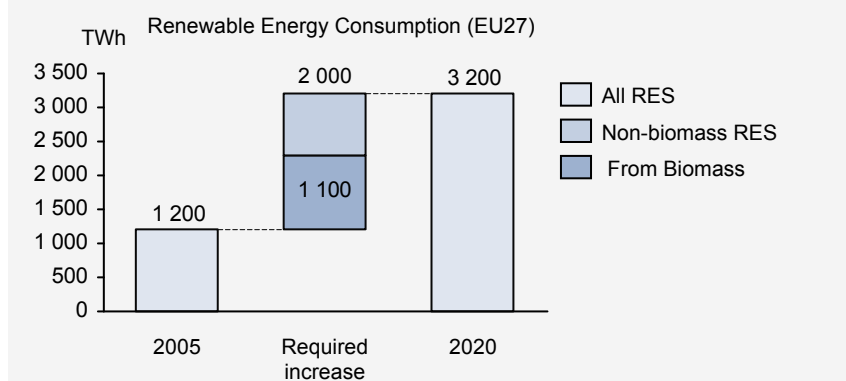
## The EU has set targets for CO2 emissions and renewable energy that will drive demand for biomass

We need at least double volume of biomass 2020 !

Final energy consumption in the EU is forecasted to increase somewhat from 2006 to 2020



Future renewable energy demand in the EU driven by policy instruments can be estimated by quantifying RES target



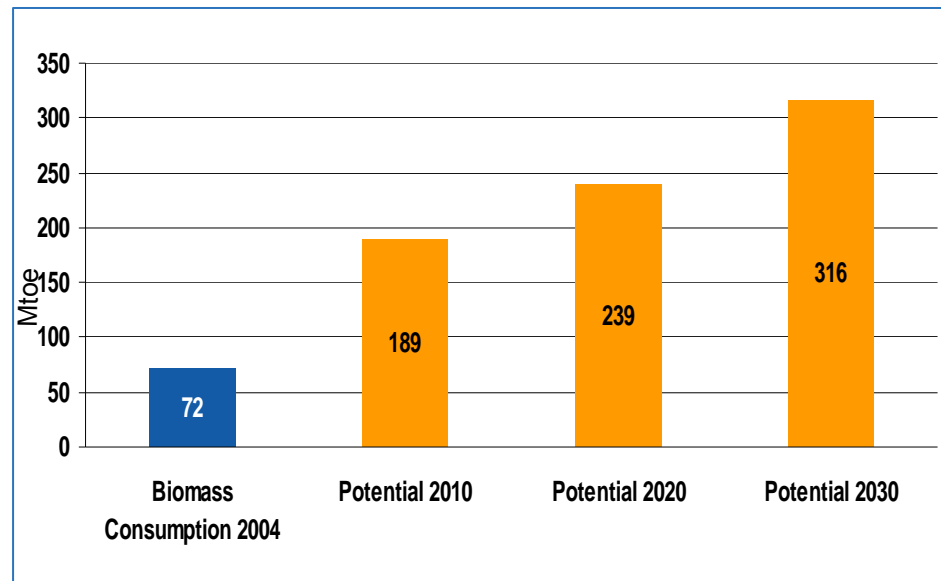
# Future potential of biomass in the EU is large

Total bio energy potential from agriculture, forestry and waste ~300Mtoe in 2030  
(compared with ~72Mtoe in 2004)

**The biggest potential growth lies in biomass from agriculture, 142 Mtoe of the total 300Mtoe**

Obtained from 19 million hectares of agricultural land → 12% of the utilised agricultural area in 2030

Land reserves are available without harming food supply



(239 Mtoe  
ca 2500 TWh)

## ... Brussels 24.4.2009:...potentials...

Commision staff working document:

” A European Commision funded review, of over 70 studies, found that total 2020 potentials, estimated for the EU 27, differ to a considerable degree,  
76 Mtoe – 480 Mtoe”  
...say 800 TWh – 5000 TWh !

...any risks of overuse of forests should be assured...

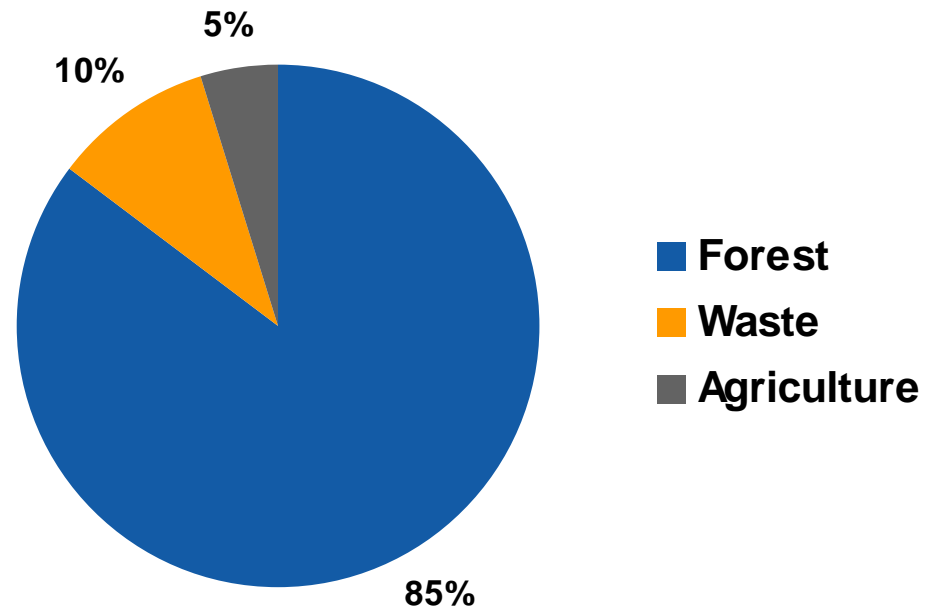
...national ”*Biomass Action Plans*” shall ensure long term sustainable supply of biomass, increased investor confidence and biomass technologies...

...forest resources...



# Forestry is the main source of supply for biomass in Europe

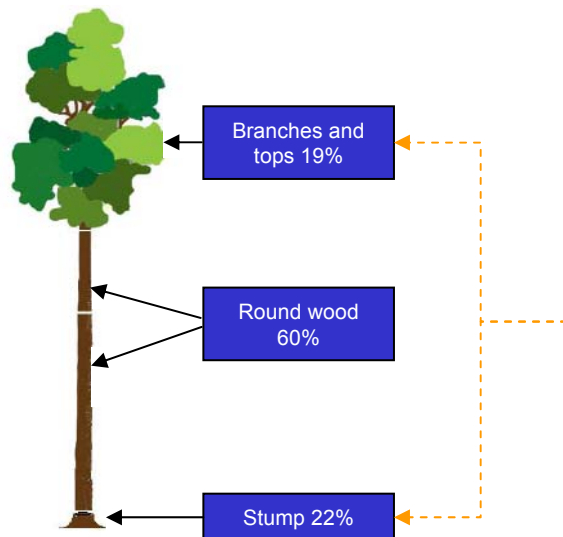
Composition of biomass as energy carrier in EU 25, 2004



Source: European Biomass Association

## ..more from the tree...

Each tree consists of trunk, stump and branches & tops, of which round wood usually refers to the trunk



More can be used as solid fuel,  
especially from stumps...

Each m3 of harvested round wood could generate:

~0.3 m3 branches and tops

~0.35 m3 stump

(based on Swedish conditions)

# Forest fuels

Residues – in forest: branches & tops (even green), stumps, fines etc  
Residues – from sawmills etc  
Residues from p&p.: bark etc  
Wood pellets/briquettes  
Etc.

**More dev./demo on supply side needed**

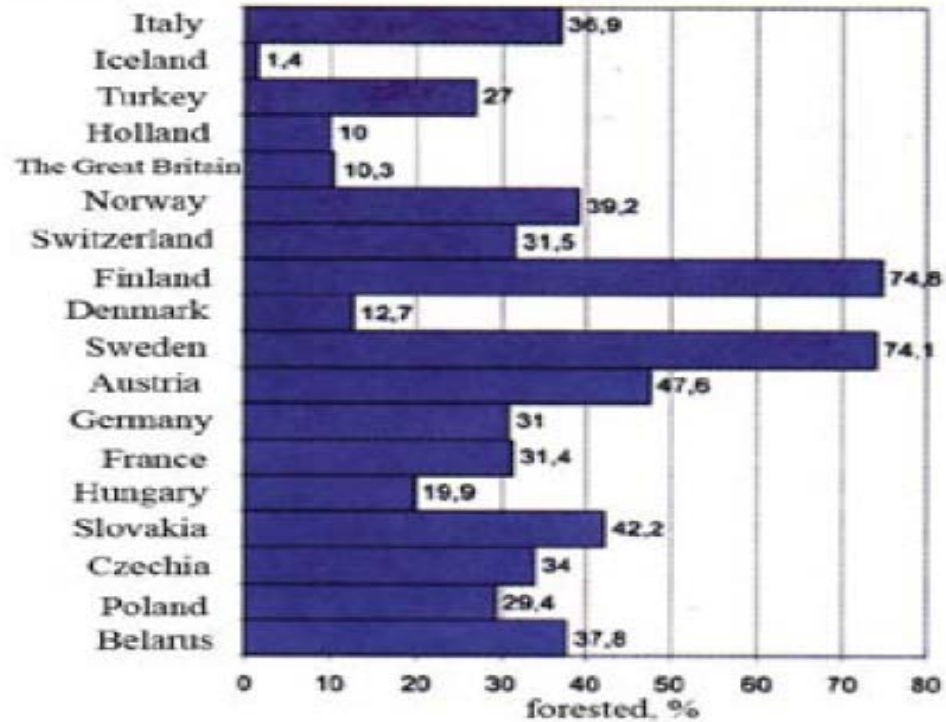
Acceptable commercial thermal/technical solutions today – **but improvements still needed !**

- **Cofiring**
- **High steam data**
- **Low quality – high output**





# Forested area



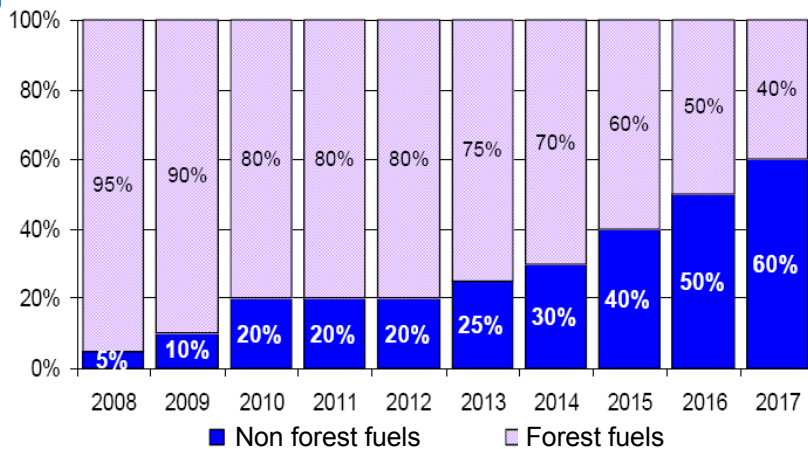
Forested area in some countries of Europe

Figure 2: Forested area in some countries of Europe

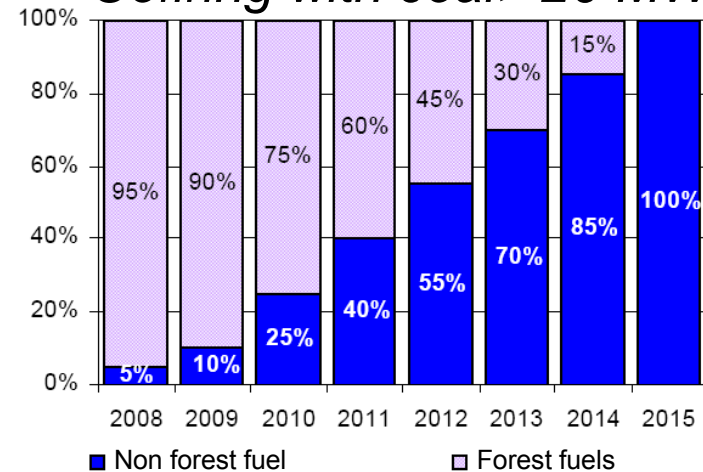
# Example Poland

Limited use of forest fuels demanded, at least for getting green certificates.....!

*Dedicated biomass boiler*



*Cofiring with coal > 20 MWe*



# BRAZIL IS A WORLD BENCHMARK IN FORESTRY

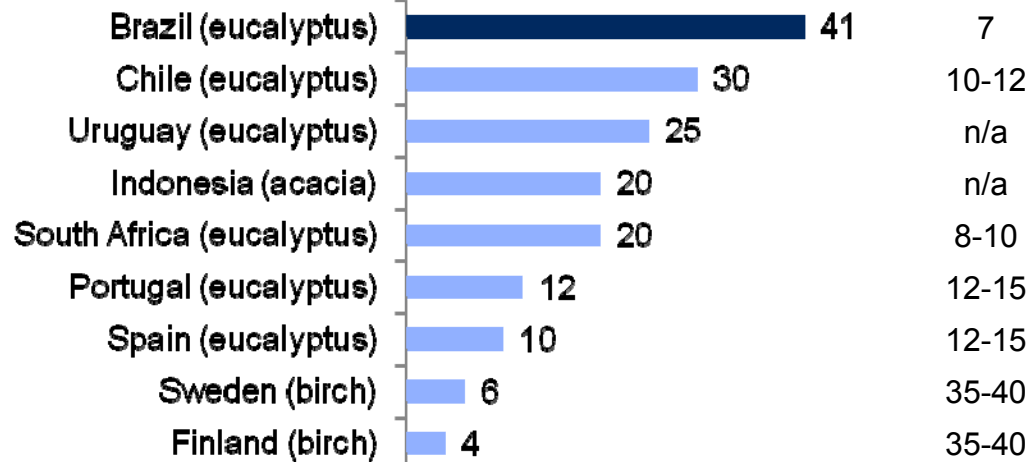
Yield

m<sup>3</sup> / hectare / year

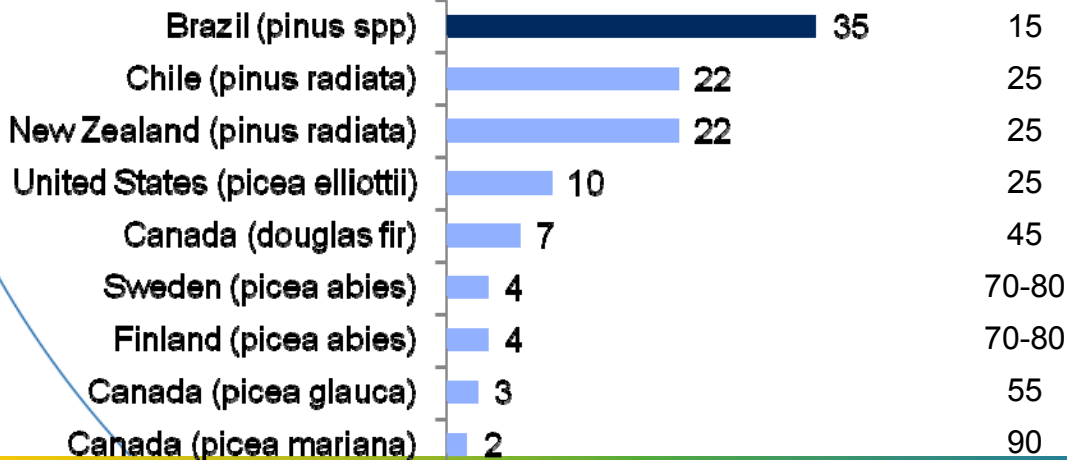
Rotation

years

Hardwood



Softwood



- *Brazilian eucalyptus has the highest average yield in the world, 41 m<sup>3</sup> per hectare per year*
- *At Stora Enso's Veracel plantation, the yield exceeds 53 m<sup>3</sup> per hectare per year*
- *This leads to a production cost well below USD 10 per m<sup>3</sup> of wood (excluding cutting, transport, and capital costs)*

# EUCALYPTUS PLANTATION, BRAZIL



Stora Enso's Veracel plantation, South Bahia, Brazil



Production cost ca 15 Euro/MWh



# Agricultural biomass fuels

A large variety of qualities.....

## Energy crops, SRCs...



(*Salix viminalis*)

Foto: Börje Wernersson

Ex Willow

6-8 ton DS/ha,a or 30-40 MWh/ha,a possible – corresponding to 4 tons of oil/ha

MANY ENERGY CROPS  
CAN BE PRODUCED AT  
COSTS BELOW

20 EURO/MWh

## Fuel Quality – important parameters

- Chlorides
- Sodium
- Potassium
- Nitrogen
- Heavy metals
- Ash content
- Variations / not homogeneous
- Bulk density



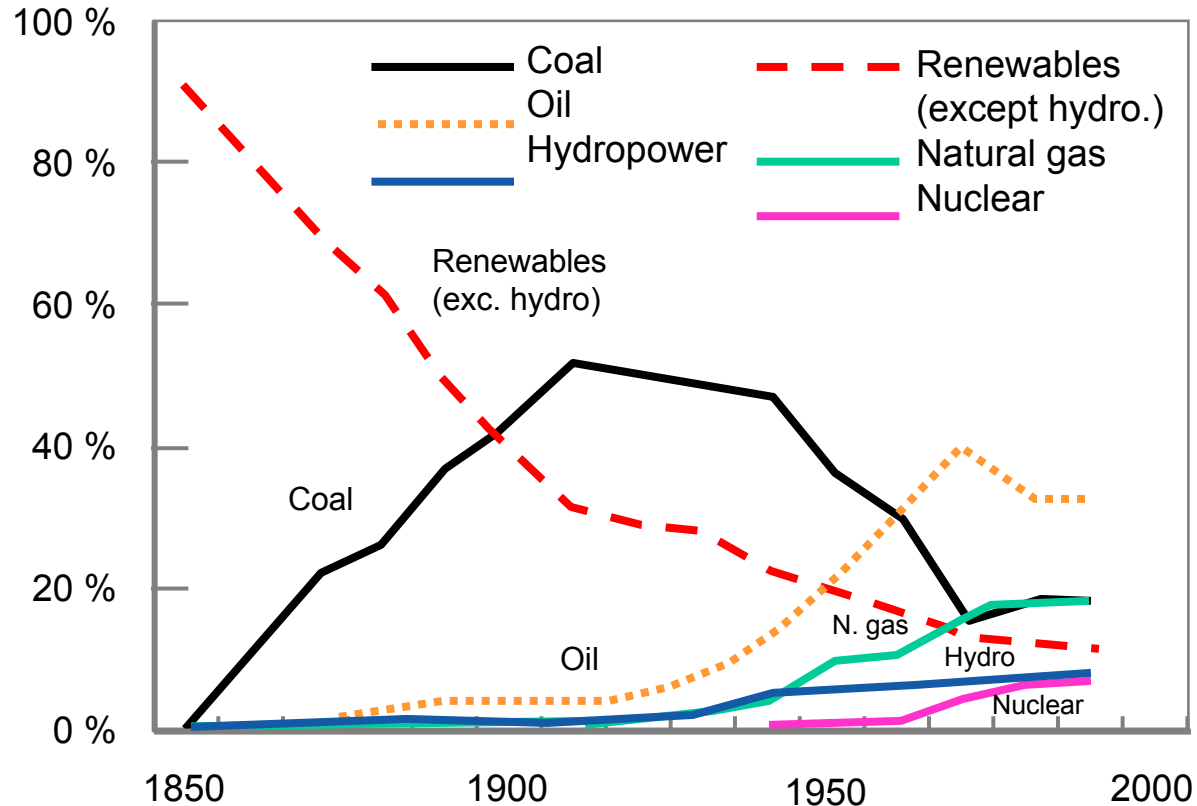
## Willow – harvested in bundles instead of directly chipped



# Energy crops – R&D&D areas

- Clones
- Growing, harvesting, logistics, compacting, storing etc
- Attitude, culture, businessmodels/contracts, cooperation etc
- Thermal areas – availability / slagging / fouling / ashes etc
- Sustainability – total GHG bal., incl land use change, NOx etc
- Politics – optimal steering instruments

# World primary energy sources



Source: Oil & Gas Science and Technology  
Pierre-René Bauquis

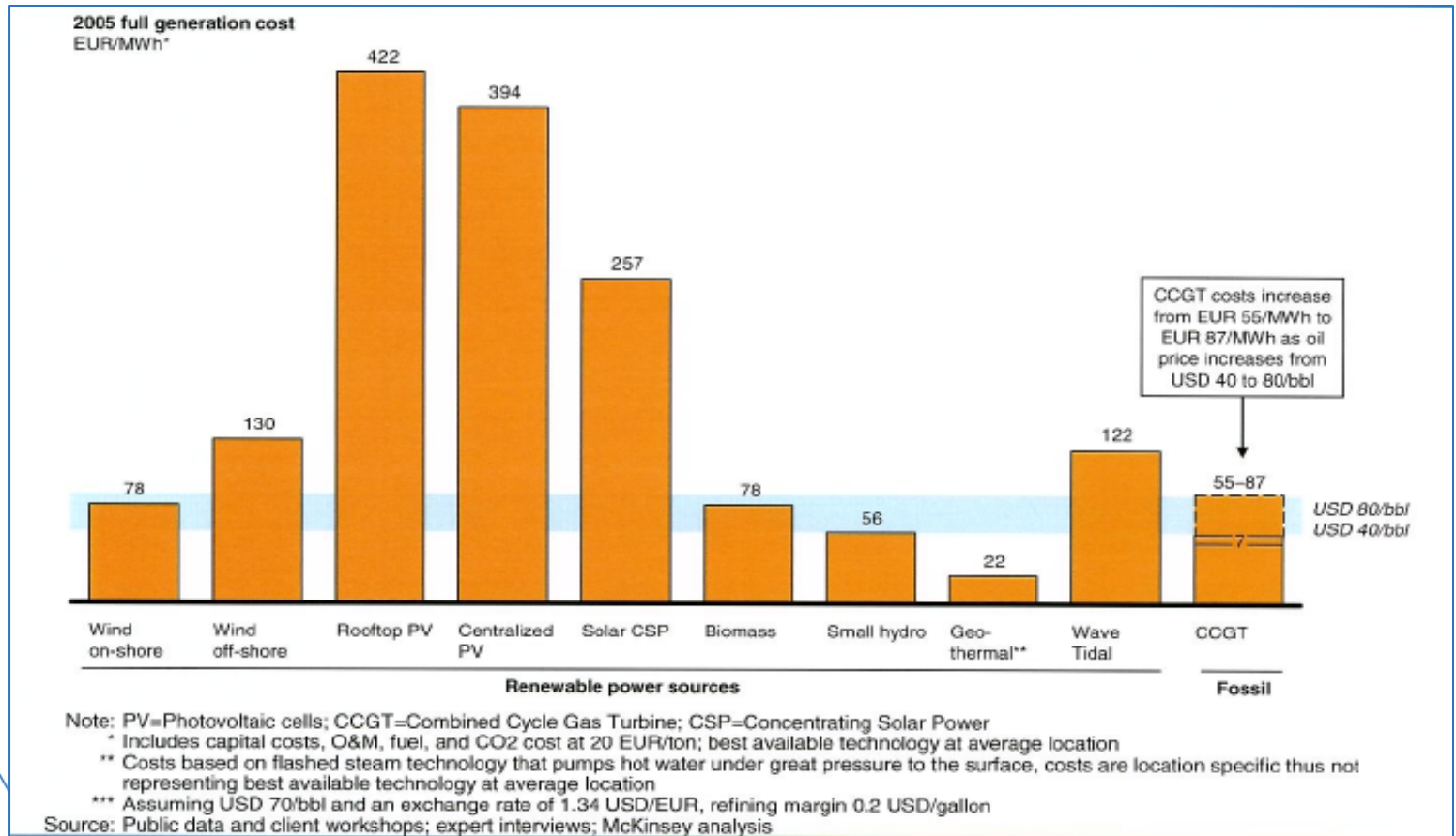
# Costs and prices ?



# Costs - and prices ?

Production cost, say 10-20 EURO/MWh

# Biomass is one of the most cost effective renewable technologies



# Parameters having impact on prices of bio fuel

## Politics / steering parameters

- Emission trading CO<sub>2</sub>; other gasses
- Taxes
- Green certificates etc
- Conditions for nuclear-power
- National Kyoto goals
- Security of supply within EU

## Techniques

- CO<sub>2</sub>-separation/storing cost, acceptance
- Other large scale techniques
- New small scale techniques

Prices of  
bio fuels

## Fuels / market

- Potential/availability/demand of conv. bio fuels
- Potential/availability/demand of not conv. bio fuels
- Potential/availability/demand of grown bio fuels
- Availability/price for
  - gas – global LNG-trade; deregulation etc
  - oil – consequences of peak ; demand outside EU
  - coal – new cond EU; demand outside EU
- Classification of waste fuels and peat.

## Others





- Cost for transportation
- Currencies: Value of Dollar, Euro etc
- Prices of electricity
- Need of biomass in industry, both for pulp and paper and as fuel
- Need of biomass for bio alcohols
- Radical/sudden climate changes

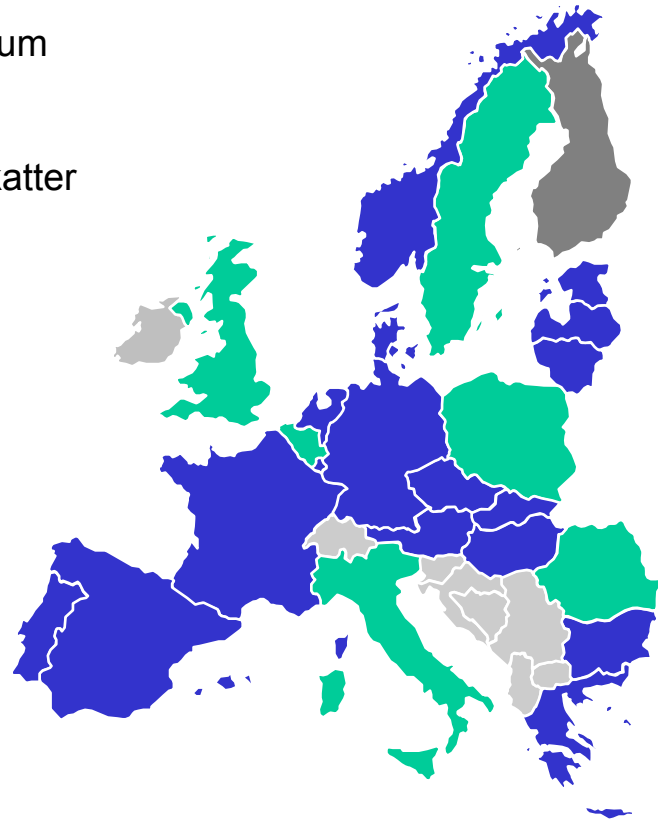
# Price development ?

	Production cost	Market price
Oil USD / Barrel	5-20	100 (140—70)
Oil Euro / MWh	2-10	50
Forest residues Euro / MWh	0-15 (excl.trsp) (waste negativ)	.....?



# Political steering instruments, renewable electricity

-  Feed-in tariff / premium
-  Certifikatsystem
-  Investeringsstöd / skatter
-  Offert (tender)



Japan

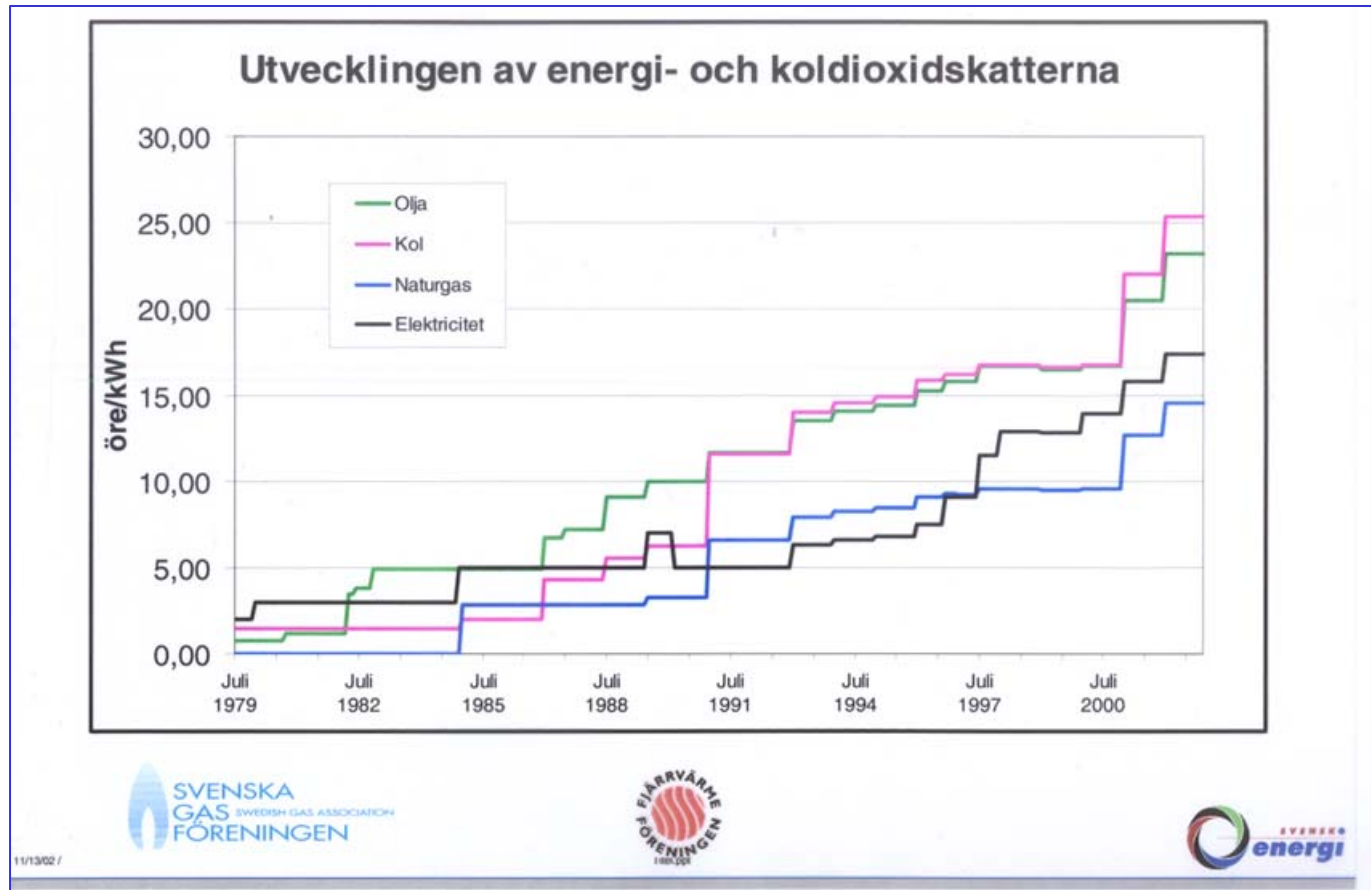
Kina

Indien

Kanada

USA

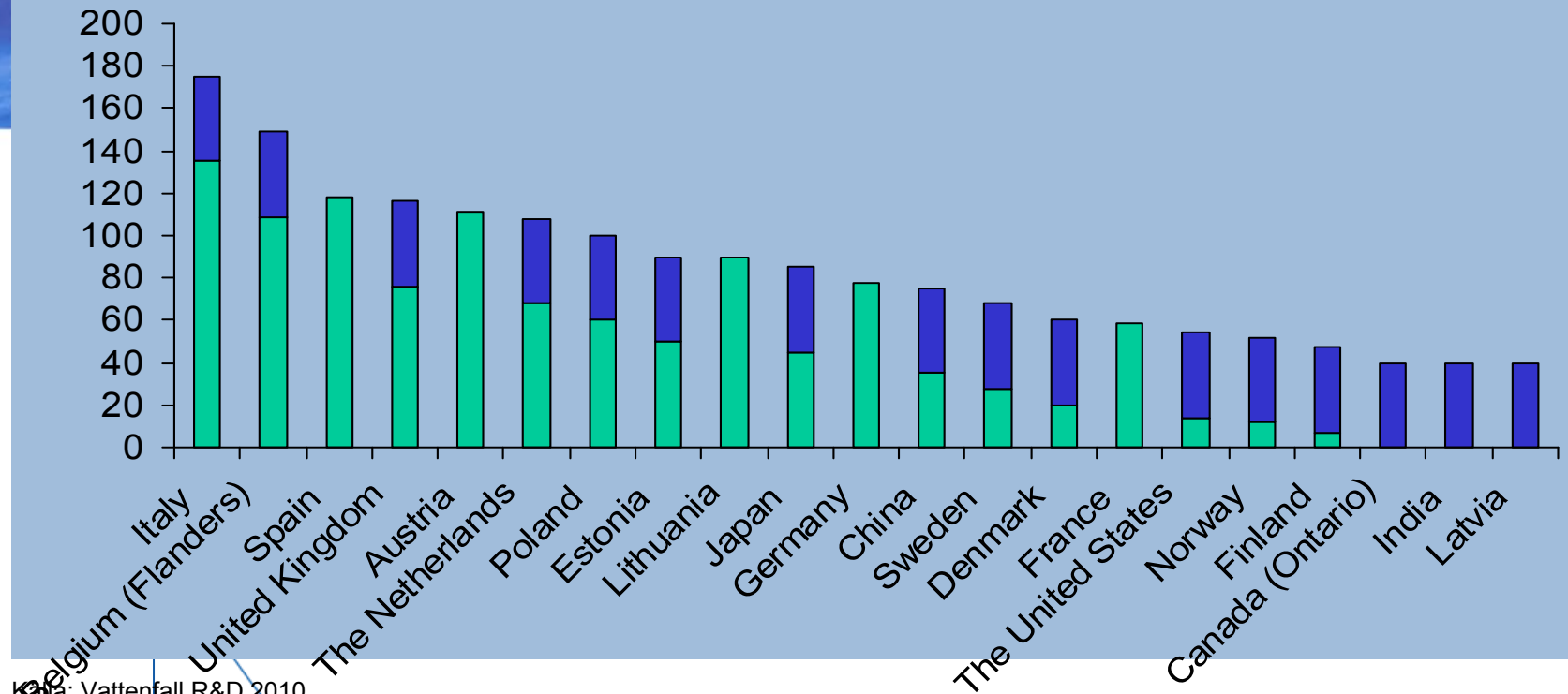
# CO2-tax, Sweden, app €/MWh<sub>heat</sub>



# Subsidy levels, feed in tariffs etc

20 MWe, 100 % biomass, only el production [€/MWh]

Assumed el price (blue): 40 €/MWh



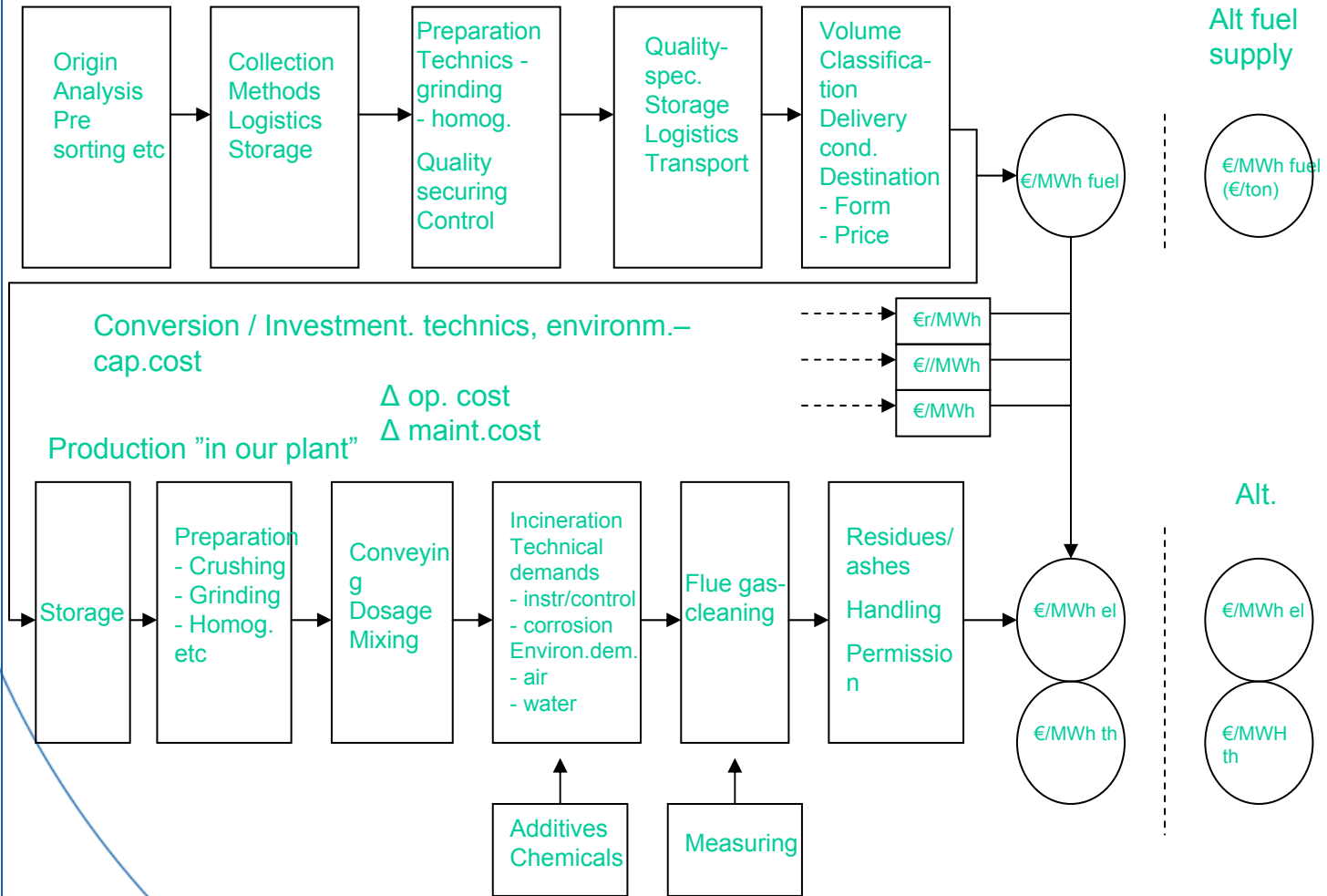
Data: Vattenfall R&D 2010

# Competing alternatives often fuel cost = 0 !

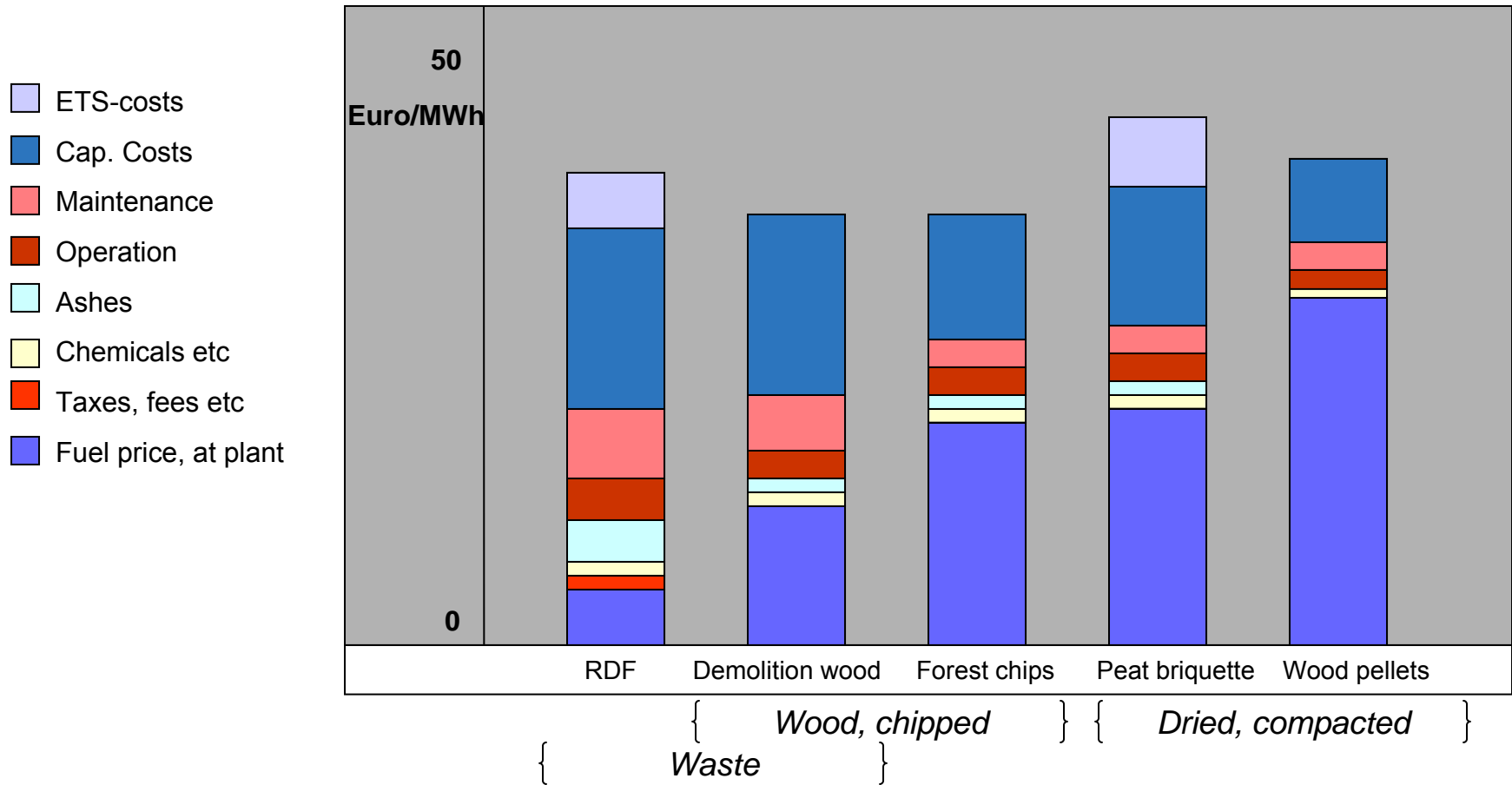


# Flow chart renewable fuel to "energy"

## Fuel value chain



# Example total production cost bio heat



## Political support / drivers....

If green certificate, feed in etc gives 100 Euro/MWh el...

Fuel trader view : 30 Euro/MWh fuel

Plant owner view : 30 – extra op&m – cap costs etc  
meaning far less, if any, more value of the fuel !

## **SCENARIOS for REFERENCE PRICE LEVELS**

- **Future price of coal and established CCS**
- **Large scale cropping**
- **Large scale and well established long distance import of residues from forest and agriculture?**
- **Enlarged supply from forest residues**
- **Optimization of logistics and transport**
- **Limitations set by pulp&paper?**



# Production cost vs market prices ?

- If fundamental presumptions only –  
reasonable price prognosis possible to do !
- Speculative businesses and political frameworks  
means temporarily variations and too high pricelevels !
- BUT - the power plant owners can integrate  
backwards in the fuel value chain – and gain control of  
the “price” !!



## And never forget : Total Sustainability

- All traditional CSR questions
- GHG – prod of biomass – handling, transports, fertilizer etc
  - Land Use Change – direct / indirect
  - Efficiency in conversion
- Of course – first use residues, but also a large potential for energy crops
- No lack of prod capacity for food – lack of money to buy food
- If a future problem – change to food again

A white flag is flying against a clear blue sky. The flag features the word 'VATTENFALL' in bold, black, sans-serif capital letters. To the right of the text is a logo consisting of a yellow sun-like shape with a white star inside, positioned above three blue wavy lines representing water. The flag is attached to a silver pole on the left side.

**VATTENFALL**



Thanks for listening!