

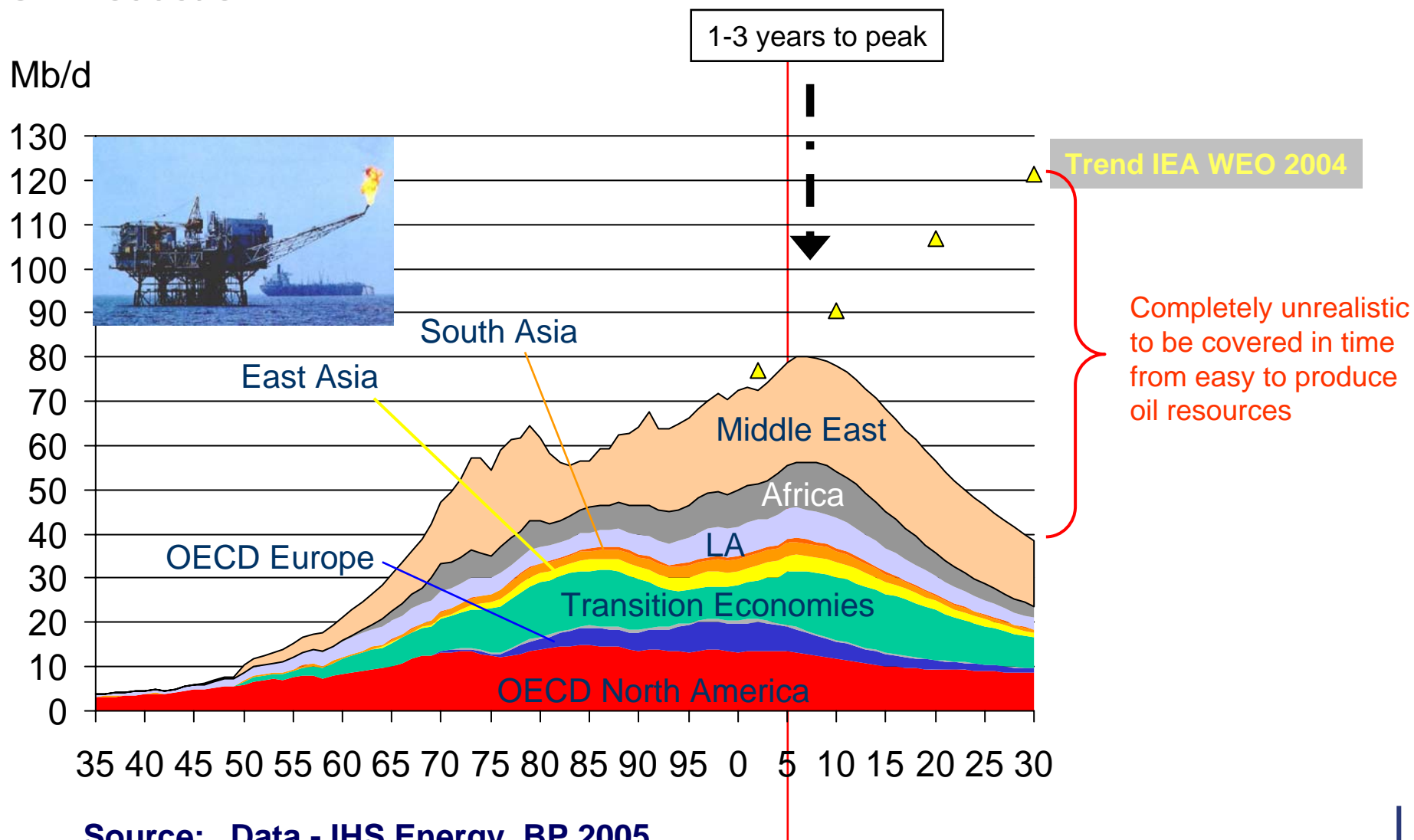
# Primary Energy for the Production of Hydrogen



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Ludwig-Bölkow-Systemtechnik  
<http://www.lbst.de>

# Supply Situation: Oil, Natural Gas, Coal, Nuclear and Renewables (1)

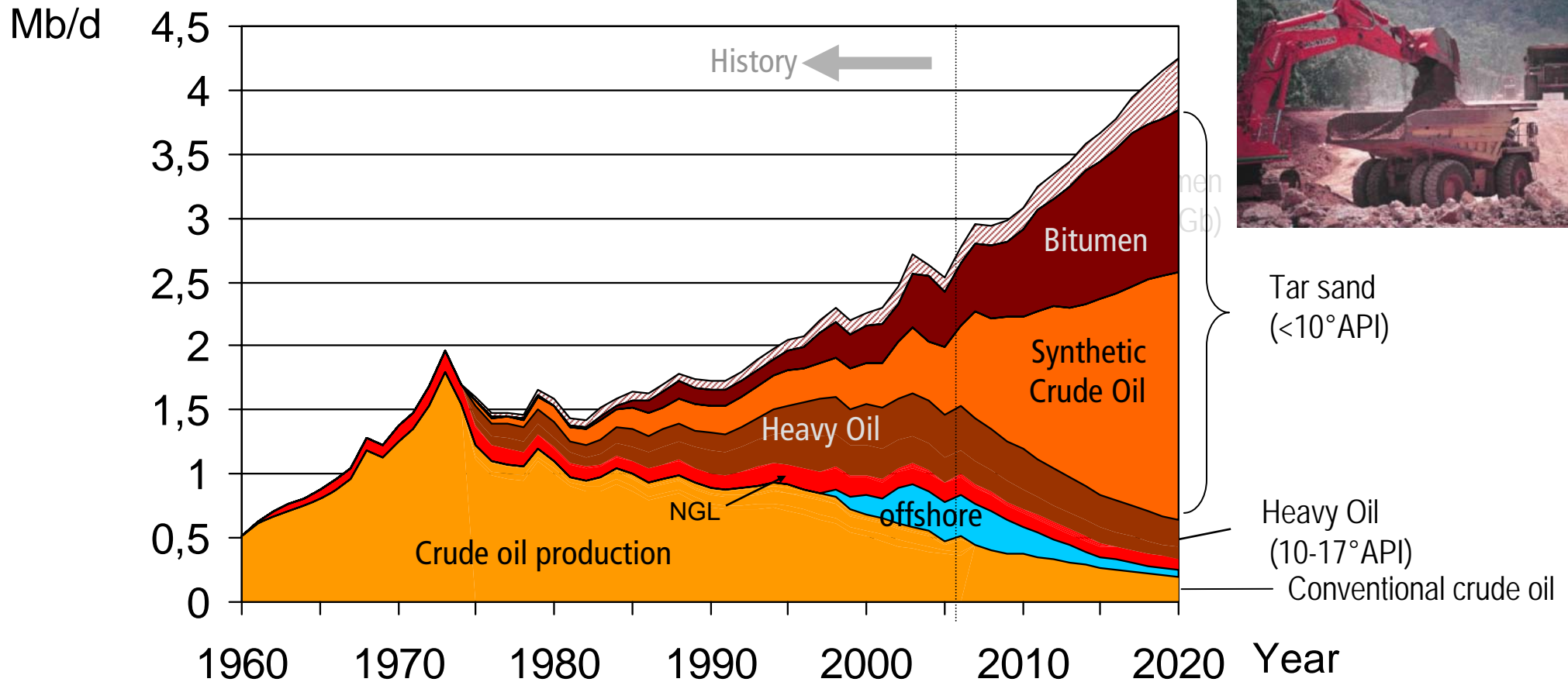
## World Oil Production



Source: Data - IHS Energy, BP 2005  
Forecast - LBST 2005 (based on ASPO scenario)

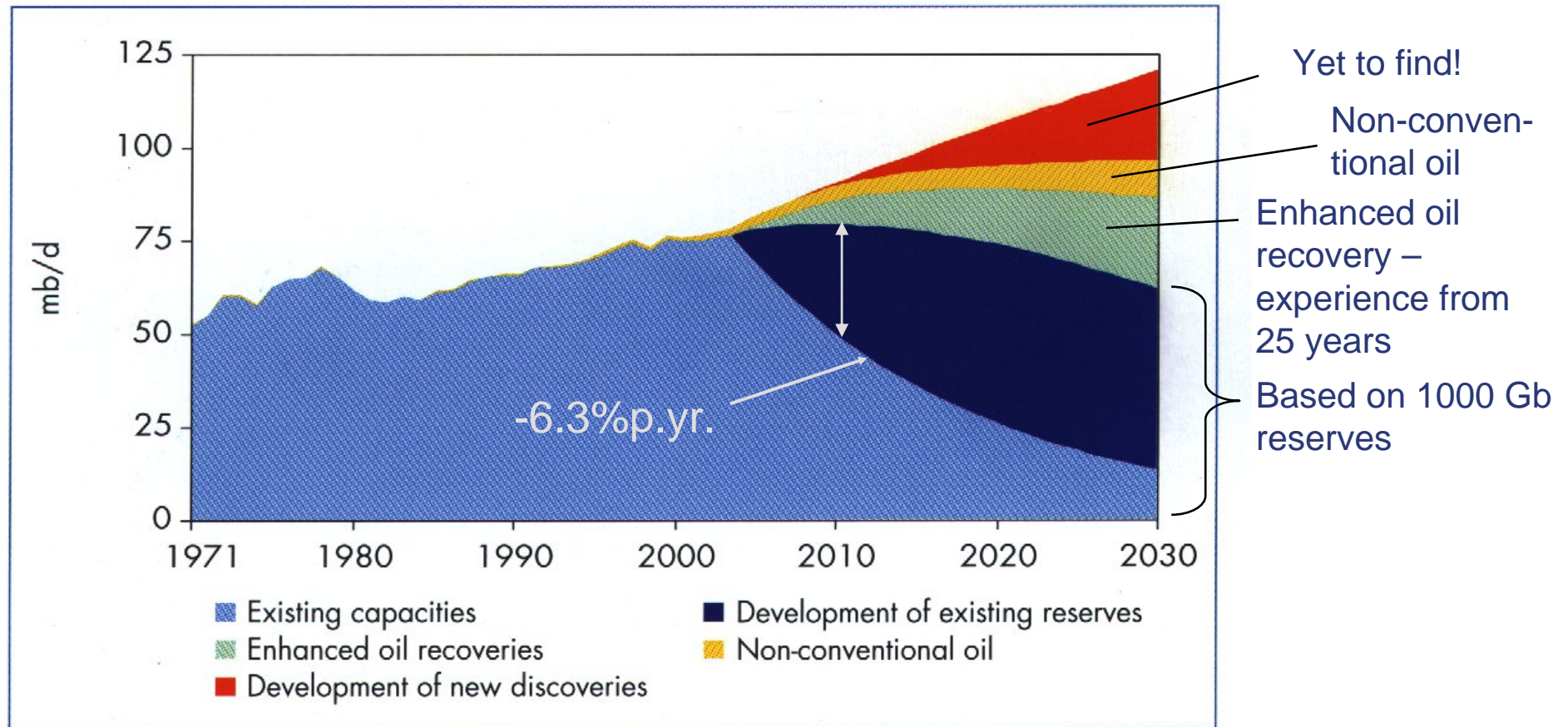
# Supply Situation: Oil, Natural Gas, Coal, Nuclear and Renewables (1)

## non-conventional oil production from tar sands in Canada



Source, 1975-2005 data National Energy Board, CDA  
 1960-1974 data US-DoE-Energy Information Administration  
 2006: Estimate by NEB, August 2006  
 2007-2020 Forecast, tar sands based on CERI-study, October 2005,  
 conventional and heavy oil based on LBST estimate

Figure 3.20: World Oil Production by Source

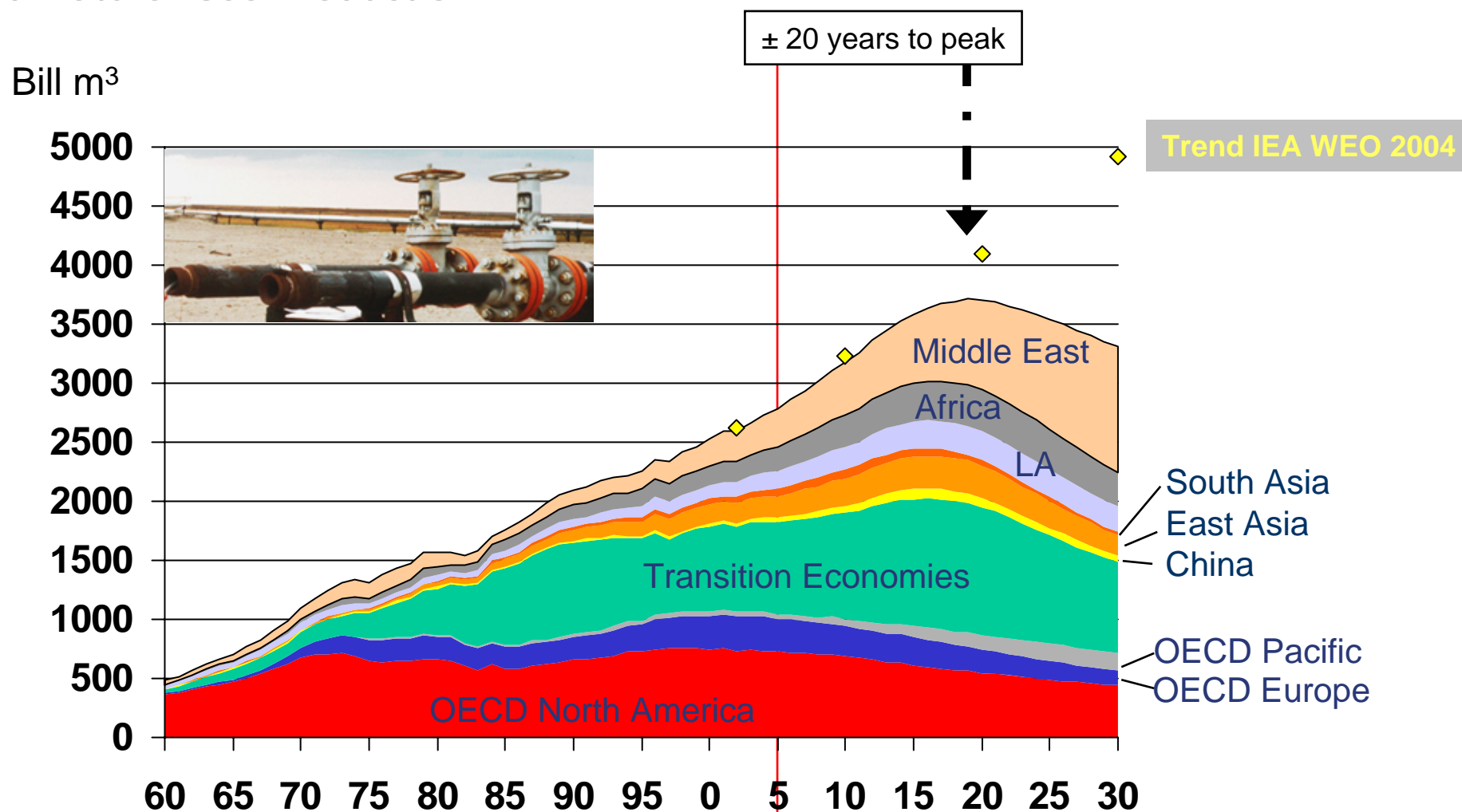


Source: IEA 2004

Between 2003 and 2010: 30 – 45 Mb/d additional production capacity !?

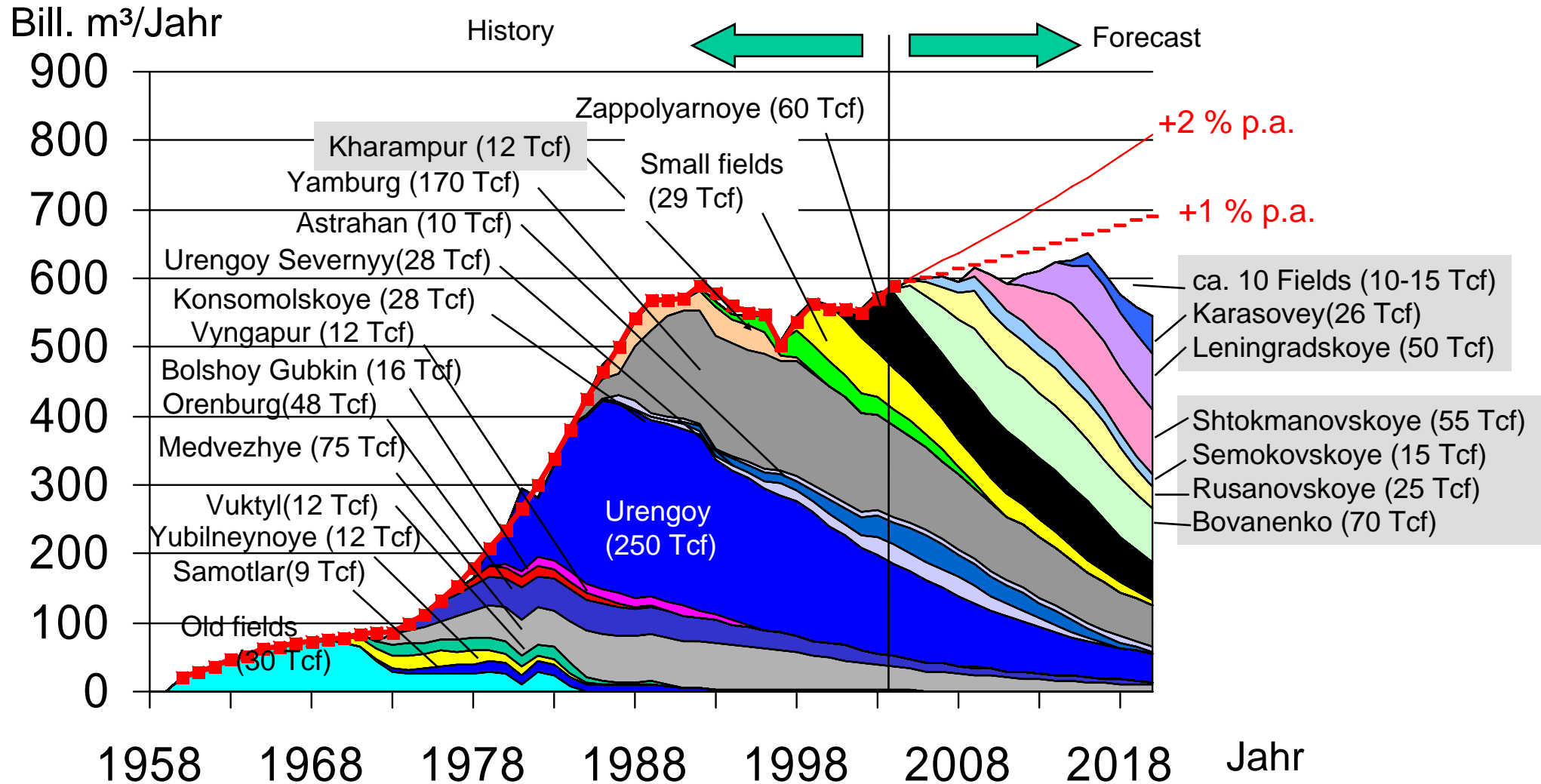
# Supply Situation: Oil, Natural Gas, Coal, Nuclear and Renewables (2)

## World Natural Gas Production



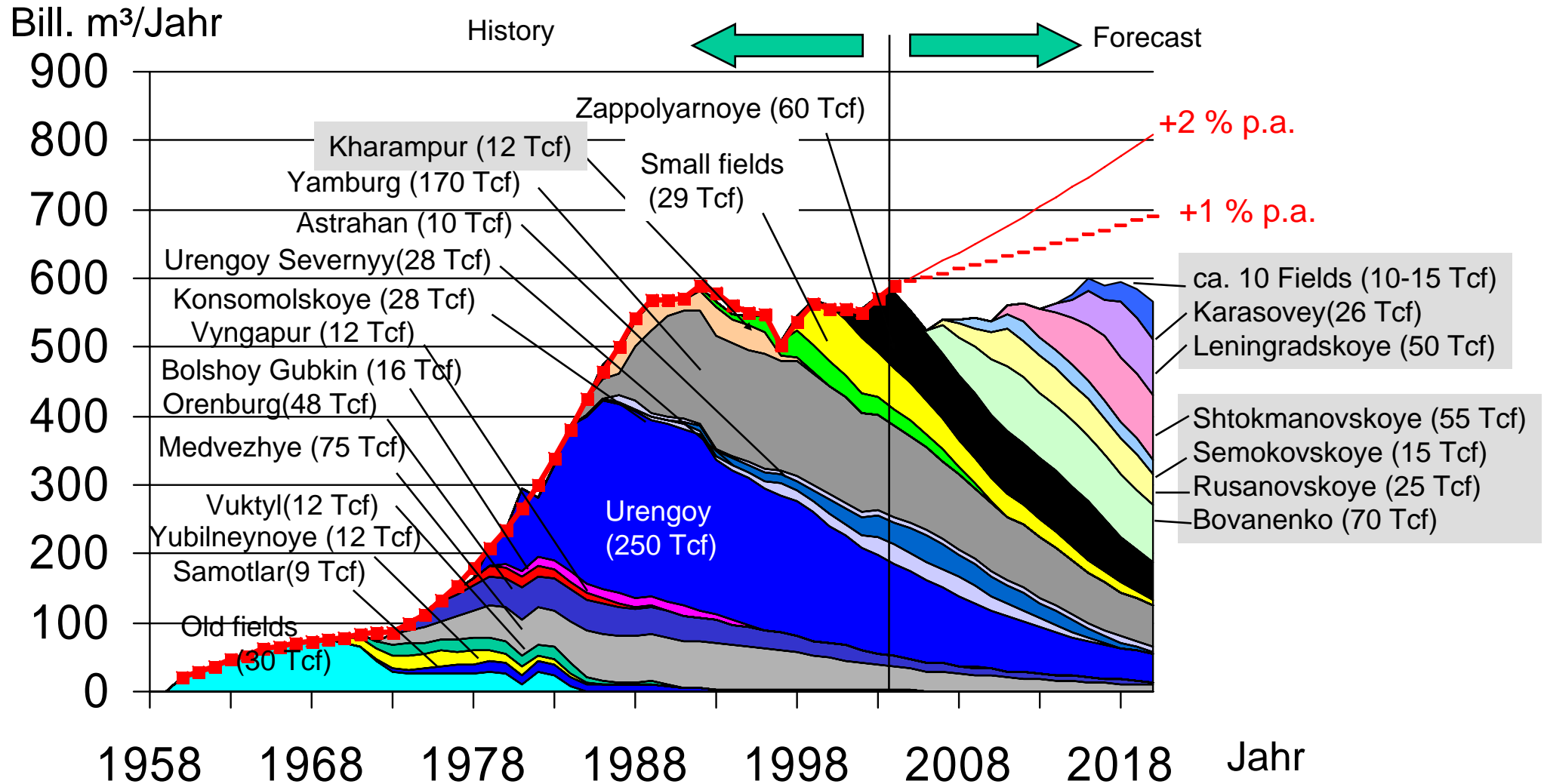
Source: Data - IHS Energy, BP 2005  
Forecast - LBST 2005 (based on ASPO scenario)

# Single Field Analysis of Russian Natural Gas Production



Source: Laherrere, LBST

# Single Field Analysis of Russian Natural Gas Production

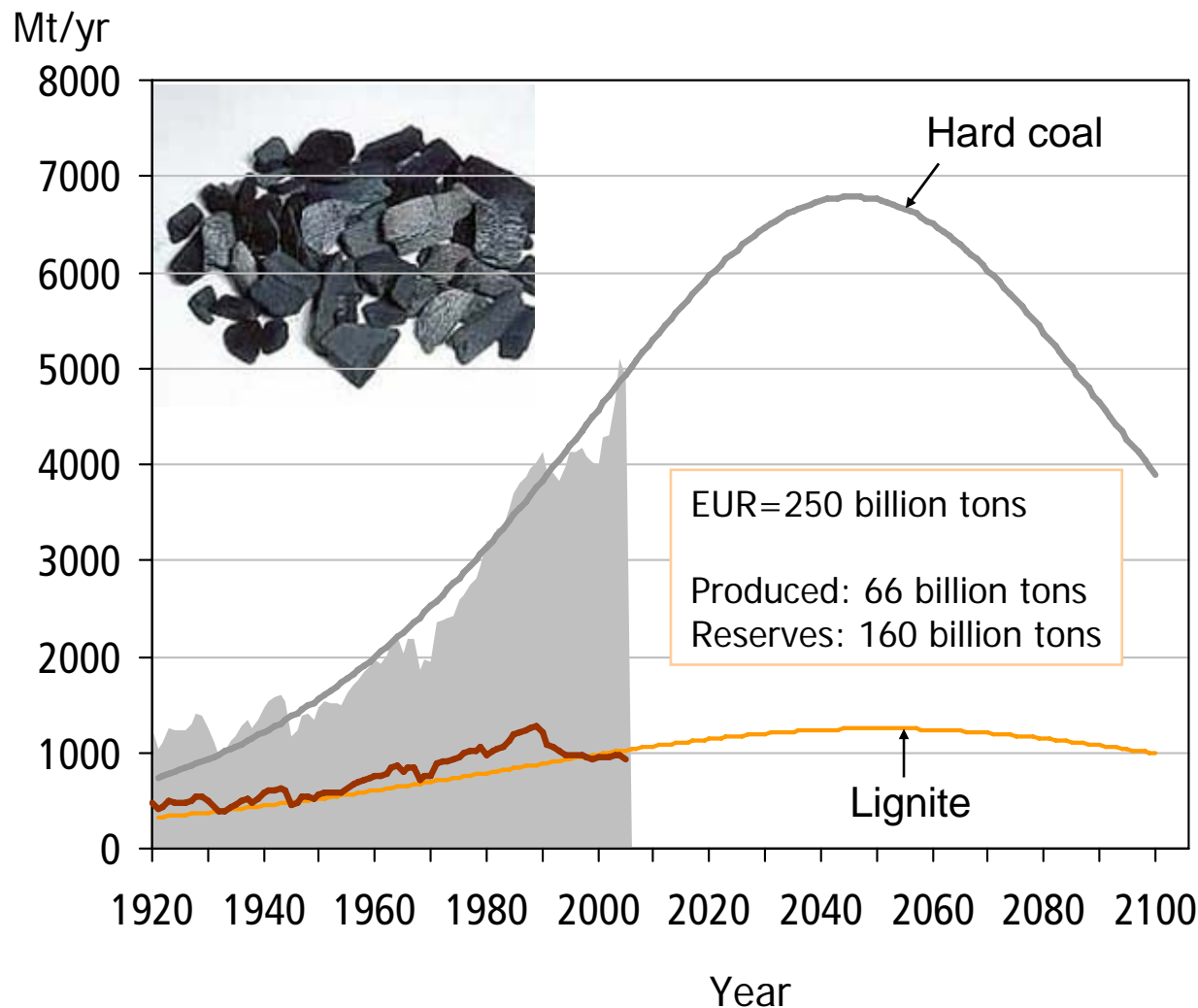


Source: Laherrere, LBST

Delay of Fields Brought to Production: 2 Years

# Supply Situation: Oil, Natural Gas, Coal Nuclear and Renewables (3)

## World Coal Supply – History and Two Scenarios



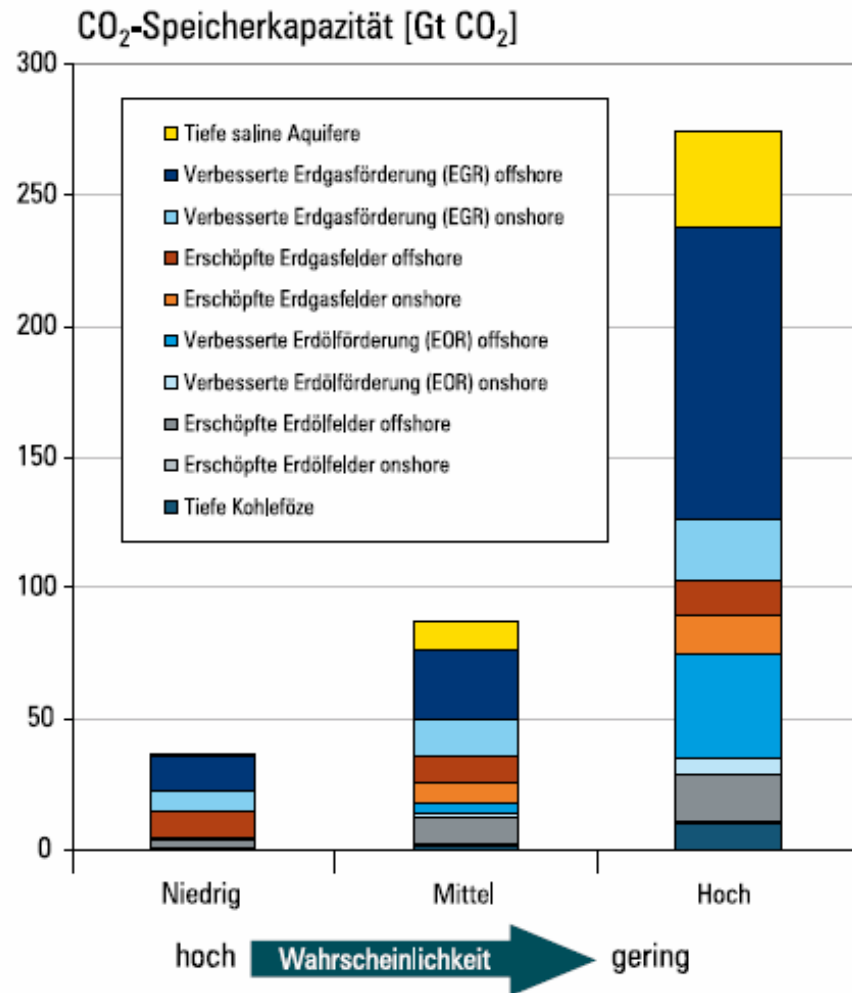
Hard coal  
EUR=950 billion tons  
Produced: 200 billion tons  
Reserves: 750 billion tons  
(bituminous 480 billion tons,  
subbituminous 270 billion tons)

Hard coal, lignite:  
R/P=155 years

**Data source:** Historical Data BP Statistical Review of World Energy, BGR  
**Scenario:** LBST 2005

## Supply Situation: Oil, Natural Gas, Coal Nuclear and Renewables (3)

### Carbon capture and storage from fossil energy use



**Gesamtes Speicherpotenzial Europa (OECD):**  
36,5 – 275 Gigatonnen

**Kohlendioxid Emissionen pro Jahr in Europa (OECD):**  
4,5 Gigatonnen bzw. 1,6 Gigatonnen (nur Strom)

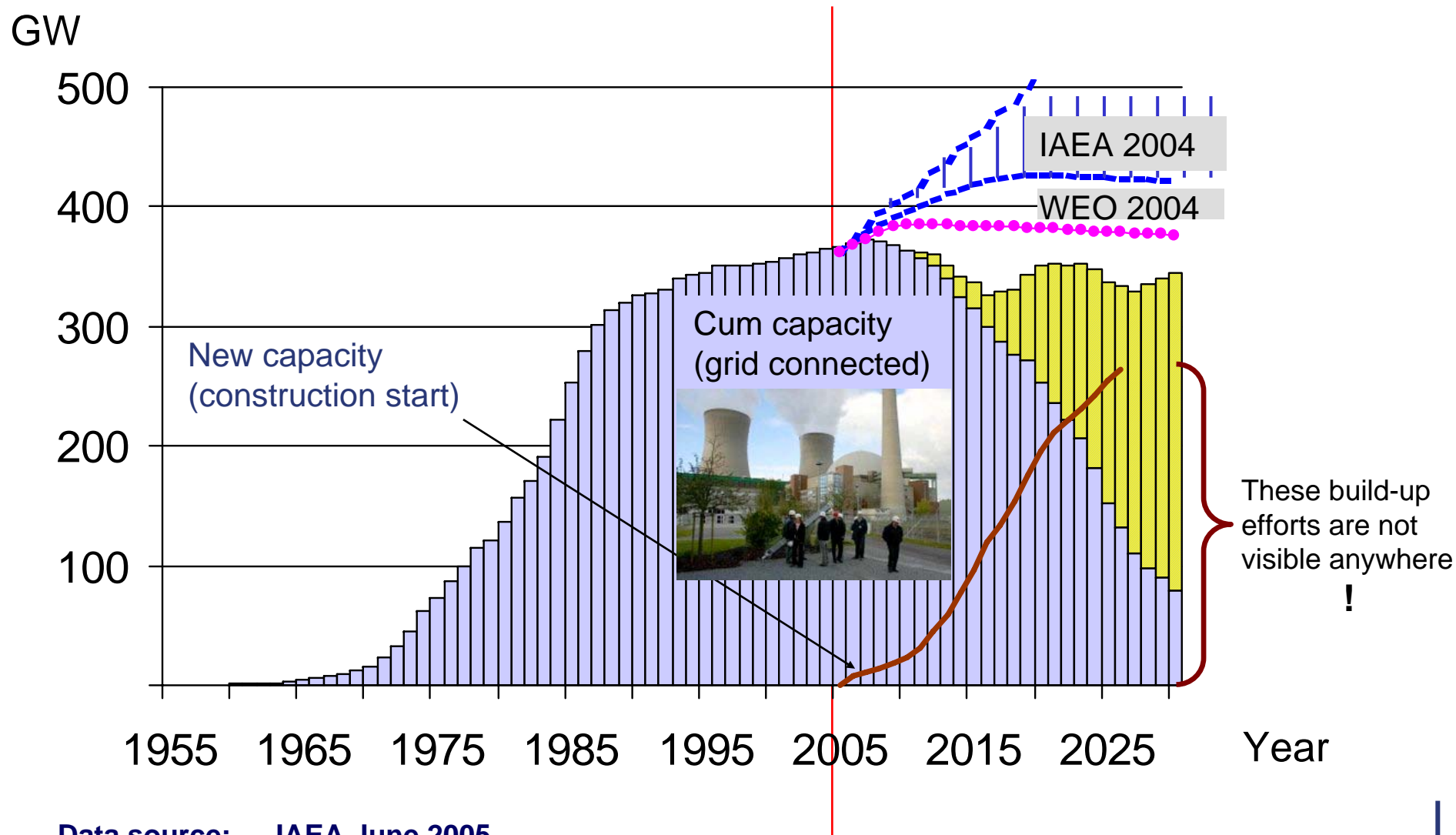
**...ergibt eine theoretische Nutzungsdauer der Speicher:**  
8 – 62 Jahre bzw. 23 – 174 Jahre (nur Strom)

**...und im mittleren Szenario:**  
19 Jahre bzw. 55 Jahre (nur Strom)

**Für Emissionen und Speicher nur Deutschland:**  
6 – 22 Jahre

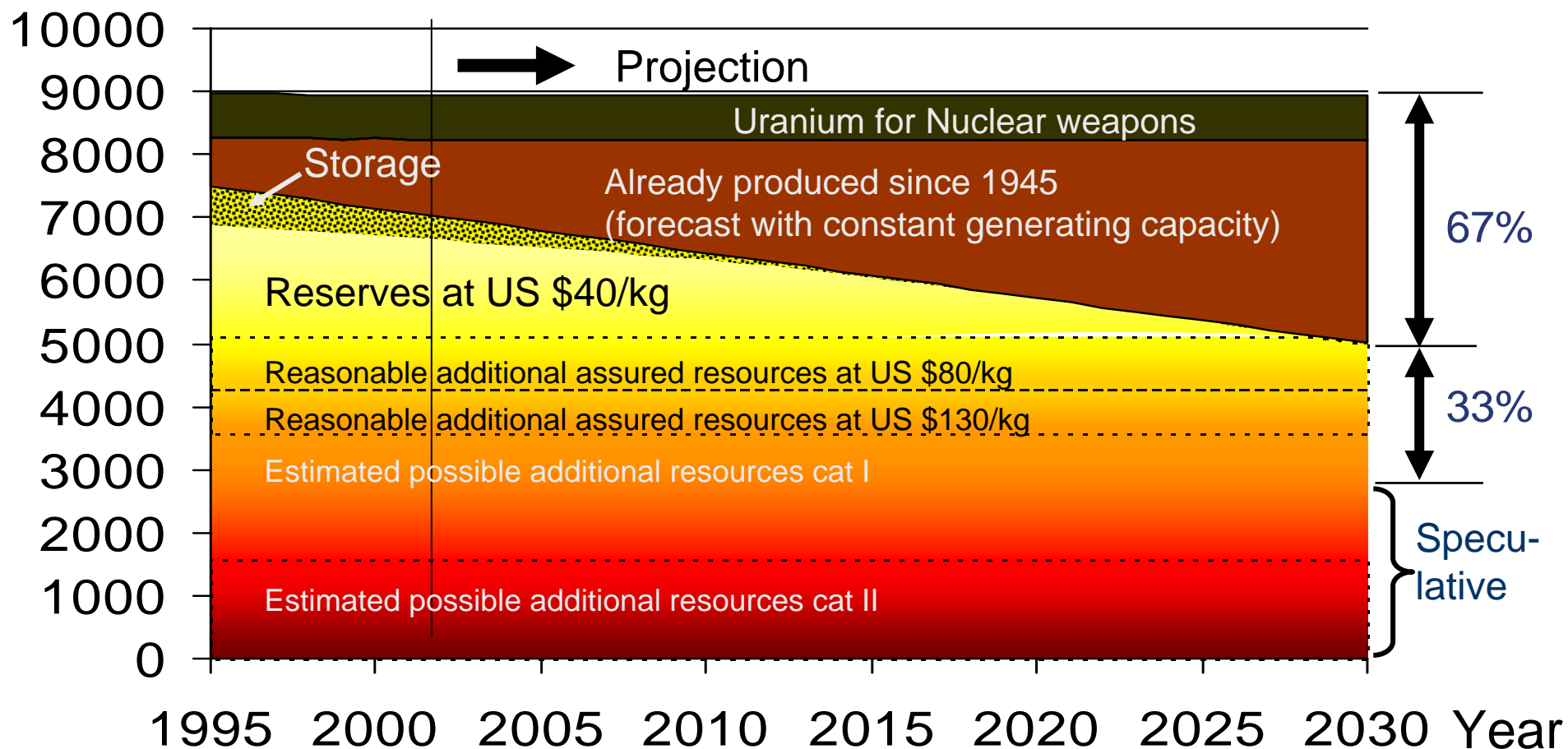
**Data source: ECOFYS 2004**

## World Nuclear Power Plant Capacities



Data source: IAEA June 2005  
Scenario: LBST 2005

## 1000 t Uranium

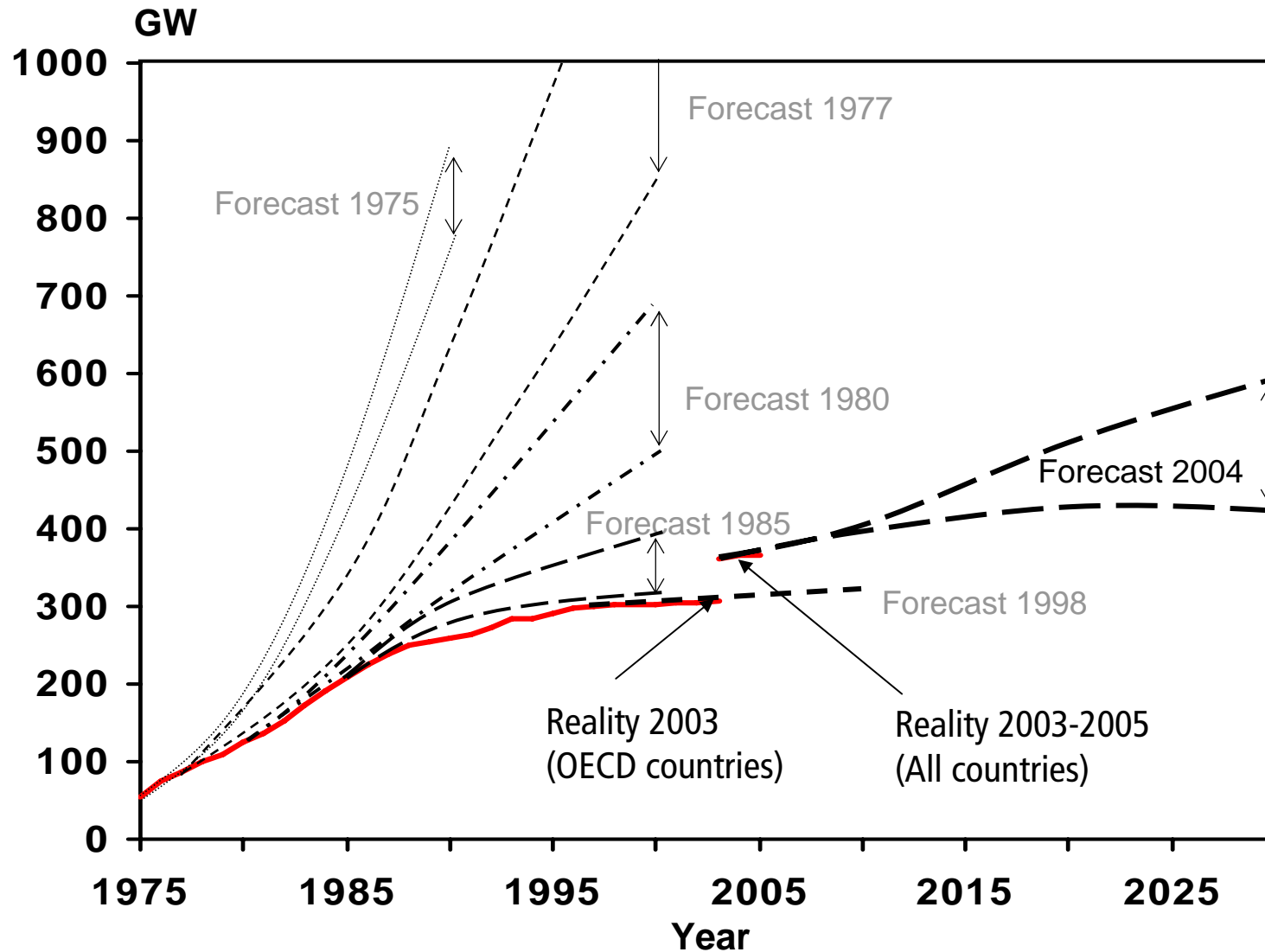


Data source: BGR 2003

For more detail see also:  
[http://www.lbst.de/publications/studies\\_\\_e/2006EWG-uranium\\_\\_e.html](http://www.lbst.de/publications/studies__e/2006EWG-uranium__e.html)

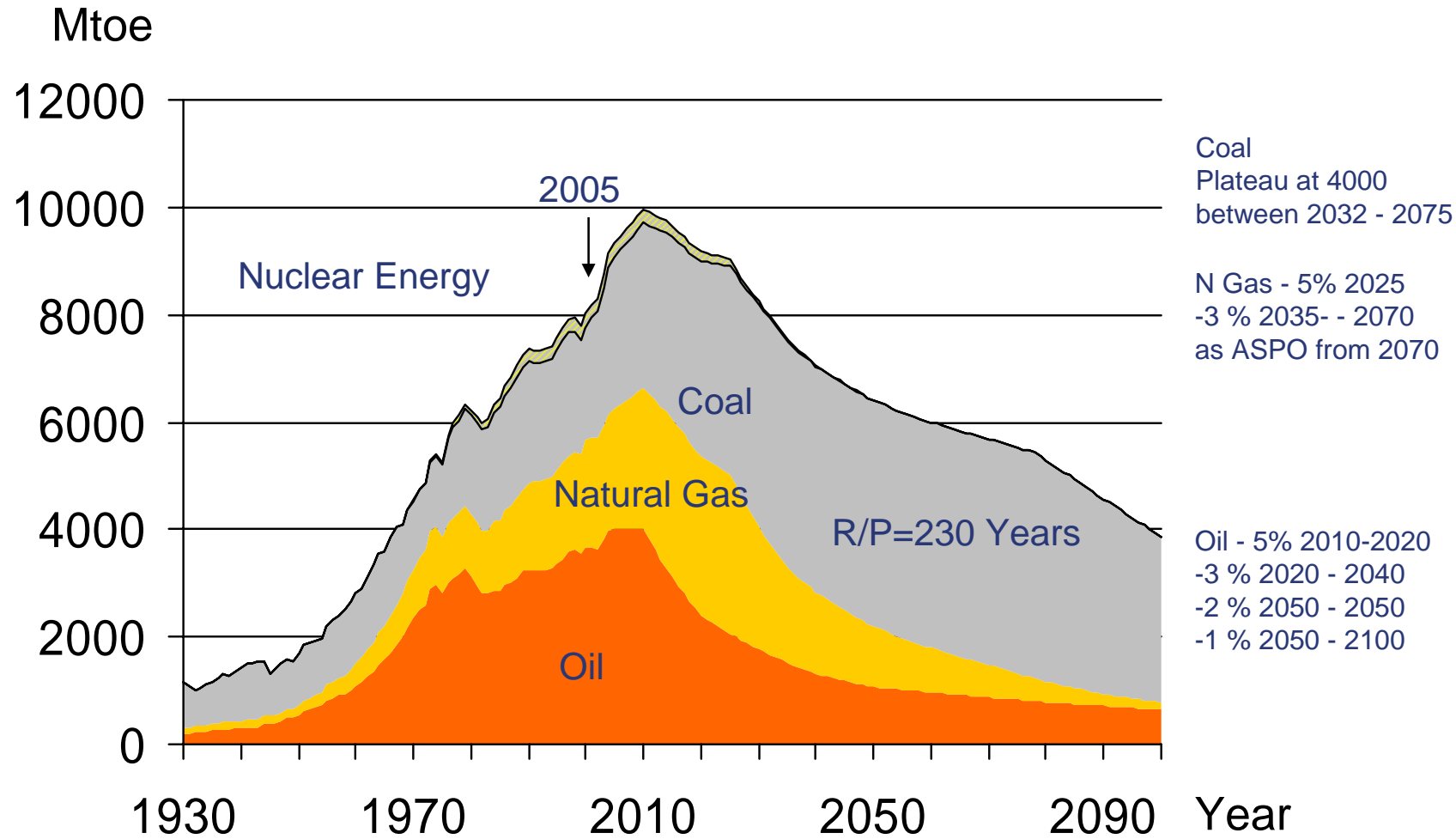
[www.lbst.de](http://www.lbst.de)

# Forecasts 1975-2004 by IAEA on World Nuclear Power Capacities



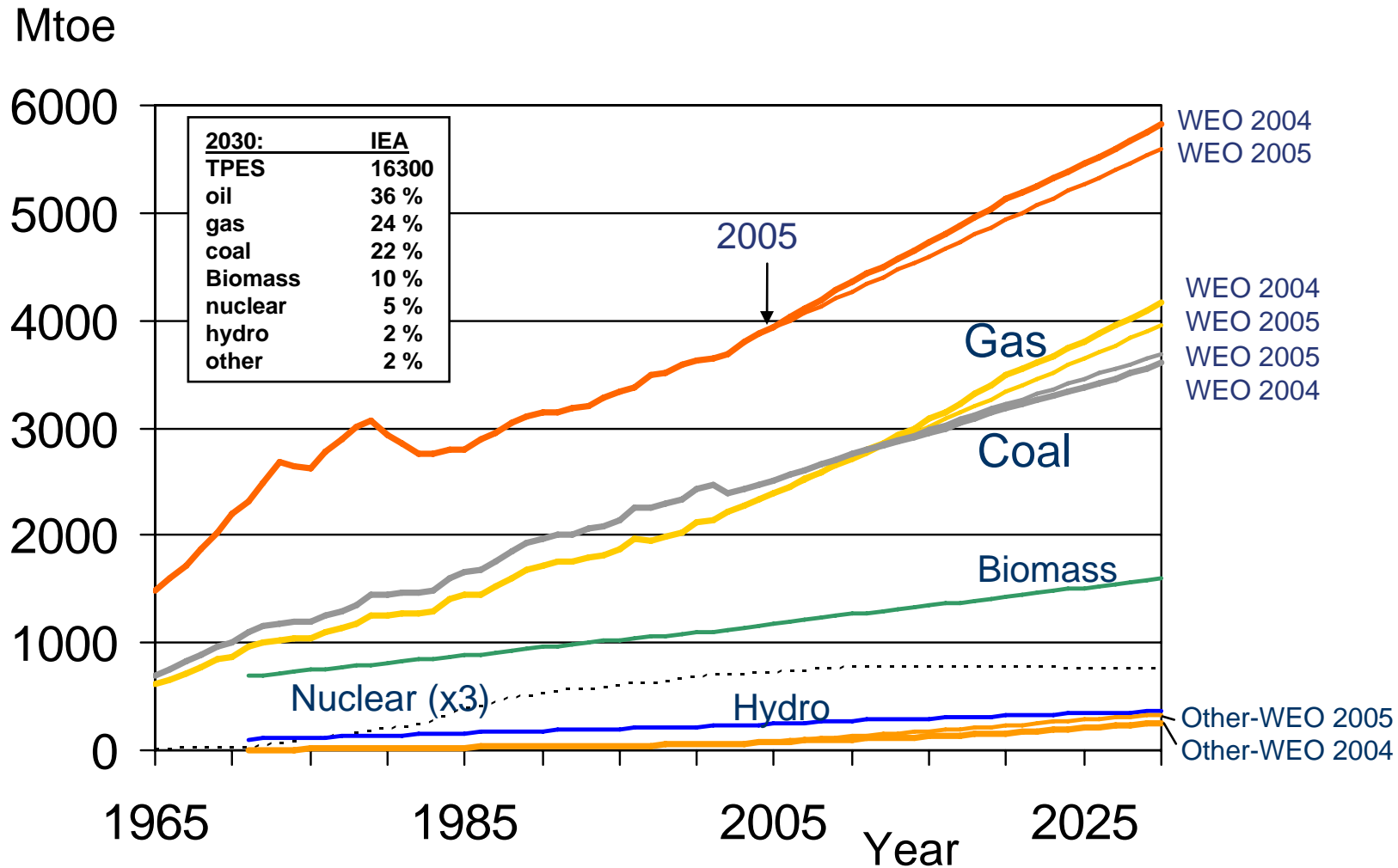
Data Source: IAEA  
Graphics: LBST

# Contribution of Fossil and Nuclear Energy Sources



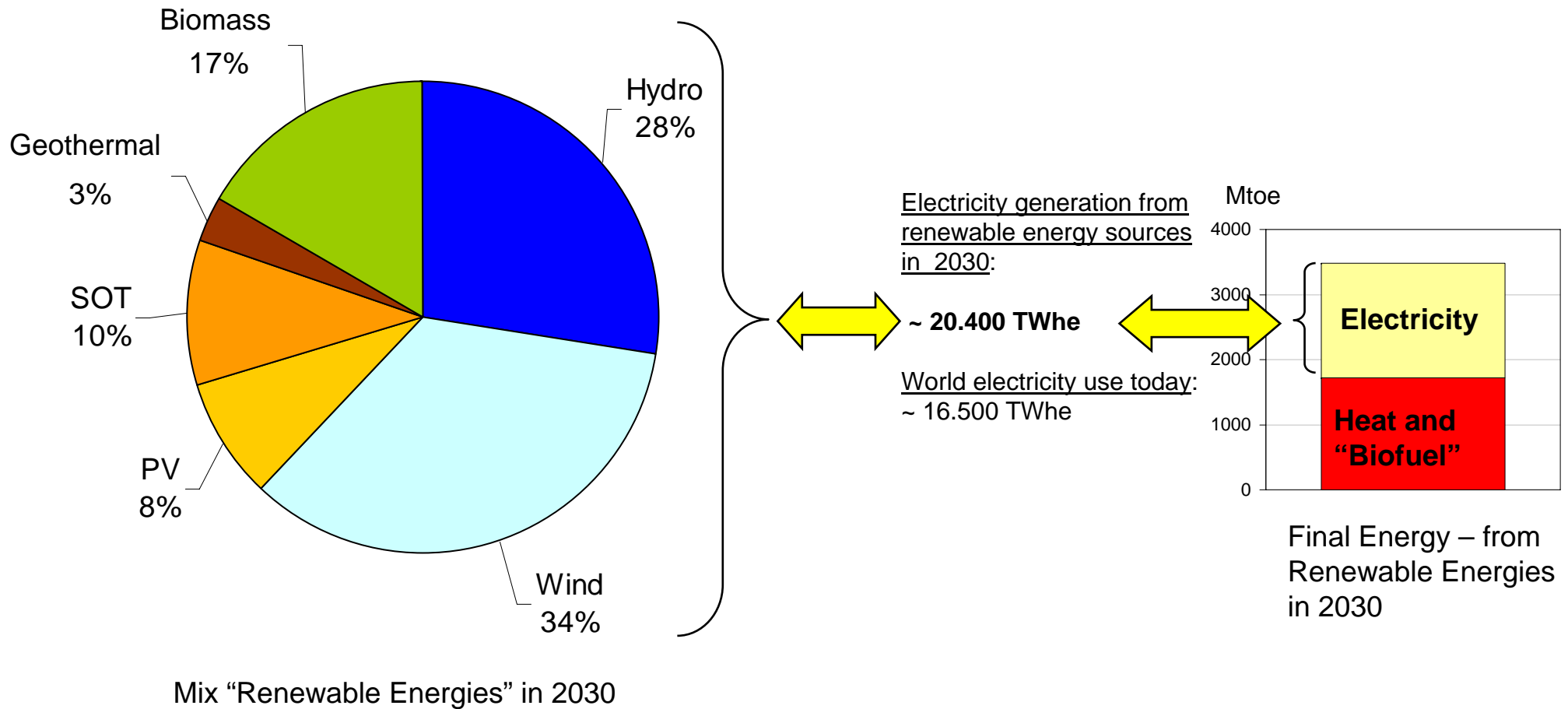
Data source: Oil, Gas, Coal-, Nuclear Scenario, LBST 2005

[www.lbst.de](http://www.lbst.de)



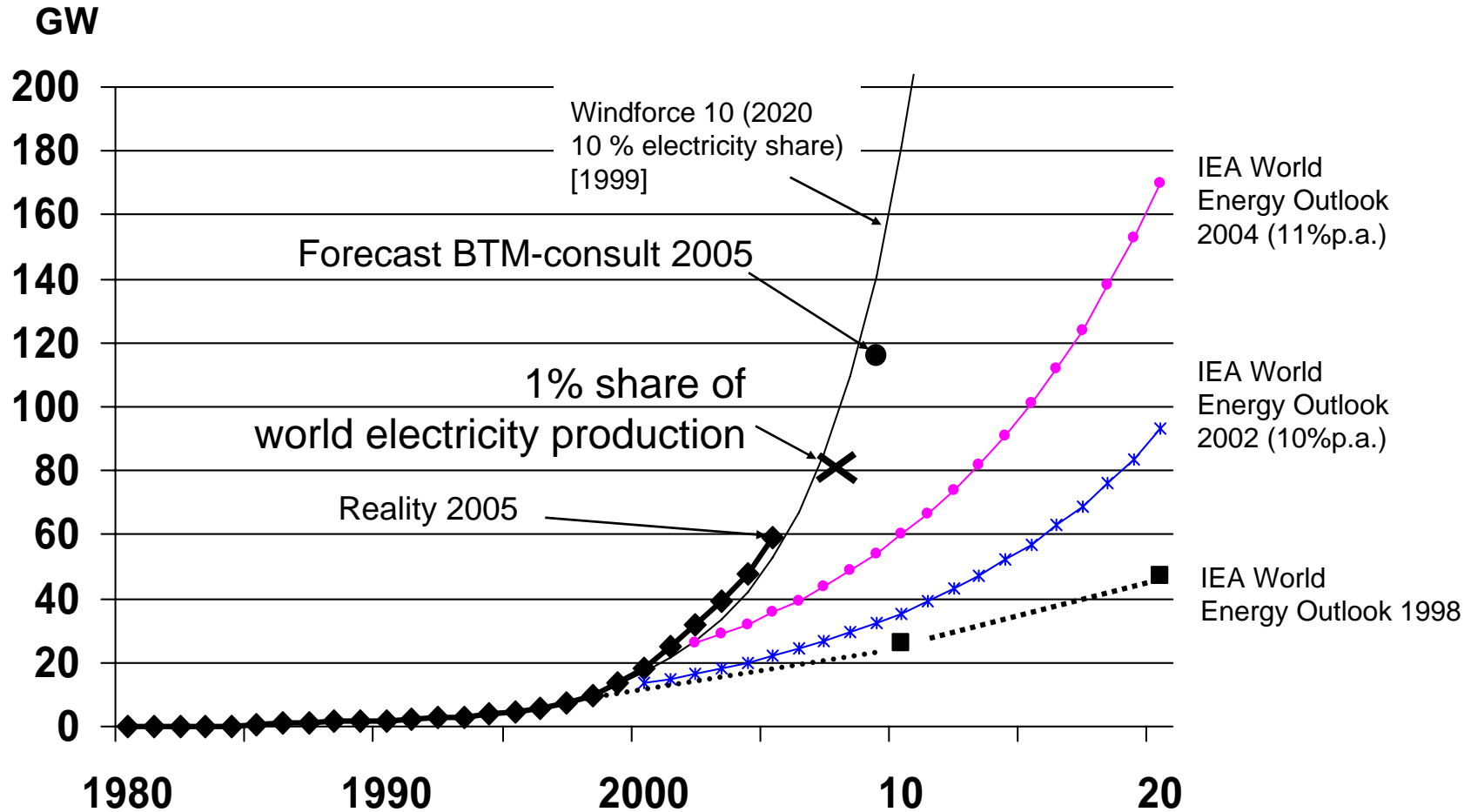
Source: Historical data - BP Statistical Review of World Energy  
Outlook - International Energy Agency 2004, 2005

World electricity production from renewable energy sources in 2030



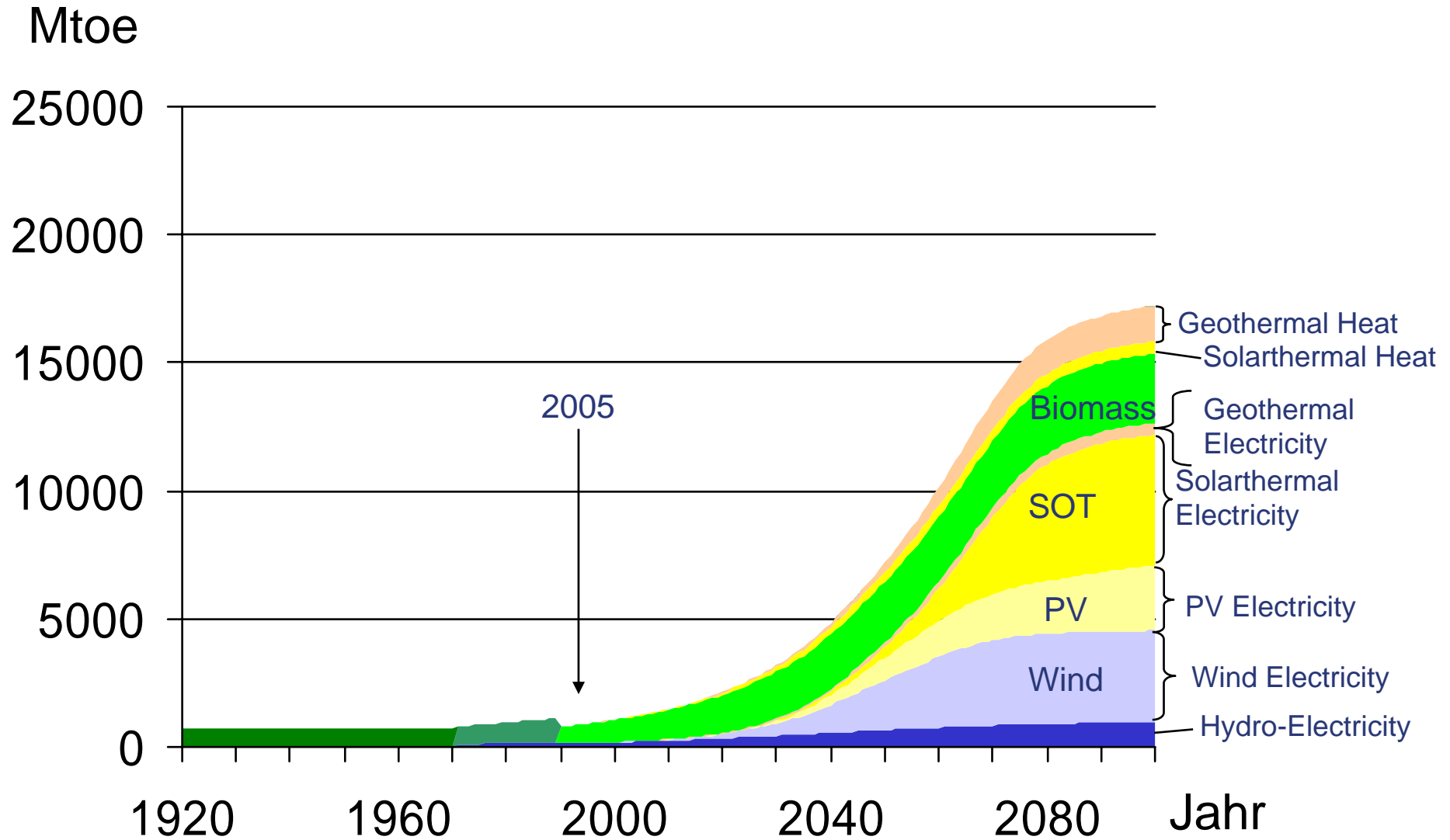
Source: LBST - "Alternative World Energy Outlook 2005"

# Forecasts 1998-2002 by IEA and Greenpeace on Wind Power Capacities



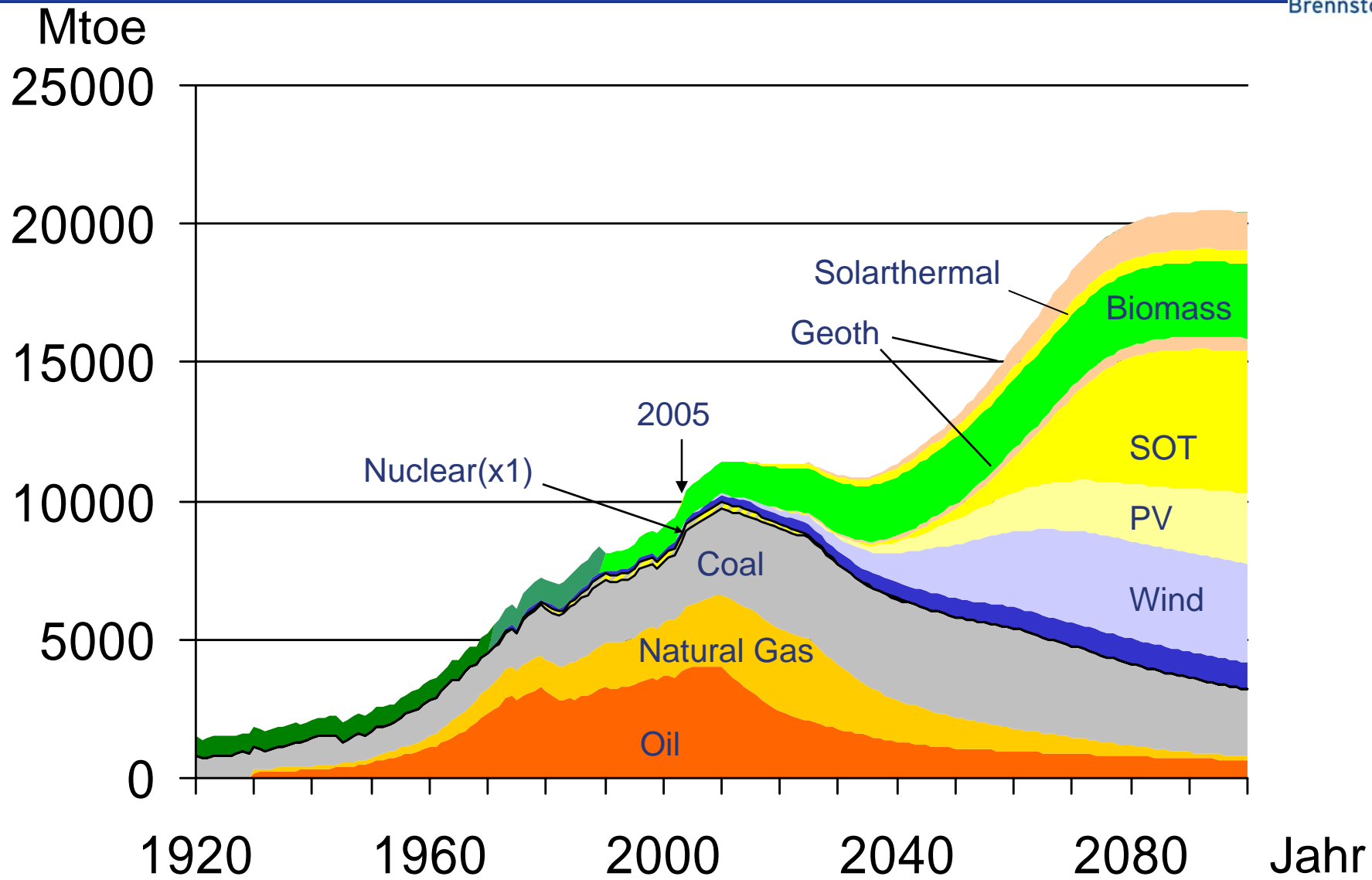
Data compilation and graphics: 4 July 2006, LBST

# Contribution of Renewable Energy Sources and Use



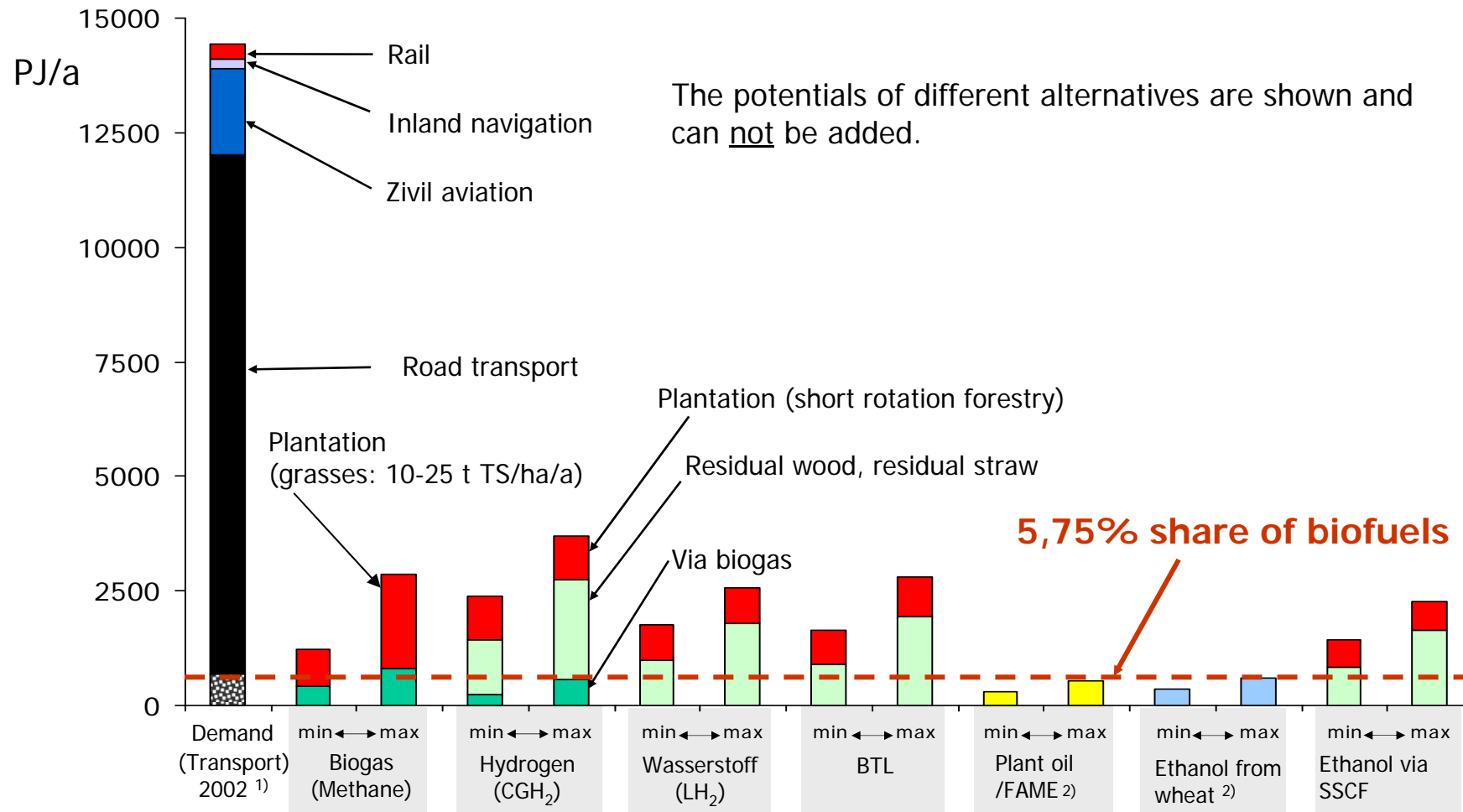
Source: LBST - "Alternative World Energy Outlook 2005"

# A Possible World Energy Scenario



Source: LBST - "Alternative World Energy Outlook 2005"

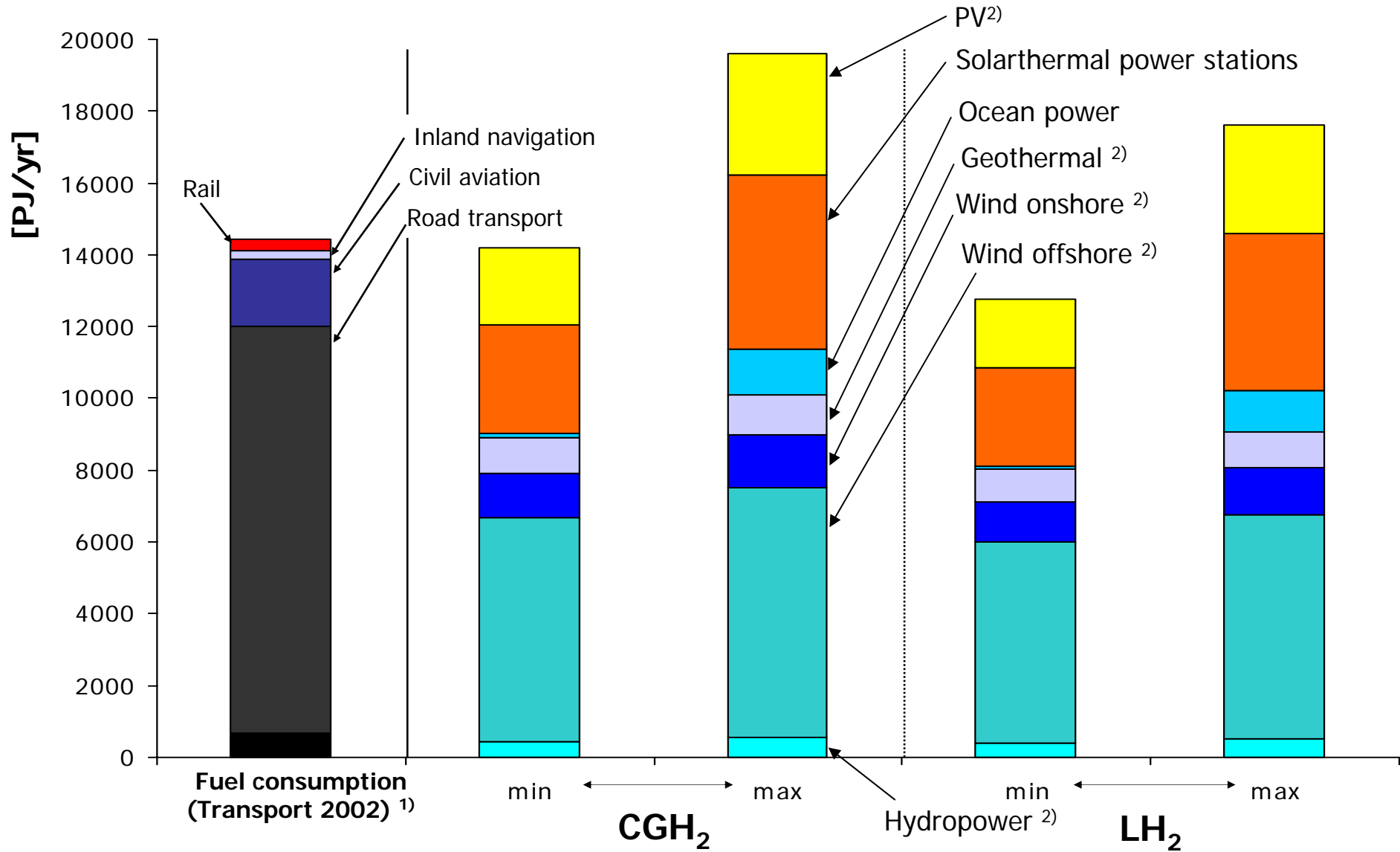
# Technical potential of different biofuels in the EU-25



<sup>1)</sup> Source: IEA-Statistics 2001-2002

<sup>2)</sup> Gross (without the energy efforts for the supply of the fuels e.g. the use of external energy for the ethanol plant)

# Technical potentials for hydrogen from renewable electricity in EU 25

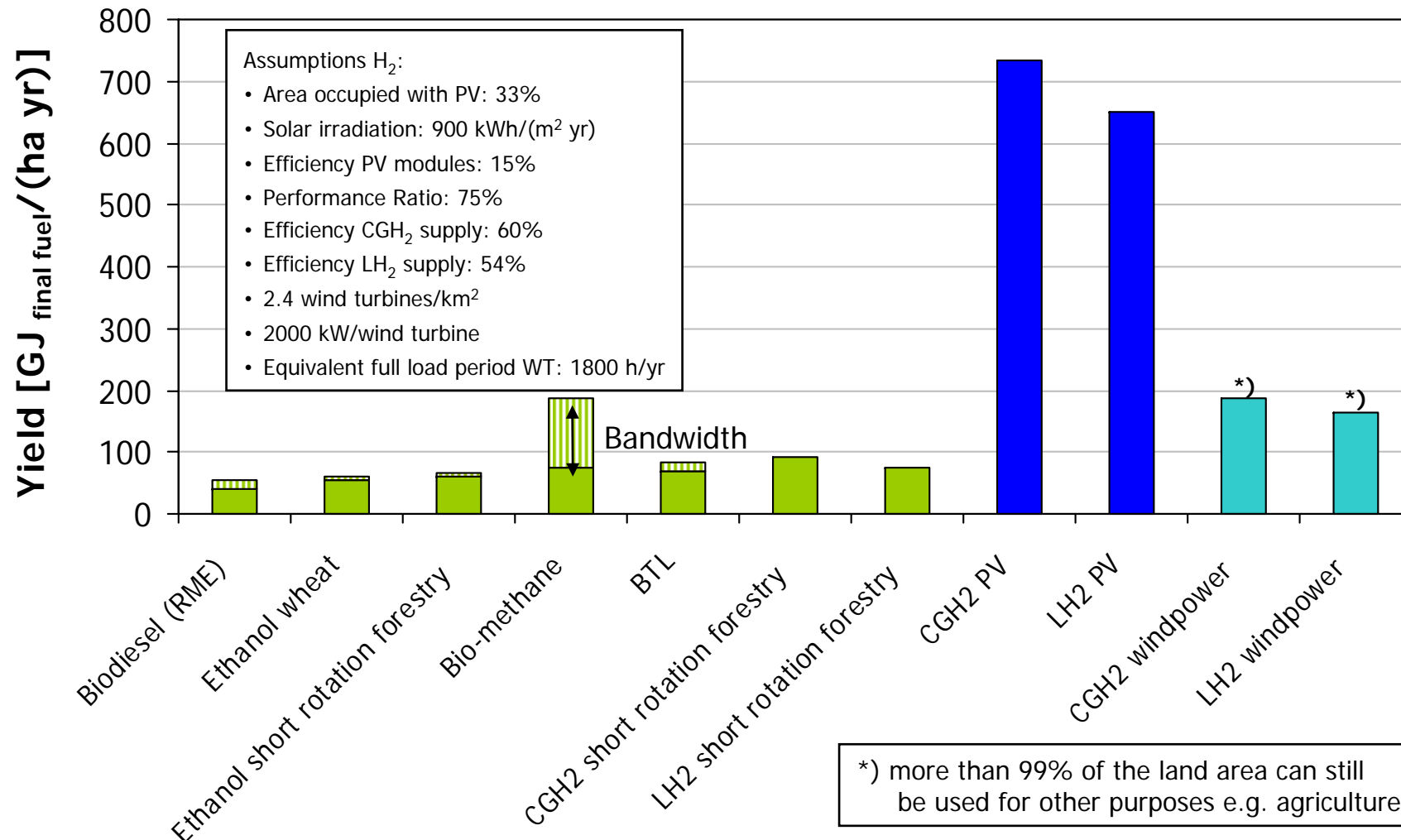


<sup>1)</sup> Source: IEA-Statistics 2001-2002

<sup>2)</sup> still exploitable within the EU

Data compilation and graphics: LBST

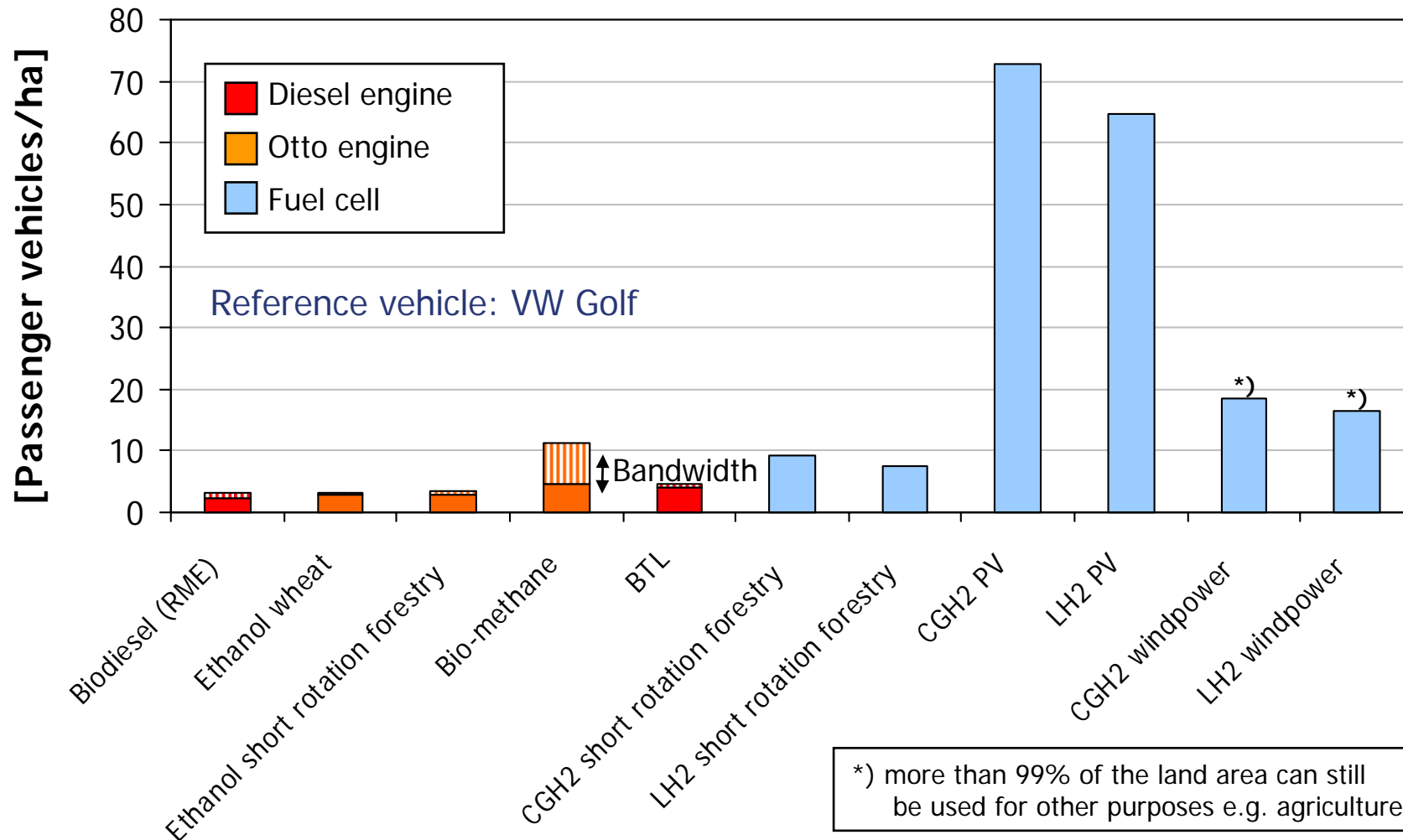
# Yield of per ha and year for different transportation fuels



Source: LBST

# Number of passenger vehicles (hybrid) which can be supplied per ha

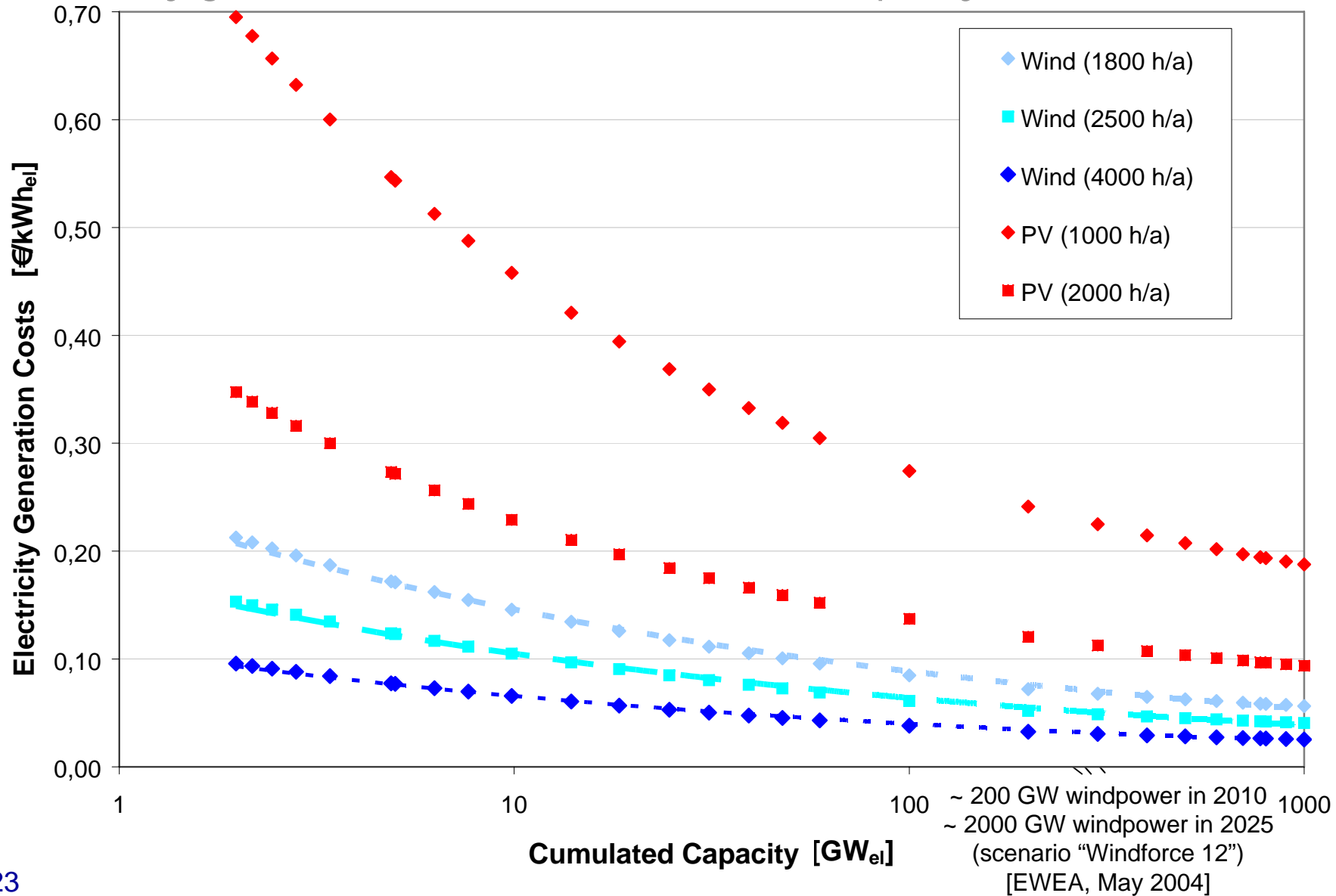
Annual mileage passenger vehicle: 12,000 km



Source: LBST

# Cost reduction of renewables

## Electricity generation costs versus installation capacity

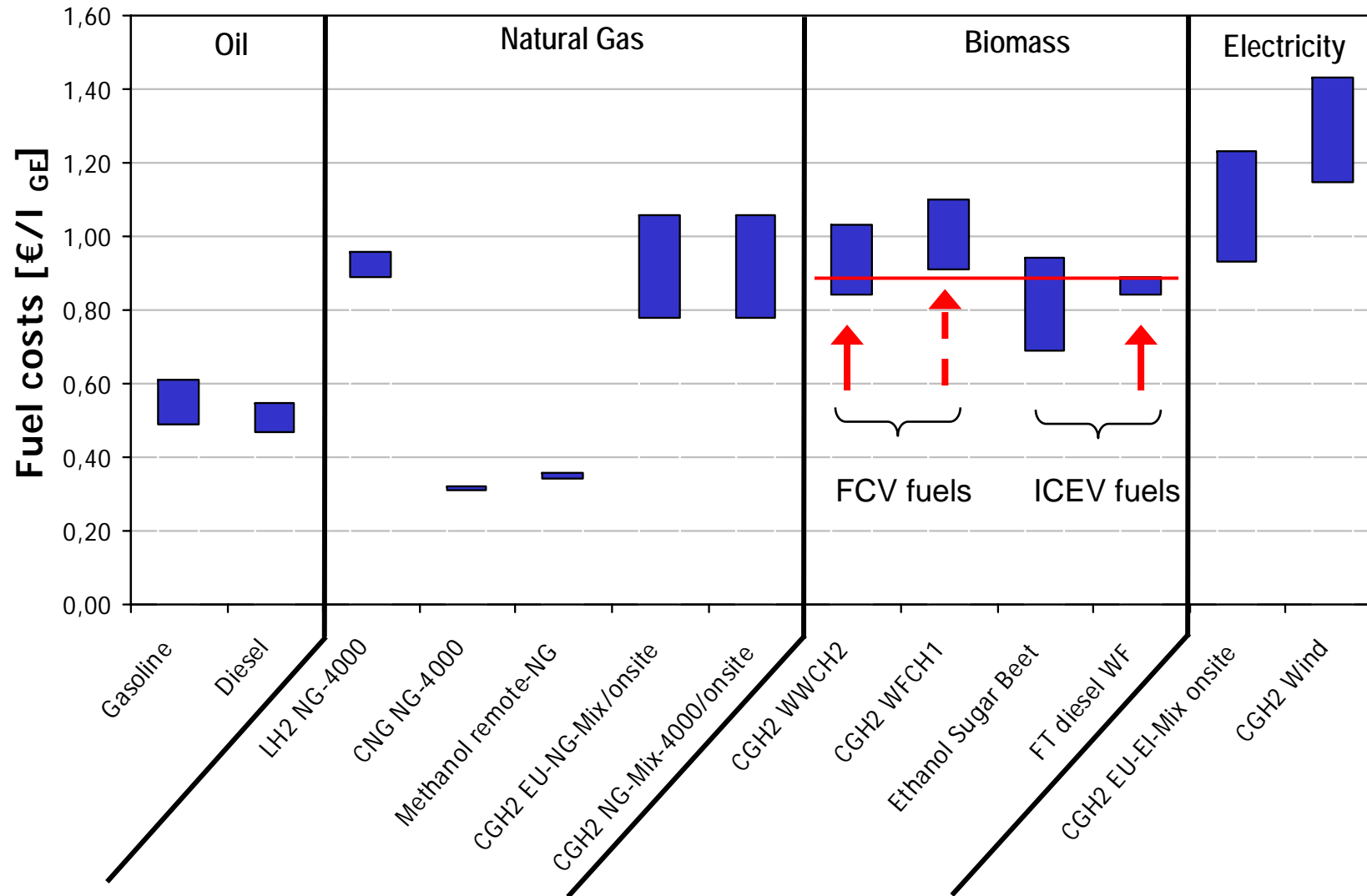


Data compilation and graphics:

LBST

[www.lbst.de](http://www.lbst.de)

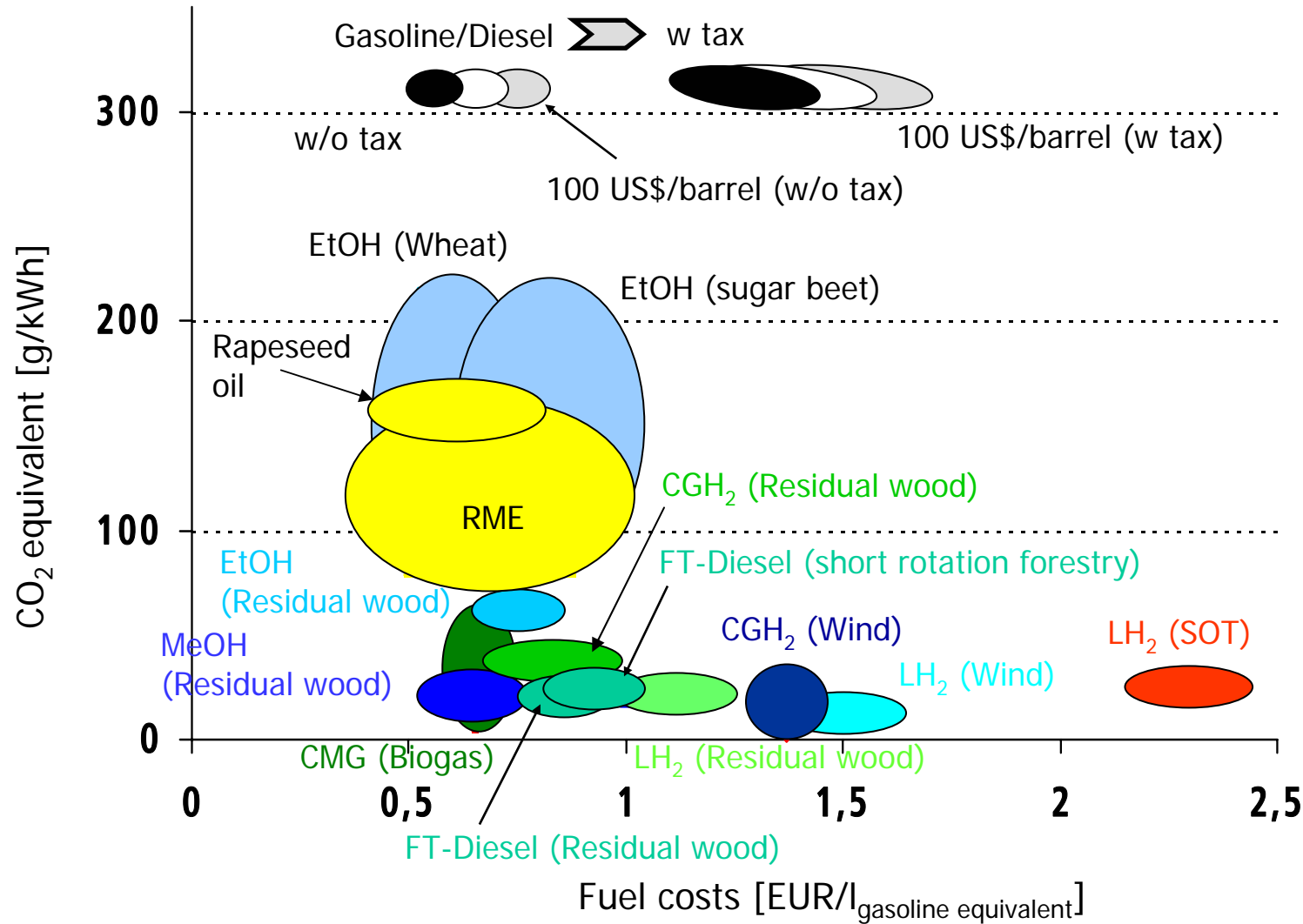
# Fuel costs "Well-to-Tank"



Crude oil based gasoline and diesel: price ex filling station without taxes in June 2006

Source: LBST

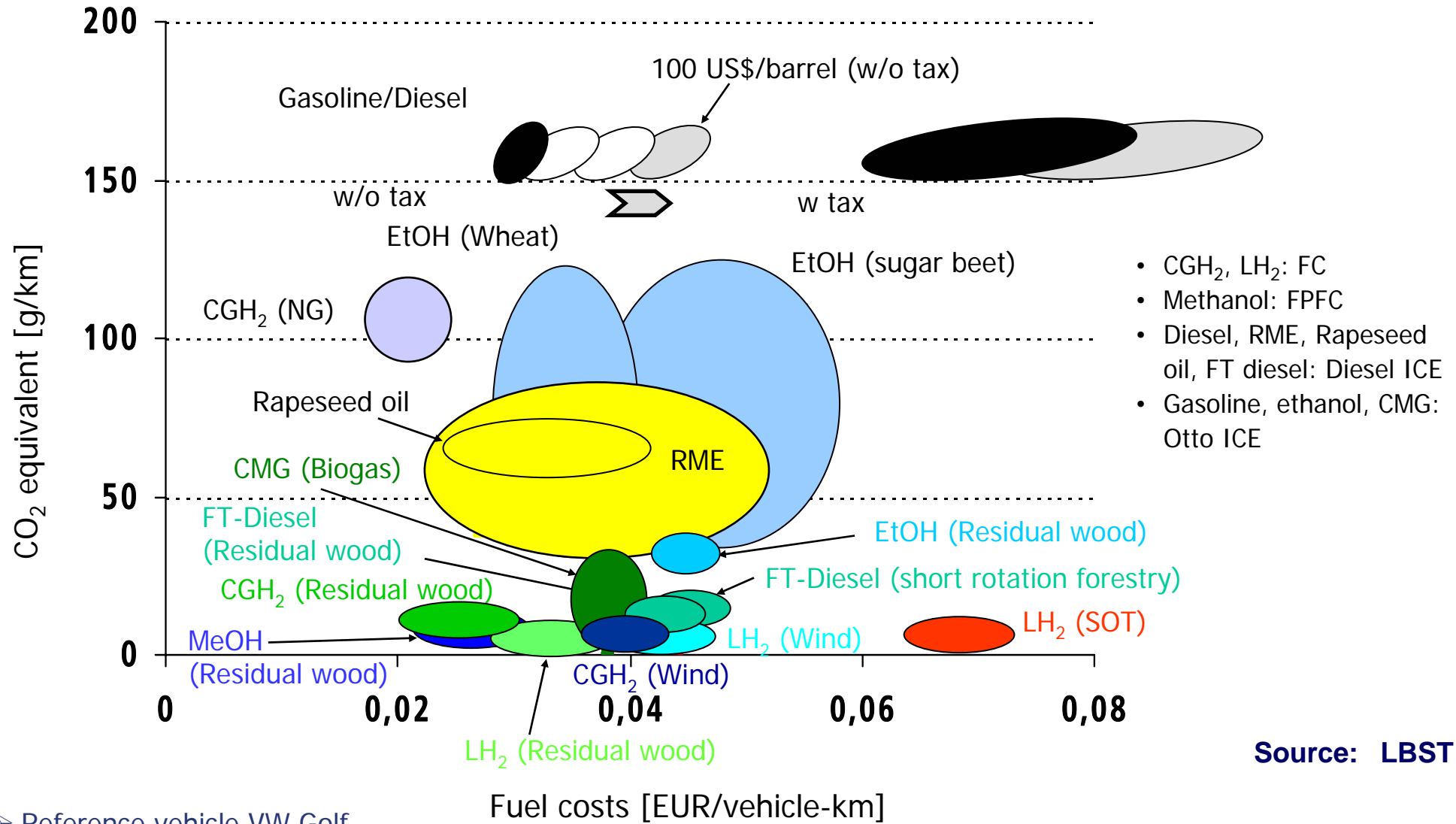
# Fuel costs versus GHG emissions "Well-to-Tank"



CGH<sub>2</sub> from NG  
(onsite SMR):  
380 - 440 g/kWh  
~ 0,80 EUR/l<sub>GE</sub>

Source: LBST

# Fuel costs versus GHG emissions "Well-to-Wheel"



Source: LBST

- Reference vehicle VW Golf
- Non-hybrid