

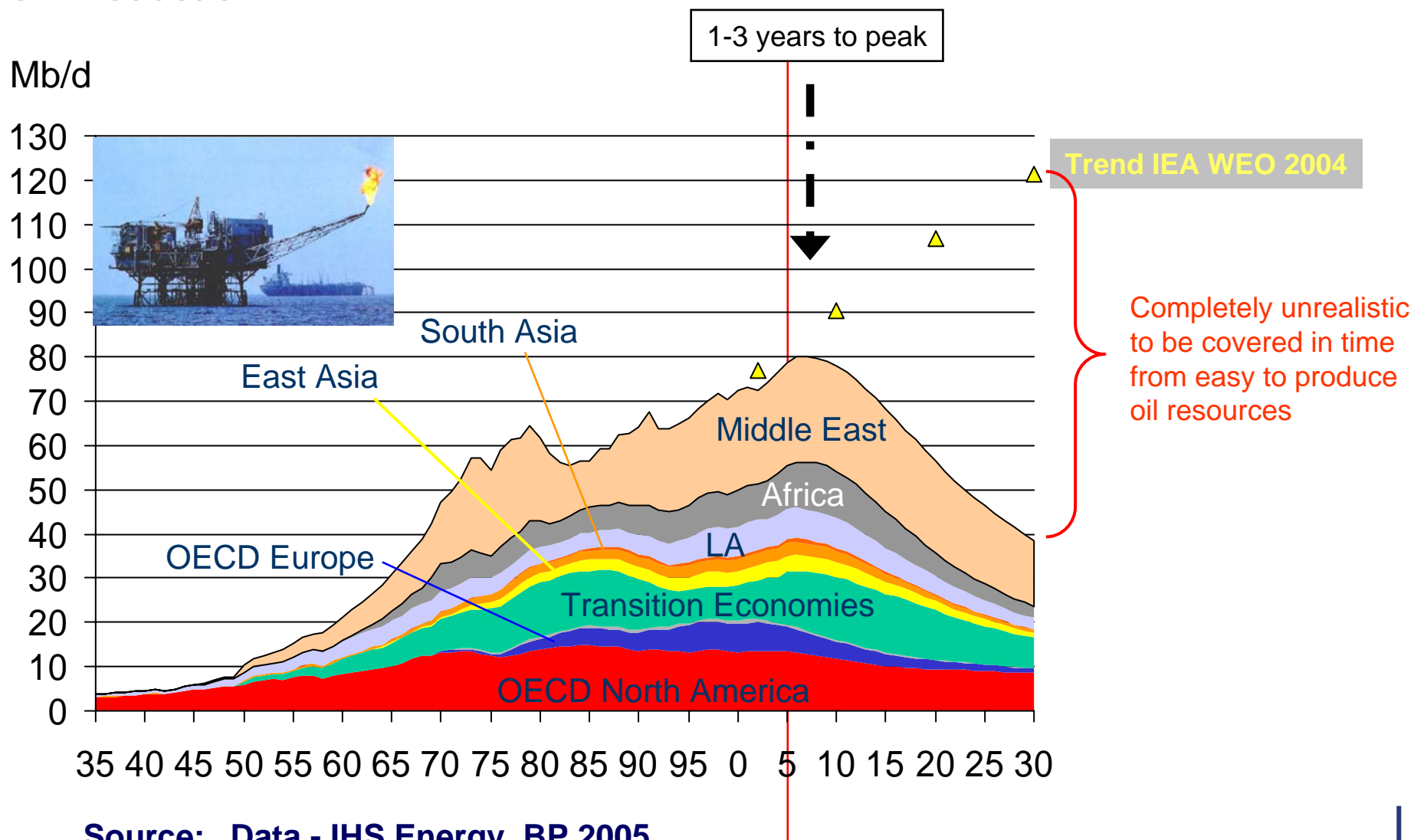
Primary Energy for the Production of Hydrogen



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

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

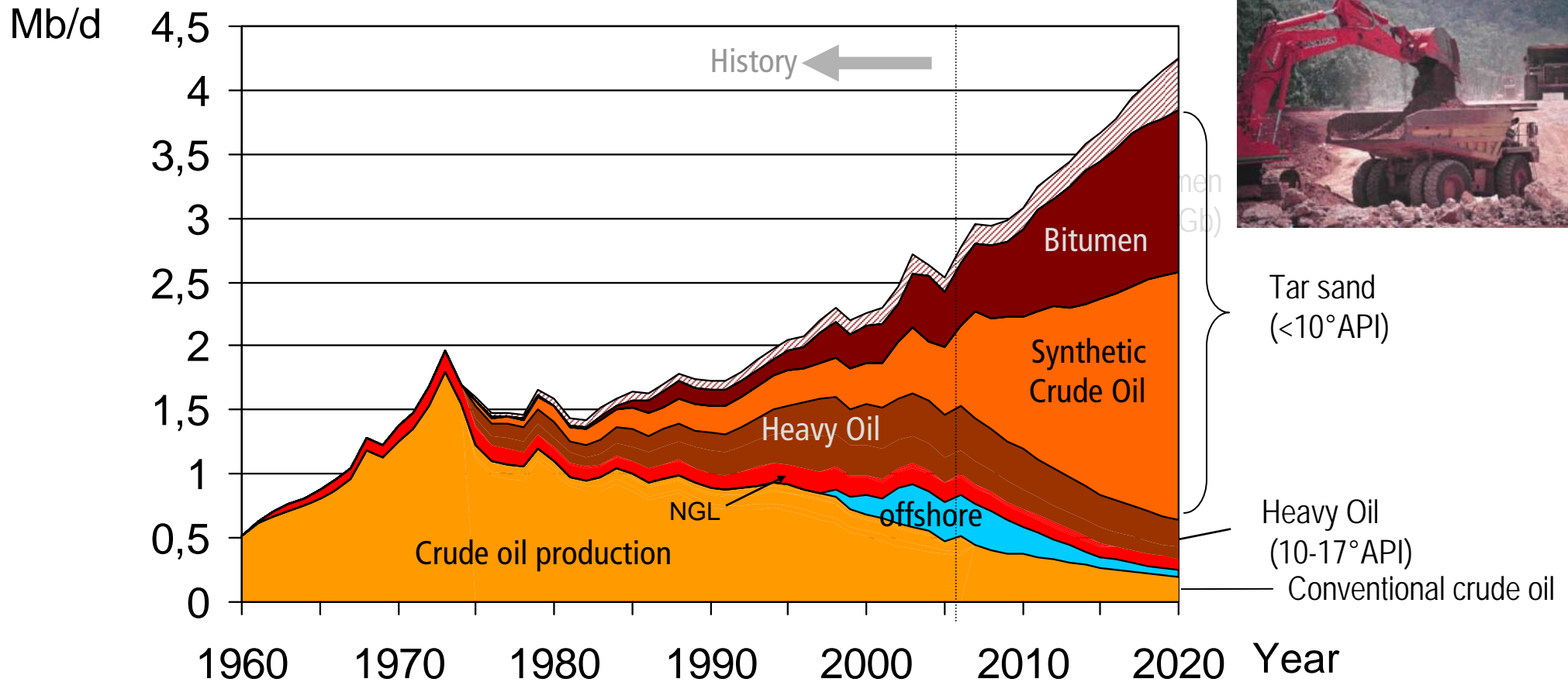
World Oil Production



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

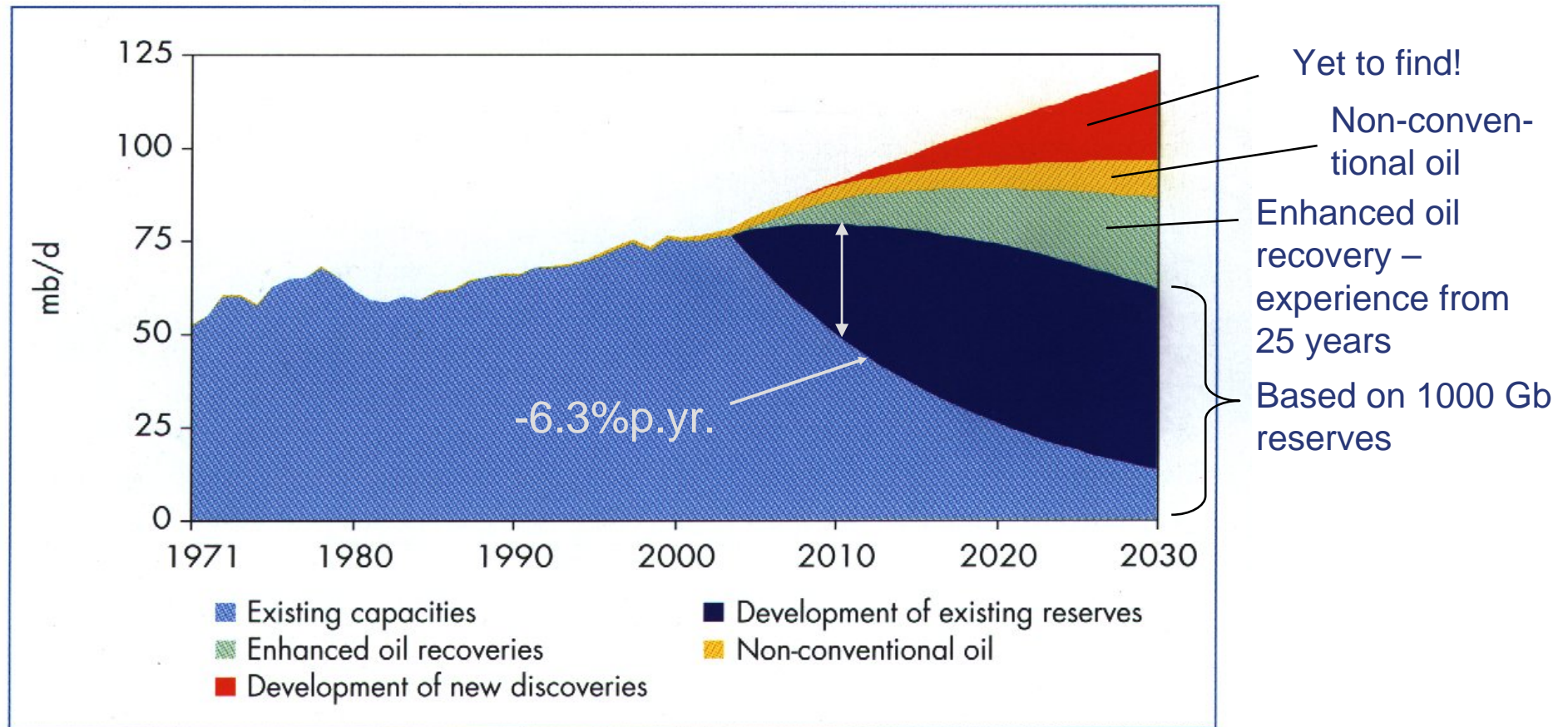
Supply Situation: Oil, Natural Gas, Coal, Nuclear and Renewables (1)

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

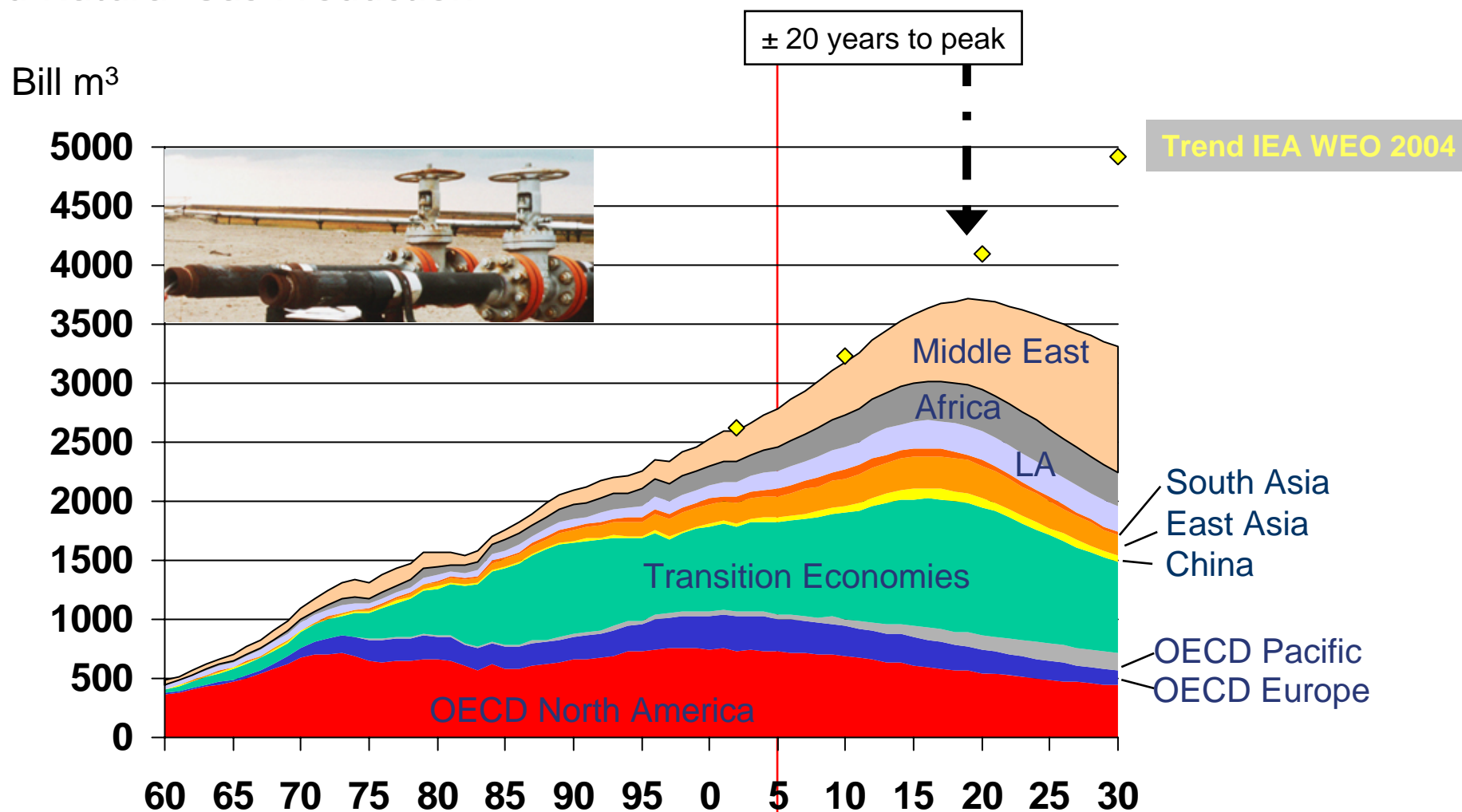


Source: IEA 2004

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

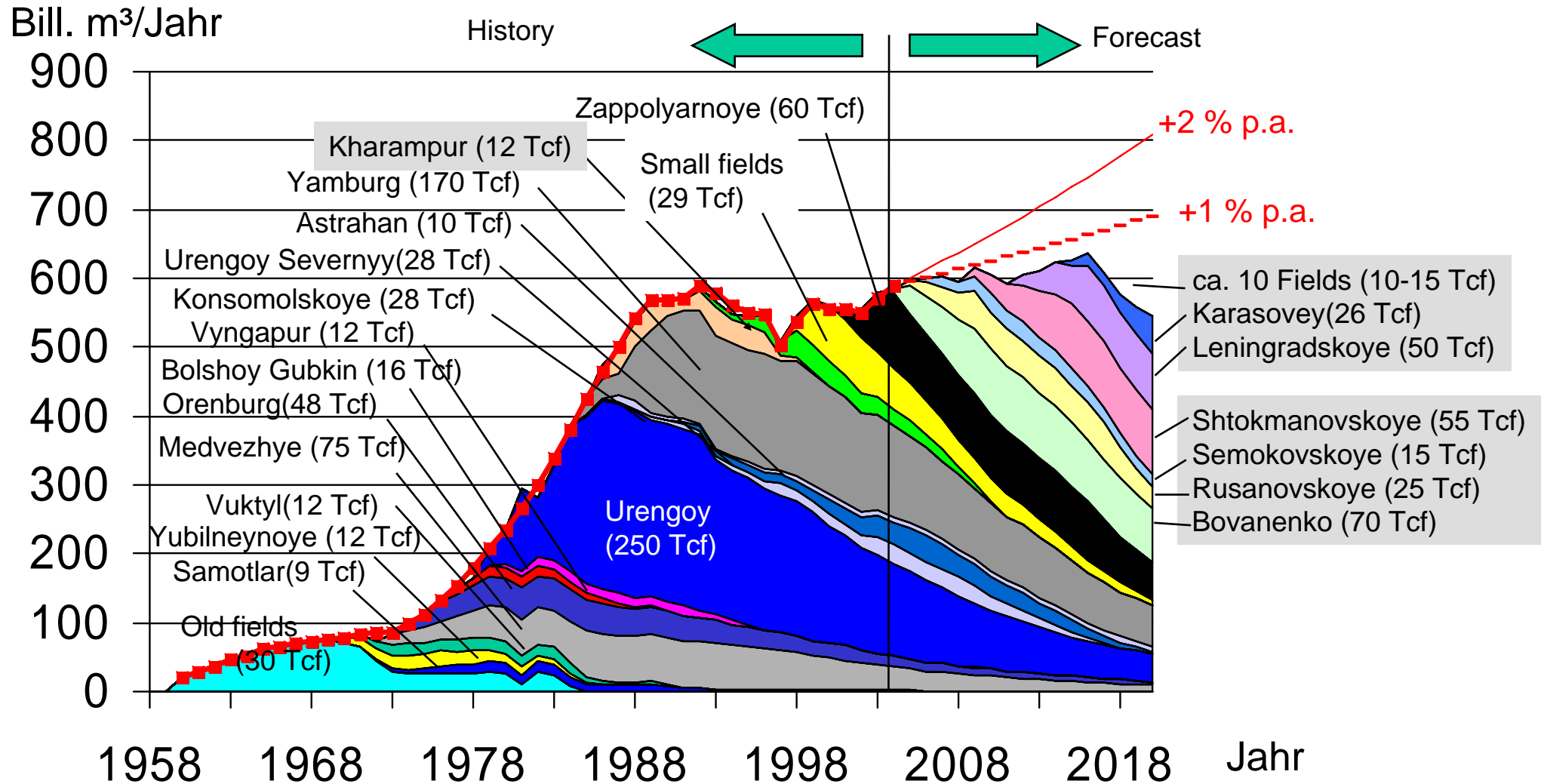
Supply Situation: Oil, Natural Gas, Coal, Nuclear and Renewables (2)

World Natural Gas Production



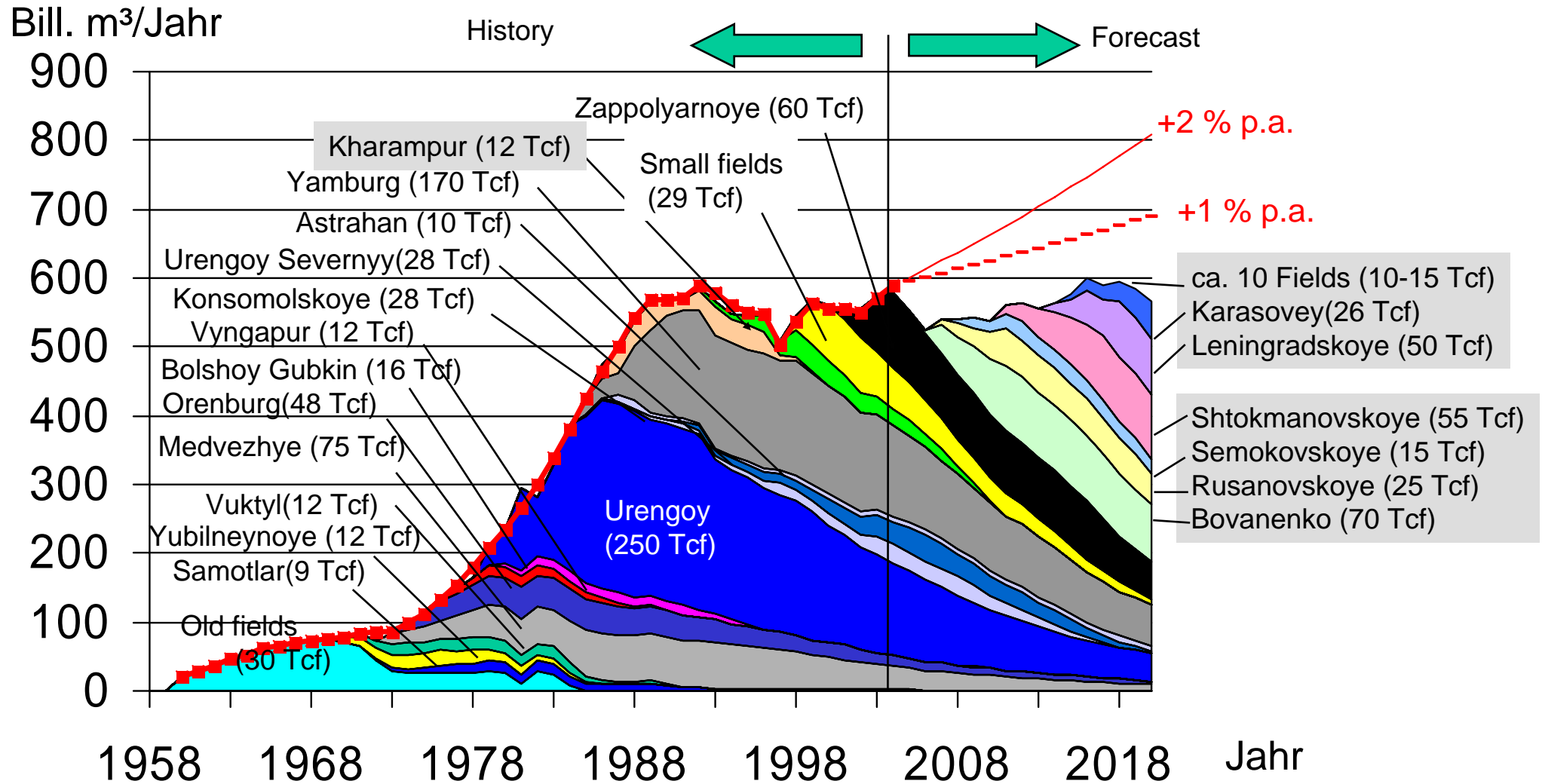
Source: Data - IHS Energy, BP 2005
Forecast - LBST 2005 (based on ASPO scenario)

Single Field Analysis of Russian Natural Gas Production



Source: Laherrere, LBST

Single Field Analysis of Russian Natural Gas Production

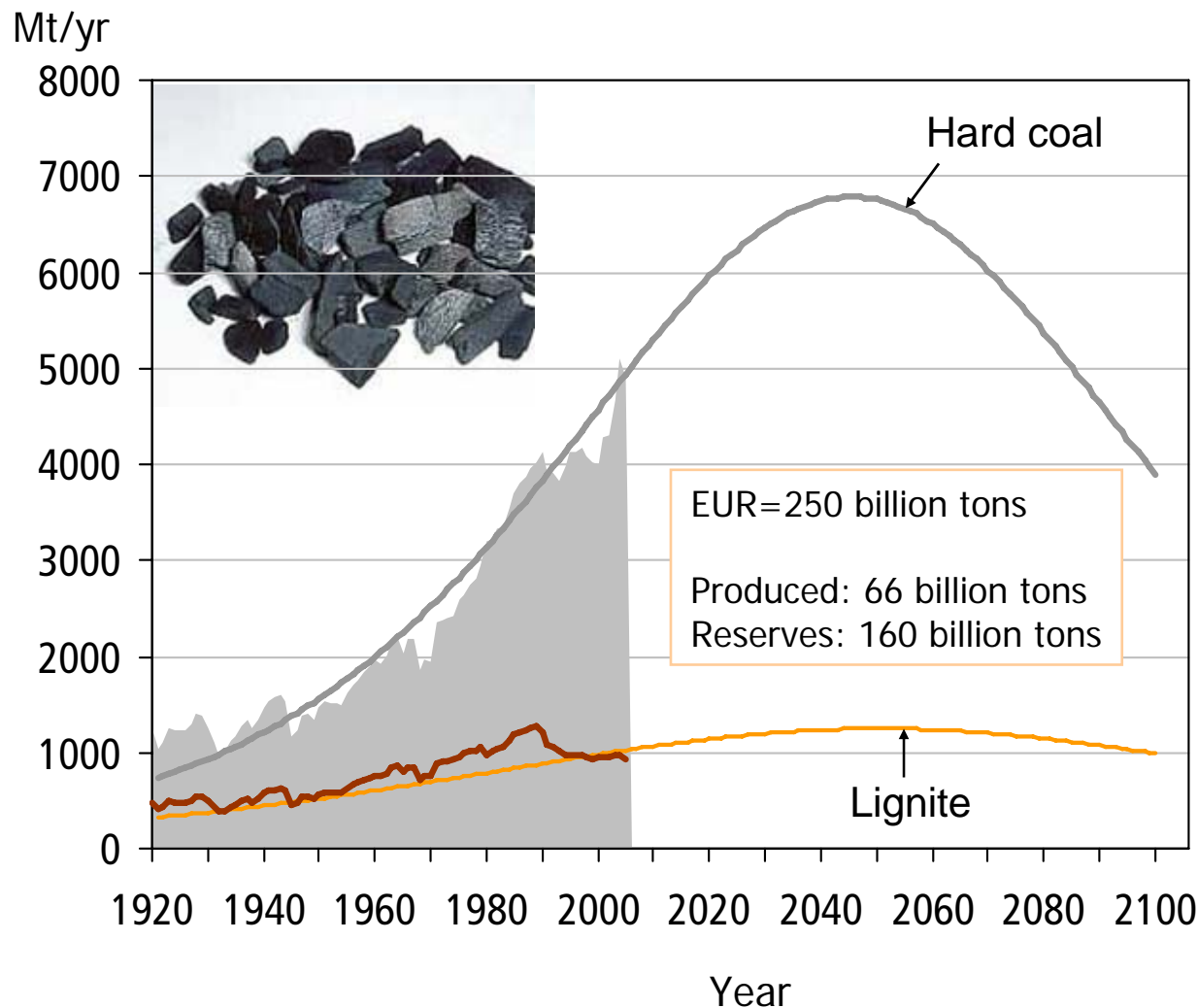


Source: Laherrere, LBST

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



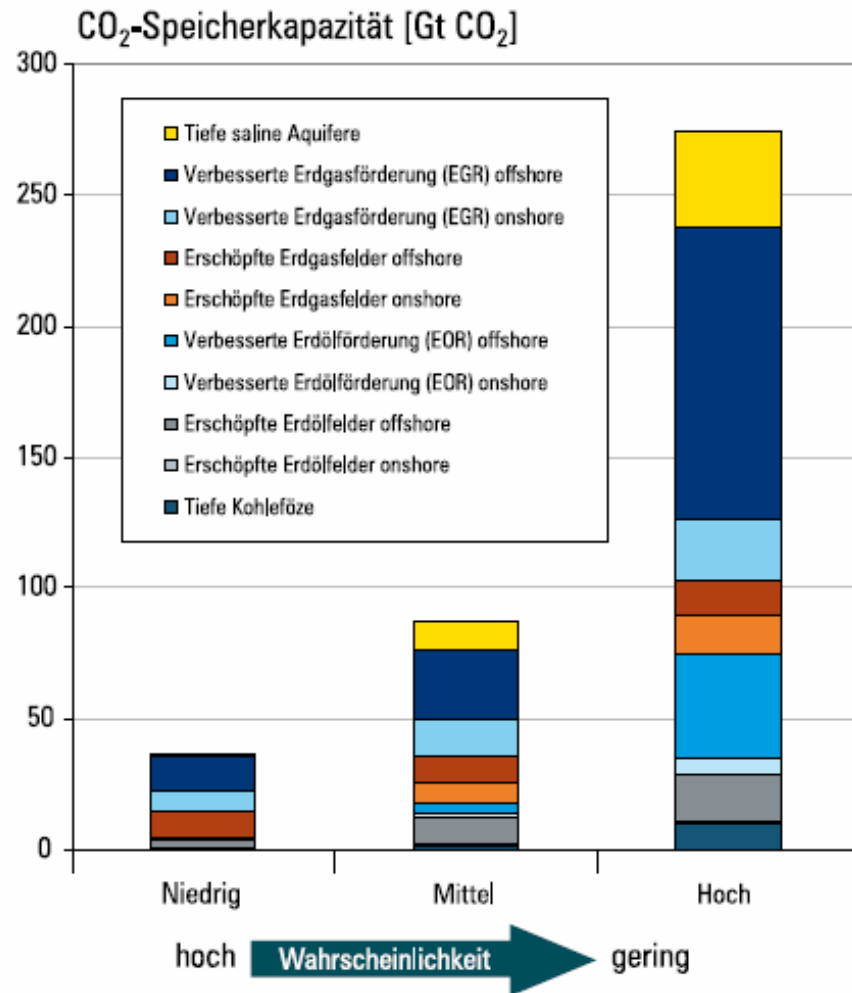
Hard coal
EUR=950 billion tons
Produced: 200 billion tons
Reserves: 750 billion tons
(bituminous 480 billion tons,
subbituminous 270 billion tons)

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)

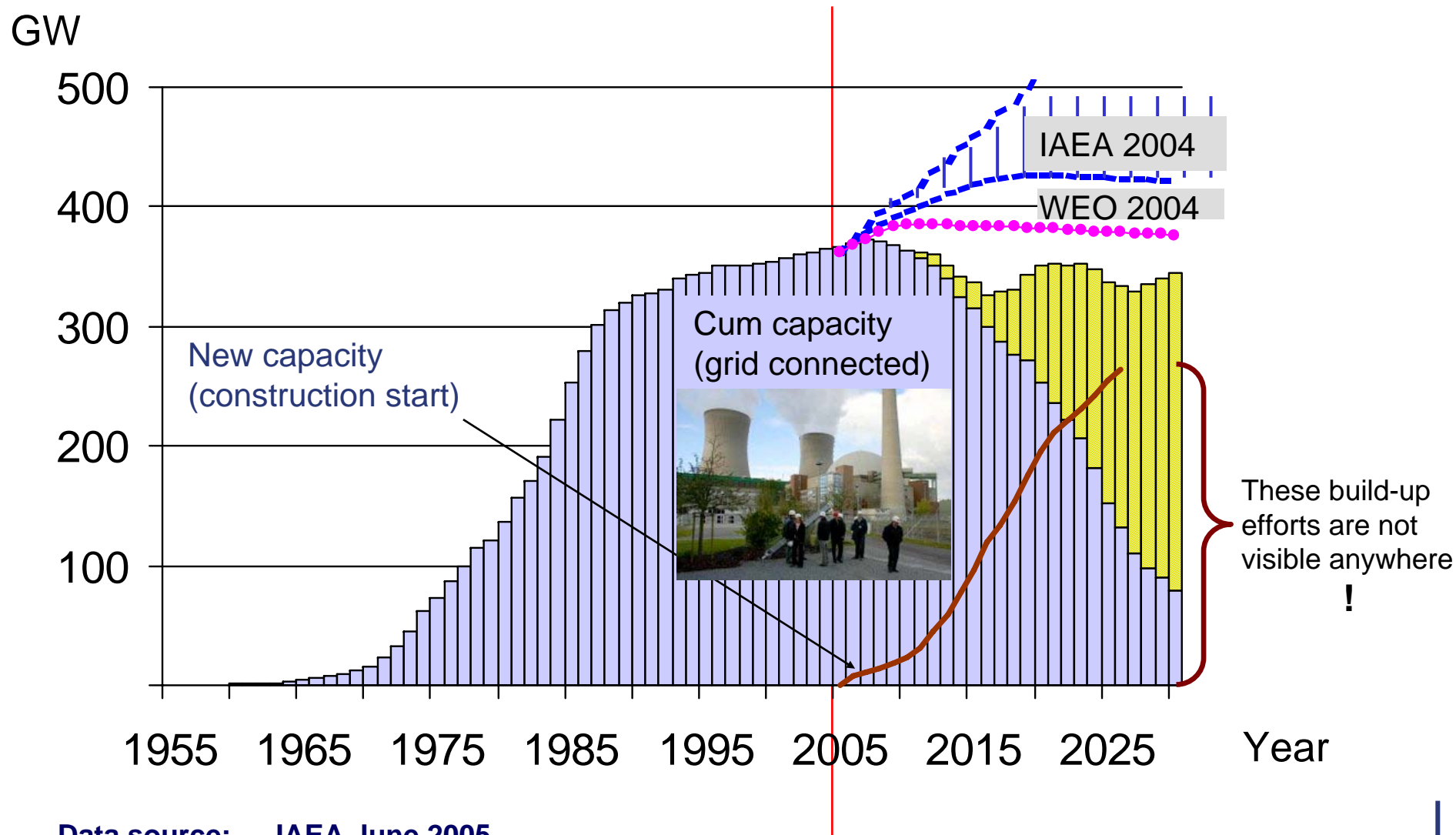
...ergibt eine theoretische Nutzungsdauer der Speicher:
8 – 62 Jahre bzw. 23 – 174 Jahre (nur Strom)

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

Für Emissionen und Speicher nur Deutschland:
6 – 22 Jahre

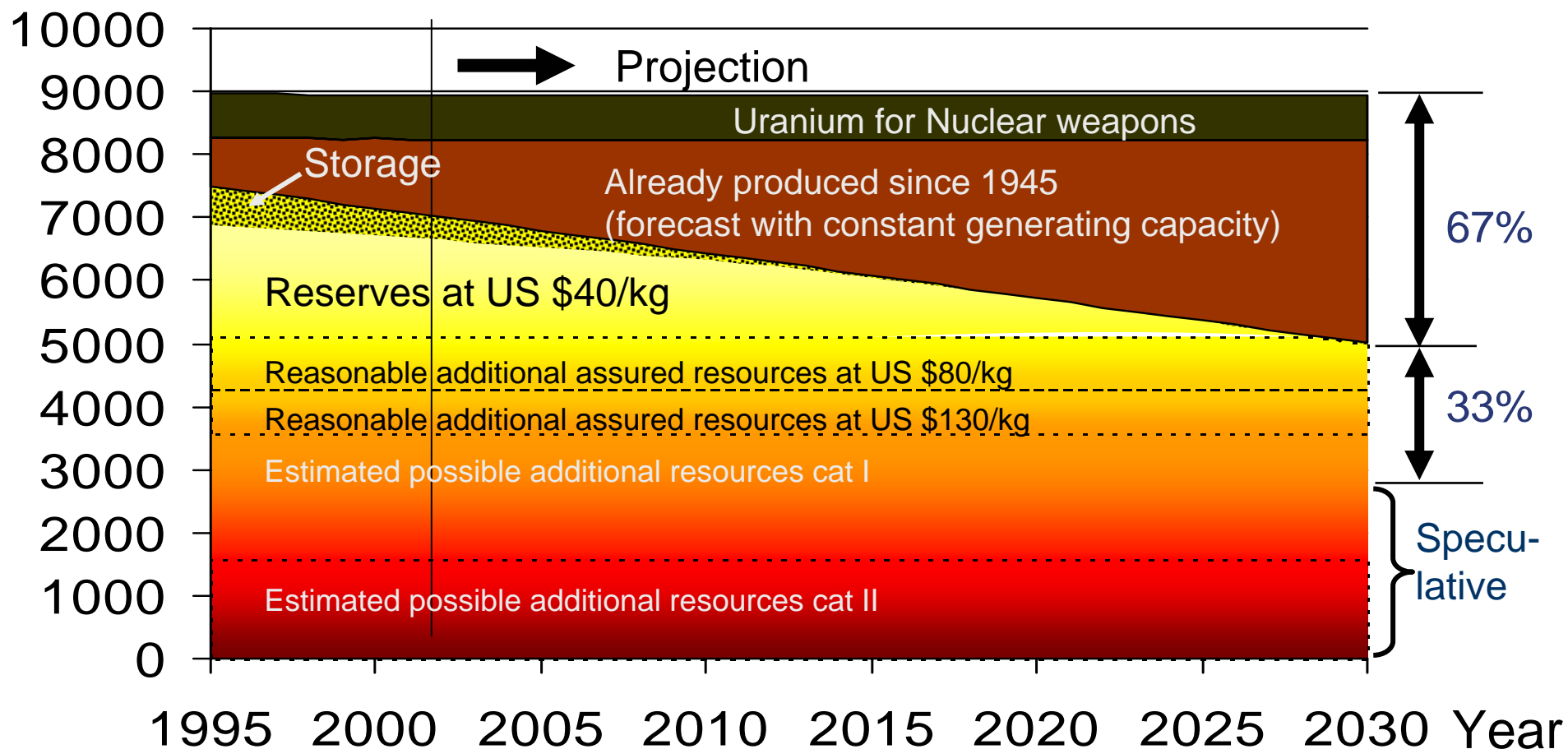
Data source: ECOFYS 2004

World Nuclear Power Plant Capacities



Data source: IAEA June 2005
Scenario: LBST 2005

1000 t Uranium

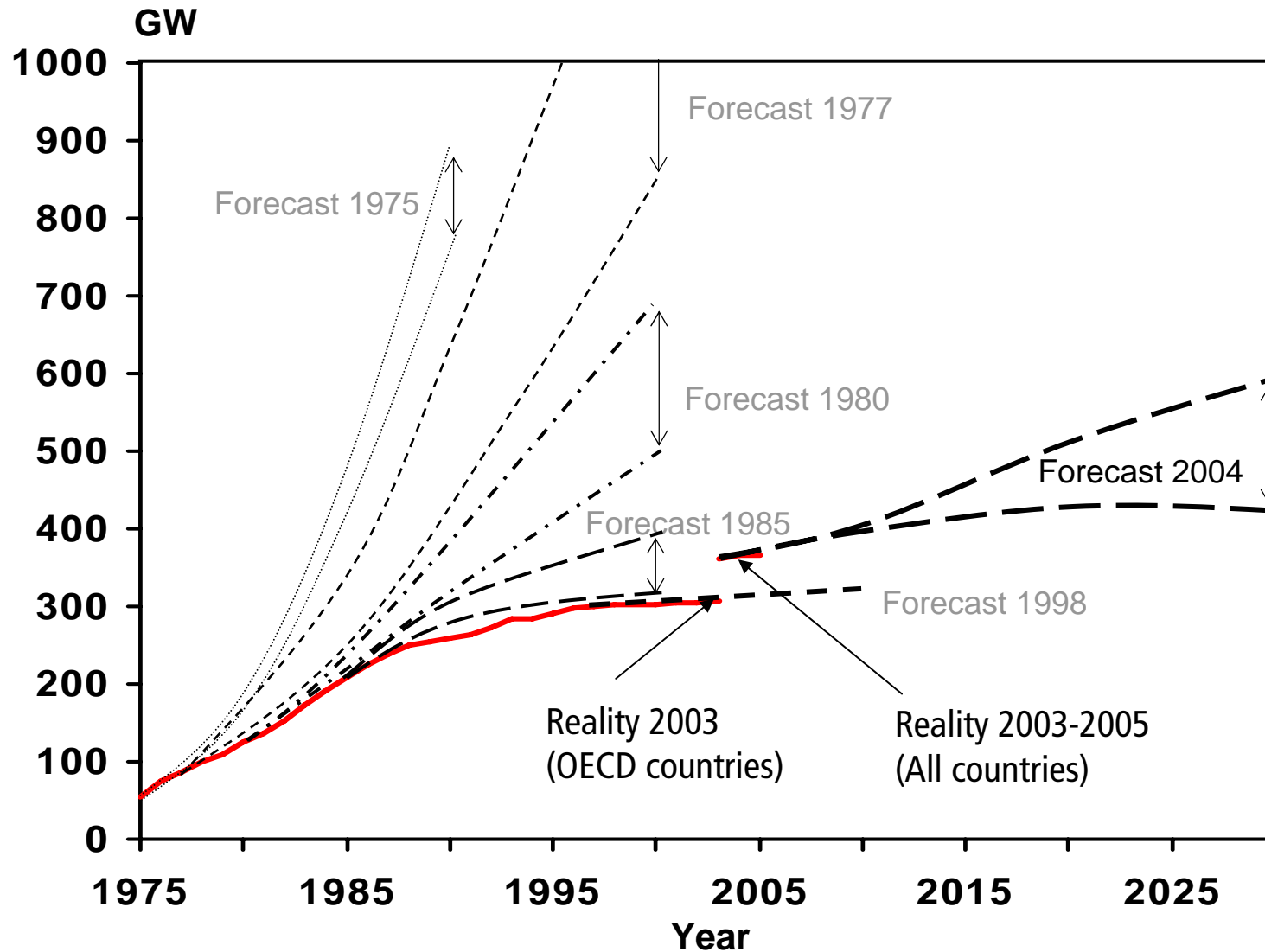


Data source: BGR 2003

For more detail see also:
http://www.lbst.de/publications/studies__e/2006EWG-uranium__e.html

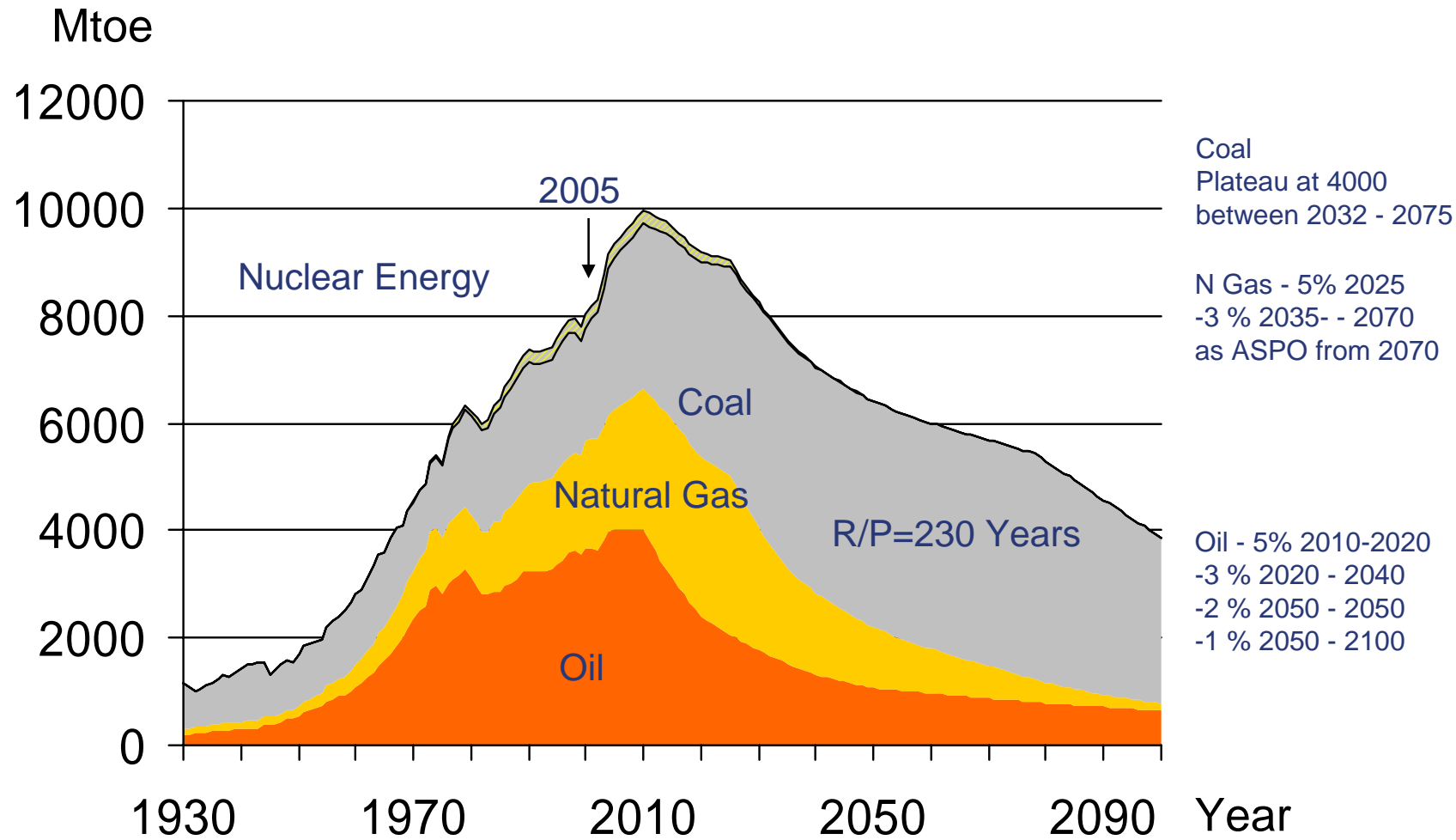
www.lbst.de

Forecasts 1975-2004 by IAEA on World Nuclear Power Capacities



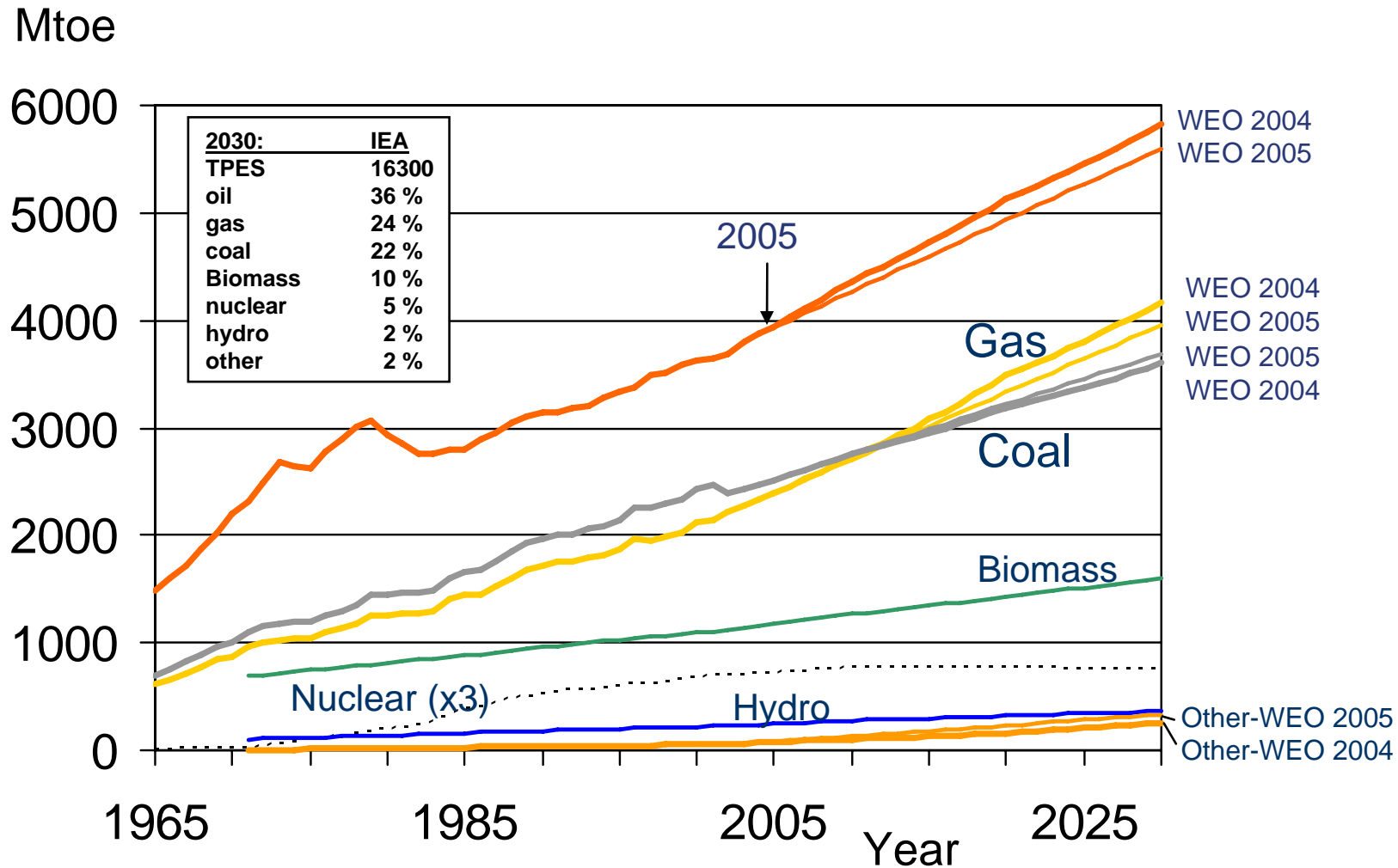
Data Source: IAEA
Graphics: LBST

Contribution of Fossil and Nuclear Energy Sources



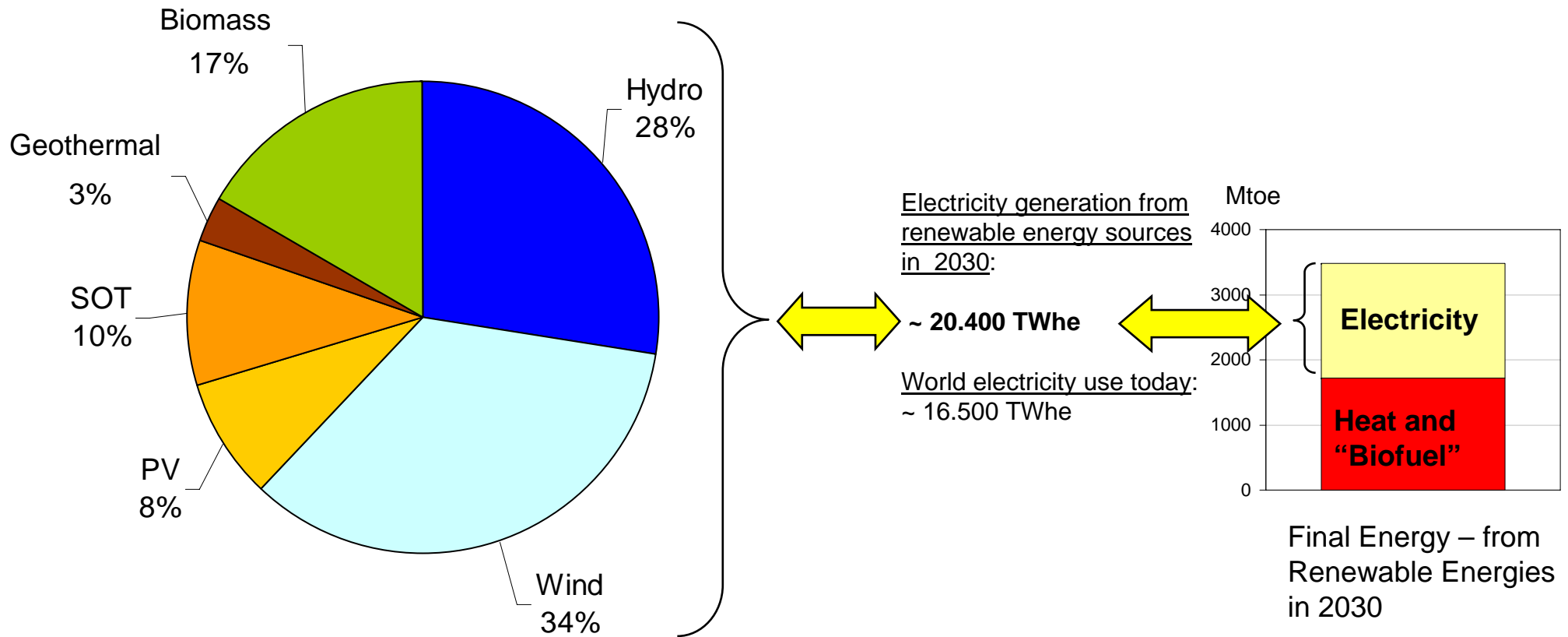
Data source: Oil, Gas, Coal-, Nuclear Scenario, LBST 2005

www.lbst.de



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

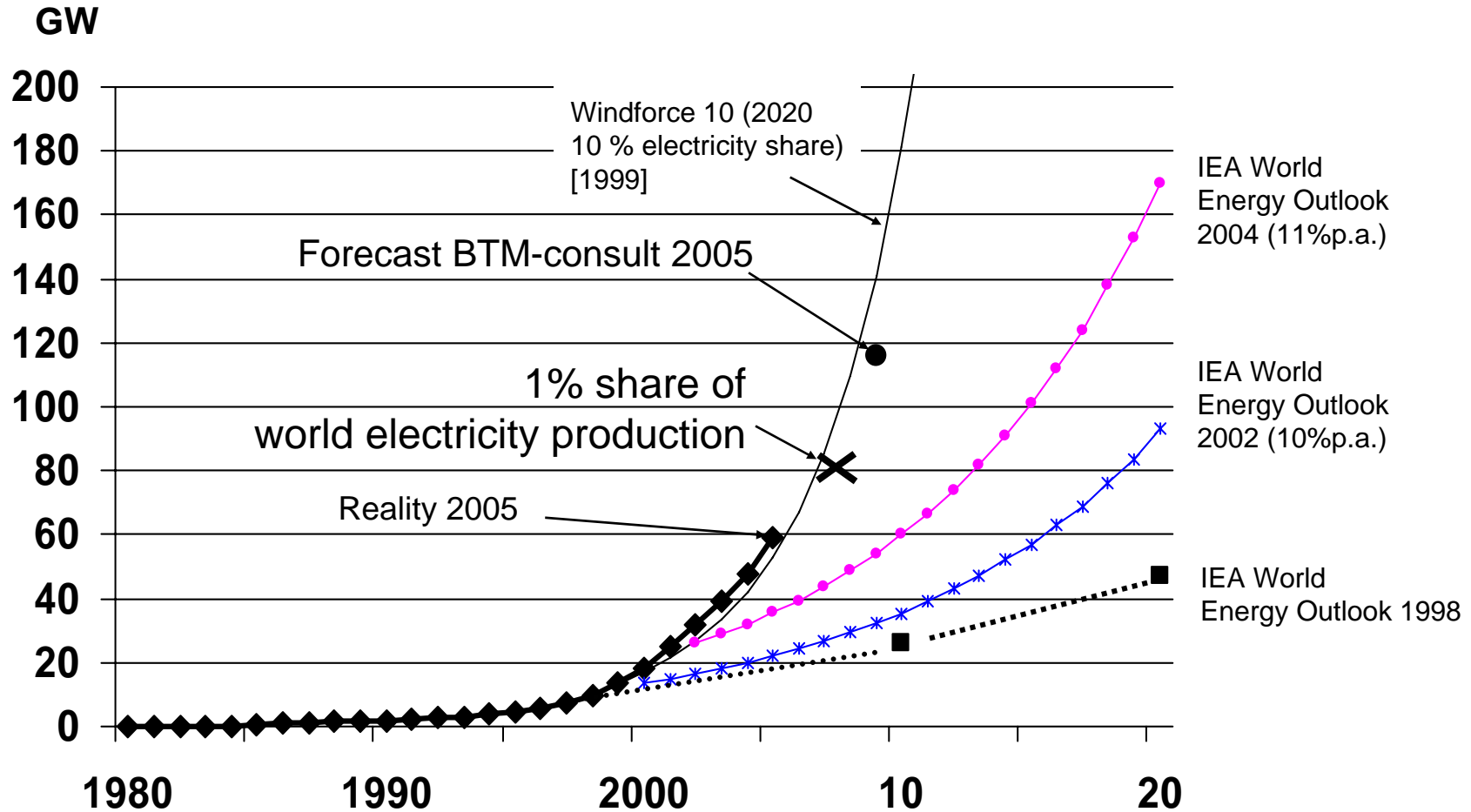
World electricity production from renewable energy sources in 2030



Mix "Renewable Energies" in 2030

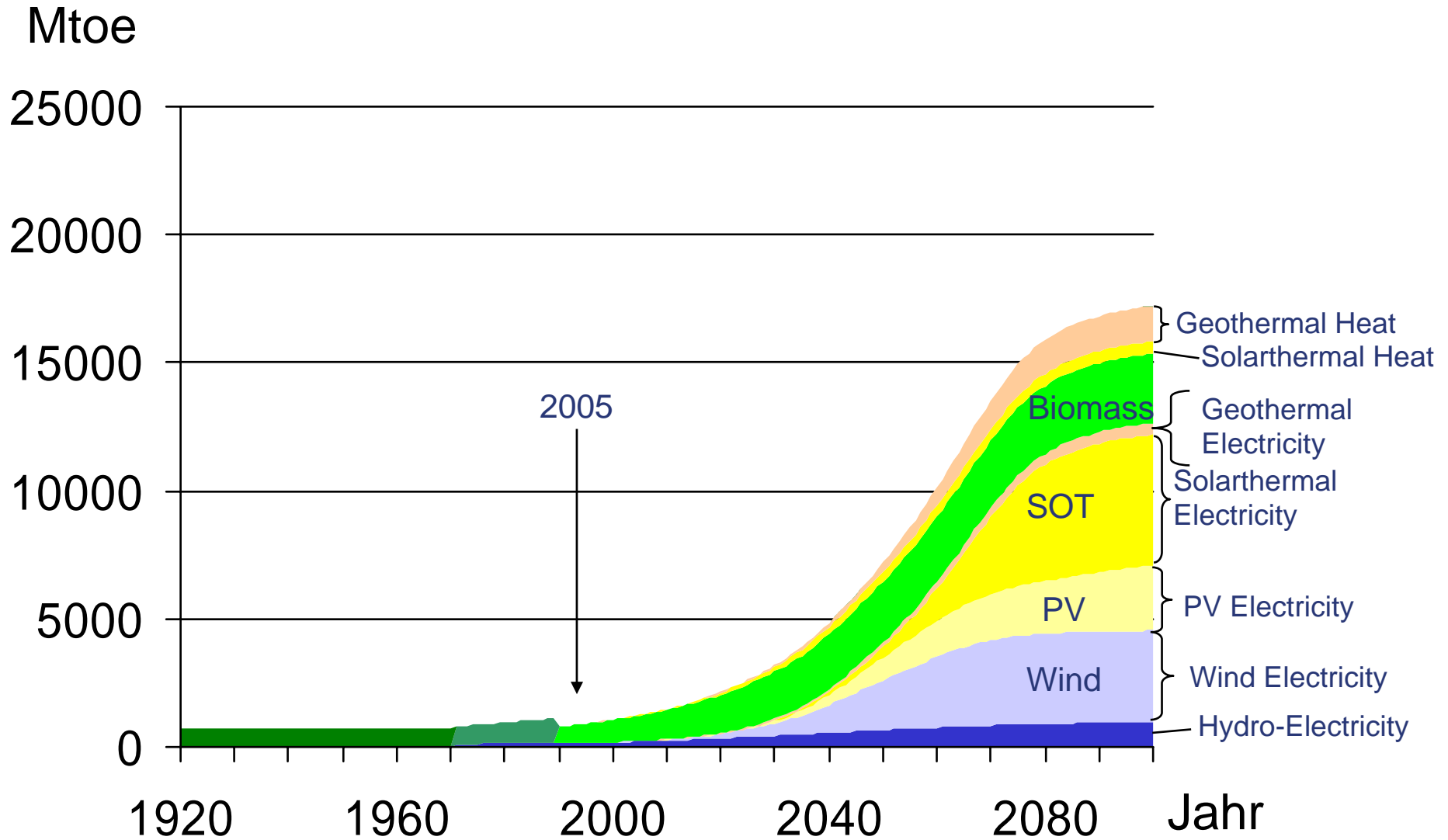
Source: LBST - "Alternative World Energy Outlook 2005"

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



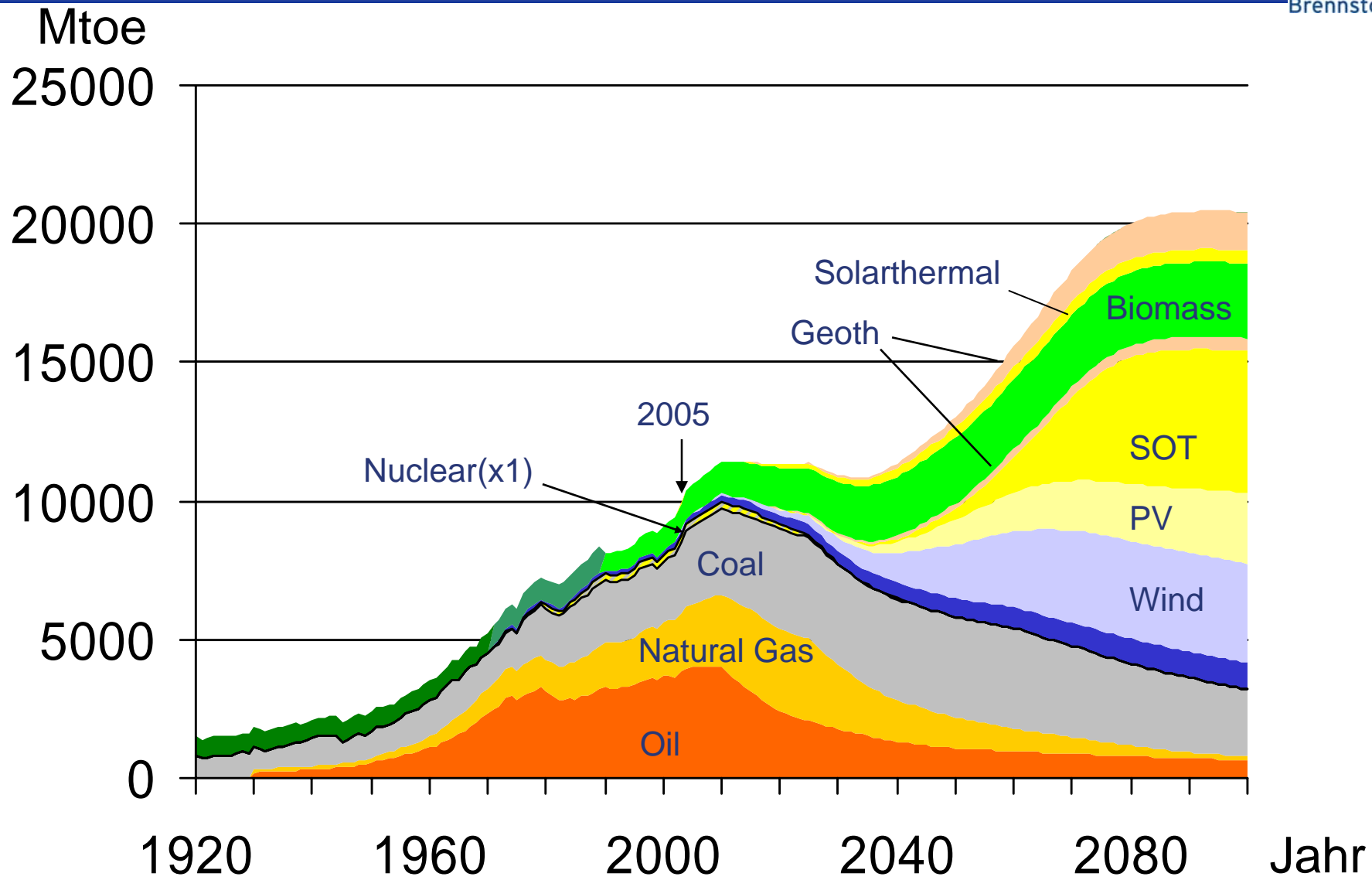
Data compilation and graphics: 4 July 2006, LBST

Contribution of Renewable Energy Sources and Use



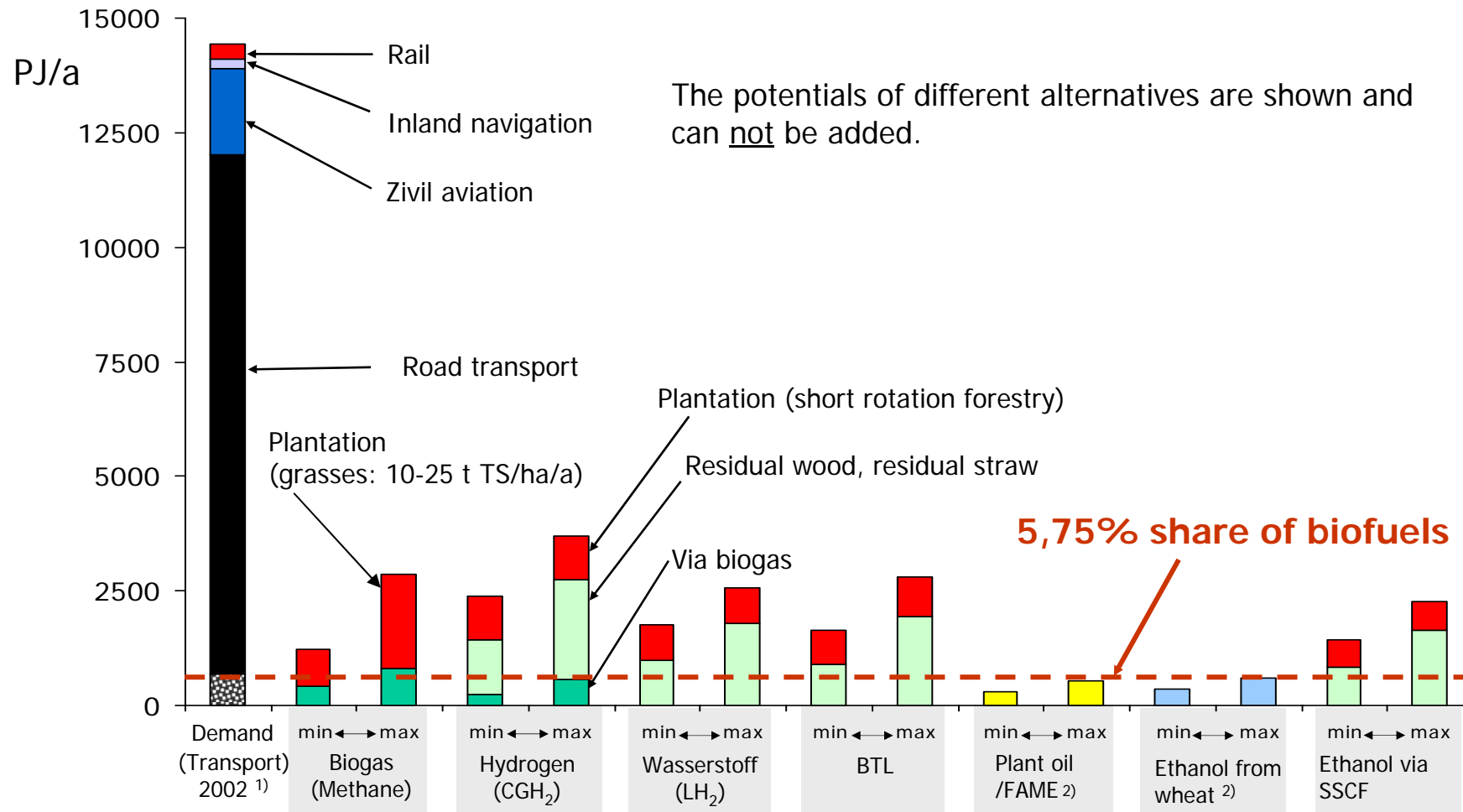
Source: LBST - "Alternative World Energy Outlook 2005"

A Possible World Energy Scenario



Source: LBST - "Alternative World Energy Outlook 2005"

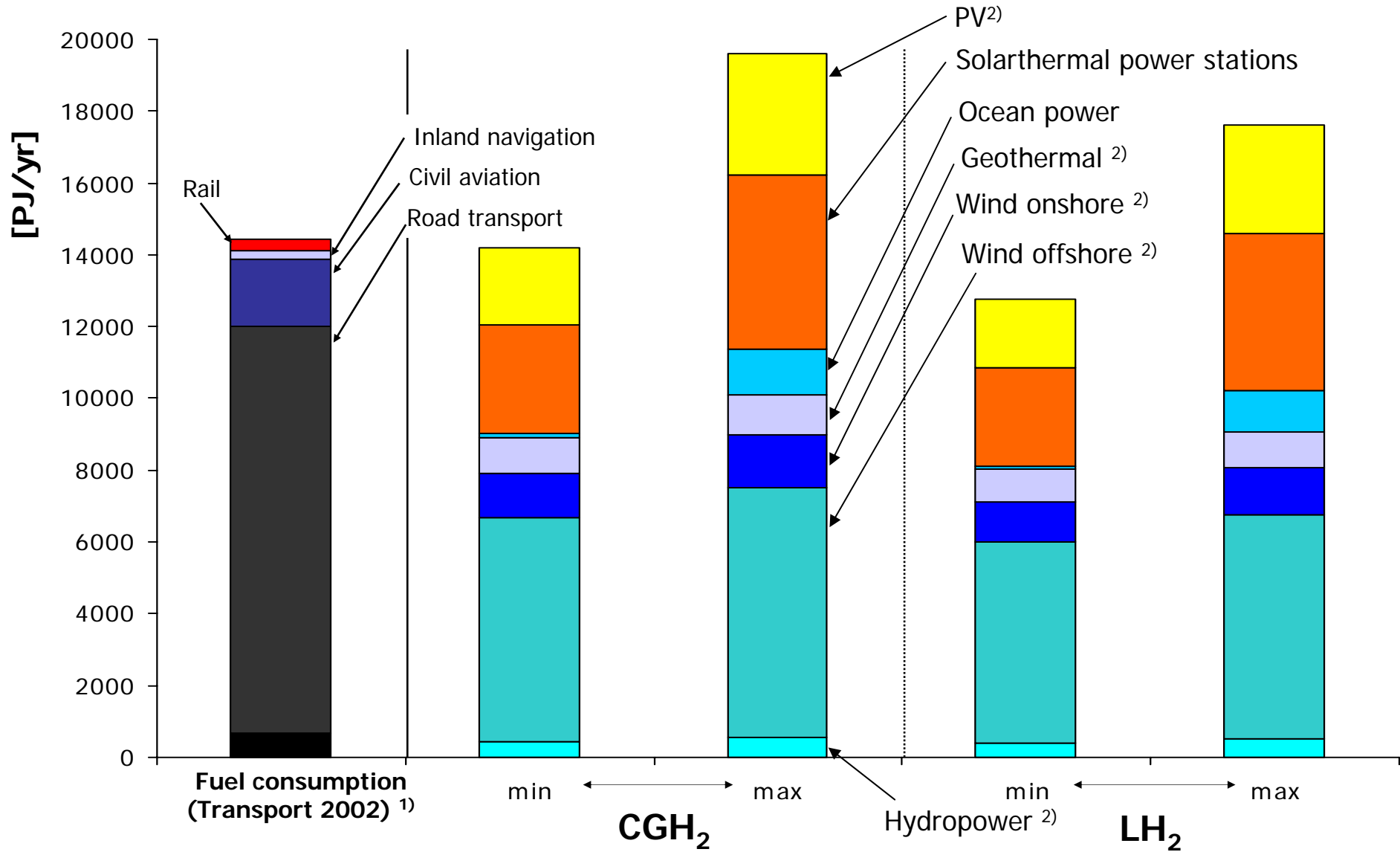
Technical potential of different biofuels in the EU-25



¹⁾ Source: IEA-Statistics 2001-2002

²⁾ 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

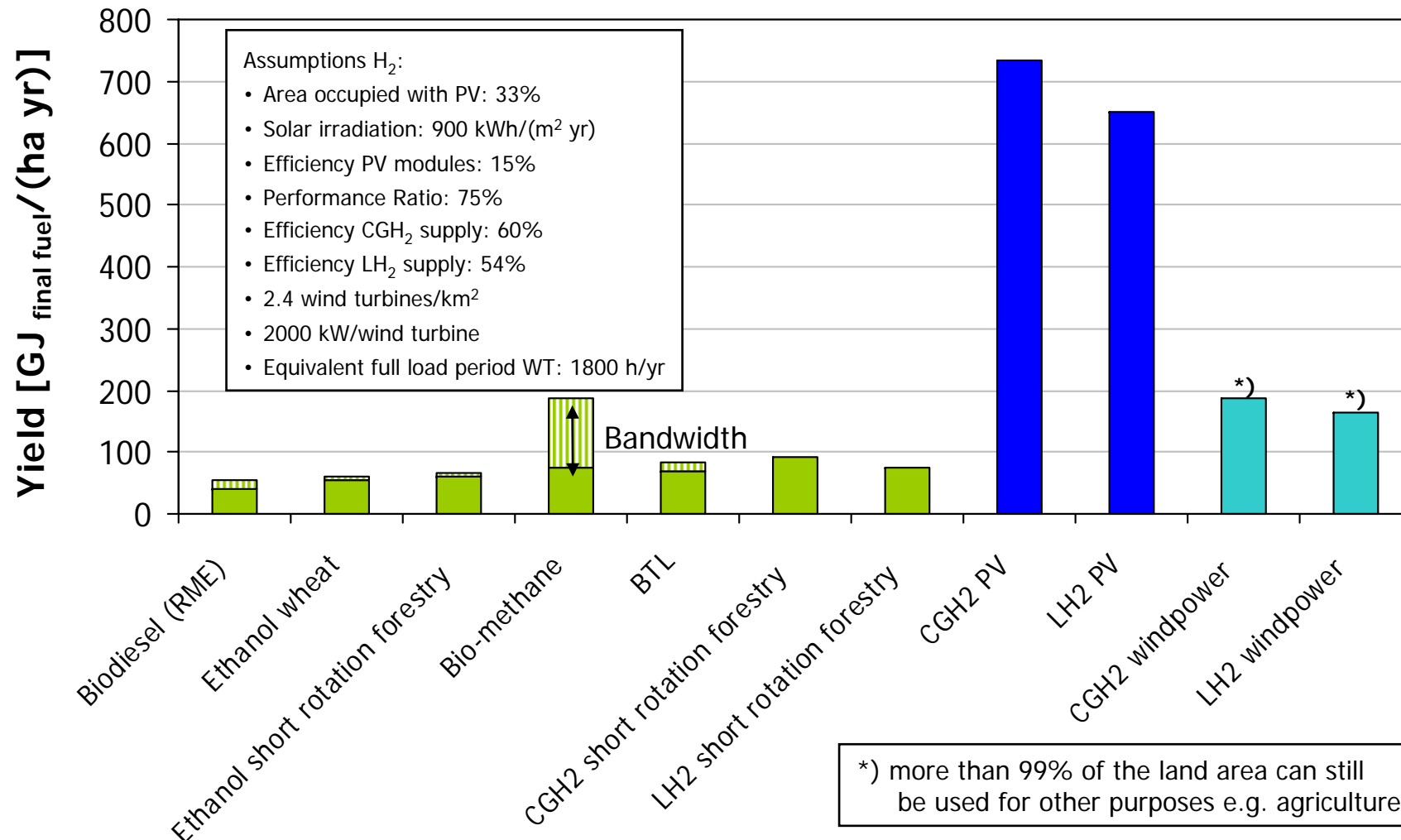


¹⁾ Source: IEA-Statistics 2001-2002

²⁾ still exploitable within the EU

Data compilation and graphics: **LBST**

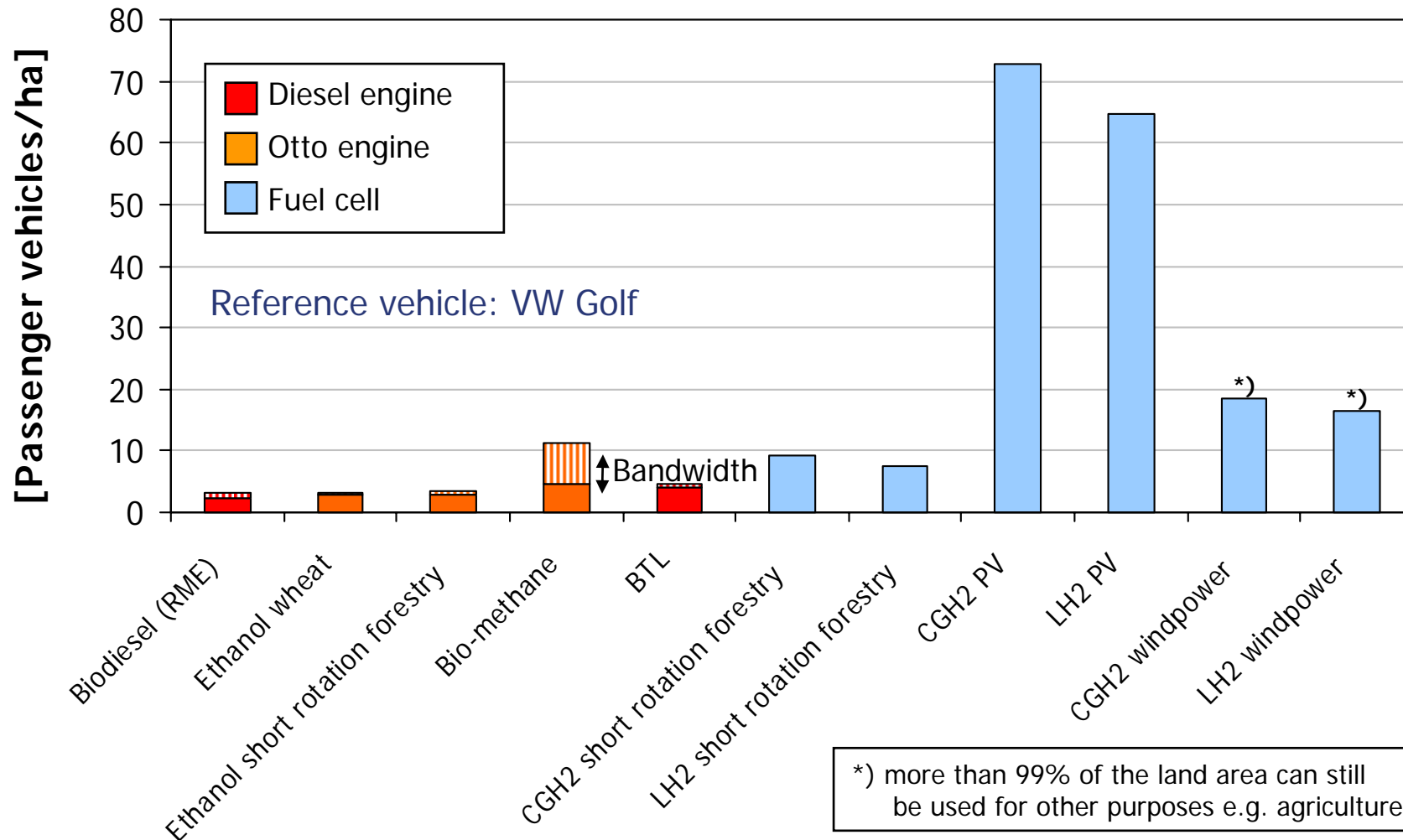
Yield of per ha and year for different transportation fuels



Source: LBST

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

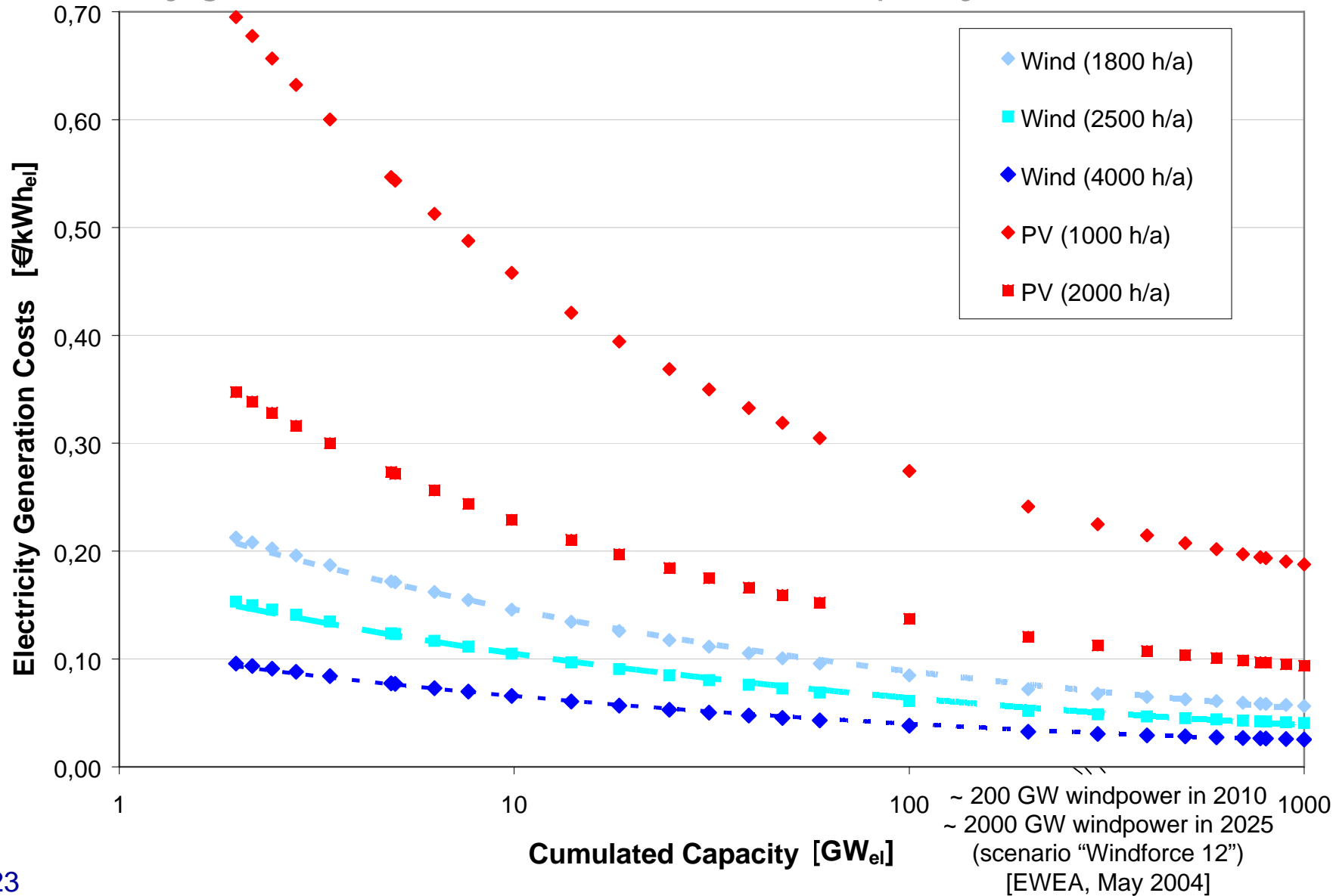
Annual mileage passenger vehicle: 12,000 km



Source: LBST

Cost reduction of renewables

Electricity generation costs versus installation capacity

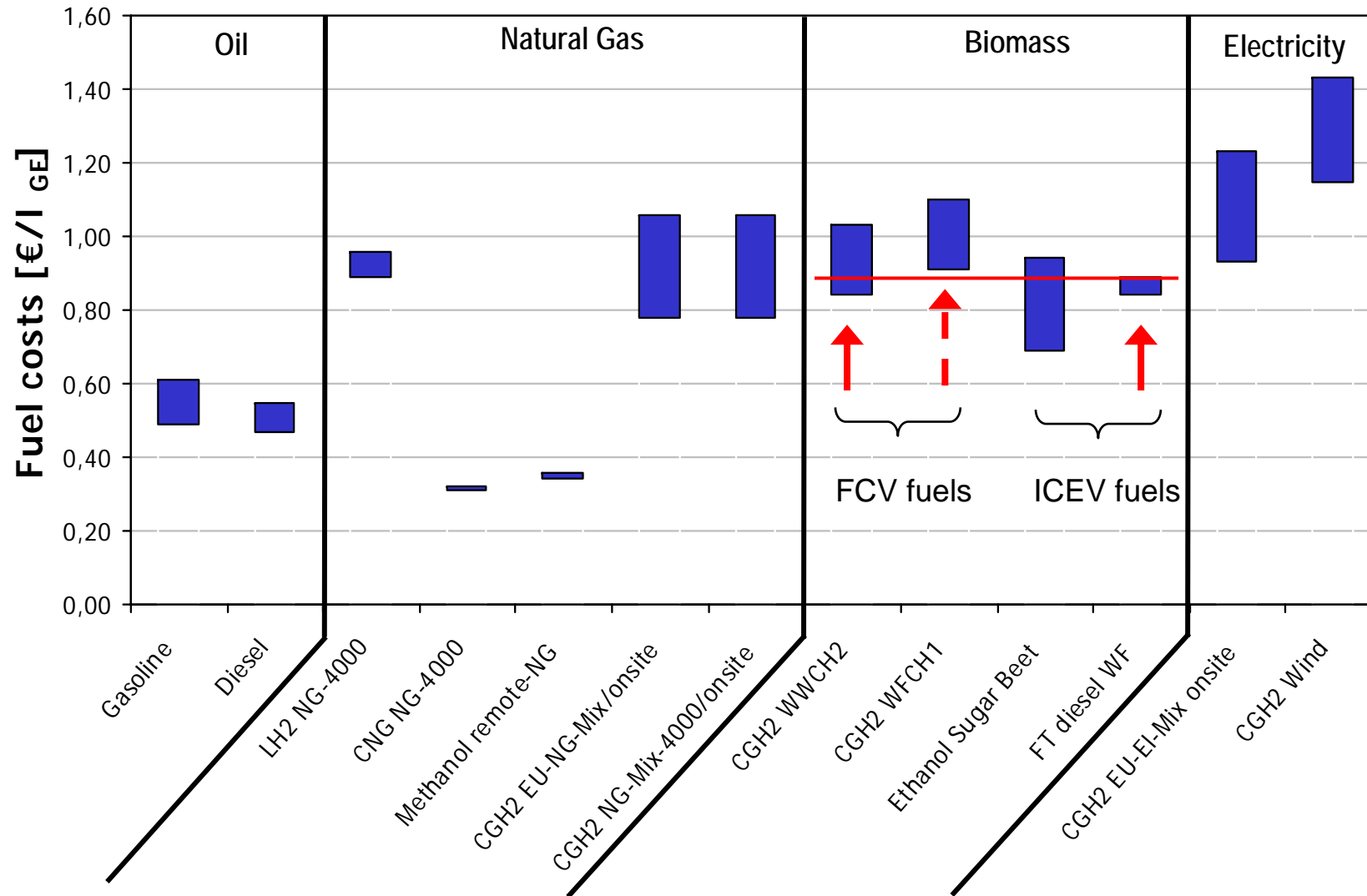


Data
compilation
and
graphics:

LBST

www.lbst.de

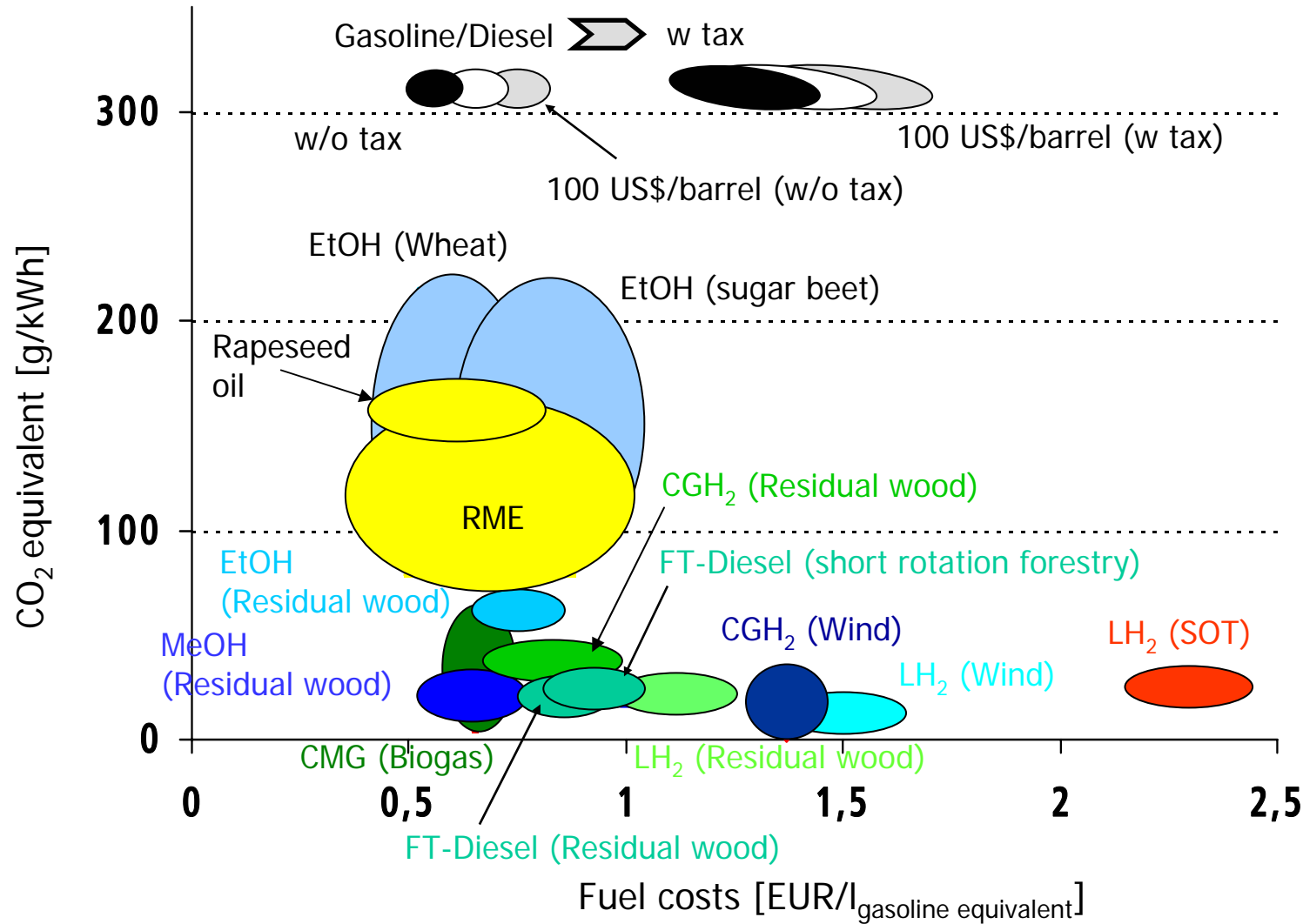
Fuel costs "Well-to-Tank"



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

Source: LBST

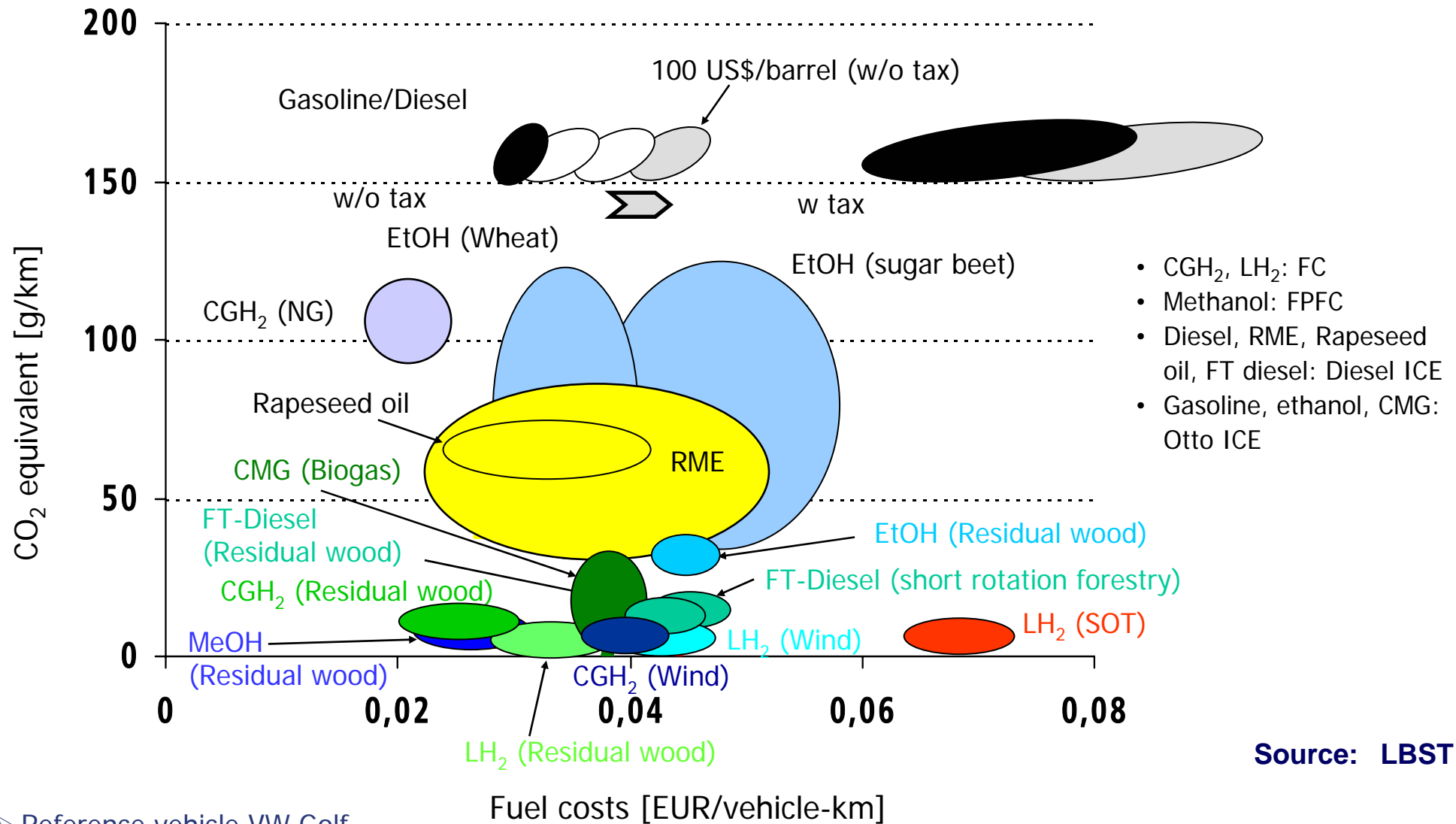
Fuel costs versus GHG emissions "Well-to-Tank"



CGH₂ from NG
(onsite SMR):
380 - 440 g/kWh
~ 0,80 EUR/l_{GE}

Source: LBST

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



Source: LBST

- Reference vehicle VW Golf
- Non-hybrid