Forecasts – can they be trusted?

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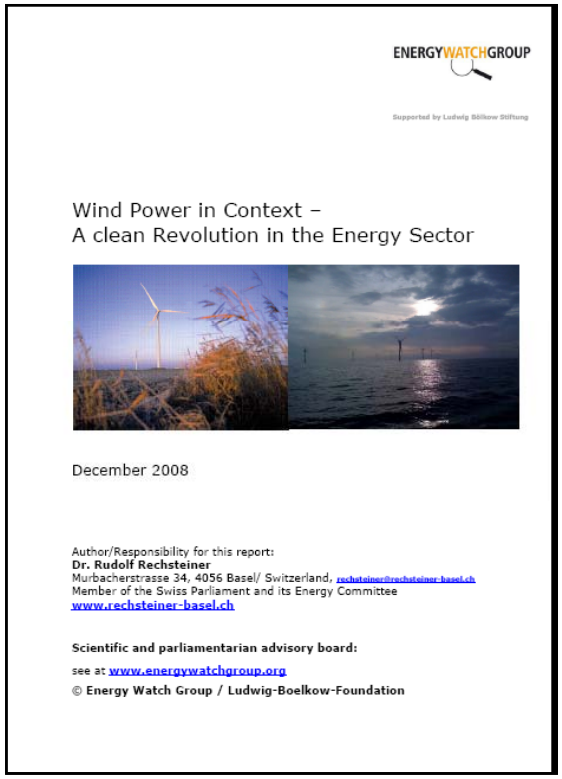
www.rechsteiner-basel.ch



ENERGYWATCHGROUP

Supported by Ludwig Böllkow Stiftung

Wind Power in Context –
A clean Revolution in the Energy Sector

December 2008

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Scientific and parliamentarian advisory board:

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DATA AND COMMENTS FROM:
WIND POWER IN CONTEXT -
A CLEAN REVOLUTION IN THE ENERGY SECTOR
A STUDY OF THE ENERGY WATCH GROUP
WRITTEN BY RUDOLF RECHSTEINER

Overview

1. The facts: Energy in turmoil

2. The forecasts:
   How IEA got it wrong

3. A personal outlook

Part 1

1. The facts: Energy in turmoil
2. The forecasts:

   How IEA got it wrong
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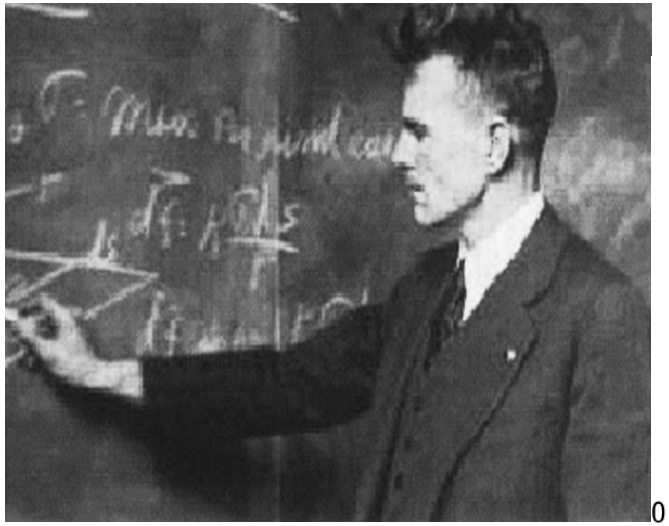
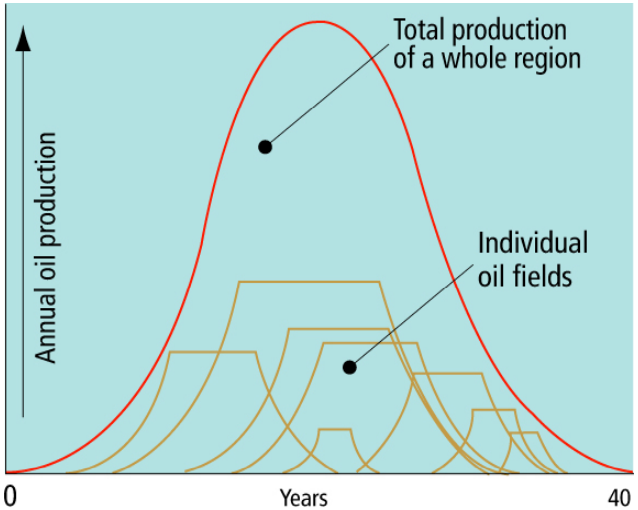
M. King Hubbert and Colin Campbell: „World Oil production will peak“ (2000?, 2010?)



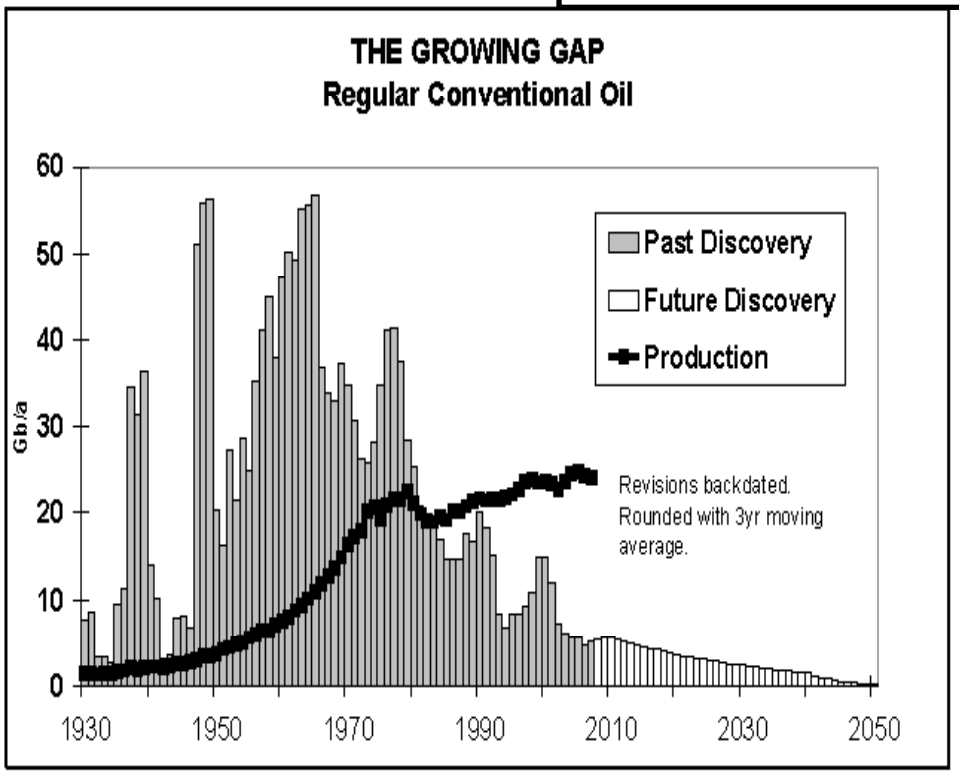


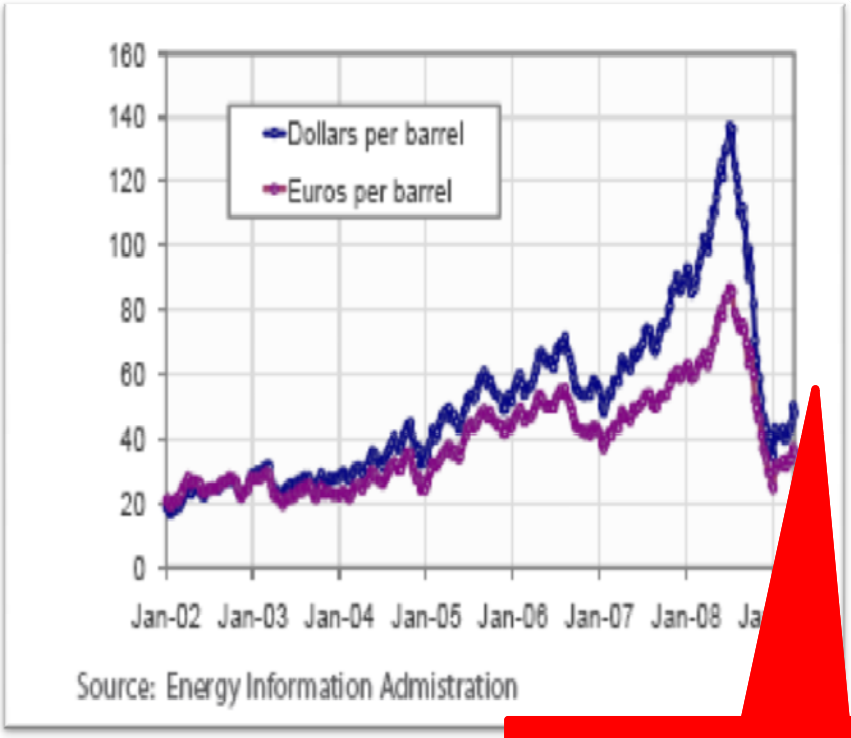
Hubbert-Curve: Oil peaks, after it starts declining.

Growing gap of oil discoveries and production: significant higher prices since 2000

Source: Aspo newsletter (Colin Campbell) and aspo Netherlands newsletter (R.Koppelaar)

Oil at 60 $ per barrel, May 12 2009

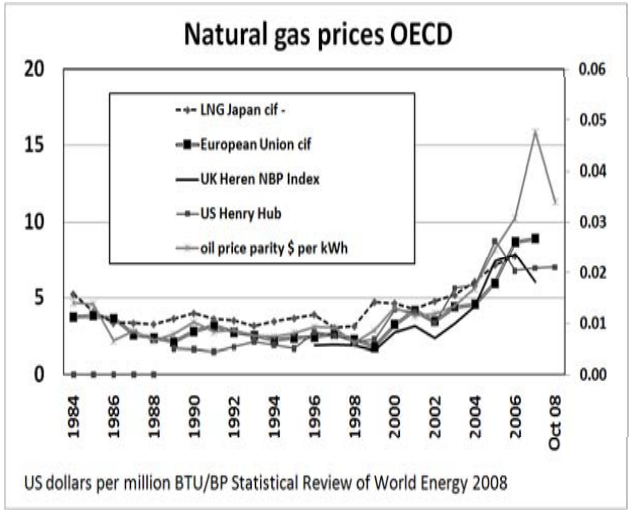


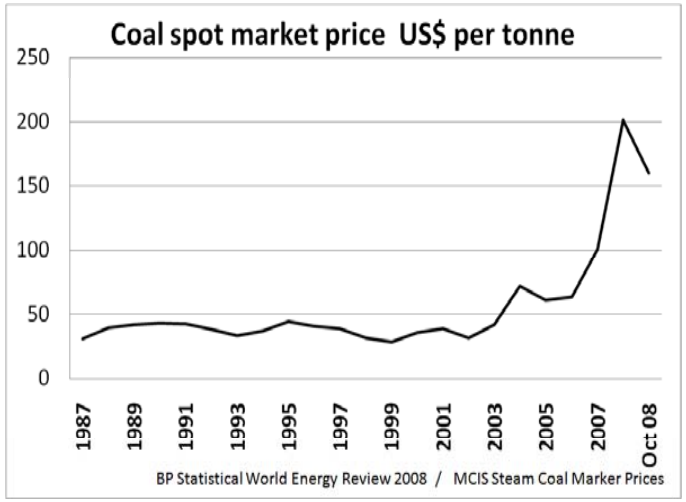


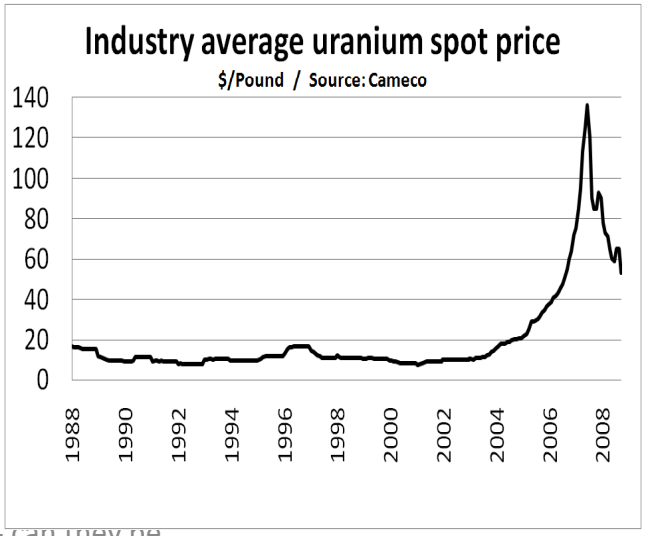
Oil at 60 $ per barrel, May 12 2009

Oil at 60$ means: price three times higher than in the 1990ies

Natural gas, coal, uranium prices on the rise + x-100% compared to 1990es



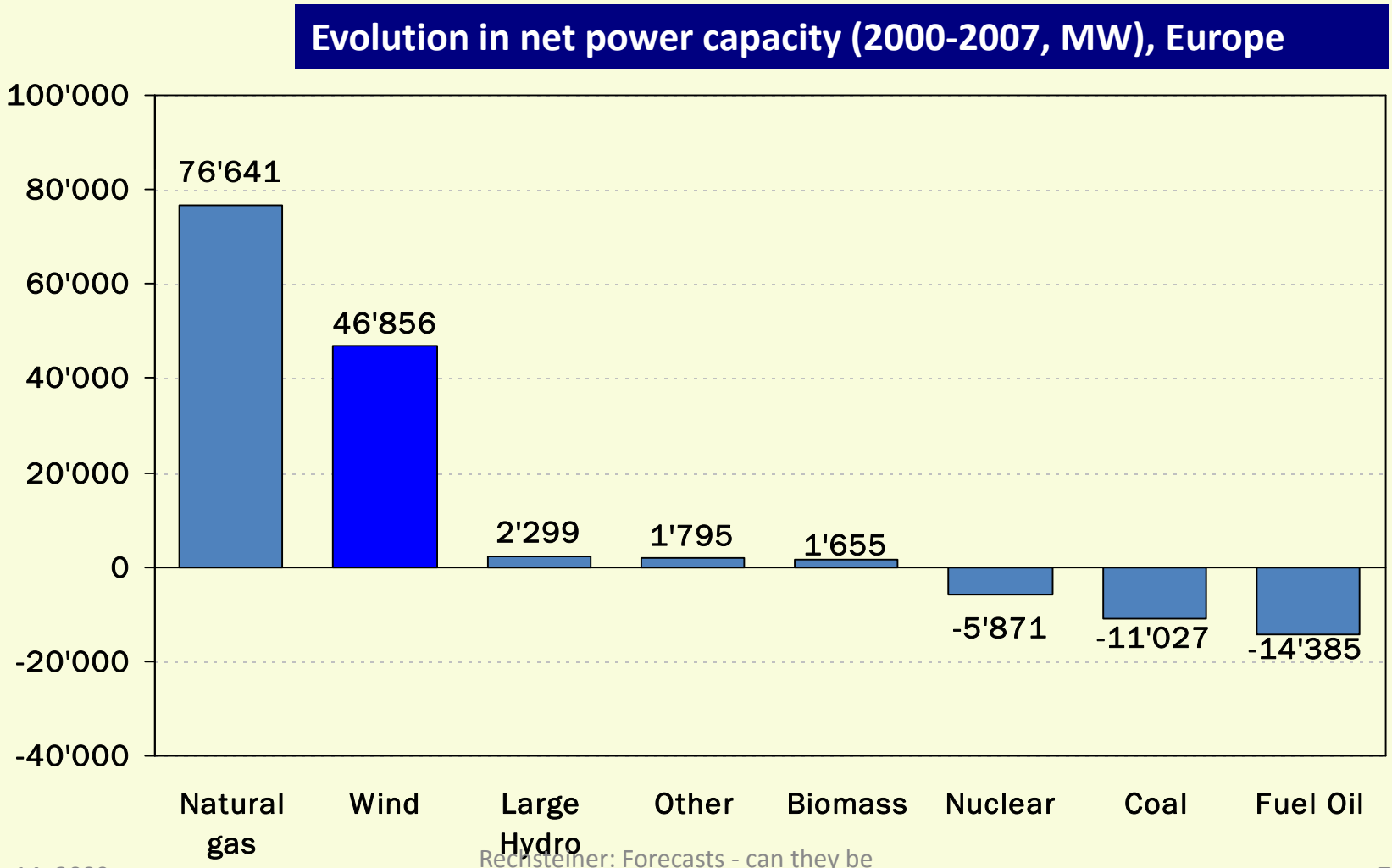




What happened in the power sector?

2000-2007: lots of natural gas plants, but:

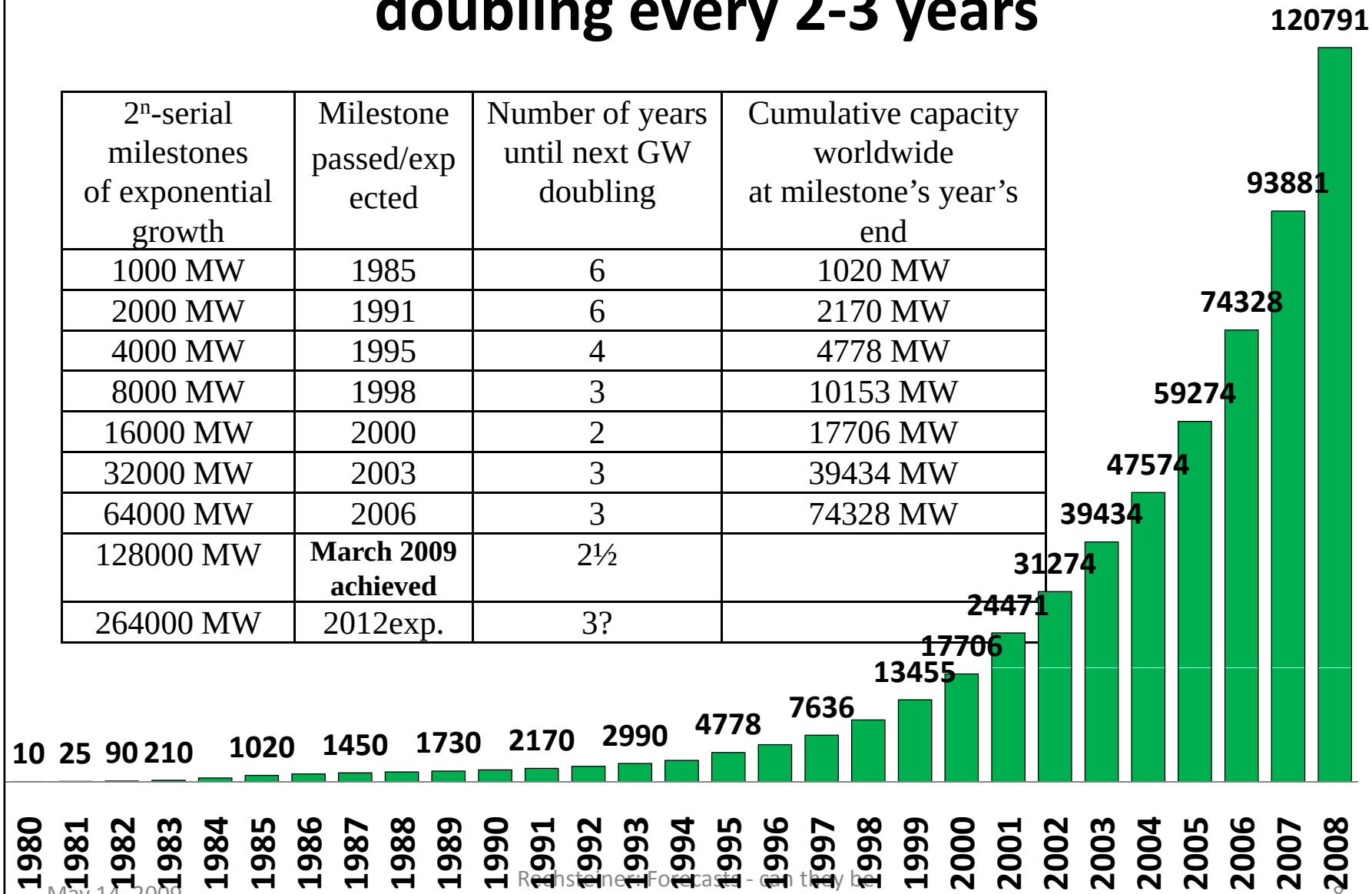
new renewables strong rising!



Source: EWEA Pure Power report, Platts PowerVision

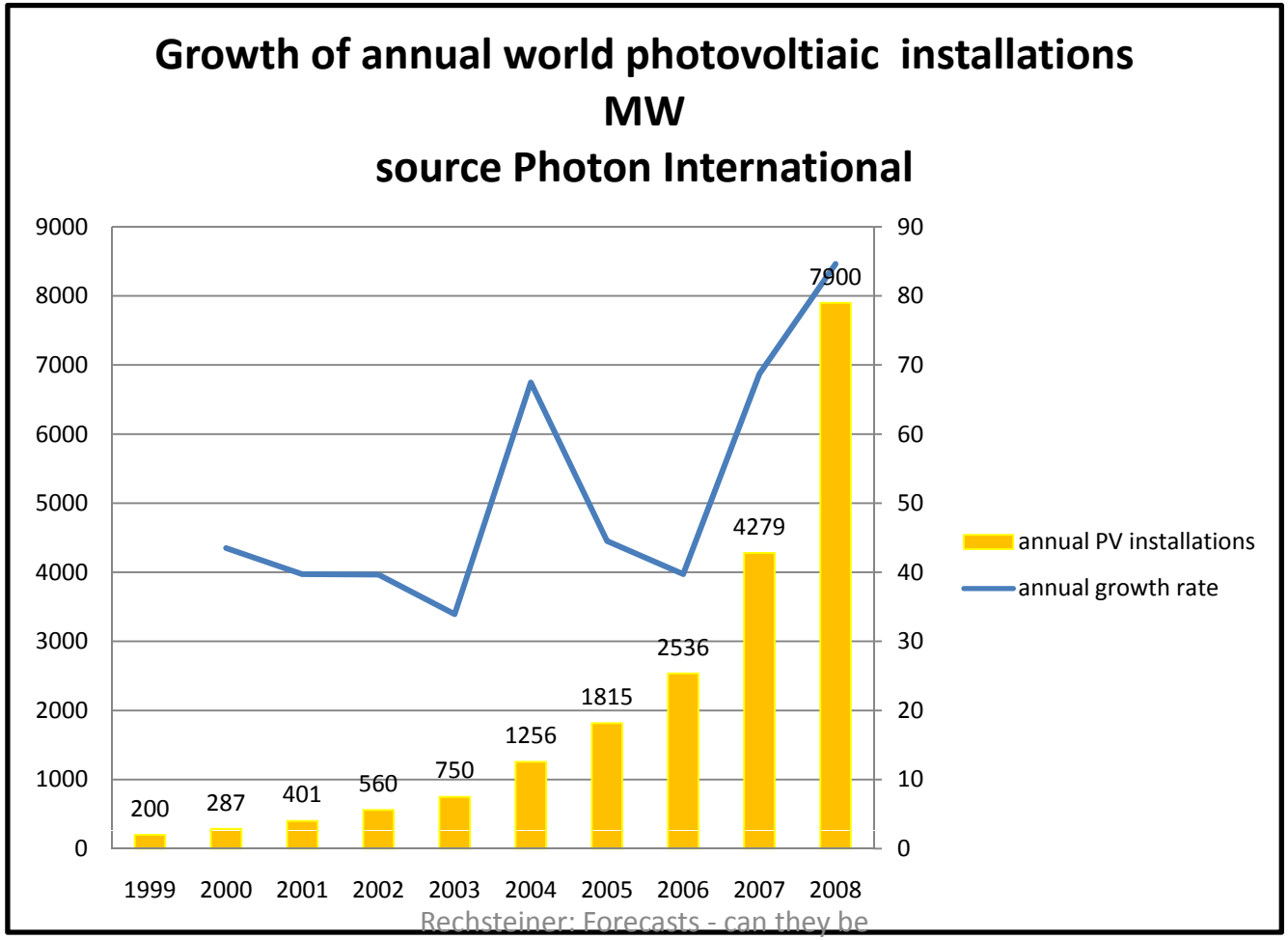
world wind capacity (MW) doubling every 2-3 years

2^n-serial milestones of exponential growth	Milestone passed/expected	Number of years until next GW doubling	Cumulative capacity worldwide at milestone's year's end
1000 MW	1985	6	1020 MW
2000 MW	1991	6	2170 MW
4000 MW	1995	4	4778 MW
8000 MW	1998	3	10153 MW
16000 MW	2000	2	17706 MW
32000 MW	2003	3	39434 MW
64000 MW	2006	3	74328 MW
128000 MW	**March 2009 achieved**	2½	
264000 MW	2012exp.	3?	

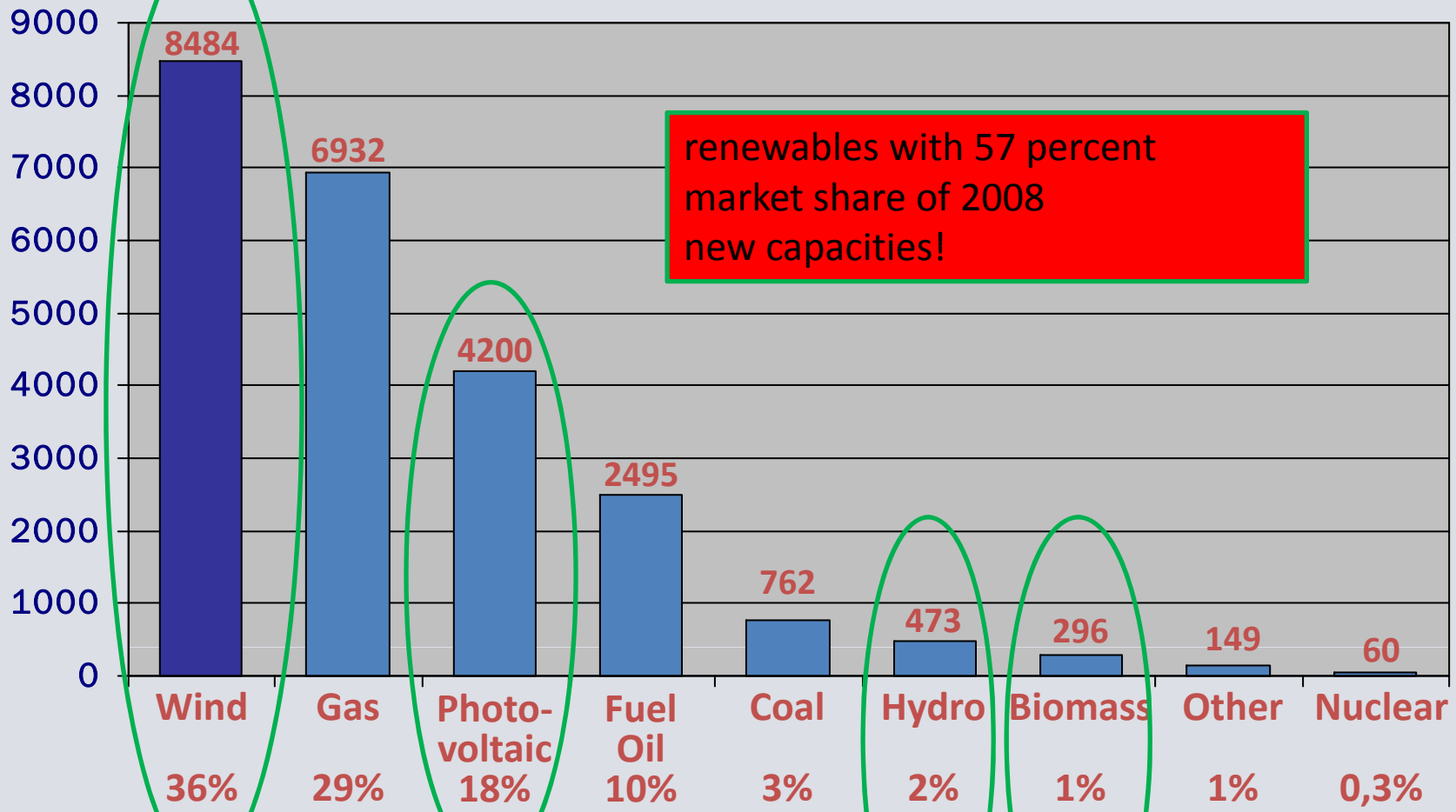


Photovoltaics market grows fourty fold since 1999

8 GW new installations in 2008



Wind number 1 in 2008, solar number 3 in Europe! (Total 23,851 MW)



renewables with 57 percent market share of 2008 new capacities!

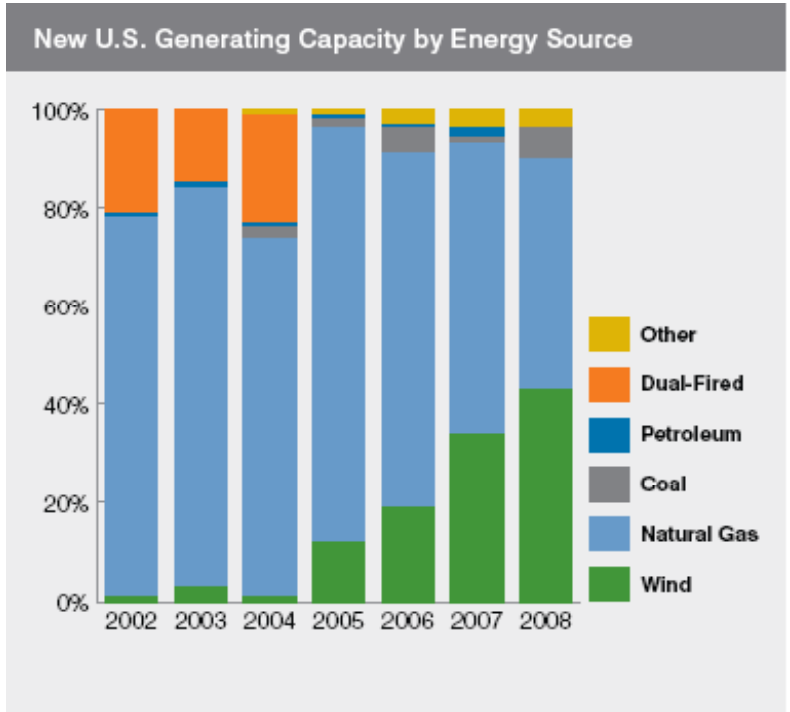
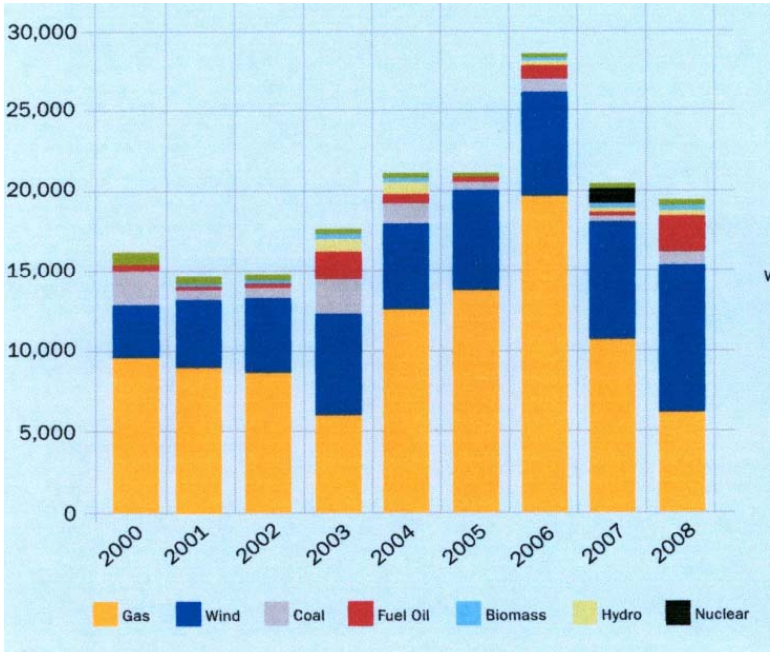
Note: Preliminary figures for solar photovoltaic installations

Source: EWEA, EPIA and Platts PowerVision

Continuous growth not in Europe only: US wind market share 42% in 2008

Wind power 42 percent of new US power plant capacity in 2008

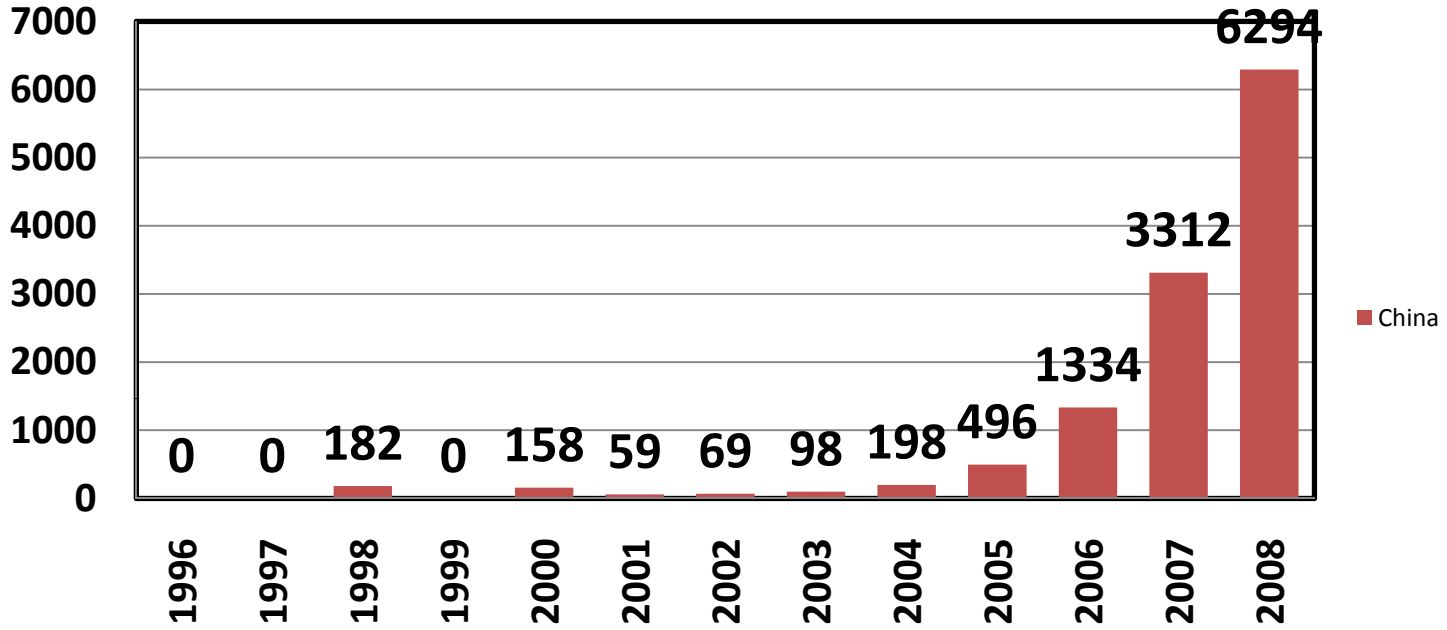
Wind power number one in Europe in MW 2008

United States 2000-2007	Europe 2000-2008
	

From close to 0,1 to 6 GW in China 2003-2008

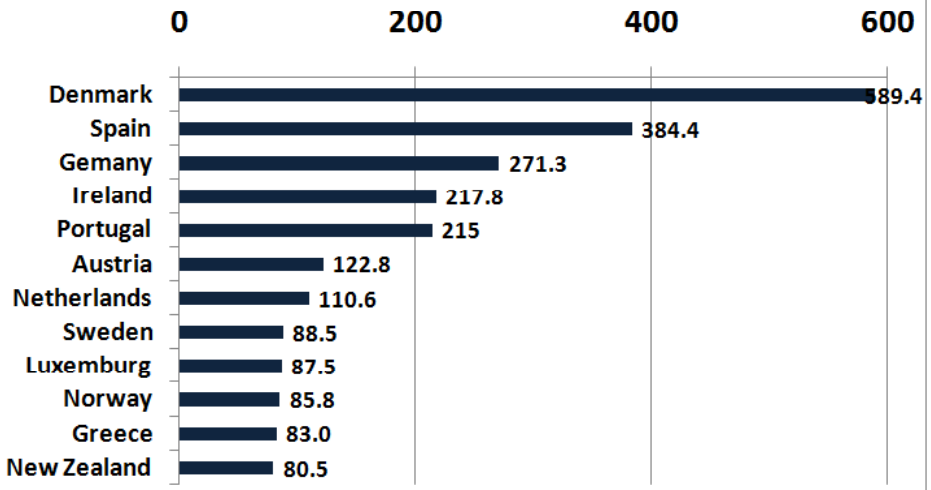
China probable world market leader 2009

Annual wind installations China (MW)



nations without nuclear agendas are the world leaders in wind power

Wind power per capita
End 2007 (Data WPM)

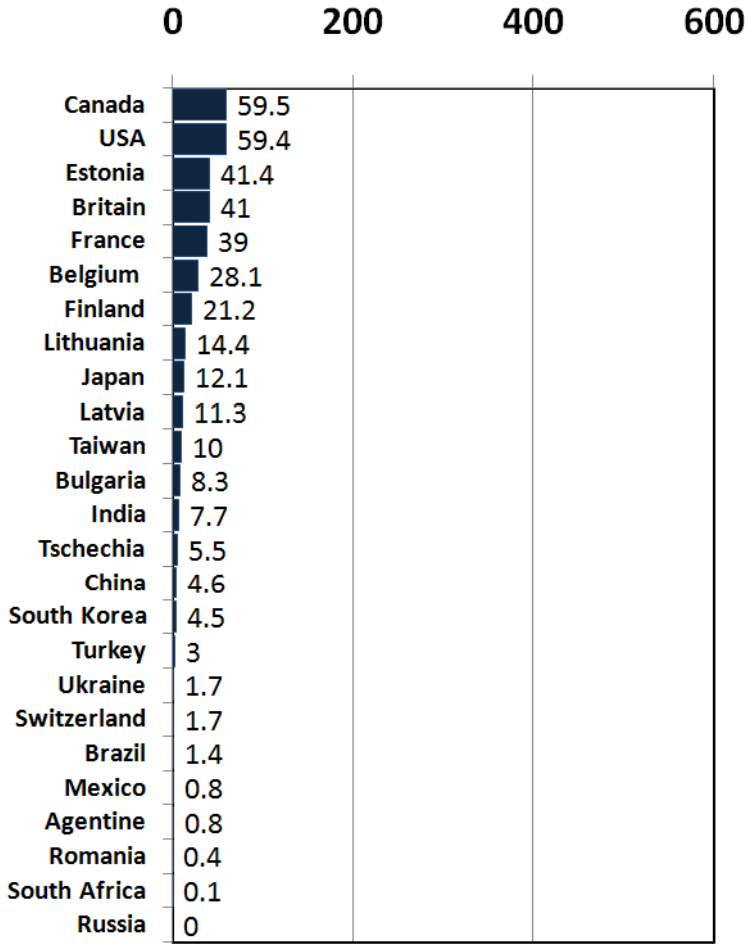


all 12 world leaders (Wind W/cap) said good-bye to nuclear power

Nuclear lobby for decades worked as a roadblock against renewable energies

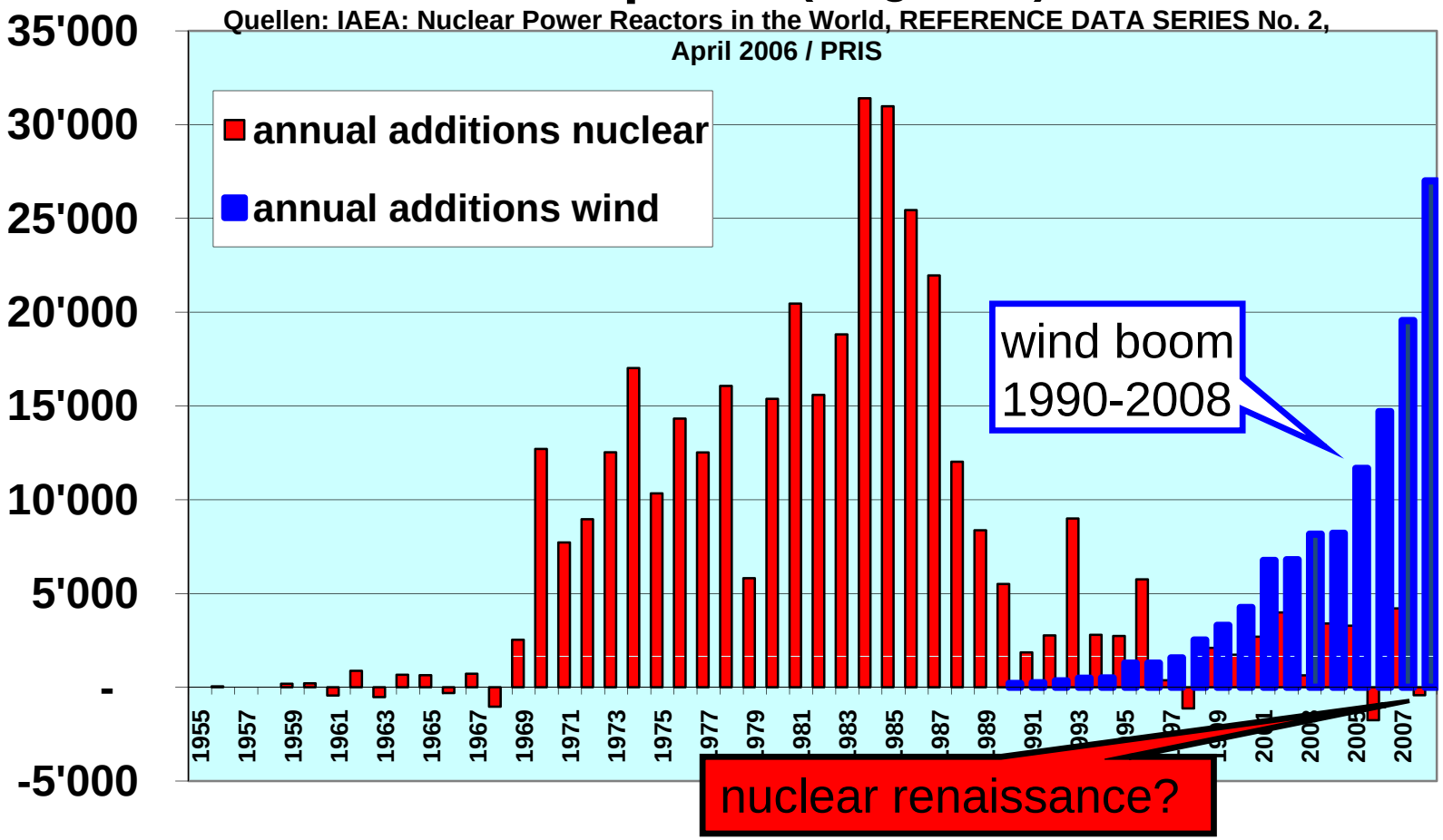
Nations with a nuclear agenda put hurdles to renewables !

Wind power per capita
End 2007 Data WPM)



Wind boom continues - no nuclear renaissance so far!

Annual net additions of nuclear and wind compared (Megawatt)



capacity additions of nuclear power exceeded by closings in 2008 -
more fade outs expected due to high age of nuclear fleet

Part 2

1. The facts: Energy in turmoil
2. The forecasts:

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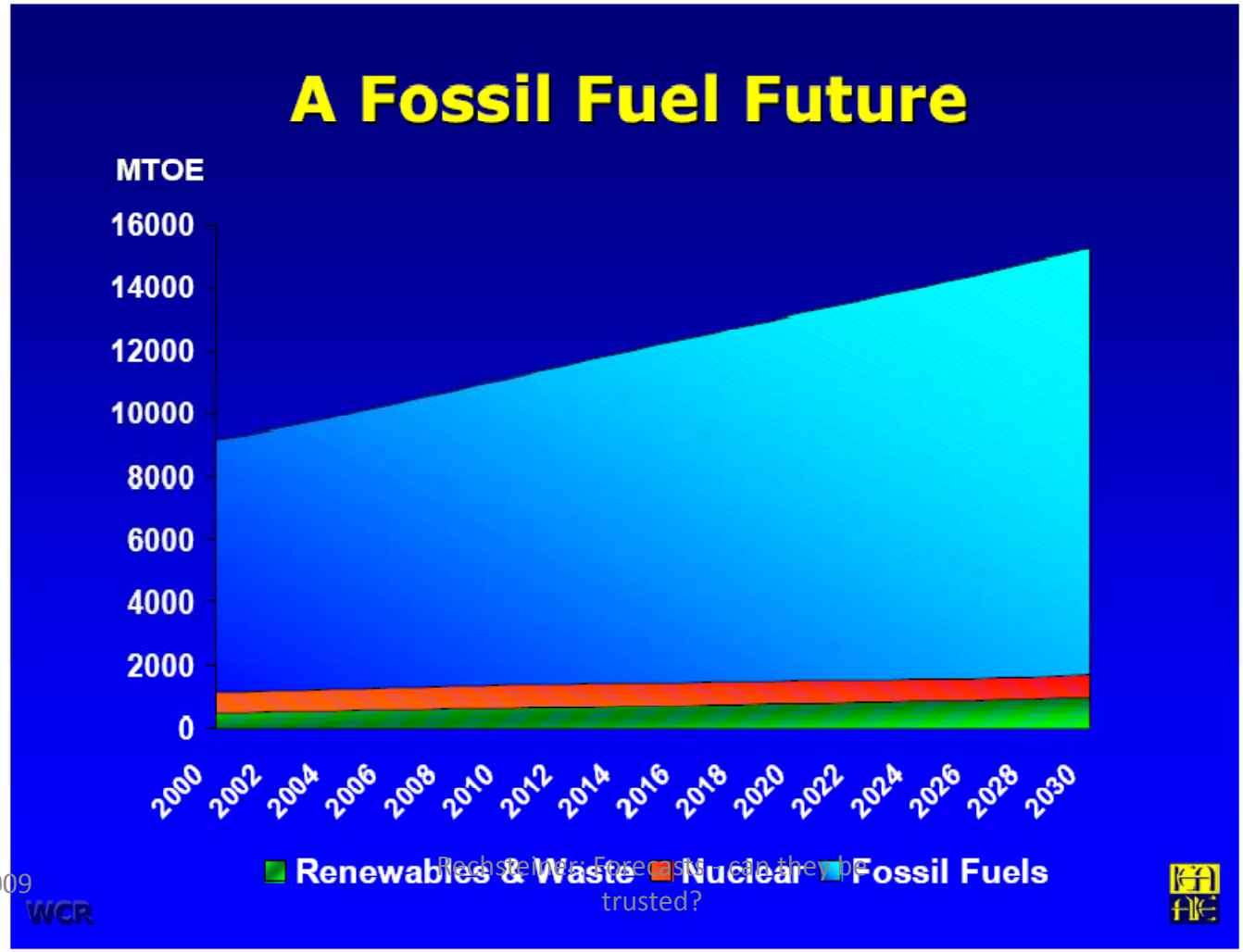
3. A personal outlook

What did IEA tell us on fossil fuels?

The IEA view

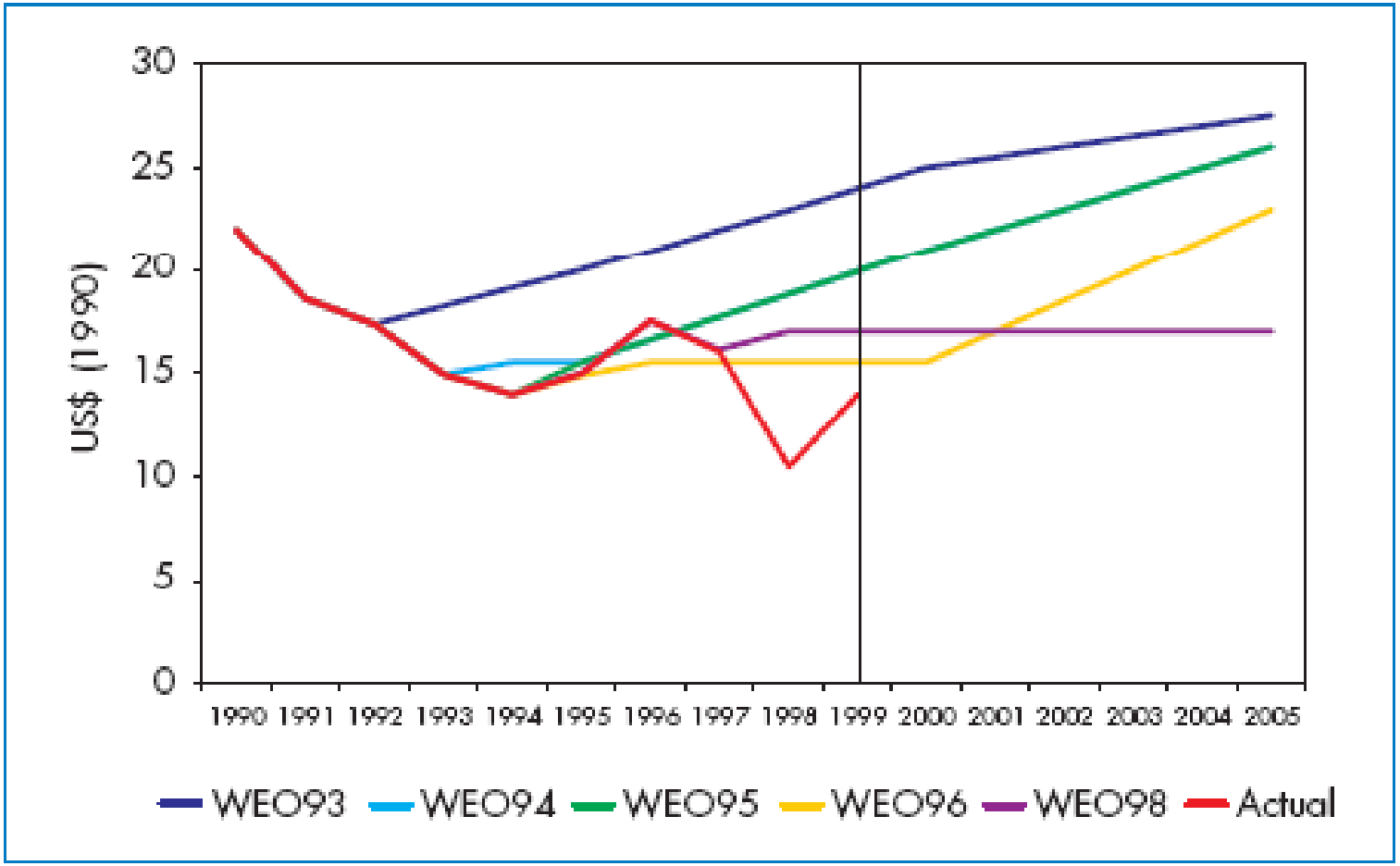
William Ramsay deputy director IEA

presentation for the Swiss Parliament (Energy Commitee) 2003



IEA oil price forecasts worked in the 1990es

Figure 14.1: **Oil-Price Assumptions**



IEA Oil Price Forecast in 2002

"*Crude oil prices are assumed to remain flat until **2010** at around **$21 per barrel** (in year 2000 dollars) – their average level for the past 15 years. They will then rise steadily to **$29 in 2030**. Natural gas prices will move more or less in line with oil Prices…"*

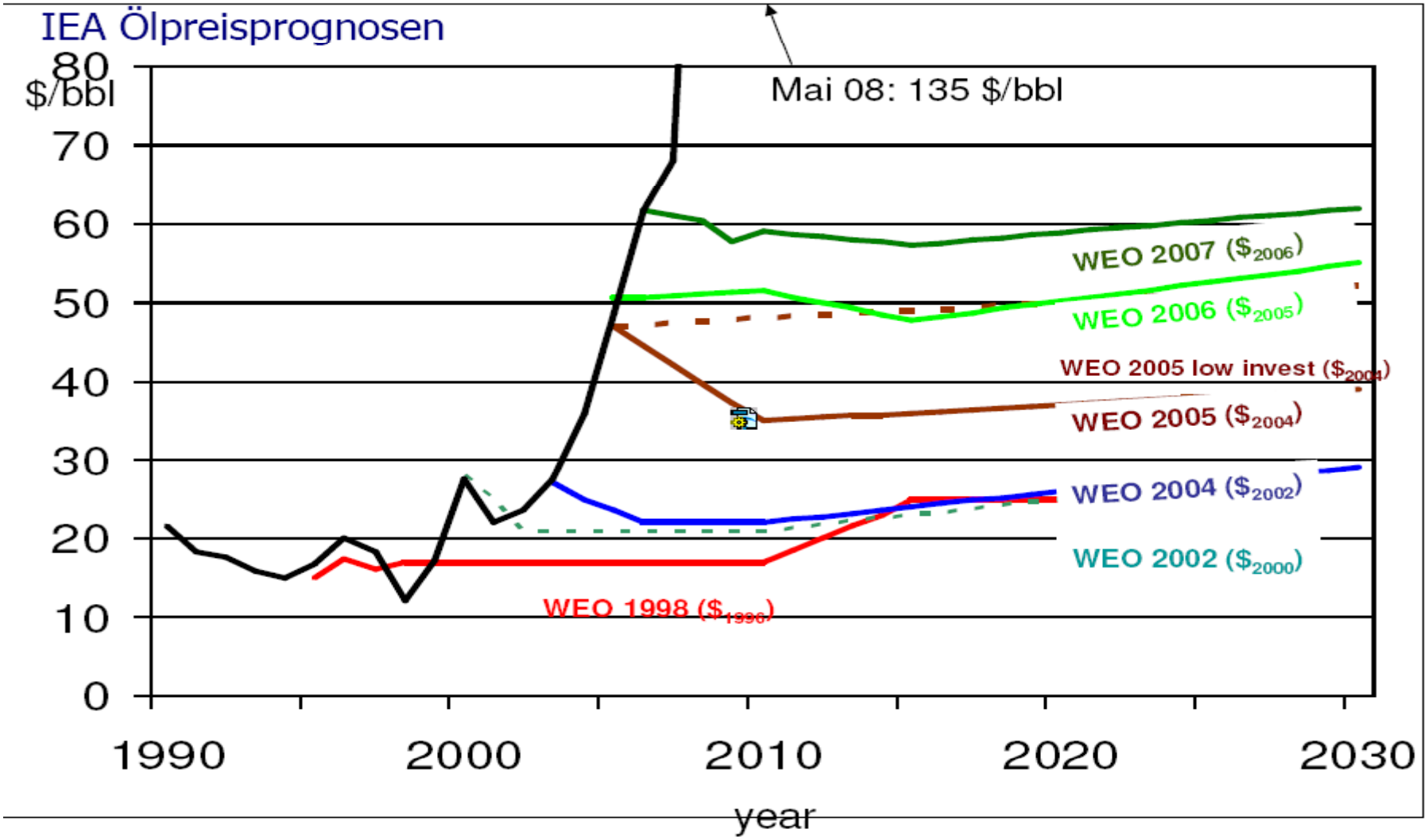
*International Energy Agency: World Energy Outlook **2002**, p. 37*

The IEA method of supply prediction: ***predict demand!***

*„The **oil supply projections** of this Outlook are **derived from aggregated projections of oil demand**.... Opec conventional oil production is assumed to fill the gap.“*

World Energy Outlook 2002 p. 95

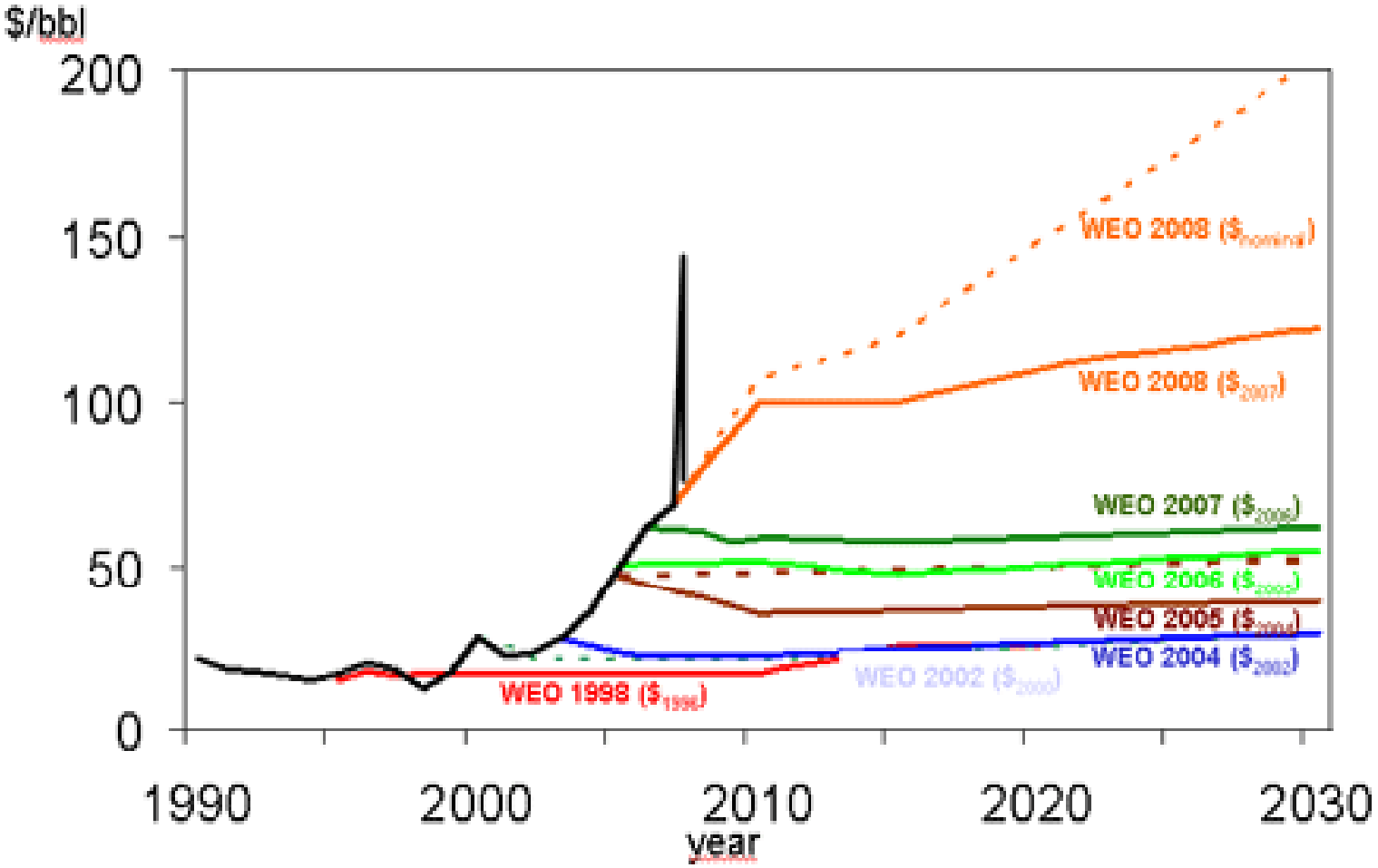
1998-2007
IEA Forecasts laged behind oil price



In 2008 IEA adapted ist forecast:

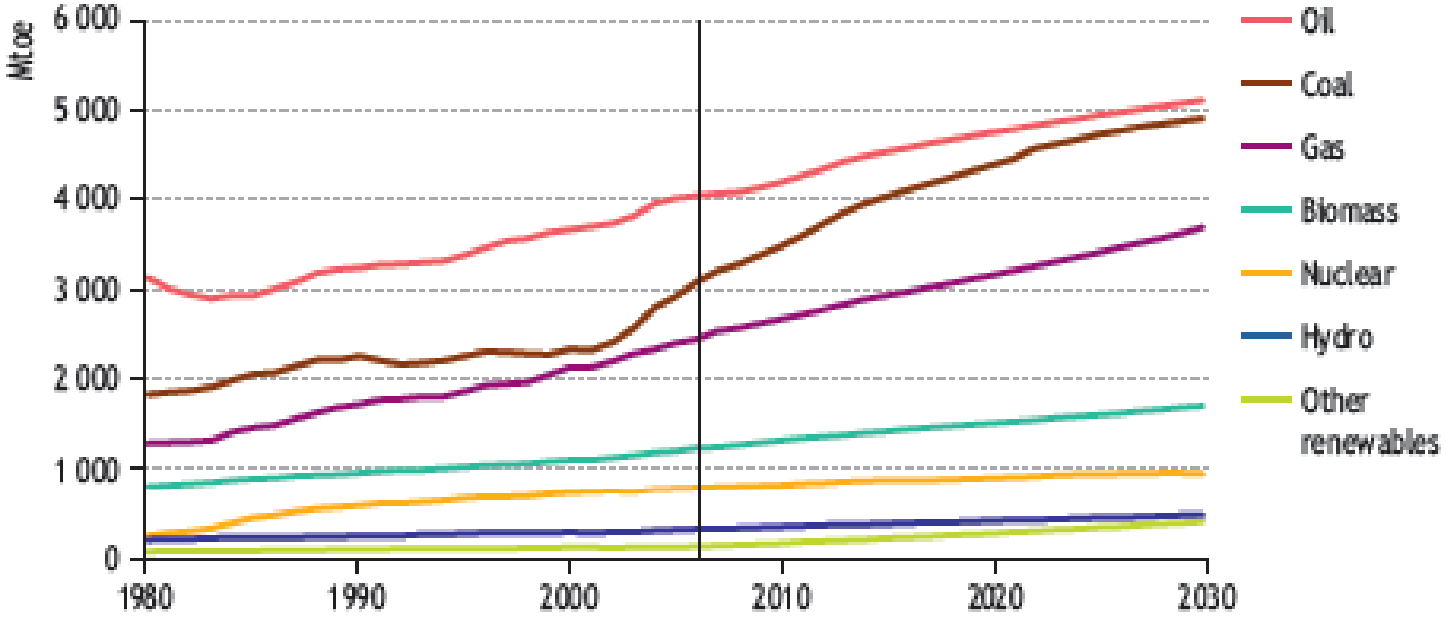
„supply crunch imminent“ and „100-120$ per barrel level for 2010-2030“

graph LBST



But: energy mix stayed about the same: ever more fossil fuels , nuclear, but more coal and some biomass

Figure 2.1 • World primary energy demand by fuel in the Reference Scenario



IEA WEO 2008 p. 80

Analysis of IEA forecasts

- IEA is promoting big business solutions regardless of cost and availability:
  - Oil, gas, coal, nuclear and recently some (industrial) biomass
  - Despises renewables despite expnential growth
  - No proper analysis of resources and costs

- IEA is unwilling to adopt a peak/decline methodology for oil, gas and coal.
- Instead some scapegoats are named:
  - „Lack of investments“
  - „Political reasons for lack of drilling“
  - „strong demand from China“

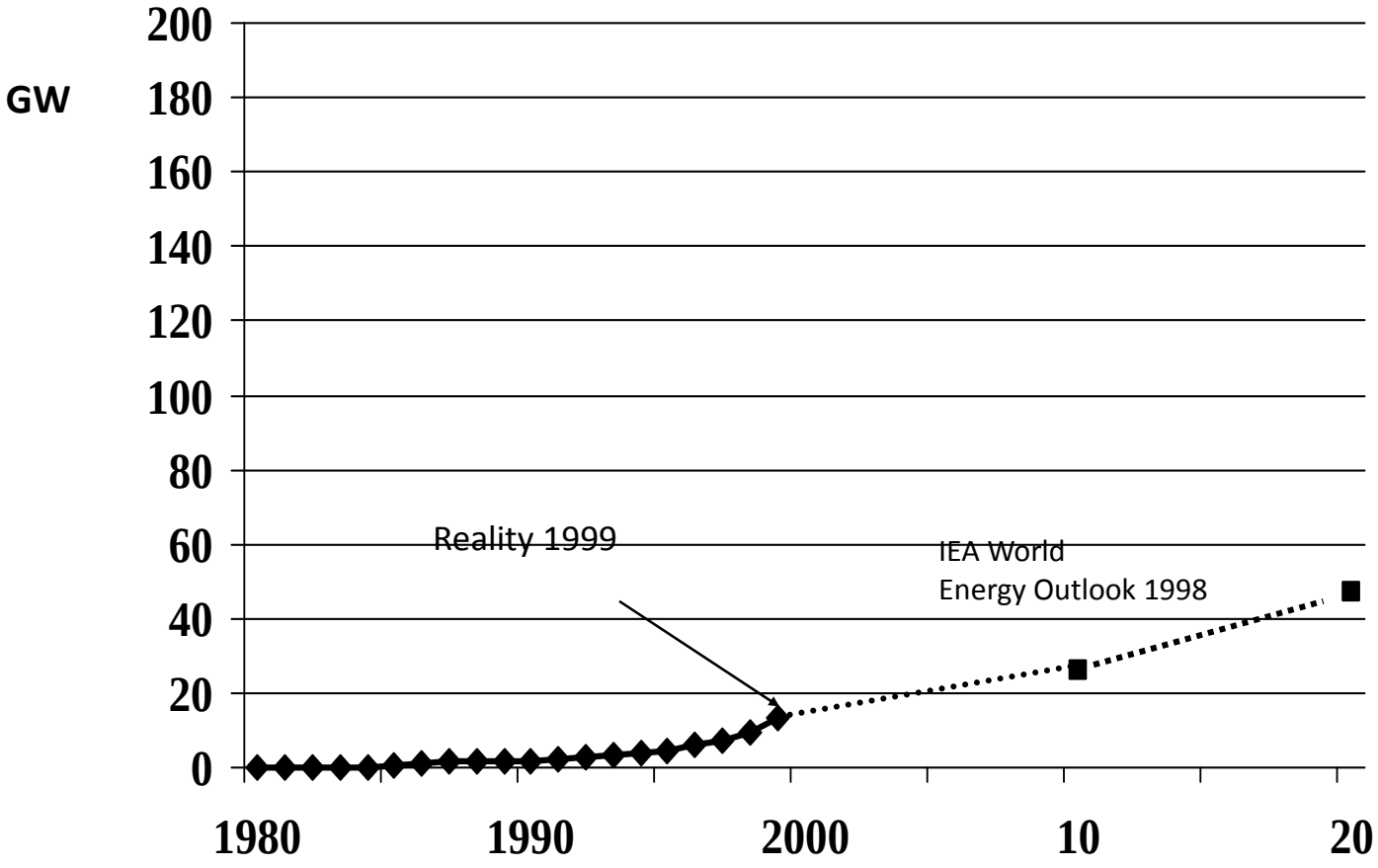
  Poor substitutes for a proper analysis.

Weak forecasts come at high costs

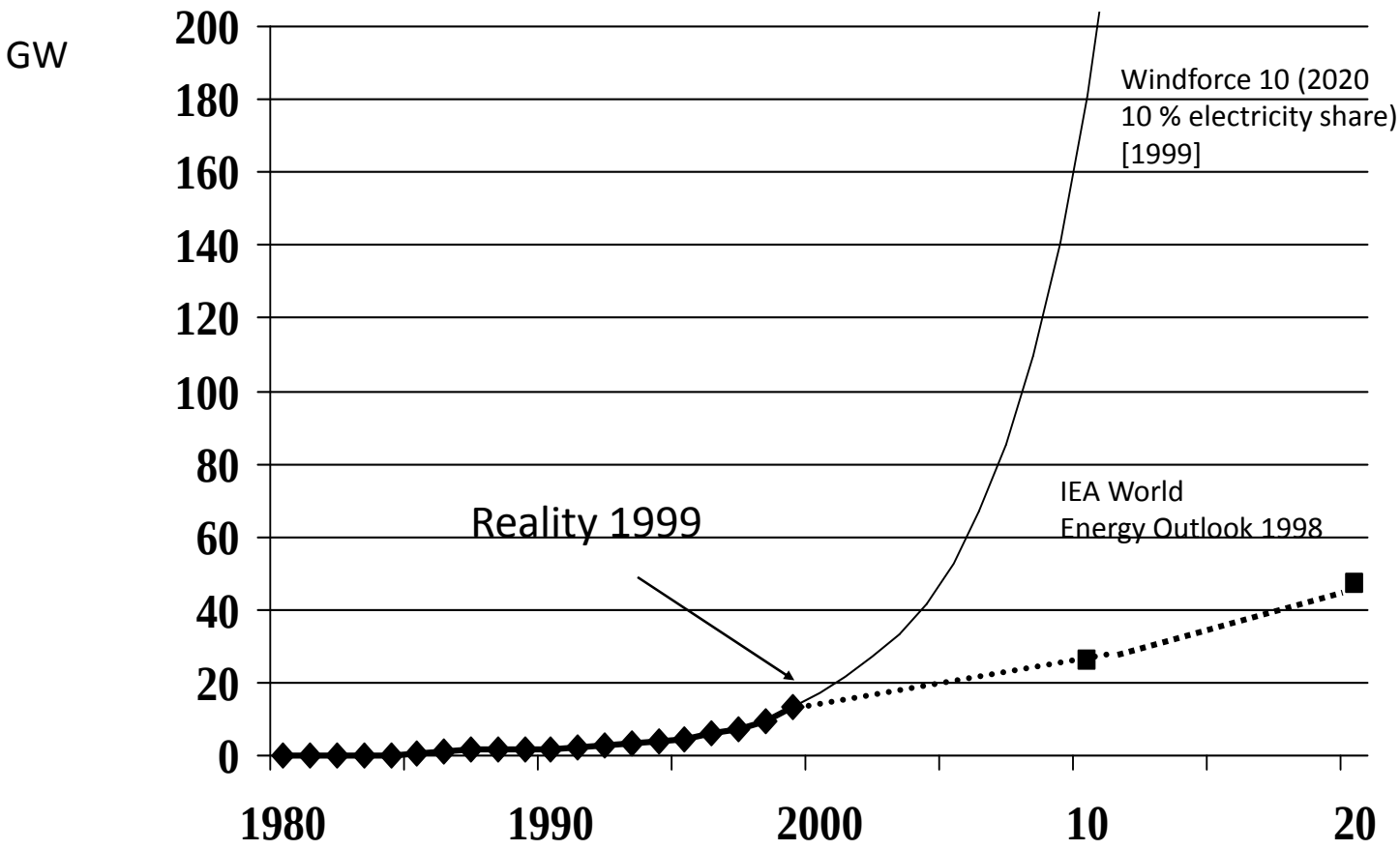
- Profitability of renewables was permanently underestimated
- Wrong infrastructure decisions
  - New streets instead of public transports
  - Airports instead of high speed connections
- Financial crisis is a crisis of wrong investments
  - Expanded suburbs not usefull with expensive gasoline
  - Lack of trains and railway infrastructure

Another IEA example:
IEA Forecasts on Wind energy

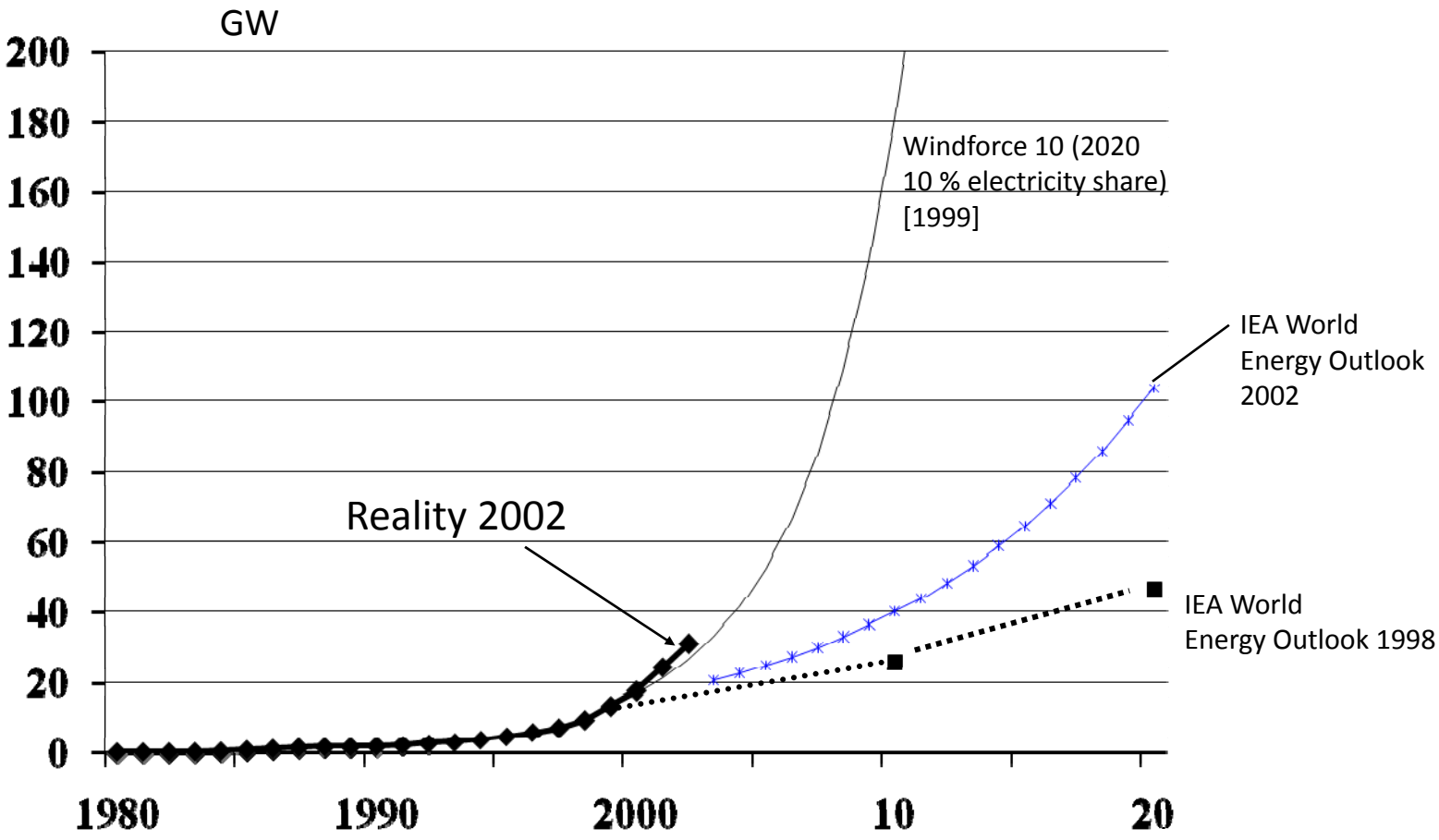
IEA Outlook for wind power 1998
42 GW Wind power by 2020



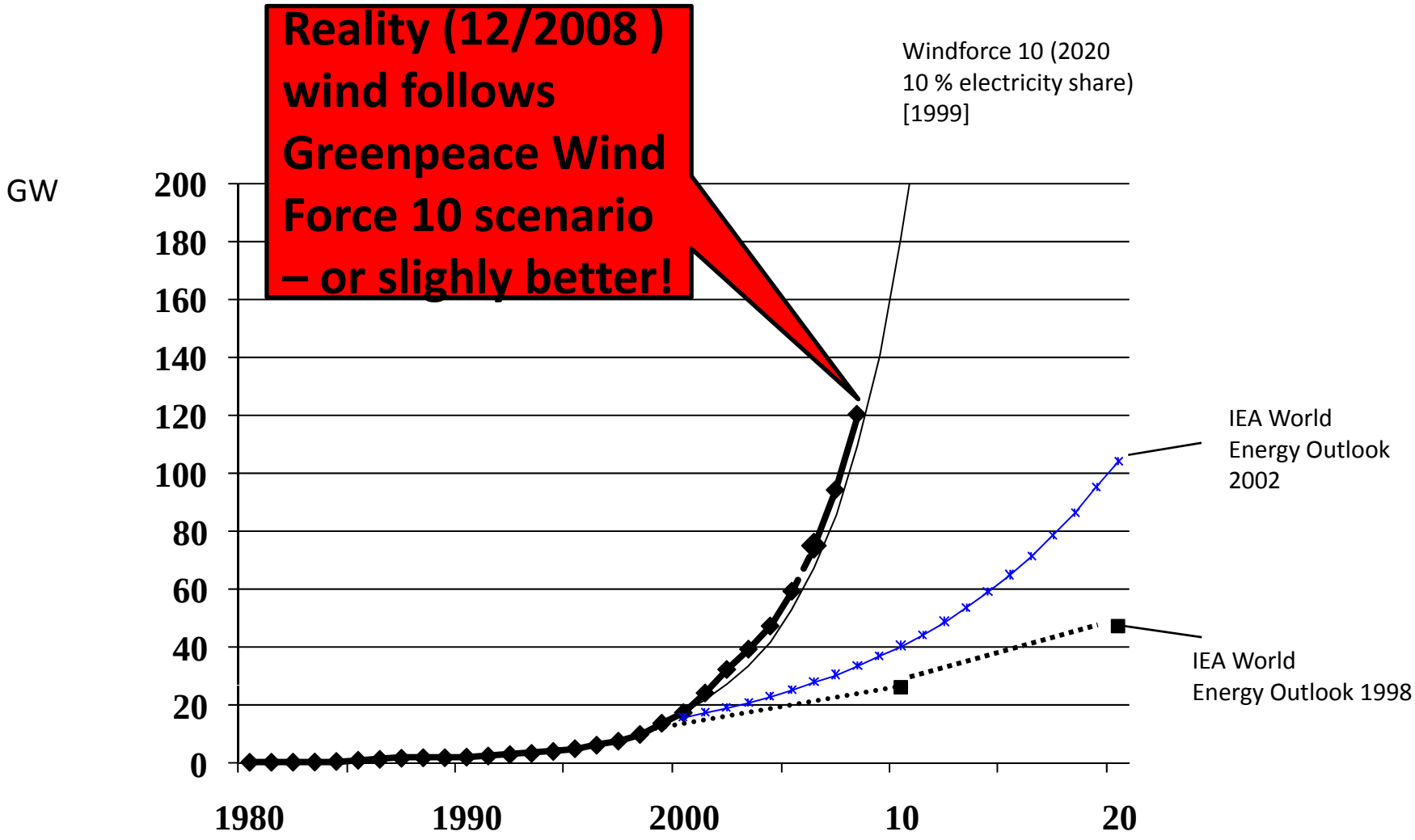
Greenpeace: Wind Force 10 (1999)
Ten percent wind power by 2020 - or more



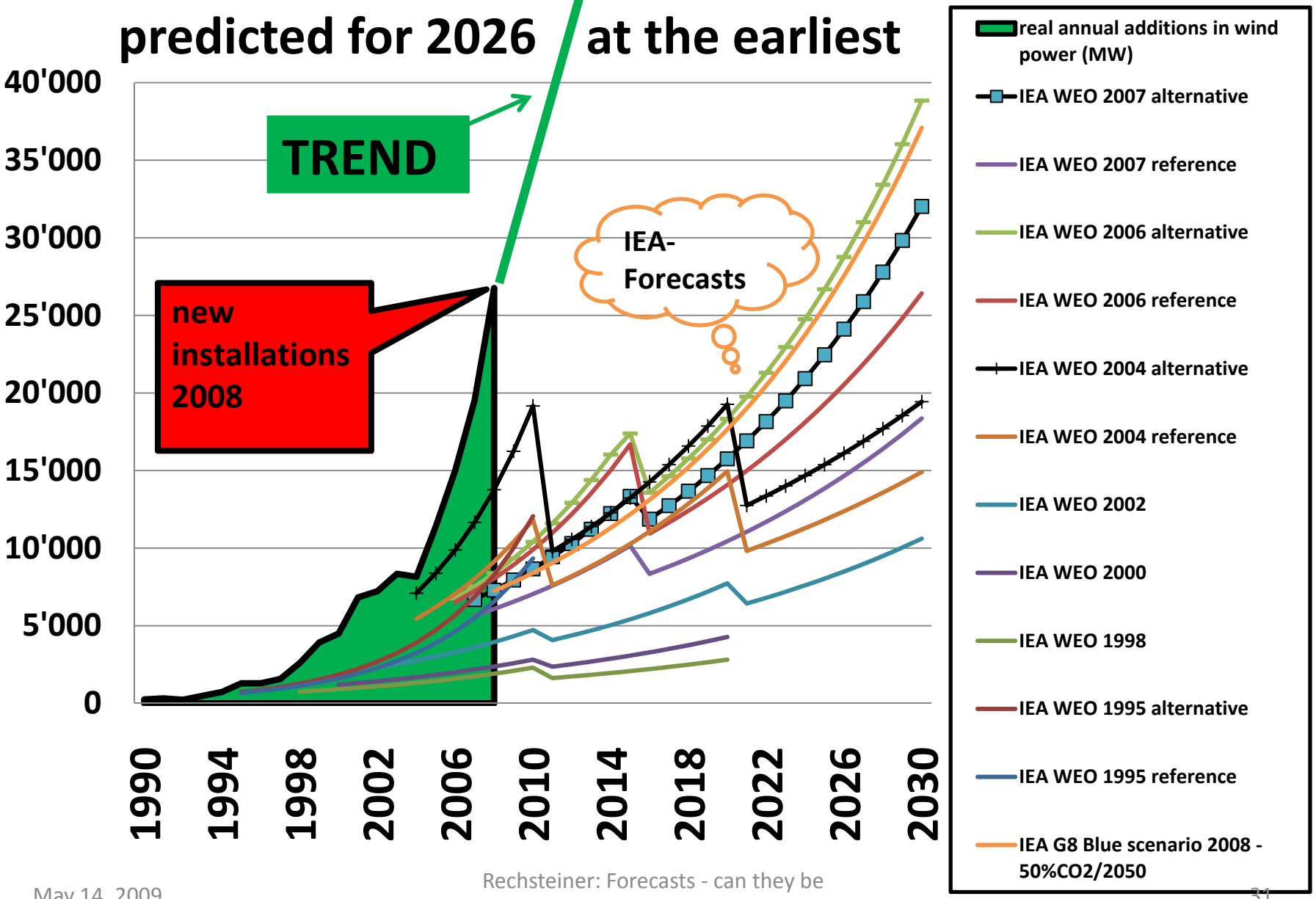
IEA-forecast 2002:
wind forecast doubled to 105 GW by 2020



Reality: IEA 1998 forecast for 2020 passed in 2004
IEA 2002 forecast surrounded in 2008



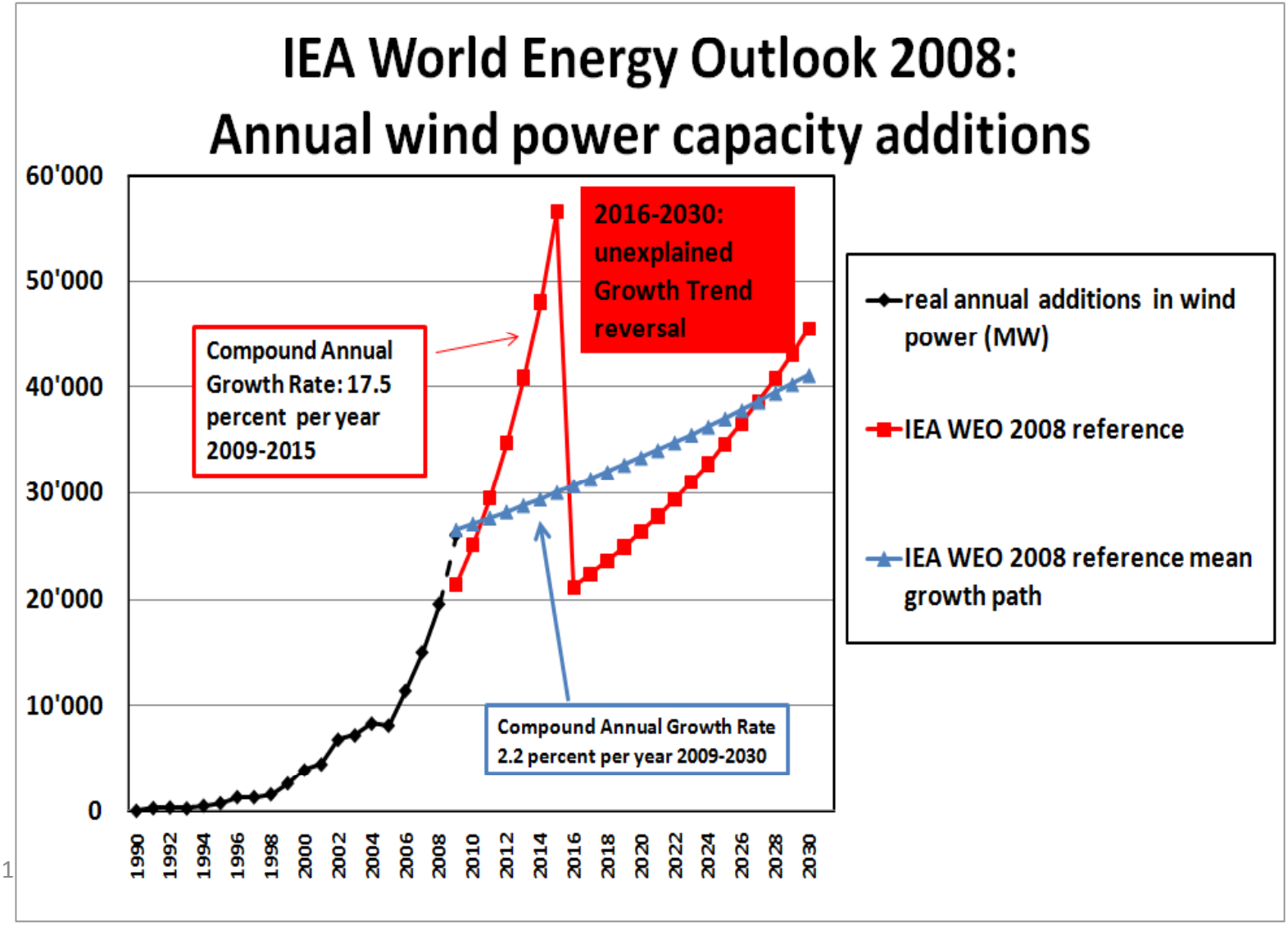
IEA forecasts and reality: predicted for 2026 / 2008 installations at the earliest



2008 IEA World Energy Outlook: **Change of perception**

- IEA acknowledges "risk of a supply crunch"… "driving up oil prices – possibly to new record highs",
- **But IEA fails to revise its forecasts for renewables:**
  - Wind cheaper than oil,gas in terms of $/kWh
  - More renewables become least cost (solar)
  - Resources are enormous and **available**
  - Market conquest by renewables would be the most logical advice –
    - following a net cost perspective
    - but also due to environmental concerns.
- But: nothing heard so far from IEA except CCS and nuclear

WEO 2008: New IEA Wind forecast:
short term growth, mid-term failure



IEA and wind power: a new vision with old results (WEO 2008 resumed)

- wind output projected to grow fivefold 2006-2015.
- after 2015: 2015-2030 only doubling.
- This translates into
  - sharp reductions of annual capacity additions
  - from 57 GW per year in 2015 down to an average of 32 GW for 2016-2030
  - overall a 2.2 percent compound average growth rate when from 1998-2008 it was some 32% per year!
- No arguments given why wind sector should suffer a crisis after 2015.

Part 3

1. The facts: Energy in turmoil
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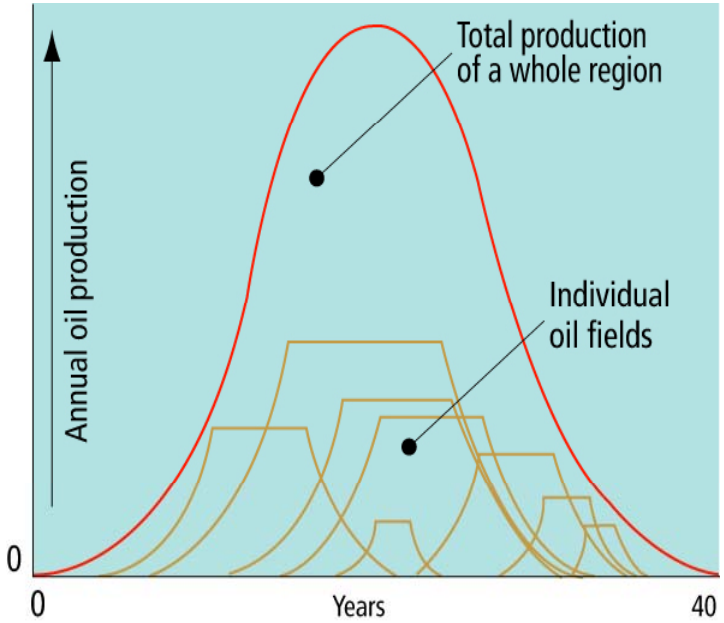
Main trends

- Renewables will substitute the fossil sector
- The internal combustion engine will disappear
  - Due to high costs of oil and gas
- The energy system will be more efficient
  - No thermal plants any more
- Less interference with climate and nature

This is a market scenario – not a scenery of ecological dreams



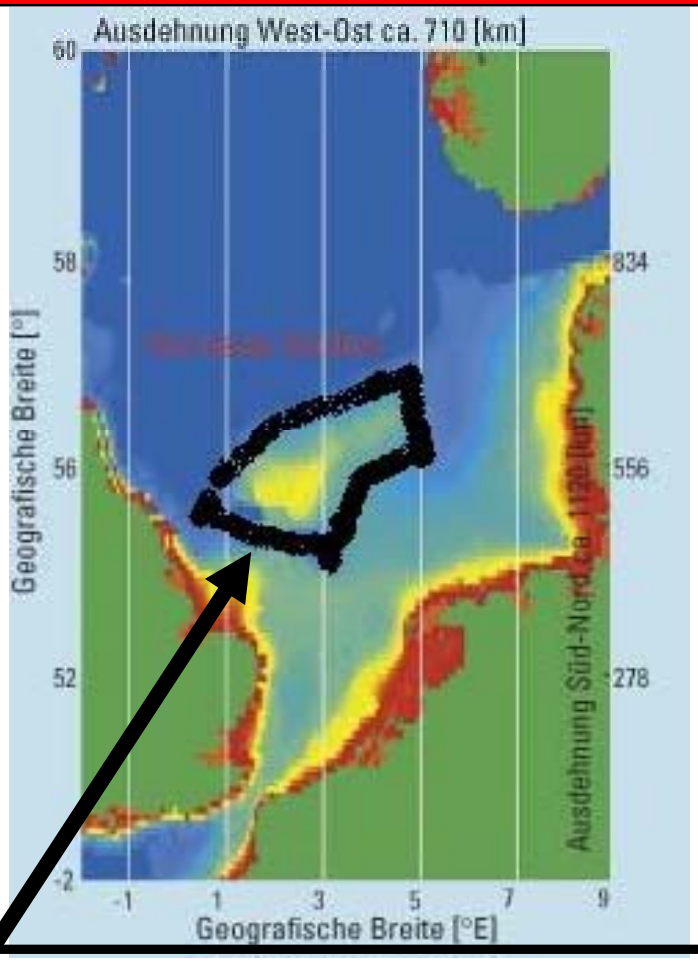
<u>Peak oil means peak price</u>

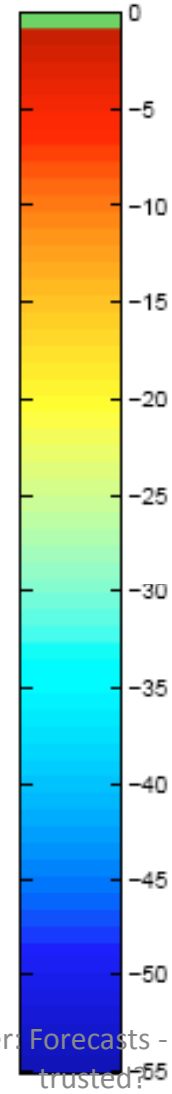
Obama understood:
Energy failures are nation's failures

Peak oil gives renewables a boost

Southern North Sea could power the World

250‘000 km^2< 45m ≈ 13 Mbd ≈ 7500 TWh

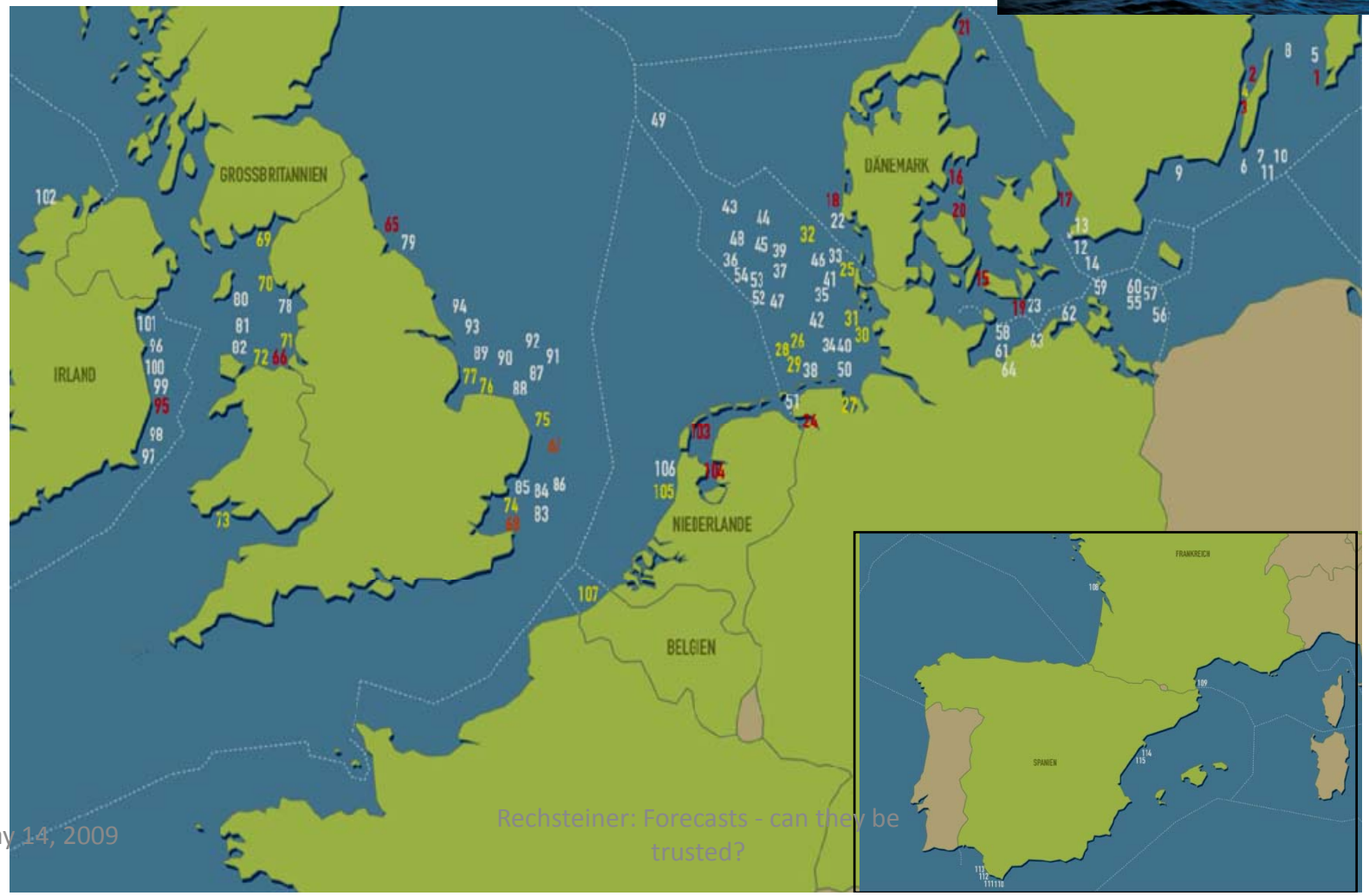




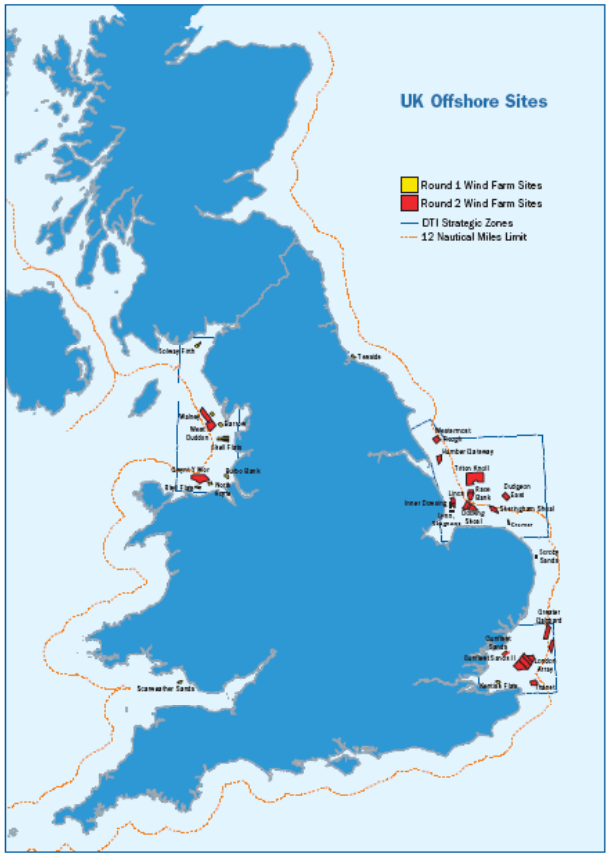
Polygon area can cover EU-electricity consumption
Two turbines / 10 MW per km^2

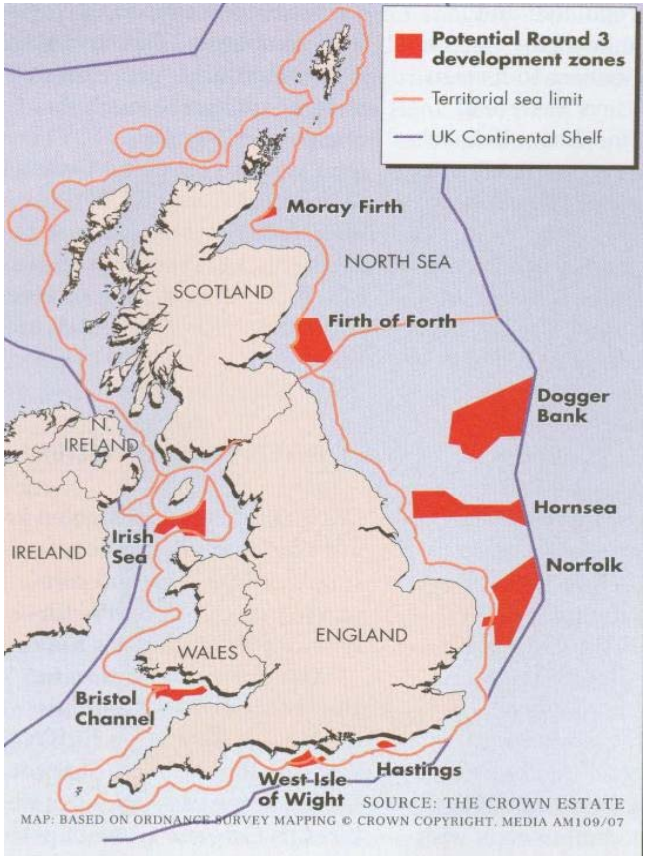
Offshore-projects in Europe:

Thousands of wind turbines projected or in construction

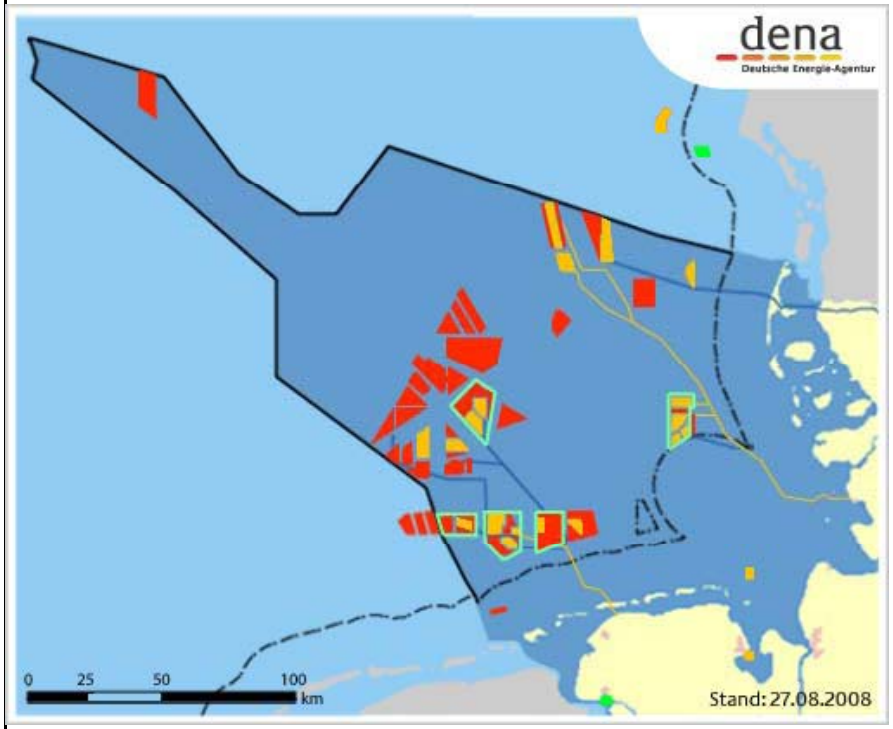


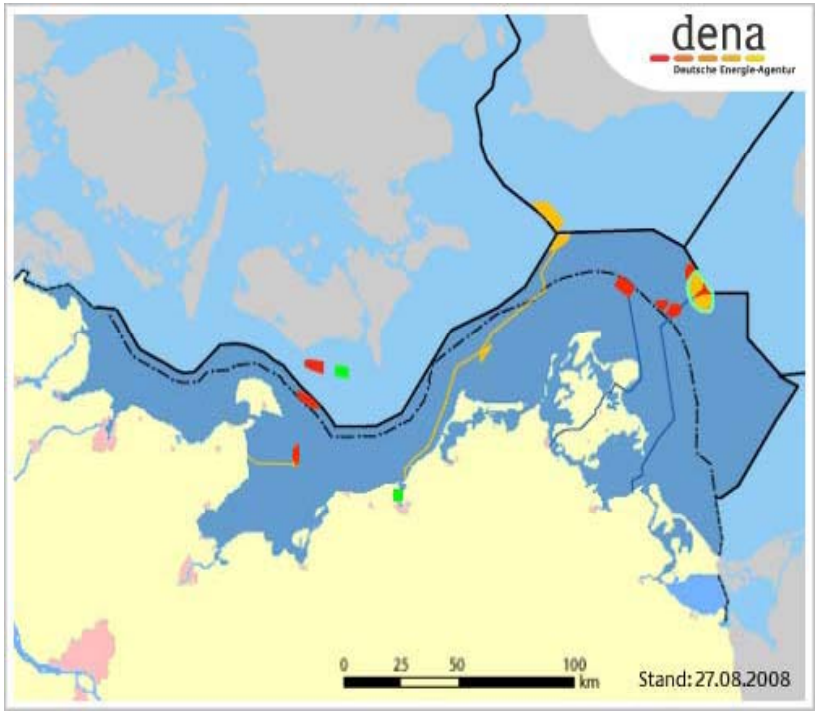
British round 1, 2 wind zones (left) and Round 3 (right)





German offshore wind sites as planned in 2008,
source:dena





Wind farm Online (green) permitted (yellow) not yet permitted (red)	Energy cabel online (green) Energy cabel permitted (yellow) Energy cabel not yet permitted (blue) priority wind zones

The next frontier: swimming Wind turbines – a new resource

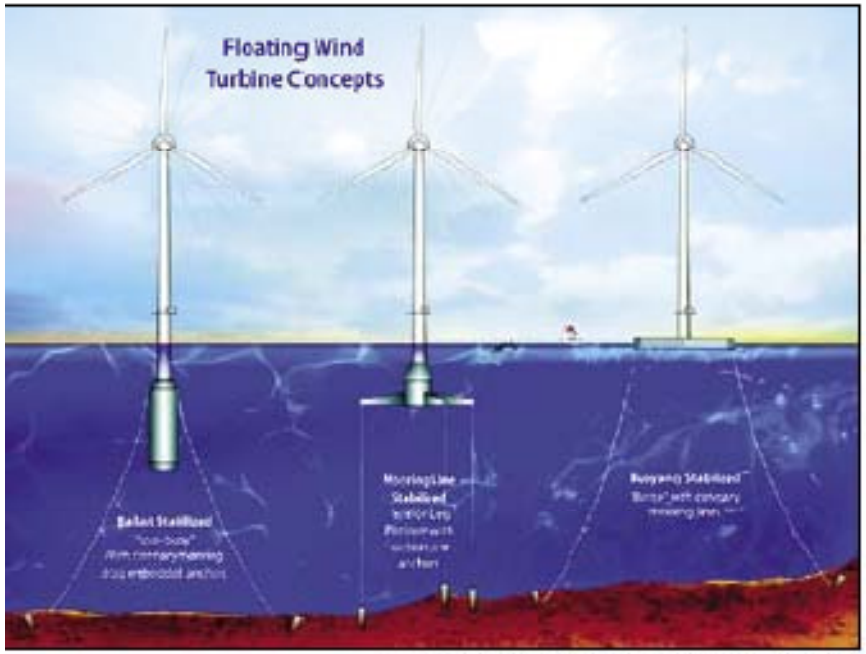
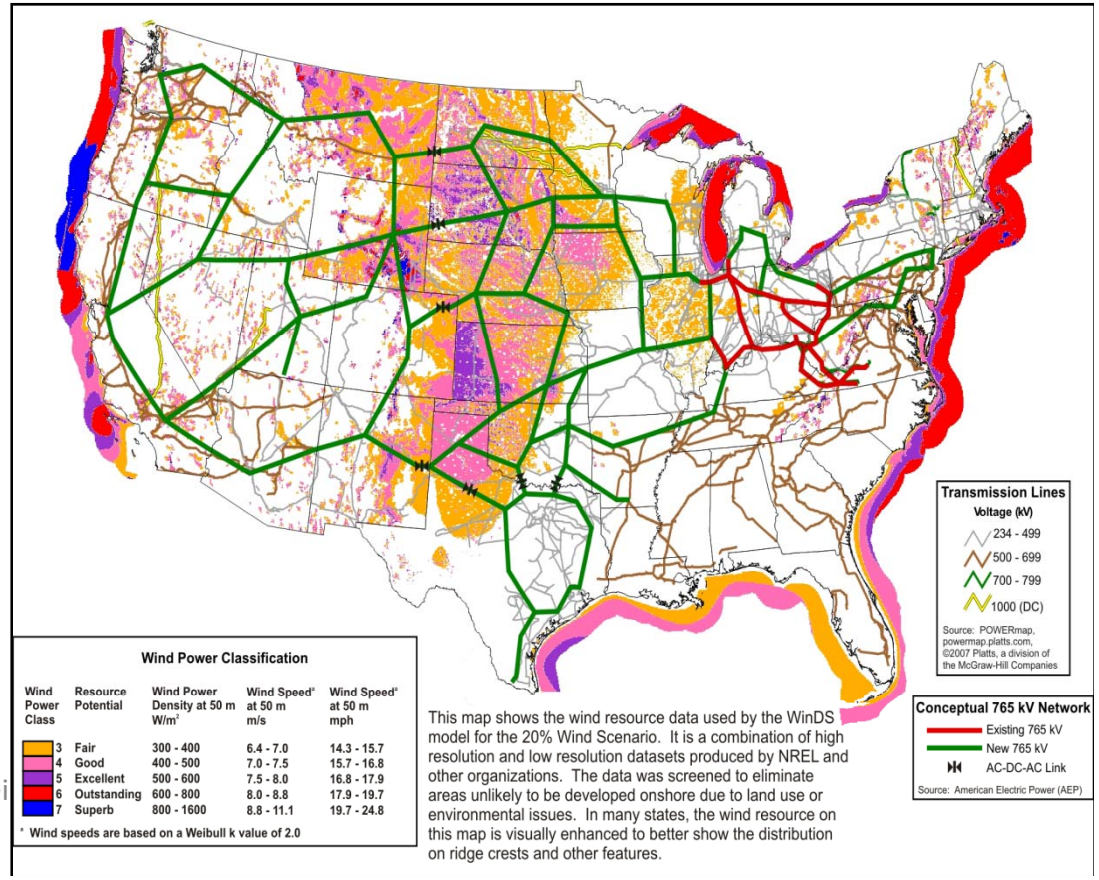


FIGURE COURTESY / NATIONAL RENEWABLE ENERGY LABORATORY

"Deep-sea oil rigs inspire MIT designs for giant wind turbines"

Norsk hydro: erster Prototyp für 2007 angekündigt

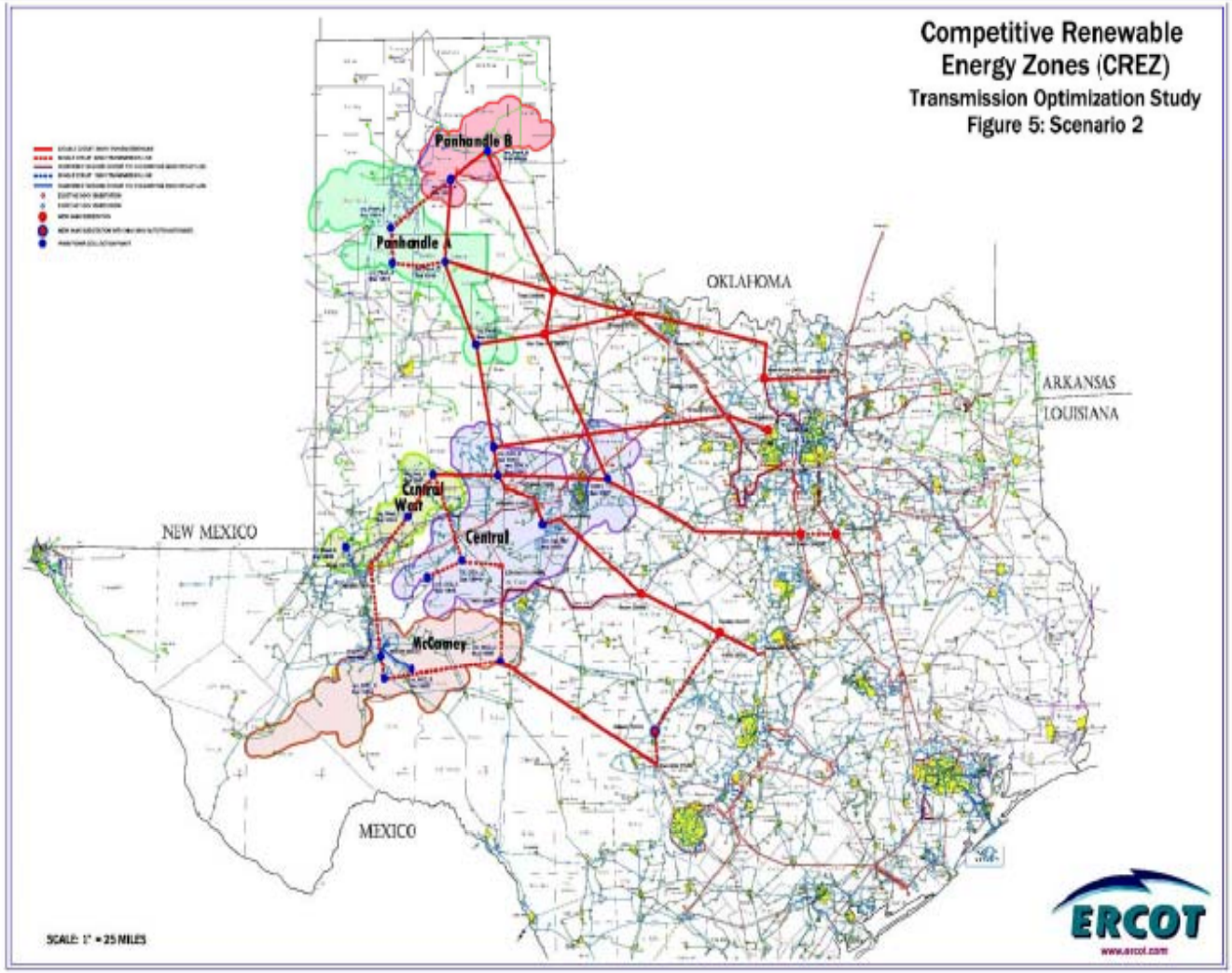
New sources of energy need a new grid! Renewable energy means de-globalization and regionalisation of energy



Texas: 5 billion $ interconnection

45 billion $ private investments in turbines

Texas PUC decision July 2008

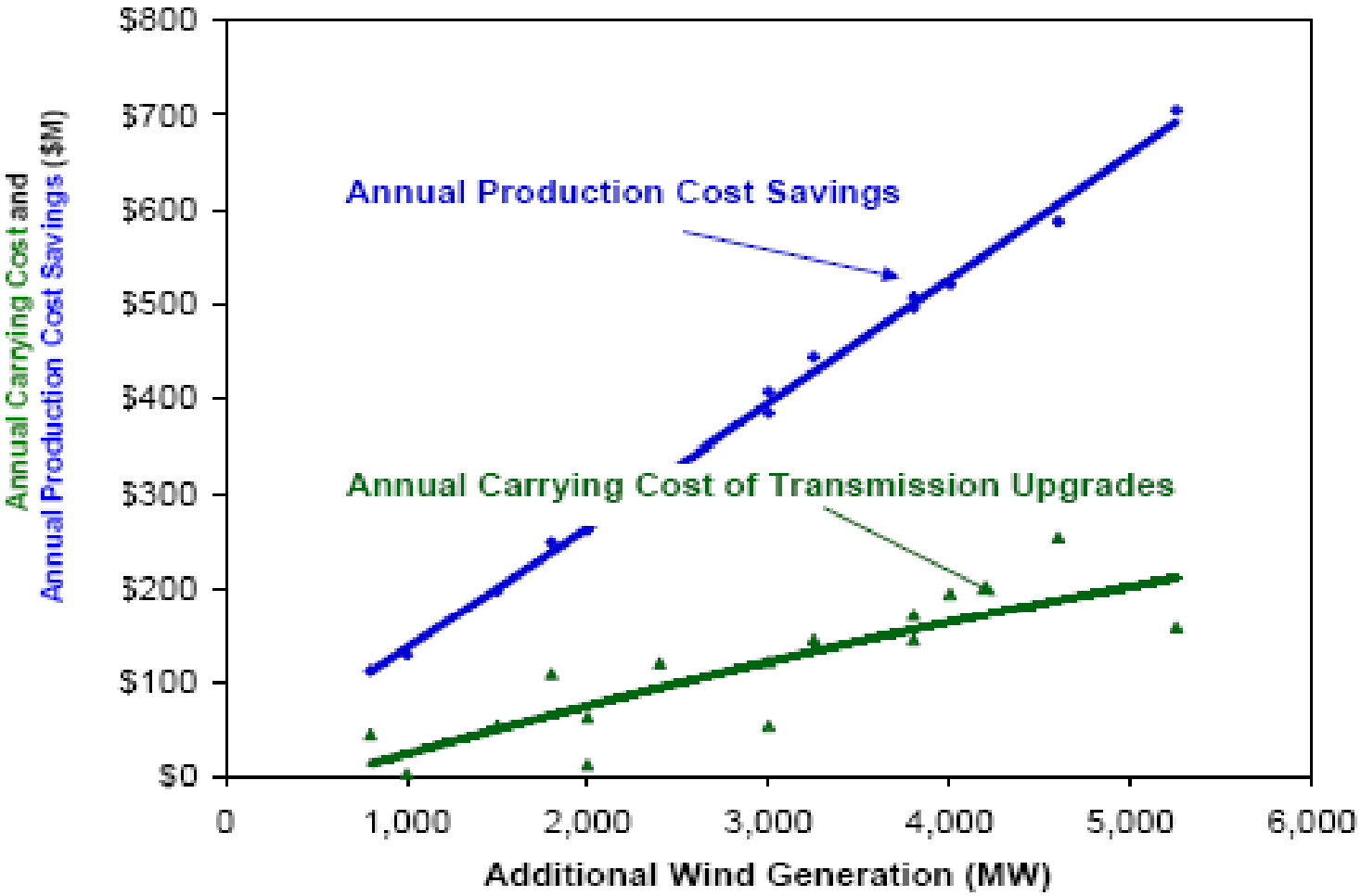


T. Boone Pickens
Texas oil billionaire
Investing 10 billion $ in
Texas wind energy

Texas: New grids reduce electricty costs!

net savings of 3.8 Cents per kWh from wind!

source: Texas PUC public utility commission 2008



The example of wind power: 16 reasons of wind power's success

1. The primary energy is cost-free ;
2. The primary energy never runs out;
3. There is an abundant resource creating power independence in many regions of the world;
4. Stable life-cycle-cost can be guaranteed;
5. Wind power is competitive with other new power sources;
6. wind turbines cause no carbon, air emissions nor hazardous waste;
7. No water for cooling is needed;
8. Wind has an energy payback of less than 1 year;
9. There is global, easy access to wind technology;
10. Time to market is very short;
11. Fast innovation cycles prevail;
12. Wind is a young technology, allowing progress on the learning curve and cost reductions;
13. Wind is decentralized power with a non-exclusive structure;
14. Distance to consumers is moderate (1-1000 miles);
15. Wind has positive side benefits such as taxes, income for farmers, and remote areas;
16. Wind energy creates know-how and human labor;

Model assumptions: Scanarios A-D

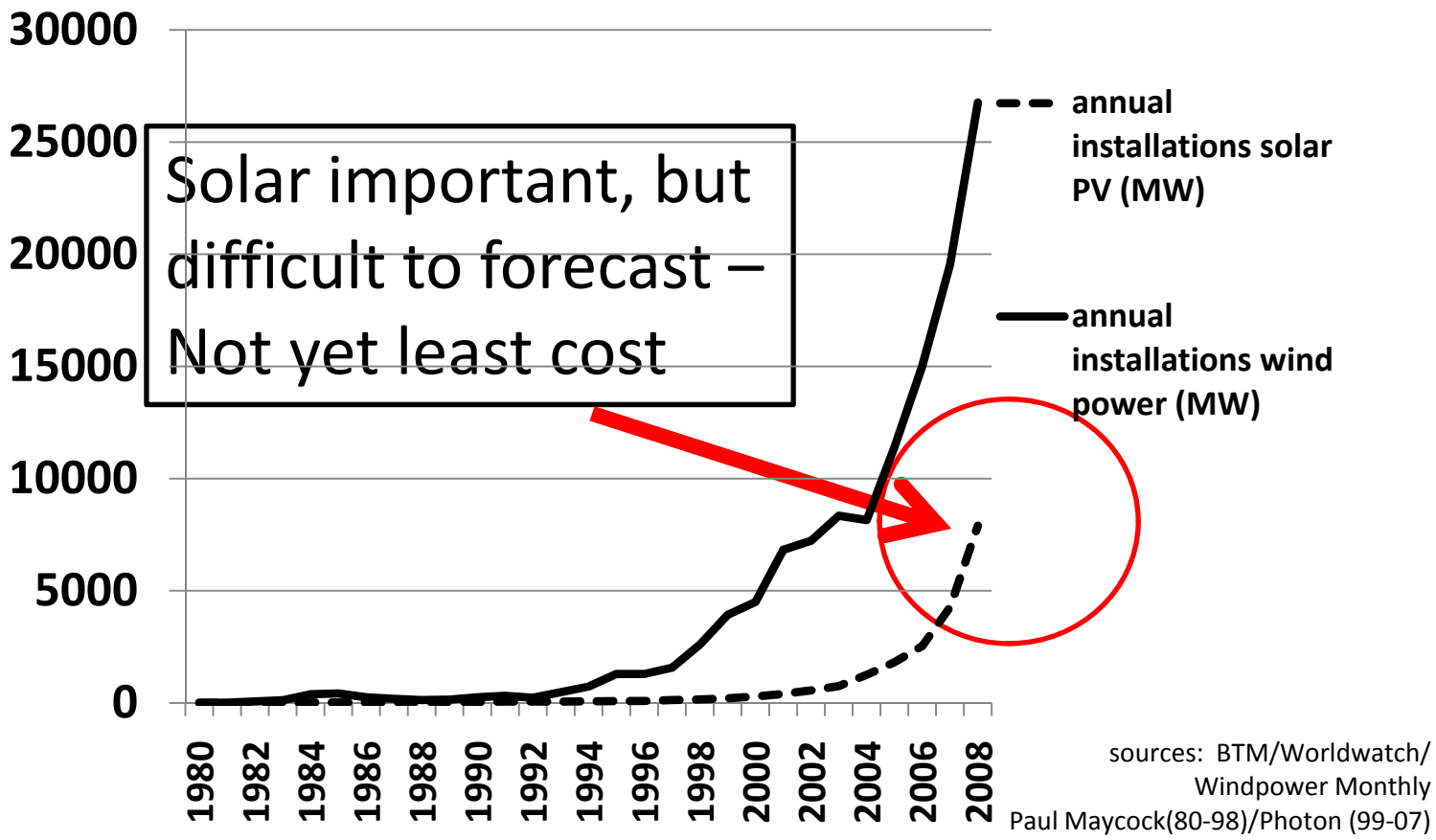
growth parameters: 1) world electricity consumption 2) world wind power

- **High growth = growth to continue at <u>mean annual rate</u> 1998-2007**
- **Moderate growth = growth to continue at <u>half of mean annual rate</u> 1998-2007**

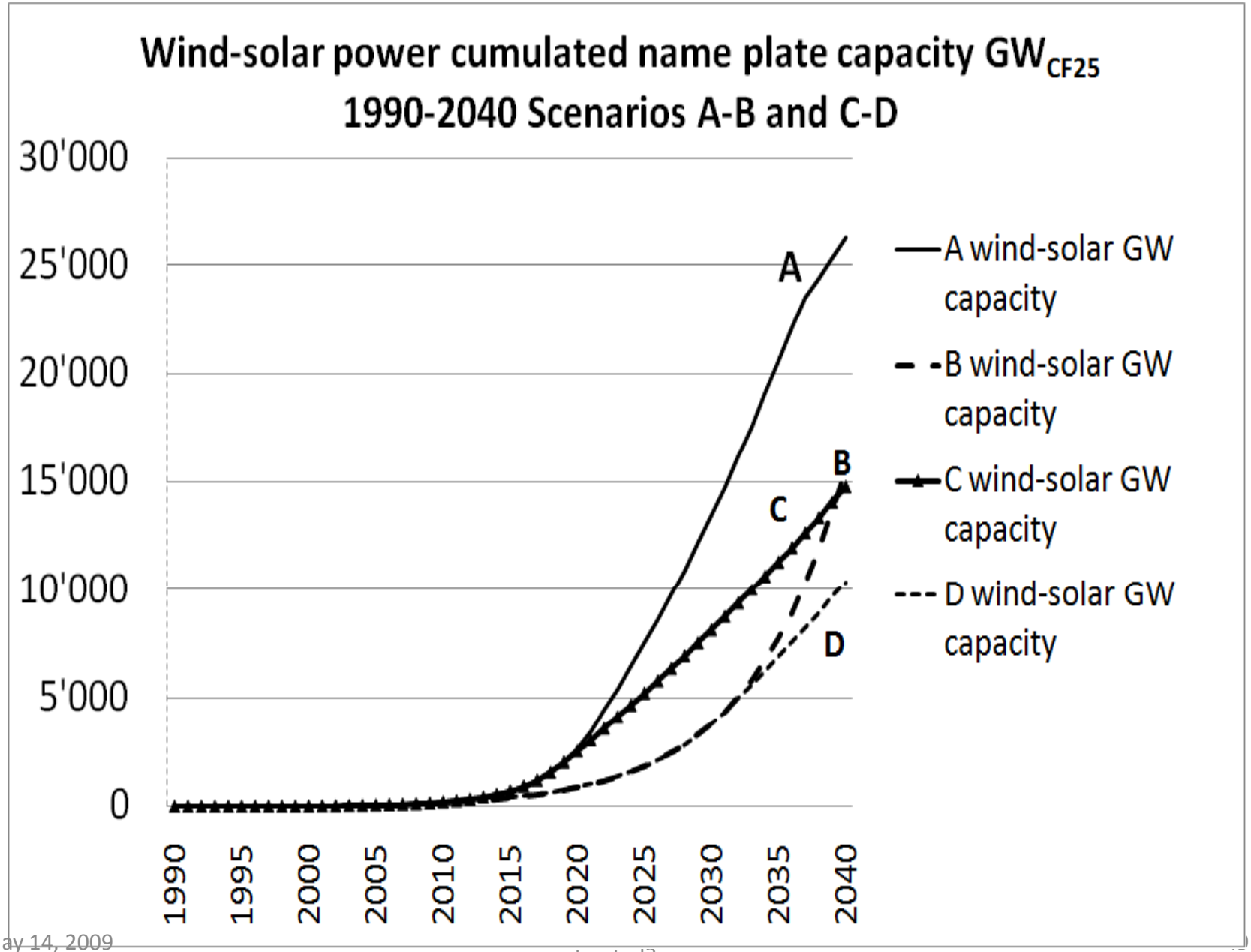
Scenario	World electricity consumption growth	Wind sector growth annual additions (may include solar)
A	**3.6%**	**30.4%**
B	**3.6%**	**15.2%**
C	**1.8%**	**30.4%**
D	**1.8%**	**15.2%**

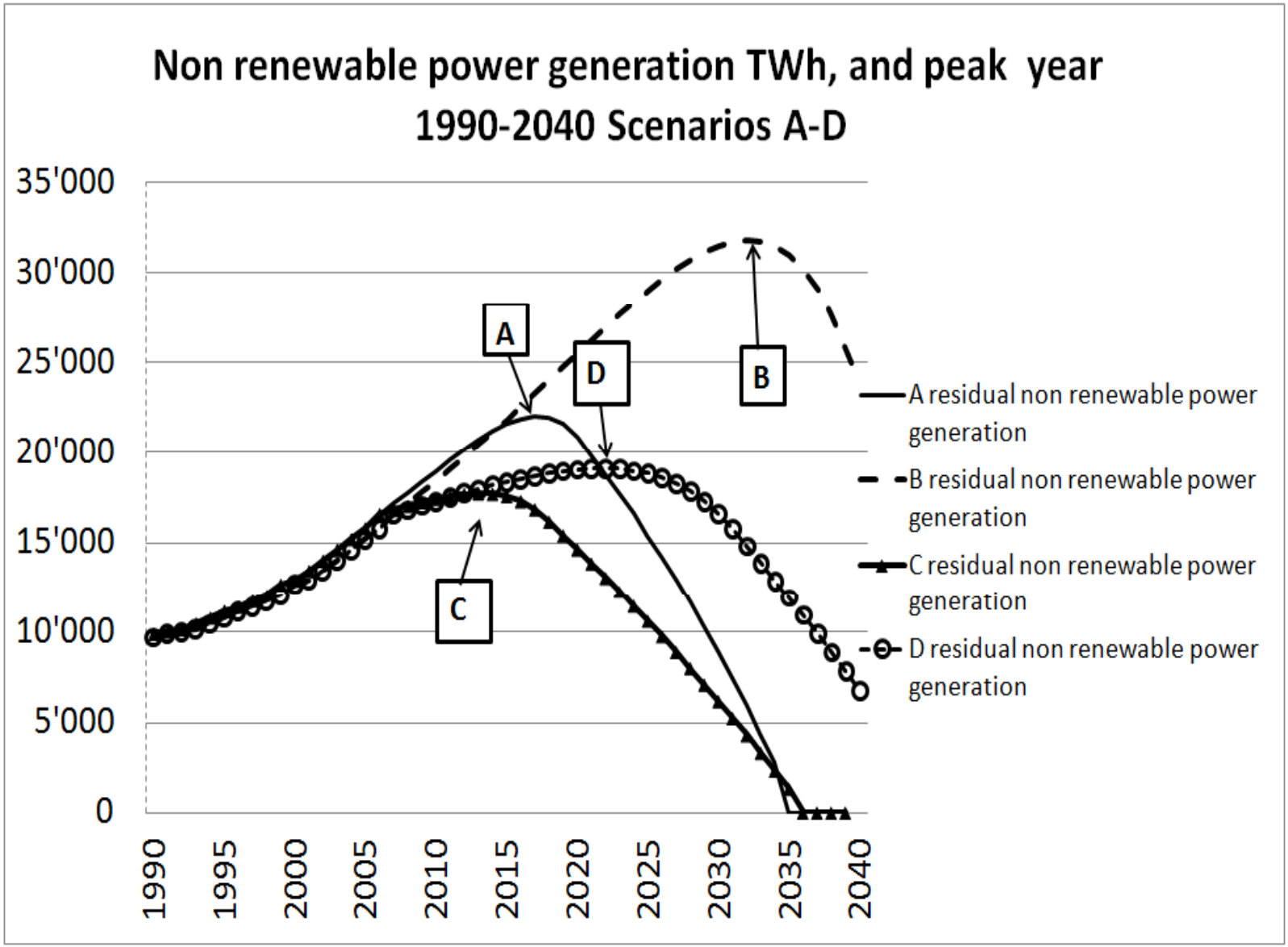
Annual additions Wind Power and solar PV

1980-2008, MW nameplate capacities



sources: BTM/Worldwatch/ Windpower Monthly
Paul Maycock(80-98)/Photon (99-07)


Wind-solar power cumulated name plate capacity GW$_{CF25}$
1990-2040 Scenarios A-B and C-D
30'000
25'000
20'000
15'000
10'000
5'000
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
A
B
C
D
A wind-solar GW capacity
B wind-solar GW capacity
C wind-solar GW capacity
D wind-solar GW capacity


Non renewable power generation TWh, and peak year
1990-2040 Scenarios A-D
35'000
30'000
25'000
20'000
15'000
10'000
5'000
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
A
B
C
D
A residual non renewable power generation
B residual non renewable power generation
C residual non renewable power generation
D residual non renewable power generation

Situation in 2025: more than 50% of power from renewables

scenarios A and C with historical growth rates through 2020

source: Energy Watch Group/Rechsteiner: Wind Power in Context (2009)

Situation 2025

2025	Wind (incl. solar)	other renew-ables	Conventional (fossil/ nuclear)
scenario A	44%	12.2%	44%
scenario B	11%	12.2%	77%
scenario C	42%	16.8%	42%
scenario D	15%	16.8%	69%

Situation 2040

2040	Wind (incl. solar)	other renew-ables	Conventi-onal (fossil/ nucl.)
scenario A	90%	9.9%	0%
scenario B	53%	9.9%	37%
scenario C	82%	17.7%	0%
scenario D	64%	17.7%	19%

Main Results
fast scenarios A and C

- Wind and solar could conquer the power markets up to 100 % until around 2019
  - After that date, every retired fossil power station will be replaced by renewables
- The remaining non-renewable power stations will have disappeard by 2040.
- And:
  - With „slow“ scenarios: same results, but longer time frame
  - fading out of nun-renewables after 2050

General impact:

Swiss model of 2000-Watt-society instead of 6000 Watt per capita

- Driving with electric cars
- Heat with direct solar, geothermal, biomass and heat pumps
- Industrial energy covered by electricity
- No more thermal power plants
- No more internal combustion engines
- Lower losses, lower energy needs
- Houses = net producers of energy

Hybrid/electric cars, motor cycle and trains: plug-in, clean traffic

Elektrische Zweiräder in Shanghai

Today with gasoline: ~ **<u>20% well-to-wheel-efficiency</u>**

Tomorrow with clean power: Plug-in-Hybrid = electric car+ big battery + renewable power **<u>~ 70 % wind-to wheel-efficiency achievable</u>**

No-Go‘s

- Nuclear
  - High risks
  - Radioactive waste
  - Extrem risks = latent crime against humanity
- Carbon capture and storage:
  - More expensive than wind power,
  - logistics unresolved
  - Technology not ready for market
  - Illusive „solution“ to promote fossil fuels

Thank you for your attention!

EXTRA CHARTS