ENERGYWATCHGROUP

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

Presentation by Dr. Rudolf Rechsteiner
January 9 - 2009 press conference of Energy Watch Group
London, Foreign Press Association,

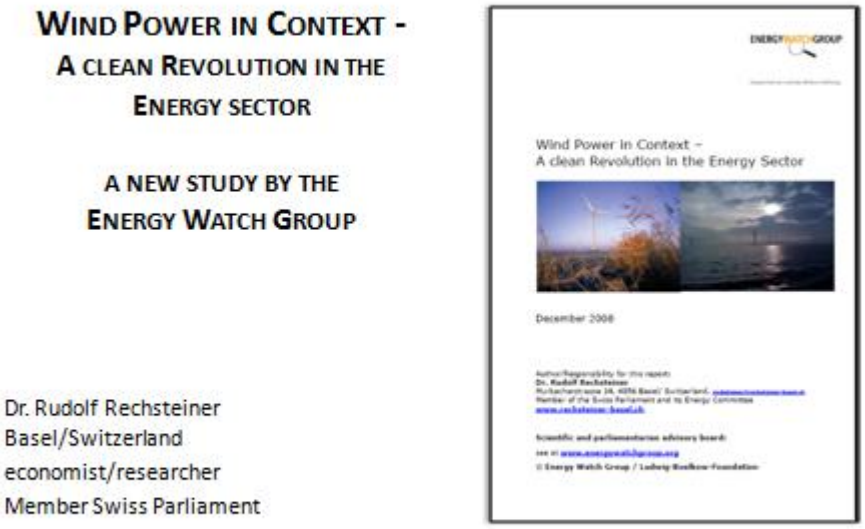

Figure 1
The study to be presented today is about growth, past forecasts and future prospects of wind energy.

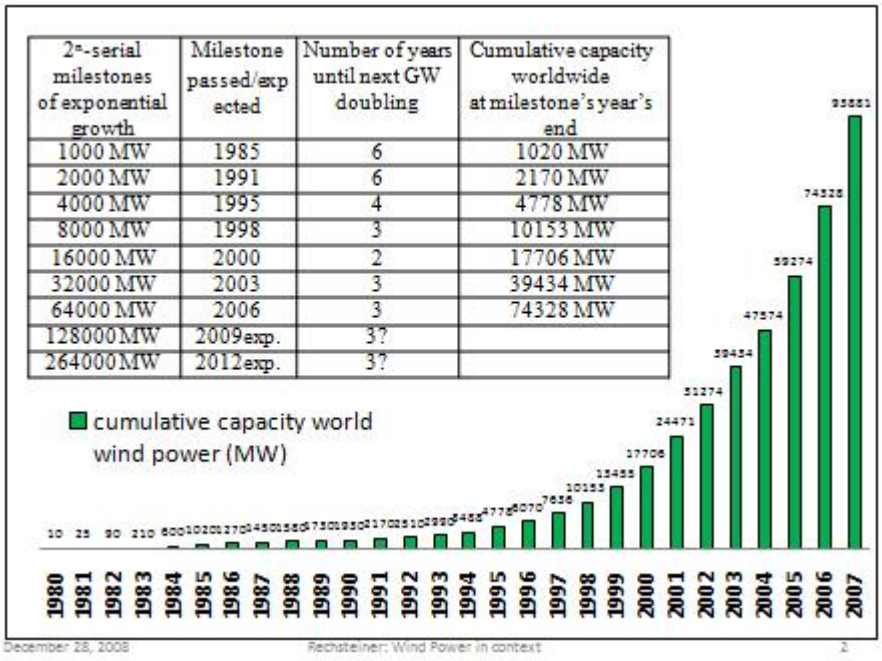

Figure 2

We have seen a decade of unprecedented growth in the wind sector. When in the 1980's and 1990s it took six years to double existing cumulative capacities in terms of 1000-MW-milestones, the observed rhythm now for world cumulative capacities is a doubling every three years. This rhythm is to be maintained up to at least 2012, expected by the most conservative forecasters such as the International Energy Agency (IEA) or Danish wind market experts BTM consult.

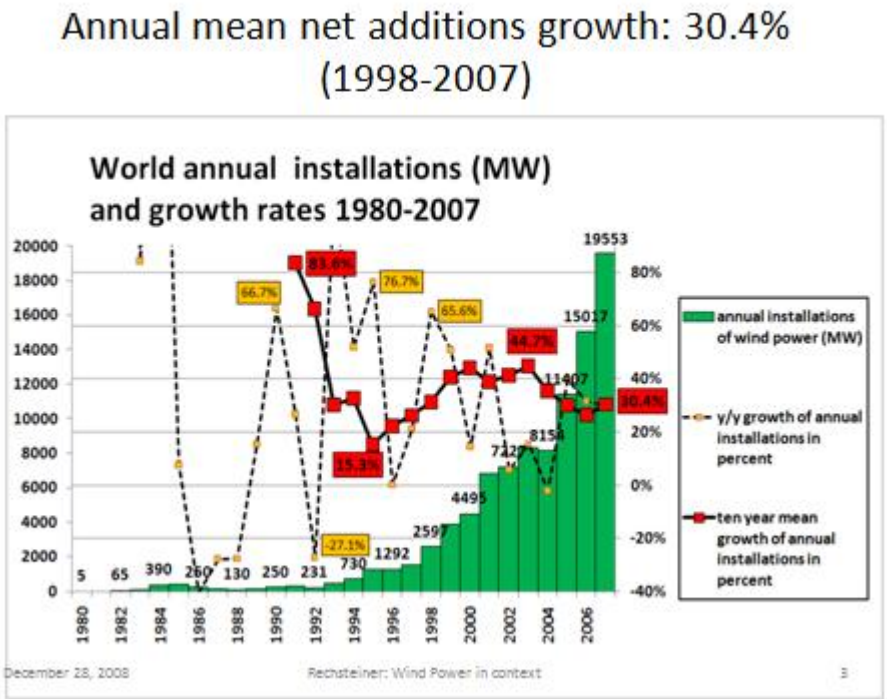

Figure 3

Wind power annual net capacity additions over the last ten years (1998-2007) have showed a mean growth rate of 30.4 percent per year, corresponding to a doubling of **annual net additions** every 2½ years.

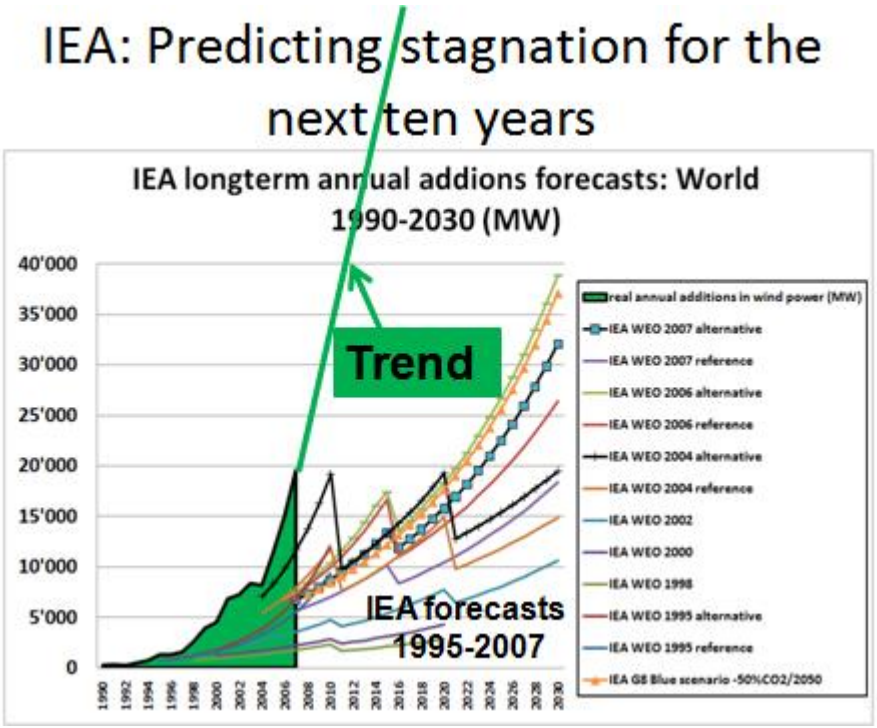

Figure 4

In 2007, annual net additions reached 19553 Megawatts, a level that most energy pundits failed to anticipate. Net additions, in 2007, were 417 percent bigger than the mean estimate published by the International Energy Agency (IEA), in its World Energy Outlook 1995-2004 editions.

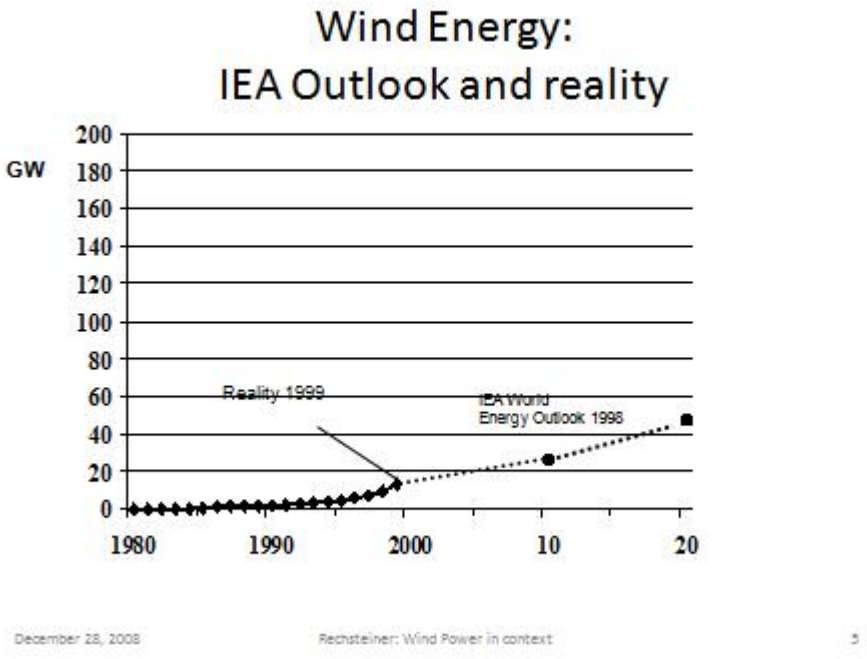

Figure 5

In fact the IEA leads the record in understating wind energy. In its 1998 World Energy Outlook the IEA made a forecast of some 47.4 GW of wind power by 2020. (1 GW = 1000 MW)

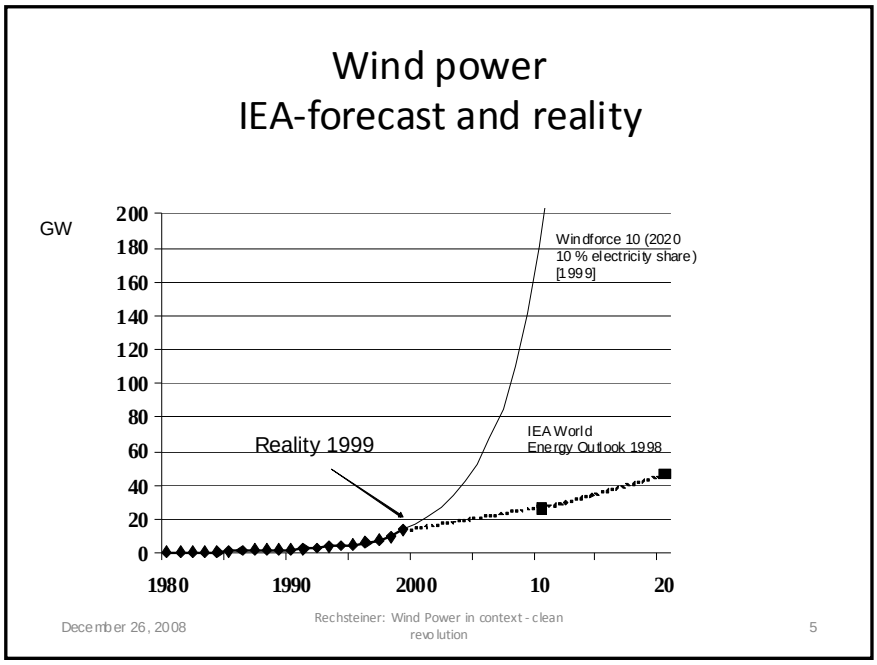

Figure 6

It was Greenpeace who in 1999 predicted that wind power will contribute at least 10 percent of world electricity and thereby exceed world nuclear power production by 2020.

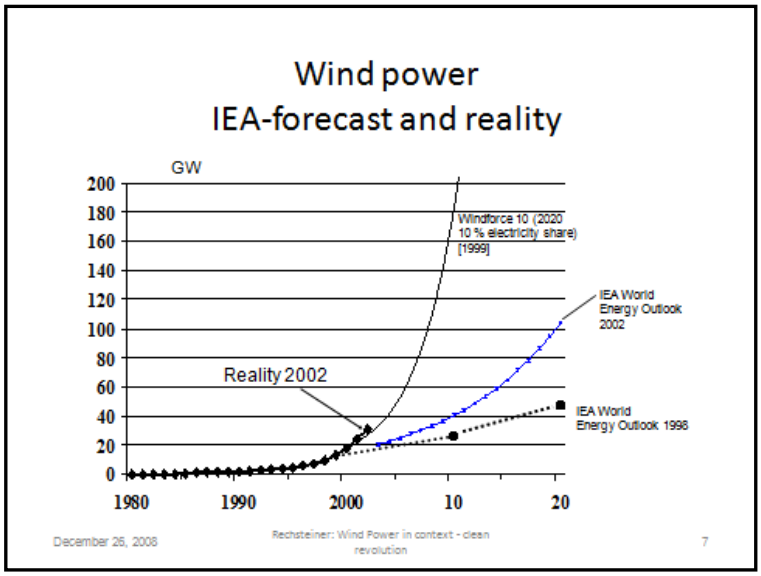

Figure 7

Apparently recognizing the unsoundness of earlier predictions, the IEA in its 2002 World Energy Outlook revised its forecasts from 47 GW to 104 GW wind power by 2020.

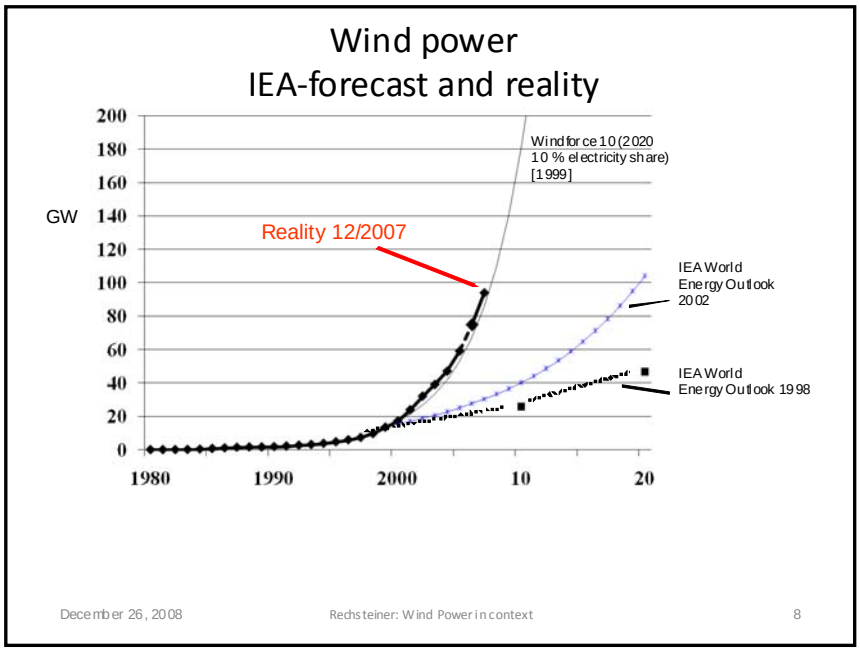

Figure 8

But again the IEA was missing the point. The 104 GW cumulative capacity was exceeded by real installations in summer 2008. Wind power has been growing slightly more dynamically than suggested in the Greenpeace 1999-vision “Wind Force 10”.

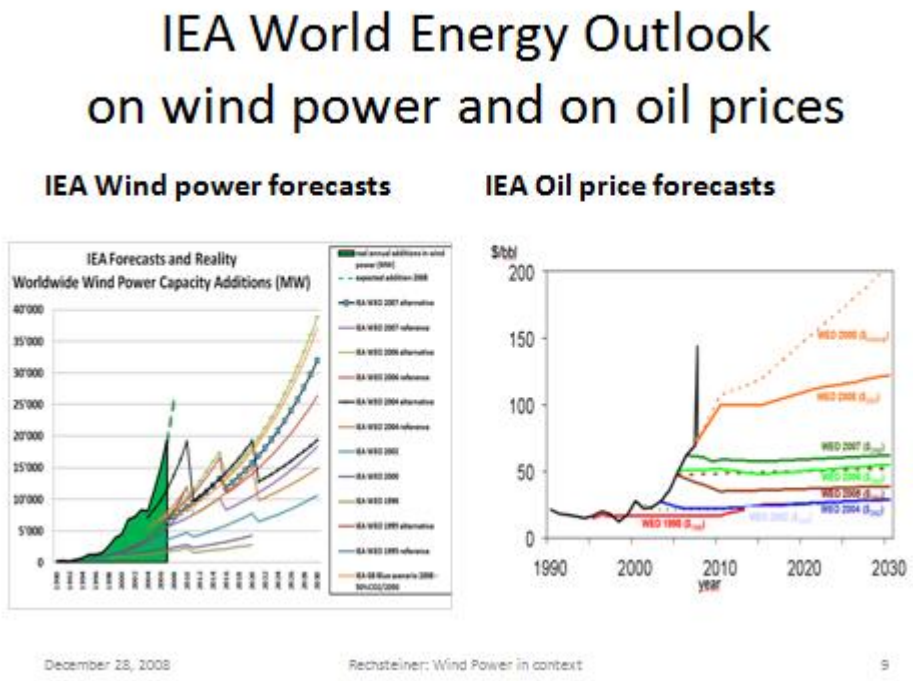

Figure 9

When we consider the IEA forecasts up to 2007, we find out that permanent stagnation or decline of the wind sector – measured in annual additions – compared to the visibly expected 25-26 GW addition of the past year 2008. Misleading data and failing forecasts have been delivered by an international tax-financed institution whose constitutional task would be to protect consumers from price hikes and to deliver energy security. This is also true vice versa for non renewable energy: As recently as 2002, IEA predicted an oil price of $29 per barrel by 2030. By summer 2008, we found out that a price of $50-$150 per barrel would be more appropriate – for 2008, let alone 2030!

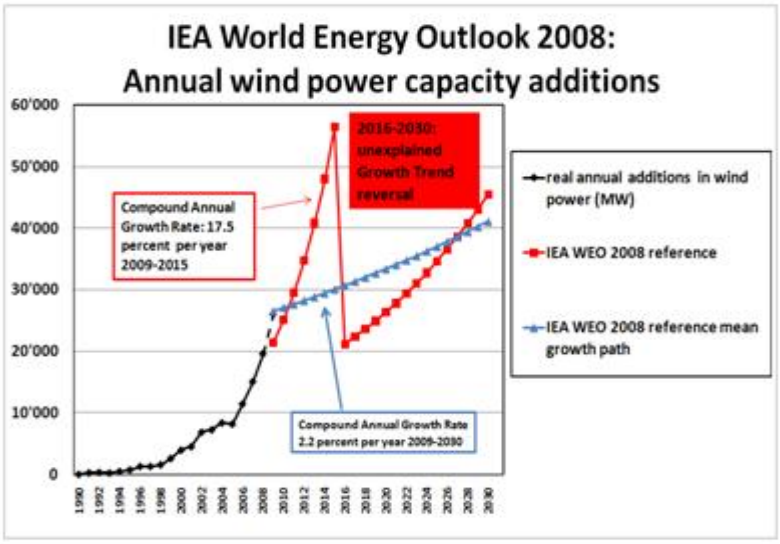

Figure 10

In its 2008-World Energy Outlook, published in past November, the IEA for the first time took a slightly different view on wind power and fossil fuel prices. The IEA acknowledges that the “risk of a supply crunch” for oil after 2010 could be ”driving up oil prices – possibly to new record highs”, but then fails to revise its forecasts for renewable energies.
Global wind output has been projected to grow fivefold from 130 TWh in 2006 to 660 TWh in 2015. But after 2015, cumulative wind power generation is forecasted to rise to 1,490 TWh by 2030 only. This translates into sharp reductions of annual capacity additions – from 57 GW per year in 2015 down to an average of 32 GW for the 2016-2030 period, a virtual stagnation compared to the 25-26 GW addition expected already for 2008, and a 2.2 compound average growth rate over the whole 2009-2030 period. No arguments are given by the IEA why the wind sector should suffer such a crisis by 2015 and after, compared with the 30.4 per cent growth rate over the last ten years 1998-2007.

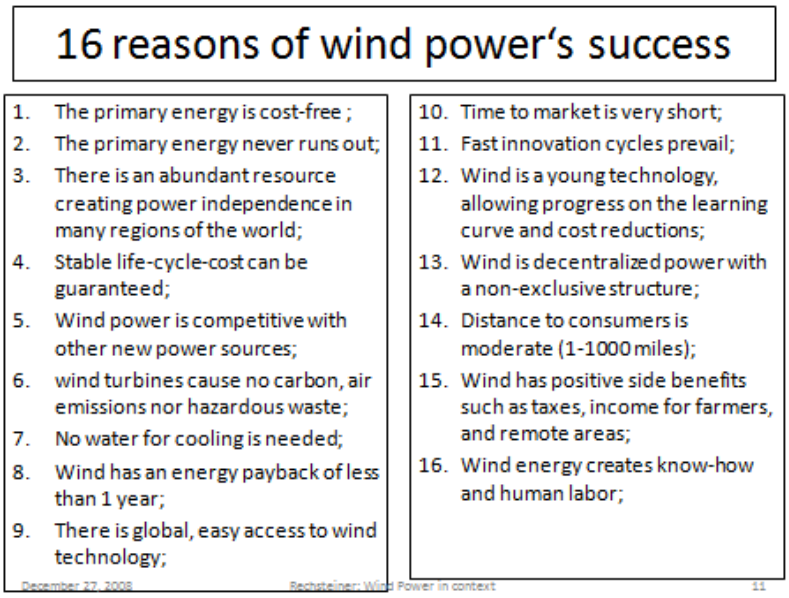

Figure 11

This study takes a different view, developing four global scenarios for the future of wind power, after scrutinizing growth trends and road blocks of the past.

It assumes that annual additions of global wind power will continue to grow over the next decades. The driving force for this growth is not ecological or moral motivations but the demonstrable economic advantages and supply security of wind power, including the abundant and cost free primary energy source (wind) which never runs out, easy technology access, short time to market, stable life-cycle-costs and continuous cost reductions due to progress on the learning curve.

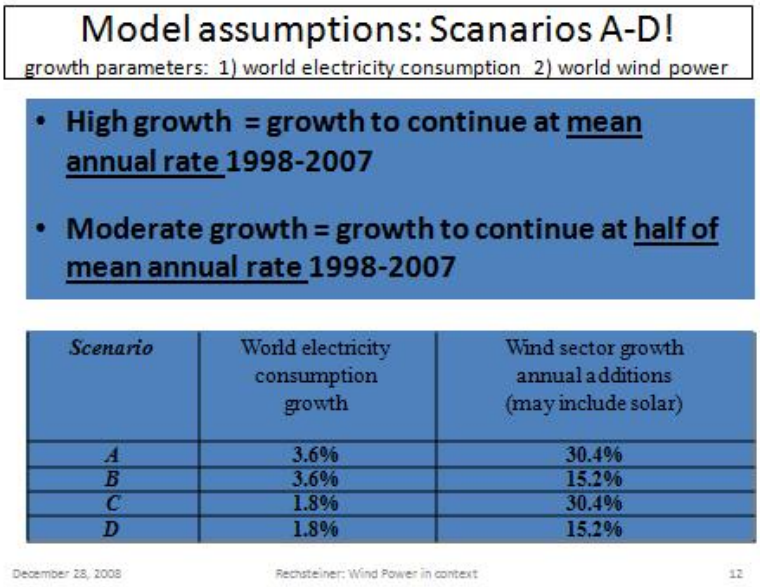

Figure 12

Our models start with two parameters variations: world power consumption and world wind annual additions growth. Wind power is seen as the most competitive new energy source, based on life-cycle cost estimates. Technical improvements will further propel the wind industry to deliver ever more affordable, secure and clean electricity at a very high speed that will be unattainable by more traditional technologies such as nuclear, natural gas or coal.

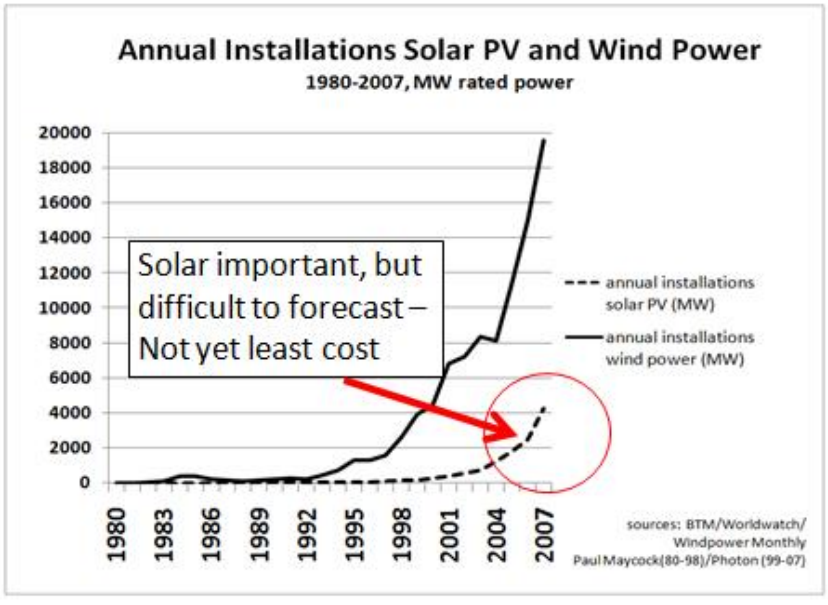

Figure 13

Some uncertainty exists regarding other renewable energies.
To successfully compete with wind power, other new renewable energy sources need to be as cost effective as wind power. This might be the case for solar energy whose annual additions

growth rate in 2008 stood at 60 percent (solar PV). For electricity generation, solar is more expensive than wind power so far. This will gradually change over the next decade. Solar will play an important part, and more renewable technologies might complement the wind sector, with hydro and biomass playing an important role for power management.
The graphs of the following scenarios therefore speak of a wind-solar sector, while not specifying the solar share, complementing or substituting wind power's growth, because there is too much uncertainty about the speed and extent of solar cost reductions.

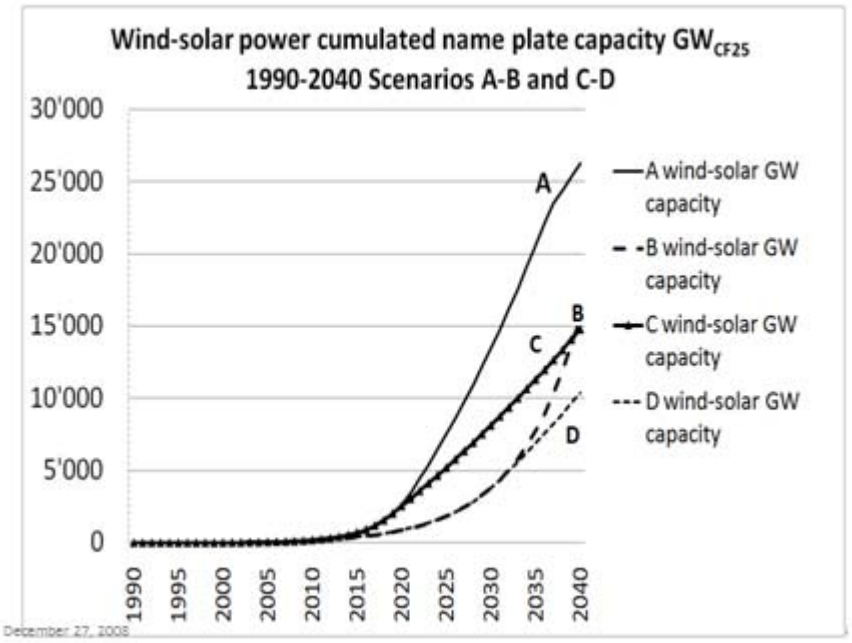

Figure 14

In scenario A, the observed mean annual growth rate 1998-2007 of wind power additions, 30.4 percent, is used as a proxy for further expansion. As a result, wind energy will have conquered a 50 percent market share of global new power plant installations by 2019 and a close to 100 percent market share by 2022, alongside with solar and other renewables such as hydro and biomass. These market share numbers are given in terms of effective new kWh produced, calculated on 100% annual availability equivalents. Counted in nameplate capacity it means that wind power's market share will stand at 7,500 GW in scenario A, 5,212 GW in scenario C and 1,837 GW in scenario B and D, exceeding any other technology much earlier. Nominal availability of wind turbines was calculated at a 25 percent capacity factor, meaning that the mean annual delivery per kW rated power stands at 2190 kWh.

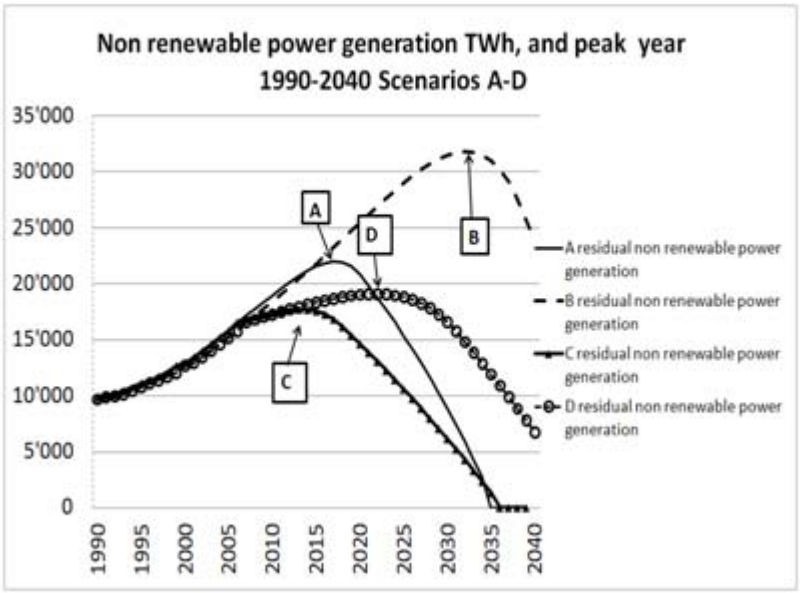

Figure 15

Scenario A and C would mean that a market clearing of renewables would take place over the next 15 years for **new** power plants. This doesn't mean that all the existing coal and nuclear power plants would disappear overnight. We would register a total wind generation worldwide of 16,400 TWh in scenario A, and of 11,414 TWh in scenario C. Global non-renewable power generation would peak in 2018 (scen. A) or 2014 (scen. C) and could be phased out completely by 2037. In Scenarios A and C renewables exceed 50 per cent of global electricity provision before 2025.

The situation in 2025 and 2040 scenarios A-D

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	Conventional (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%

Figure 16

In Scenarios B and D with a more moderate wind power growth (15.2 percent per year, half the rate historically observed 1998-2007) renewables are seen at 23 per cent or 32 per cent of global electricity provision in 2025, with a wind generation capacity of 1,837,000 MW worldwide by 2025, producing some 4023 TWh (alongside with a non specified amount of solar).

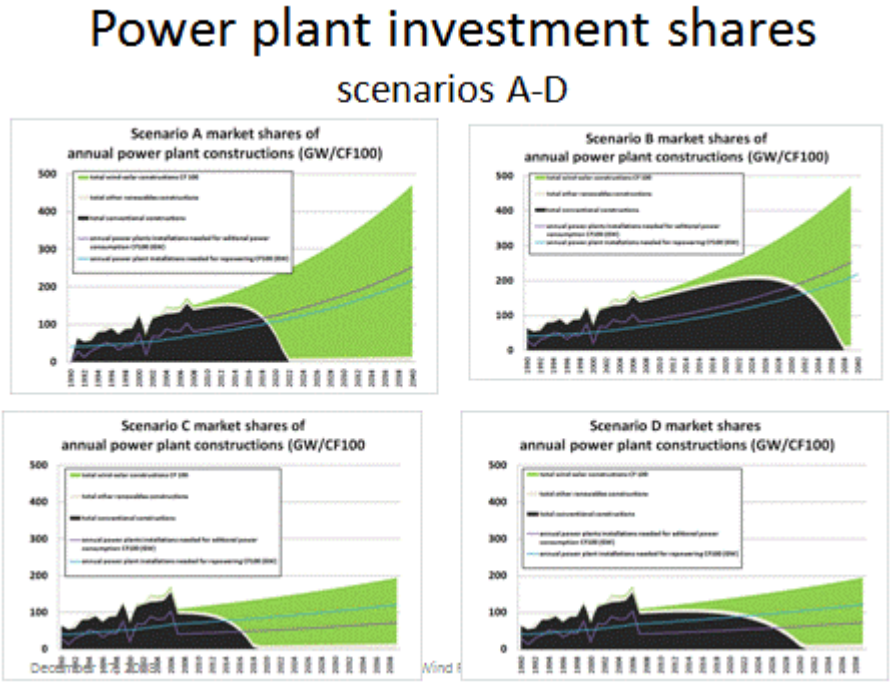

Figure 17

The next figure shows the market shares for new power plant investments. Scenario A would mean that a market clearing of renewable power plants would happen by 2022; The other scenarios, with half the annual growth rates for wind power or/and electricity consumption growth, show a market conquest of the wind sector (together with other renewables) in 2019 (scenario C), in 2031 (scenario D) or in 2039 (scenario B).

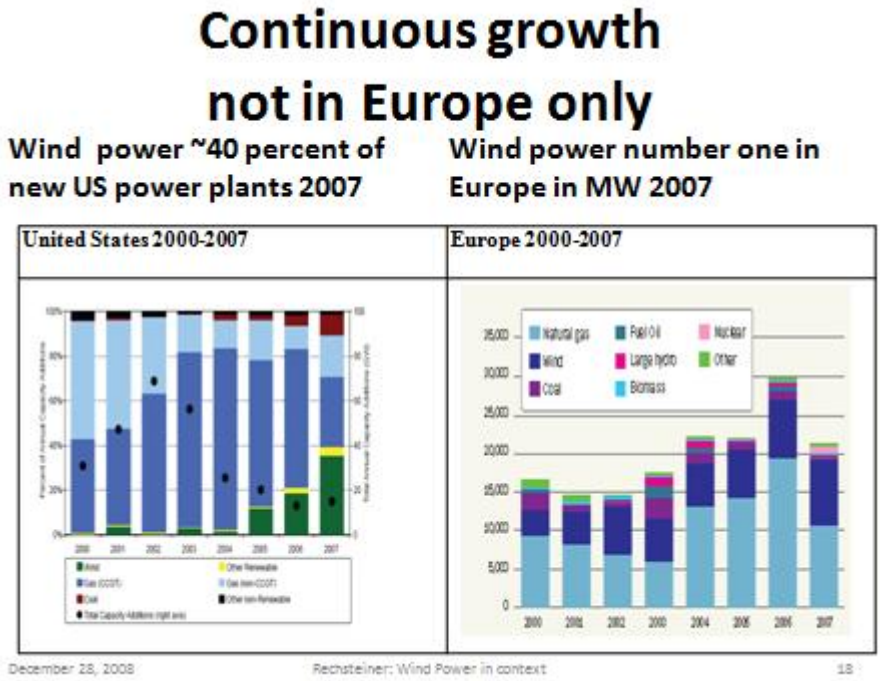

Figure 18

The shift toward a dominance of wind power in the power sector investments can be seen from the emergence of wind power in the US and Europe over the last ten years.
In Europe the decision for a 20% renewables share of overall energy consumption means that the renewable share in electricity generation might grow even faster than before because it is easier to grow renewable electricity than renewable transport or industry fuels. Recently it is China and India investing dramatically more than ever before into new wind [and solar] energy facilities.
We believe that the world financial crisis will not fundamentally change the outlook for wind power and renewables. While wind projects will not be immune in face of the credit crunch, the positive fundamentals are seen to persist, and some investors such as utilities tend to have deep pockets.
So far wind power equipments stay in high demand and for some components such as for offshore, deliveries still are in short supply.
Lower prices for copper and steel means that wind equipment can be produced at lower cost, and with new competitors at the market, wind power prices might recede, a factor that could accelerate demand in the wind business.
Oil and natural gas are limited resources. Some of the world's top oil fields are in production decline while for natural gas the situation looks equally critical. The current global economic downturn and the sudden fall in energy prices may, for a while, mask this phenomenon, but they won't change it in any significant way.

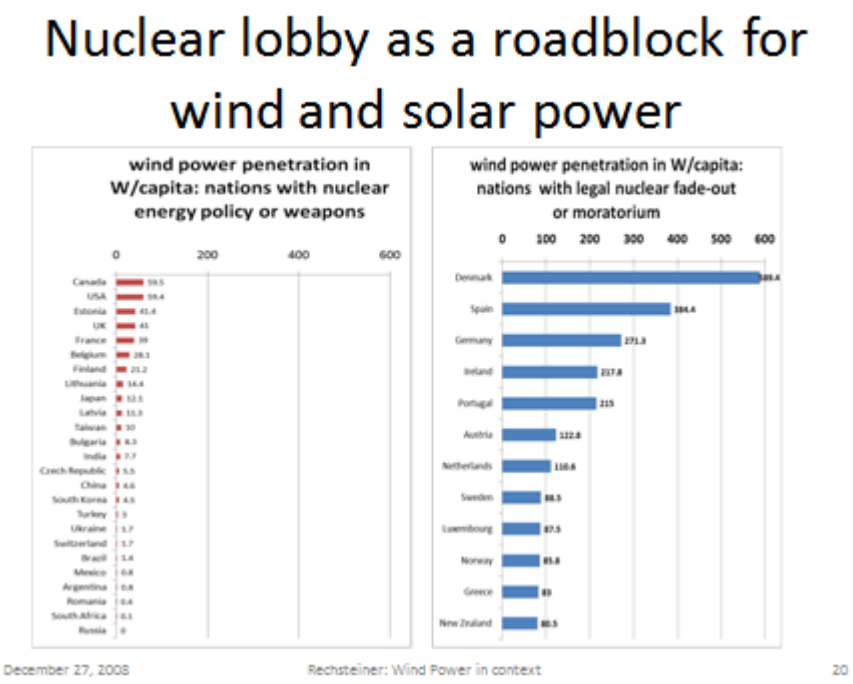

Figure 19

Our study concludes that roadblocks against wind power growth, such as fluctuations of wind, lack of grid connections and lack of reserve capacities, will be overcome through: planning, growing price incentives for new storages and interconnection, derived from the observed increase of oil prices and the restructuring of electricity markets (unbundling).
Wind power so far has not been specifically used where the best wind is. Rather it seems that wind power grew where the nuclear could be brought under control, by public decisions to fade it out or where nuclear never has started.
The twelve nations with highest wind penetration per capita are exactly those which said good-by to nuclear energy or which never started it; in nations dominated by nuclear lobbies and academia, wind power so far faces many obstacles such as discriminatory grid access, legal and permission hurdles, unfair price practices, etc.
In real terms, nuclear never has delivered as expected; its world market share is steadily declining. But its contribution in blocking wind and solar has been significant.

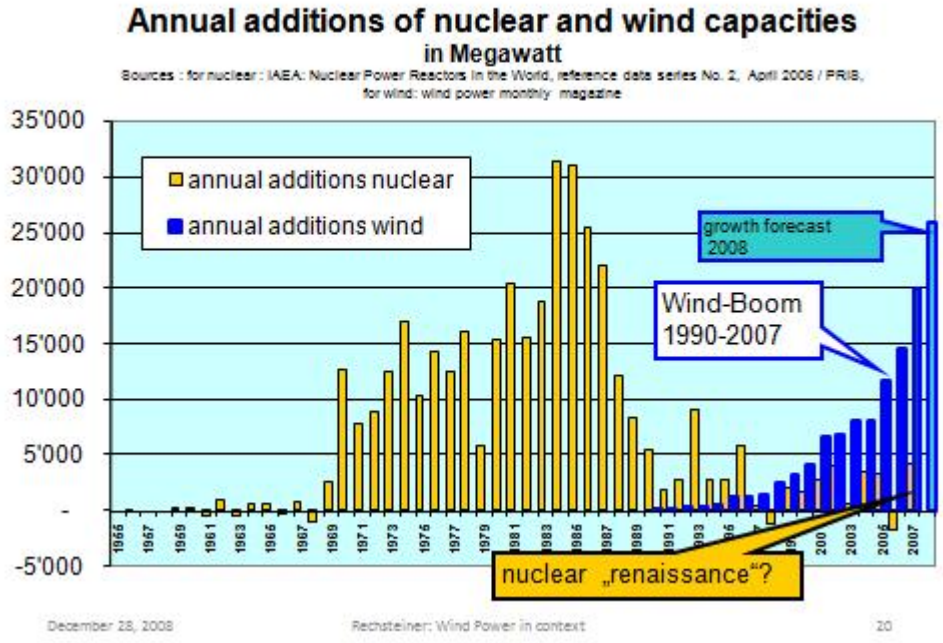

Figure 20

In an open electricity market with ever more transnational power lines, wind power will ever more play out its economic and ecological strength and it will not be stopped any more by a “nuclear power culture”.

Nuclear power has its own risks and its market share is continuously shrinking. A big capacity growth is not to be expected until 2020 – if ever – due to cost overruns, lengthy planning procedures, eroding knowledge and a shortage of components such as large vessels. A scarcity of uranium is looming, reflected in a price surge since 2000, and radioactive waste issues are unresolved as ever.

In the near future nuclear could well be reduced to a niche market compared to the emergence of wind and solar, and its advocates will find it ever more difficult to justify its necessity in the face of high costs and risks and an ever growing renewables sector.

Scenario	A	B	C	D
World electricity generation growth rate 2007-2040	3.60%	3.60%	1.8%	1.8%
growth of annual additions of wind power	30.4%	15.2%	30.4%	15.2%
Moment of renewable generation surpassing annual consumption growth (TWh)	2019	2034	2015	2023
when will wind power cross a 50% market share of all new installed power plants (CF100-equivalents) [new installed = additions + replacements]	2019	2033	2017	2026
how much GW wind-solar power capacity would there be in 2030? (CF25)	13457	3782	8126	3782
how much wind-solar power would be produced in 2030 (TWh)?	29471	8283	17796	8283
how much other renewable [hydro, biomass, geothermal] power would be produced in 2030 (TWh)?	5120	5120	5120	5120
how much non-renewable power would be produced in 2030 (TWh)?	10290	31475	7070	16583
how much non-renewable power would be produced in 2040 (TWh)?	0	23780	0	6714
peak year of non-renewable power generation TWh (and CO2-peak)	2018	2032	2014	2022
peak TWh of nonrenewable power generation	21969	31794	17703	19091
total nonrenewable electricity generation 2008-2040 (TWh)	432,978	860,192	354,091	531,543
when will CO2-emissions for the first time be lowered compared to 1990 (Kyoto-benchmark)?	2031	after 2040	2028	2038

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Figure 21

Wind and solar, accompanied by hydro power, biomass and geothermal energy, will pave the way to a 100 percent renewable power generation, very probably within the first half of this century.