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Peak Oil: What can Politics do?

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Ladies and Gentlemen

Peak oil means: We live in a time of transition. Investors do not realize the situation yet – they see the oil peak as an opportunity for short term profits. And some politicians we all know start wars for that.

But prices talk – and start to hurt.

Wasting energy now is making you uncompetitive. And wars are expensive, they bring much suffering and no relieve.

50- or 60-$-a-barrel-oil opens new opportunities.

We have energy efficiency devices like insulation or modern public transport. And we have renewable energy systems, many of them booming right now.

A new rule will emerge: "*Tax your energy consumption or you will be taxed by Opec*." OPEC's income at 50 $ a barrel stands at more than 500 billion $ a year, and prices will rise more over the next years.

[1] Rudolf Rechsteiner is the author of "Grün gewinnt – die letzte Ölkrise und danach", Zürich 2003 [title translated in English: Green will win - the last oil crisis and after – Zurich 2003] The entire book (meanwhile sold out) and graphs can be downloaded free: www.rechsteiner-basel.ch

The Oil World and the Renewables World

The Oil world

1 barrel = 159 l = 1590 kWh_{th}

1 kBd = 159 t = 1590 MWh_{th}/d

The Renewables World

1000 Barrels/day (1kbd) =

- 0.6 km2 daily solar insolation (Europe)
- 3.9 km2 daily solar electricity (15% eff.)
- 29.0 km2 daily wind onshore [=0.58 TWh/year]
- 19.3 km2 daily wind offshore [=0.58 TWh/year]

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Figure 1 Oil world and renewable world

So let's take a look at what renewables can offer (Figure 1).

You all know the oil world

1 barrel =	159 l = 1590 kWh_{th}
1000 barrel a day (1 kbd) =	159'000 l = 1590 $MWh_{th/d}$

Many people in the oil business are not used to think in renewables. So let's get some things clear:

- 0.6 km^2 area of land daily receive the equivalent of 1000 barrel of solar insolation (Europe) each day (Central European insolation is ~1000 kWh/year/m^2)
- 4 square km daily get 1000 barrels solar electricity at a medium 15% efficiency
- If you want 1 kbd (1000 barrels a day) in electricity from wind, you need around 10 square kilometers onshore at 2000 FLH (Full Load Hours) a year or some 6 square km daily wind offshore with 3000 FLH a year.

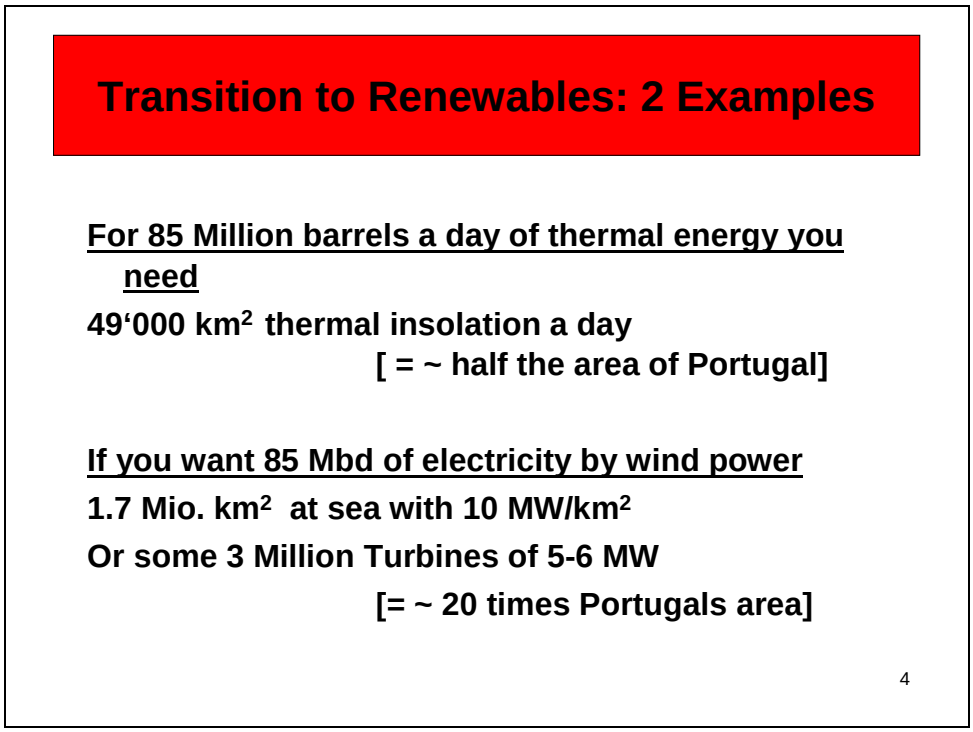

Figure 2: Examples of the potentials of Renewables

Let’s make two examples (Figure 2):

The oil consumption in 2005 is some 85 Million barrels a day. 85 Million barrels a day of purely thermal energy correspond with a medium Central European insolation of an area of 49‘300 km^2 in size which is about half the area of Portugal.[2]

If you want 85 Mbd of electricity by wind power[3] you need some 1.7 Mio km^2 of less than 45m sea depth, with 2 turbines each square km.

So this would be some 3.4 million turbines of 5 MW on a square area of around 20 times Portugal’s surface.

Please note the big variety of renewable energies. There exist more technologies than just offshore wind, namely hydro power, biomass, geothermal heat, wave and ocean energy, solar energy (thermal/PV/solar-thermal electricity) and onshore wind. I am concentrating on wind right now, as an important example, but we will remember the other technologies.

[2] This is measured in pure energy content, which of course is not the same as oil.

[3] This is measured in electricity units which of course is not the same as oil. You need three entities of oil in a power plant to generate one entity of electricity. Oil systems and electricity systems are entirely different. Regarding the “inner value” of electricty, its capacity to do work and to be transported, electricity is not as such less valuable than oil. But the private transportation sector for more than one hundred years was based on oil, so there will be some hardships in transition form an oil system to an integrated electricity system, based on renewable energy.

Renewables can fill the gap effectively:
no pollution, no risks, no wars, no nuclear threats

Wind power as an example:

- It started in Denmark
- Turbines of 500 kW (around 1995) in the Baltic Sea

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Figure 3 One of the first Danish offshore installations in the Baltic Sea (Tuna Knob/ Vestas turbines)

Off shore wind power started in the Baltic Sea in the 1990ies with small turbines of 500 kW, here a picture of a Danish wind farm erected in 1995.

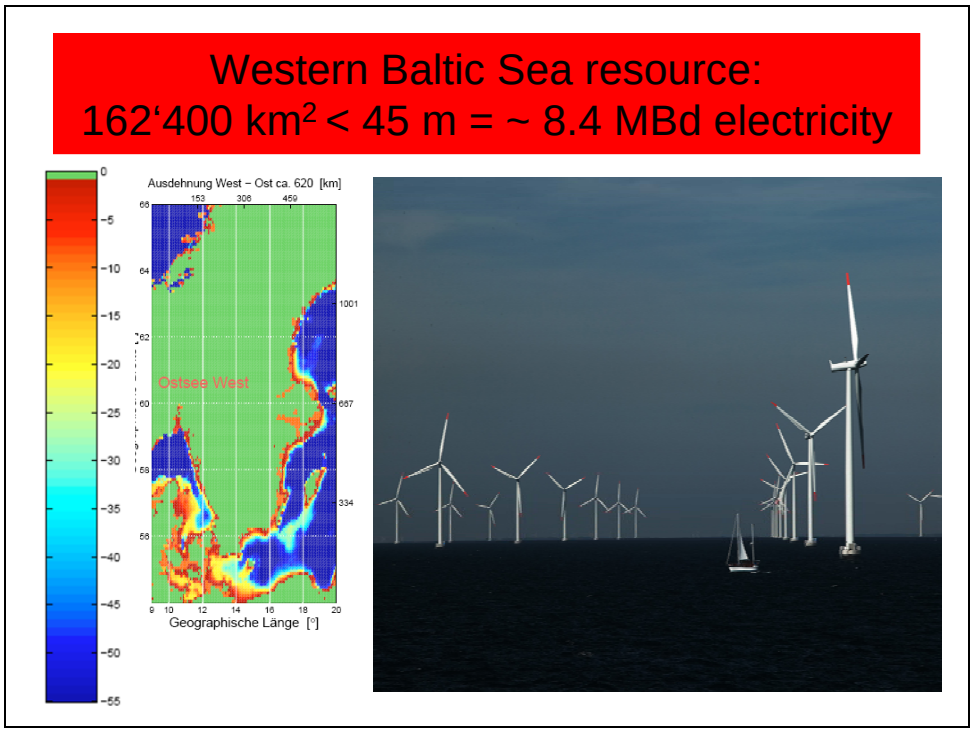


Figure 4 sea depth profile of Western Baltic Sea, Offshore Wind Farm (Nysted)[4]

If you look at the Western Baltic Sea area you have some 163‘000 km^2 with less than 45 m depth; they can bring you theoretically the equivalent of around 8.4 Million Barrel a day[5] in the form of electricity[6] or some 4900 TWh/year.

This picture on the right side shows the state of the art of a Danish offshore wind farm (Nysted), opened in late 2003.[7]

[4] All sea depth profiles are calculated by Gregor Czisch /deutsches Institut für Solare Energieversorgungstechnik: Seebodenprofile in ausgewählten Gebieten in und um Europa, http://www.iset.uni-kassel.de:80/abt/w3-w/folien/Windenergie/offshoreflaechenauswahl_2.pdf

[5] Calculation: 1 km^2 offshore has 10 MW of wind an an average of 3000 Full load hours a year; this gives you 82.19 MWh a day which corresponds to 0.05 kbd (kilo-barrel per day)

[6] Electricity measured in purely thermal units. In reality, you need some 24 MBd of oil to produce 8 MBd of electricity.

[7] It is the Nysted offshore wind farm, constructed by Bonus (now Siemens Wind) with turbines of 2.3 MW capacity.

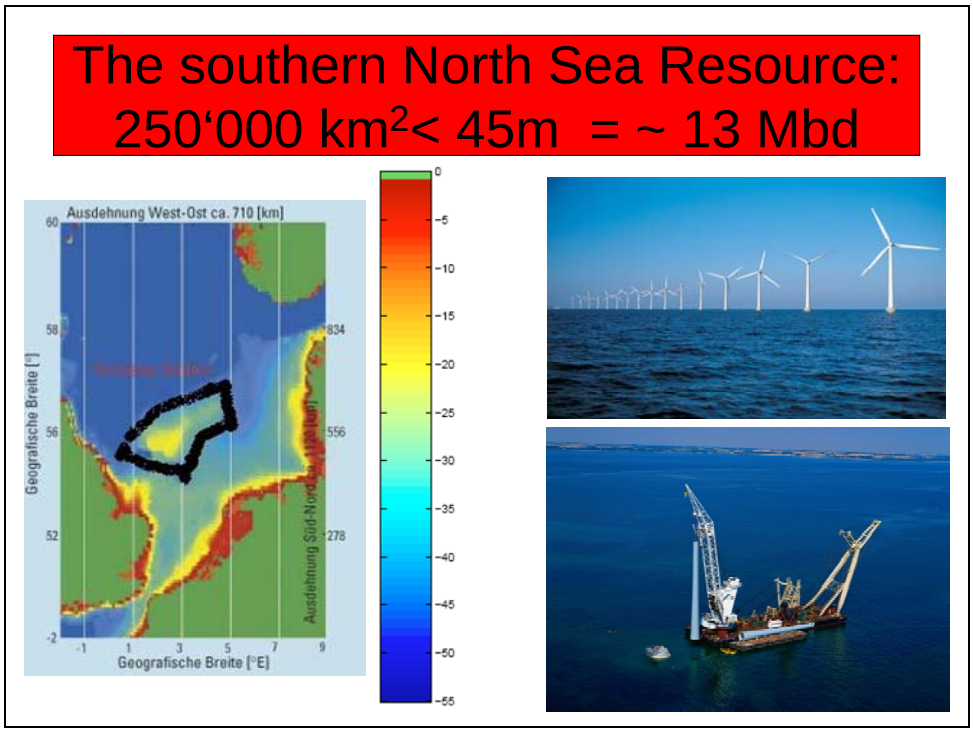


Figure 5 Sea depth profile in the Southern North Sea, construction of offshore wind farms

Take a look at the Southern North Sea wind resource: there are some 250‘000 km^2 with less than 45m depth. This area has a potential of 13 Million barrel a day in wind power (electricity), which is some 7’500 TWh/year.

The black polygon on the yellow sand bank called Dogger Bank could deliver the entire electricity consumption of the European Union (EU-15) which stands at some 2000 TWh/year – a picture to show you the dimensions and potentials of wind power.

Of course one never would put all these turbines in one place for obvious reasons.[8]

[8] Intermittency of wind can be overcome by distributing wind power installation over vast areas. The bigger the distance of wind farms and the better their interconnection, the lower the probability that there is no wind in each place at the same time. Many different places, combined with good interconnection and some hydro power as a back up can smooth out intermittency of wind energy as bulk power.

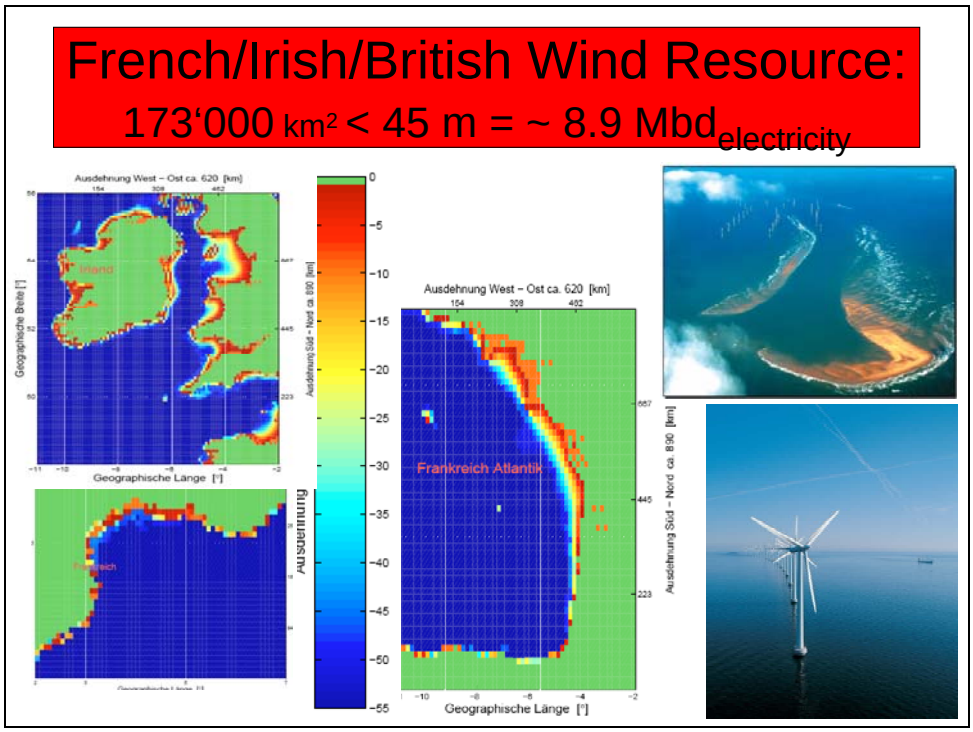


Figure 6 Irish, British and French sea profiles, offshore wind farms[9]

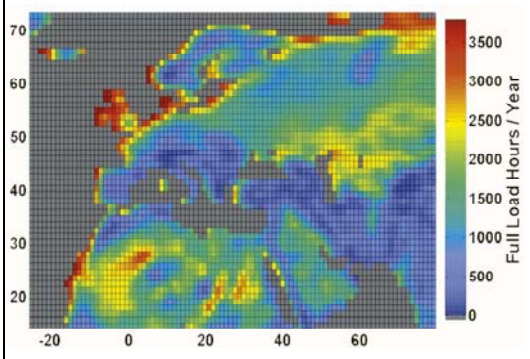
The French, Irish and British offshore Wind Resource with sea depth of less than 45 m is more than 170‘000 km^2; harnessing this wind by putting 10 MW a km^2 would deliver the equivalent of some 9 Million barrel a day or some 5200 TWH/year.

[9] It ist he new British Scroby sands wind farm (erected 2004) and the Middelgrunden wind farm at the shore of Copenhagen(below, erected 2001)

360 MBd Stranded Wind energy (Europe)

at least 1000‘000 km^2 off-shore < 45 m = ~ 51 Mbd$_{electr}$

at least ~1200 TWh/a on-shore = 310 MBd$_{electr.}$



Resource Offshore	km2	"kBd" (Electricity)
Baltic Sea West	162'400	8395
Baltic Sea East	131'000	6772
Russia	185'000	9563
North Sea South	249'000	12872
Ireland	101'000	5221
Scotland	42'000	2171
Norway North	29'000	1499
Middle Norway	13'000	672
France West	21'200	1096
France South	8'900	460
Spain & Port	15'000	775
Turkey	31'000	1602
Iceland	30'000	1551
Total	1'018'500	51098

Figure 7 wind atlas of Europe and neighboring area, measured in yearly full load hours[10]

When we take a look at the onshore wind resource of Europe and its neighbors we find even more opportunities to harness wind power.

All together we have more than 360 Million barrel a day of wind power on the European continent and its surroundings, offshore included. This corresponds to some 208’000 TWh – more than 50 times the actual consumption in this area.

This vast potential means that we have a very high flexibility in siting wind turbines. We do not need wind turbines on every hill or on every coast strip.

For a useful application of wind power we are talking about some one percent of land or low depth sea area to deliver more than half of our electricity consumption by wind power, organized in a large regional framework.

All this wind power is “stranded wind” right now, like “stranded gas” in the fossil fuels business. It is “stranded wind” not for its cost, but for the lack of wind power pipelines: there is no grid to transport this power from where it is

[10] Gregor Czisch: Global Renewable Energy Potential and Approaches to its Use, **http://www.iset.uni-kassel.de/abt/w3-w/folien/magdeb030901/**

harnessed to where it is needed. Some of the most productive wind areas are in the periphery of Europe.

The creation of a “Super-Grid” from these distant areas to the large cities and population centers is one of the main tasks for the European Union. It can provide enhanced energy security and it can smooth out the intermittency of wind power to a large degree.

But even today we find many places where the wind is blowing near by the big cities, like in Brittany, near Paris, or in the Outer Thames Estuary, near London, where a first big offshore wind farm is erected right now, and many will follow suit.

So the good news is that we can start with the cheap and close places first, and we will harness the wind from distant places later, when production costs will be driven down even further.

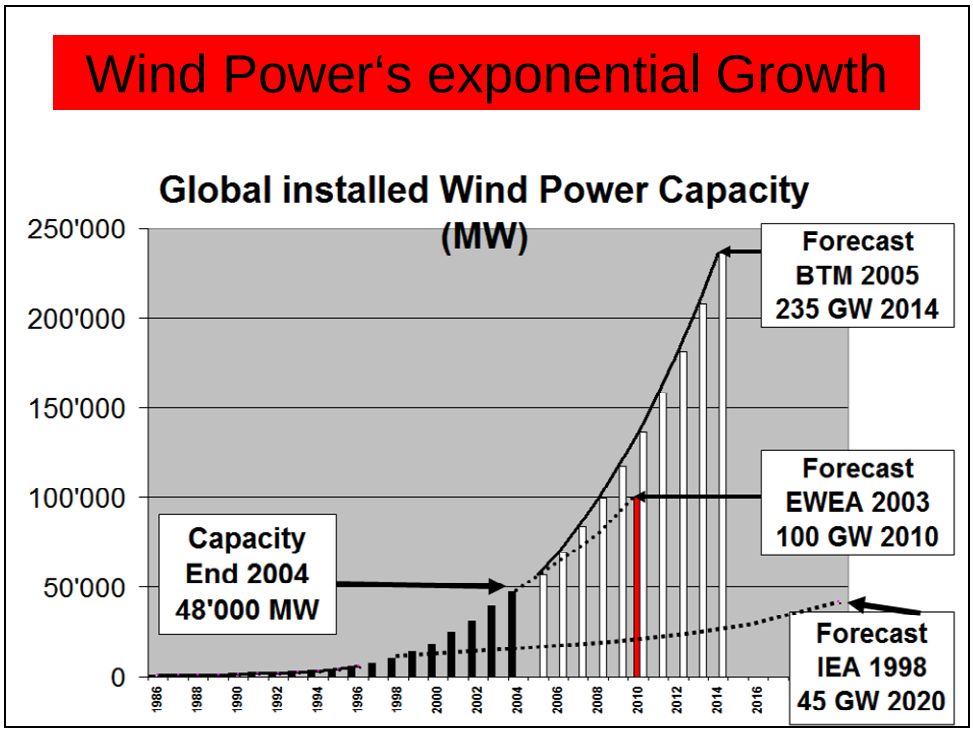


Figure 8 development of global wind capacity and forecasts

The wind business moves fast. Global wind power capacity grew more than tenfold within the last ten years and another factor 5 of growth is expected for the next 10 years, so says the most prominent wind market analyst, BTM consult.[11] So in ten years there will be a quarter a million wind turbines delivering electricity for more than half a billion people on a global scale, exceeding 1 Million Barrel of oil equivalent a day.

It is remarkable that the International Energy Agency (IEA) was – and still is – completely out of touch with wind and renewable energy, forecasting a capacity of 45 GW of wind power by the year 2020 in its World Energy Outlook 1998. The 2020 IEA-forecast of 45 GW was surpassed in 2004. Despite their compelling advantages, new renewable energy sources are consistently ignored as being economically non viable by the IEA. IEA is more a nuclear power and fossil fuel broker than anything else, misleading governments and non governmental organizations by a phenomenal, but rarely analysed, degree.

[11] http://www.btm.dk/documents/pressrelease.pdf

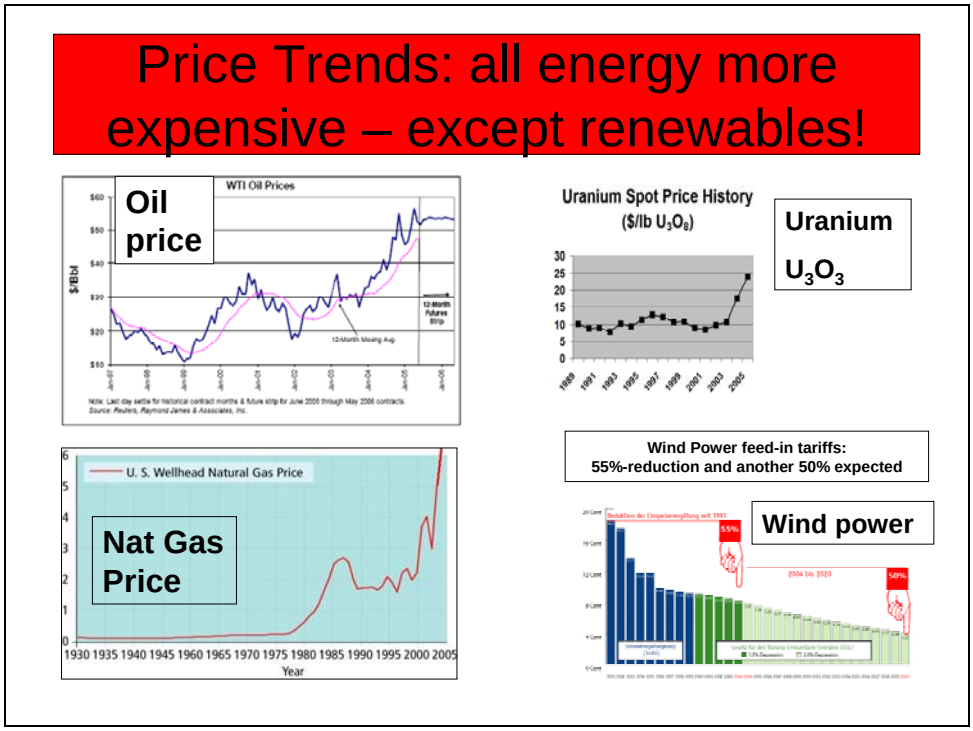


Figure 9 Price of oil, natural gas, Uranium and the German feed in tariff compared

So let's have a look at costs and prices.

In the energy field we find out that everything gets more expensive: Oil, Natural Gas, Nuclear, yes even coal deliveries bear rising costs.

But some thing gets cheaper every year: renewables, and especially wind energy.

The German Feed in tariff was reduced by a real 55% over the last 15 years and will again be cut by half within another 15 years. Onshore wind turbines are competitive today.

And wind as a primary energy source is free. There is no OPEC to control and ration wind power.

From the first moment of a project you know the costs of electricity for the next 20 years, because the cost consists mainly of capital expenditures and costs of operation and management are miniscule. There is no fuel cost risk.

Once the capital is written down, a wind turbine produces at a cost of some 1 €Cent/kWh.

Can wind power work fast enough?

- Construction time: < 1 year
- Best places not developed.
- gets cheaper every year by 3-5%
- Turbines skaling up:
  - 0,1 MW 1990
  - 0,5 MW 1995
  - 2 MW 2000
  - 3 MW 2004
  - 4-5 MW 2006/7 expected (in test since 2001)

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So the question emerges if wind power works fast enough to replace oil, gas or nuclear power in a time of depletion of fossil fuels and necessary phase out of nuclear power.

And indeed it can – supposed that you have a permission framework where utilities readily can place their orders, which is not the case yet in many countries like France or England, where a strong nuclear lobby keeps resistance high, also hindering a stable payment system for wind energy investors.

Wind power has many advantages though, compared with other energy systems, and fast growth will continue:

- Wind power potentials are abundant in all regions of the world and unlimited on a time scale.[12]
- You have construction times of less than one year for wind farms.
- The best places are not developed yet.

[12] A new global wind power map has found enough wind energy to easily supply the world's power, according to the American Geophysical Union (AGU). Researchers from Stanford University collected wind speed measurements from about 7,500 surface stations and 500 balloon-launch stations to determine global wind speeds at 80 meters (300 feet) above the surface, which is the hub height of modern wind turbines. Using a mathematical technique to extend those results over the entire globe, the Stanford researchers report that nearly 13 percent of world experiences winds with average annual speeds of 15 miles per hour, which the researchers consider strong enough for power generation. The authors found that the locations with suitable wind resources could produce about 72 trillion watts of power and that capturing even a fraction of that energy could provide the 1.6-1.8 terawatts that made up the world's electricity usage in the year 2000. **http://www.agu.org/sci_soc/prrl/prrl0514.html**

- Wind gets about 3% cheaper every year in real terms, due to technological progress and economies of scale.
- New, bigger and cheaper wind turbines come to market: 3 MW in size since 2004, 5 MW in size from 2007 on. One such turbine generates enough electricity for some 5000 European households.

Wind Power now at 20-60 €/Barrel

- Wind power on good onshore site is now at 4-5 €C/kWh
- This corresponds to 21 € per „barrel oil for electrity“ with a 33% conversion efficiency
- Wind is at 60 € per barrel on a purely thermal comparison
  - Off-shore wind is not that cheap yet, but cost reductions are expected
- Renewable electricity reduces overall energy consumption:
  - Electric Motors are more efficient
  - Plug-in hybrid vehicles available soon
  - Heat pumps and solar for space heat

Figure 10 the price of wind power compared

Wind power on good onshore sites costs now 4-5 €C/kWh. This is 21 € per „barrel electricity“ on a 33% efficiency or 60 € per barrel heat on purely thermal comparison. Offshore wind will arrive at the same low costs within the next ten years, because offshore wind is blowing more hours a year.

Renewables on a big scale can lower overall energy consumption and energy bills:

- Electric Motors are more efficient than internal combustion engines
- Plug-in hybrid vehicles will be available soon
- With heat pumps for space heat you can cost effectively save oil and gas.

What policy can do: Super-Grid, Feed-in law, Taxes on non-renewables world wide

1. **We need a continental-wide Super-Grid**
   - **Smoothing intermittency**
   - **Earn low hanging fruits**
2. **Diversity for security:**
   - **feed-in-laws for all renewables**
   - **Solar, biomass, geothermal,**
3. **Stop subsidies for non-renewables**
   - **Promote efficiency**
4. **Tax all non-renewables world wide**

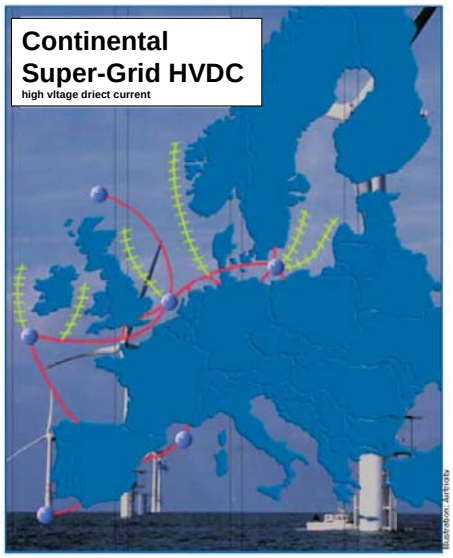

Figure 11: What can policy do

So what can policy do? The investment in renewables will be a big business for the *private* sector. What the *public* sector can do is introducing a benign framework for renewables:

1. For renewable electricity grid connection is crucial. This burden should be paid for by all consumers. With a continental-wide High Voltage Direct Current-Grid (HVDC) you can smooth out the intermittent character of renewables, solar, wind and hydro, and you earn the low hanging fruit in those good places, where the wind is strong and where the sun shines more hours a day.

A continental super grid and guaranteed grid access for all renewables give you more diversity in renewable technologies. This can enhance electricity production and security of deliveries. The more diversity the more security.

2. Develop solar, geothermal, biomass, hydro, wave power *and efficiency* on a level playing field. To do this we need feed-in-laws like in Germany, Spain, Portugal, China or elsewhere. Investors need investment security for the calculated life time of these renewable technologies.

Oil, gas, coal and the nuclear lobby pretend solutions for oil peak. They all live from subsidies and they are risky in many aspects: depletion, persistent radioactivity, environment, climate and international conflicts. So we should not subsidize these fuels any more.

3. Promote efficiency: Tax all non-renewables world wide, abolish all subsidies for non-renewables, beginning with nuclear and coal.

4. Introduce a minimum tax on non-renewable energy and reduce other taxes, and start harmonizing energy taxation as part of the WTO treaty. Many renewable energy technologies are competitive today, and will be even more with soaring oil prices. They can bring a lot of advantages to the early movers, and they are inexhaustible, giving access to basic energy service for everybody in any place of the world.