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Renewable Energy and Efficiency: The European Path for mutual prosperity

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Figure 1

Content

1. Introduction

In West and East, energy and climate change have risen to the top of the agenda.

It might be that the perceptions of these by energy exporters and by energy importers are not the same. But I'll try to show you that there are common issues and common solutions to be found!

For many years, Sustainable development has been on everyone's lips. It is endorsed by the Swiss Constitution…

Figure 2

But despite these constitutional words the Swiss – and World's – consumption of non-renewable energy is growing to new records year after year. The Kyoto goal – a reduction of CO_2-emissions by 10% from 1990 –will not be achieved in Switzerland.

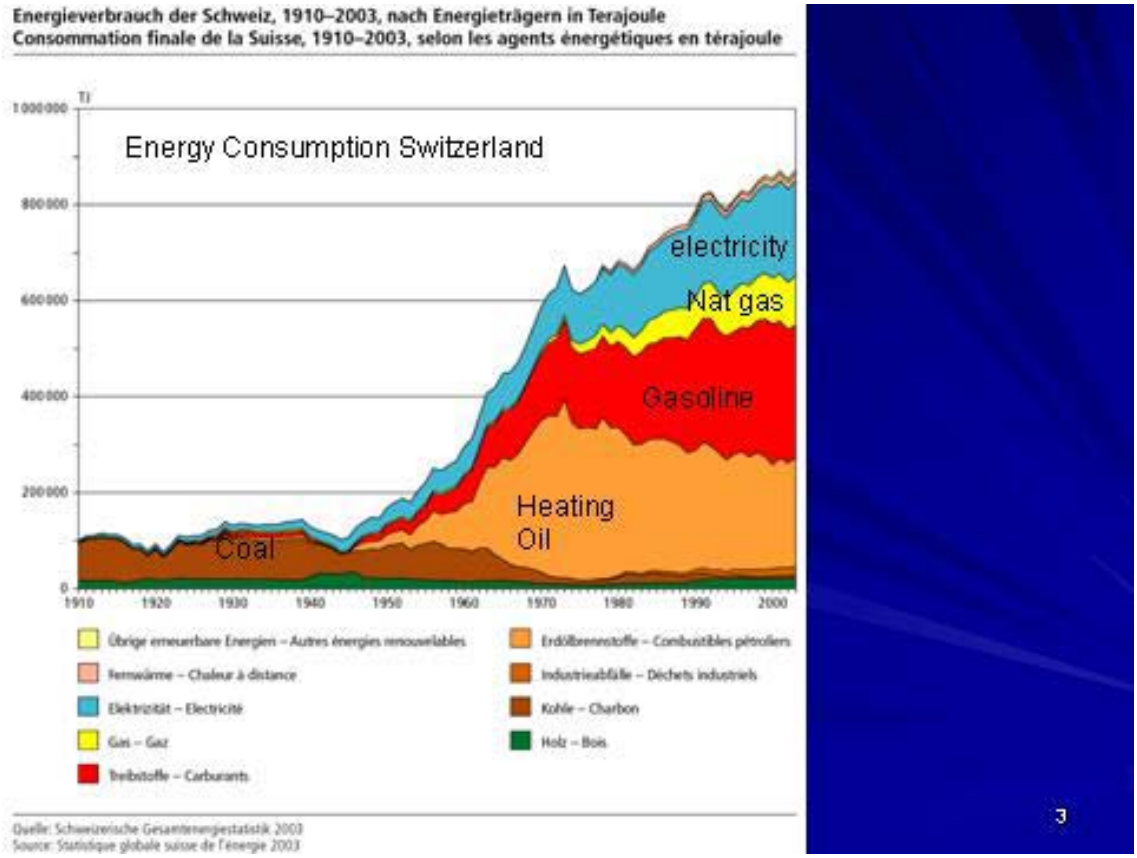


Figure 3

For decades our energy consumption grew by the use of mainly non-renewable energies. This worldwide attitude has lead to an acceleration of greenhouse gases in the atmosphere. Rising temperatures provoke floods and devastation.

Figure 4

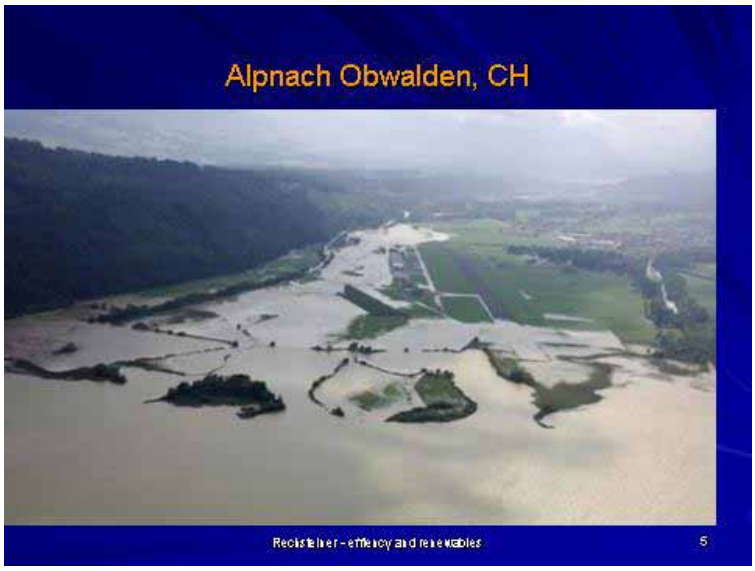


Figure 5

Figure 6

Since about 1990 we register more extreme weather events that are changing the landscapes, and the minds in Switzerland and elsewhere.

Meanwhile almost every other year, floods are streaming into cities.

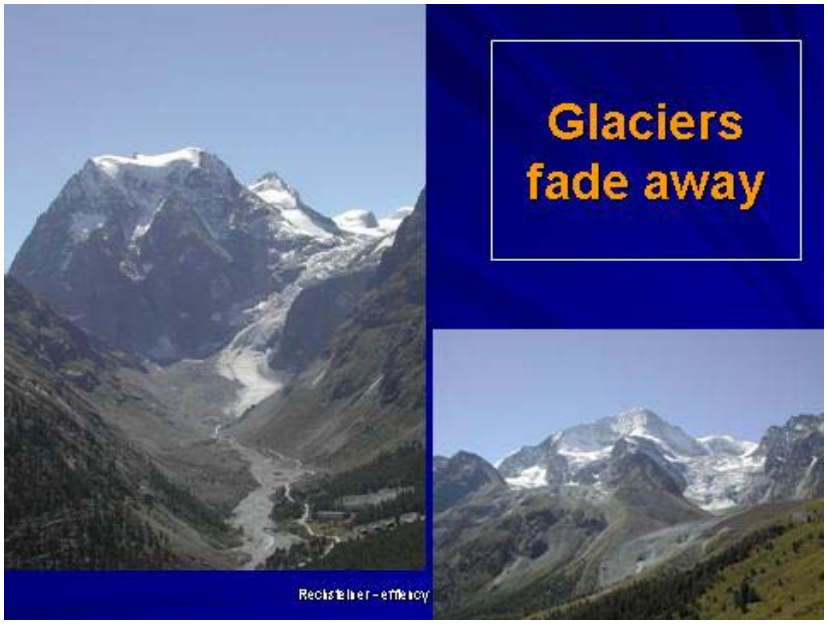


Figure 7

Switzerland's mountain regions are particularly sensitive to the impact of climate change. Extreme winter and summer temperatures cause glaciers to fade away. The risks posed by natural hazards to infrastructures are growing. Forecasts predict that the main parts of our glaciers will disappear within the next 50 years. A certain level of urgency is recognized now.

2. Swiss goals of energy Policy

Limiting the average global temperature rise to two degrees Celsius will necessitate a reduction in worldwide greenhouse emissions of between 45 and 60 percent. In view of the developing countries to catch up industrially, reductions of up to 80 percent will be required in the developed world by 2050.

The Swiss government therefore is endorsing the vision of a 2000-Watt-society, developed by the National Technical Academy (ETH).[1] World-wide average annual energy consumption per capita is 17500 kilowatt hours. This is equivalent to a continuous consumption of 2000 watts. This personal energy limit should be adopted in Switzerland and worldwide, and the primary energy it is based on

[1] Novatlantis/ETH: Smarter living: Generating a new understanding for natural resources as the key to sustainable development – the 2000-watt society, Zurich 2005, http://www.novatlantis.ch/pdf/leichterleben_eng.pdf

should, on the long run, come almost exclusively from renewable energy.

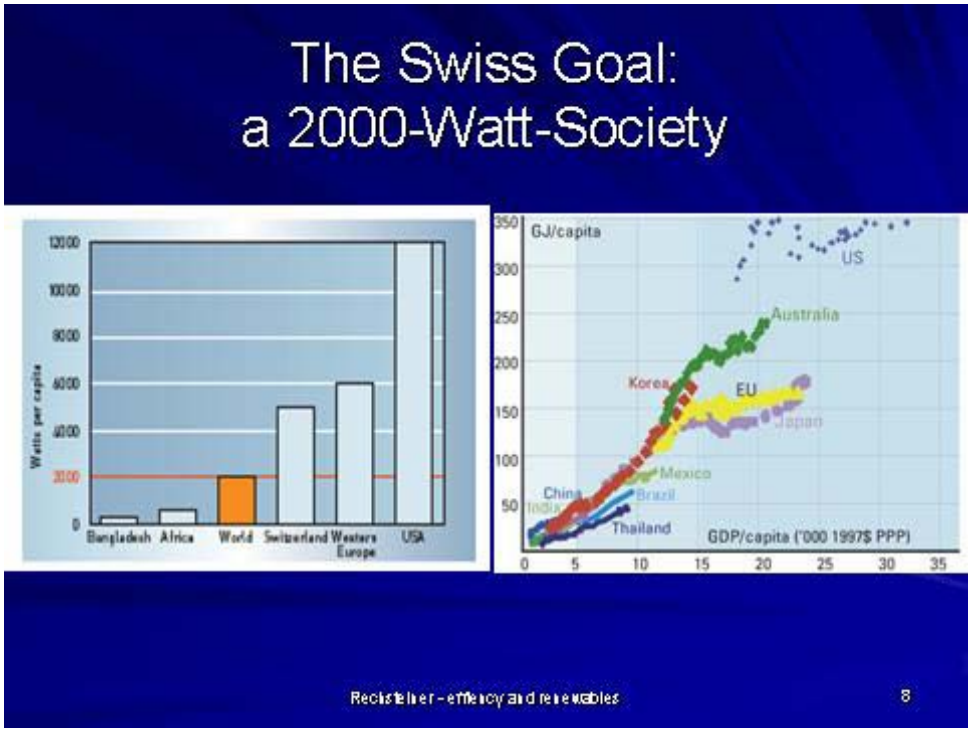


Figure 8

This 2000-Watt-society should not be realized at the expense of quality of life. We see great differences between nations today in their level of energy consumption. Nobody would dare to say that life quality is worse in Switzerland compared to the USA where energy consumption is twice as high or more.

The reduction of non-renewable energy consumption will call for rigorous modifications of buildings and installations, vehicles and equipment, as well as a new understanding for energy services. We want to make materials and processes more efficient and use resources selectively.

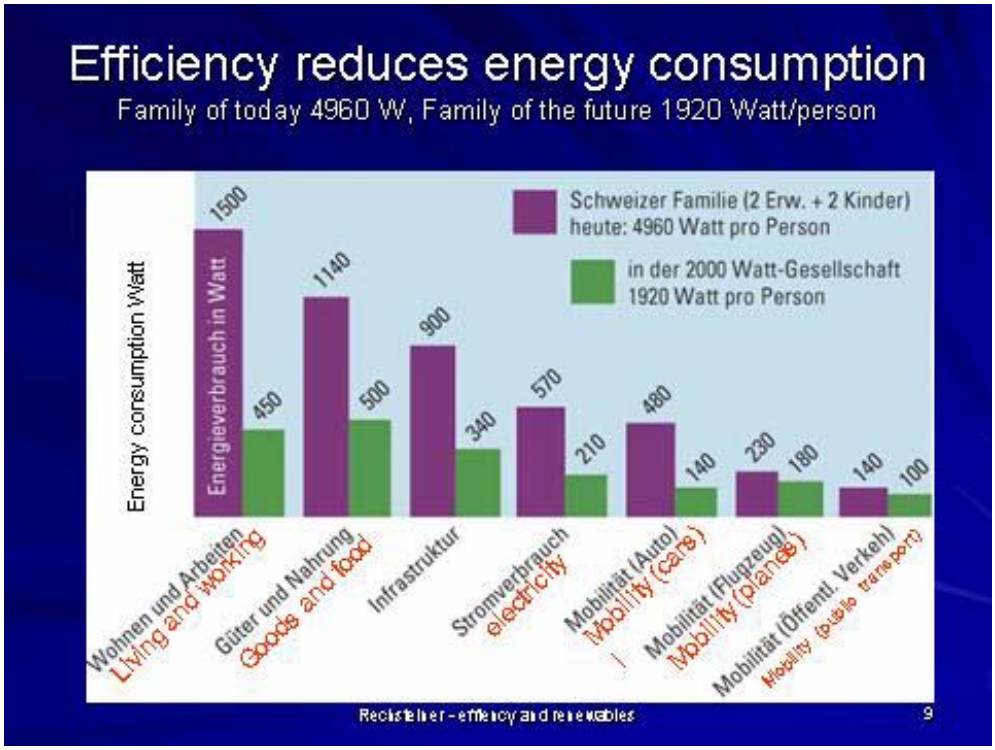


Figure 9

The main contributions of better efficiency are expected from buildings, electricity production and cars. Smaller reductions are expected by aviation and public transport.

Let me give you some examples of the shape of this transformation:

For buildings, there is the somehow famous Mr. Josef Jenni and his company.[2] Jenni constructed the first energy self-sufficient house in Switzerland.

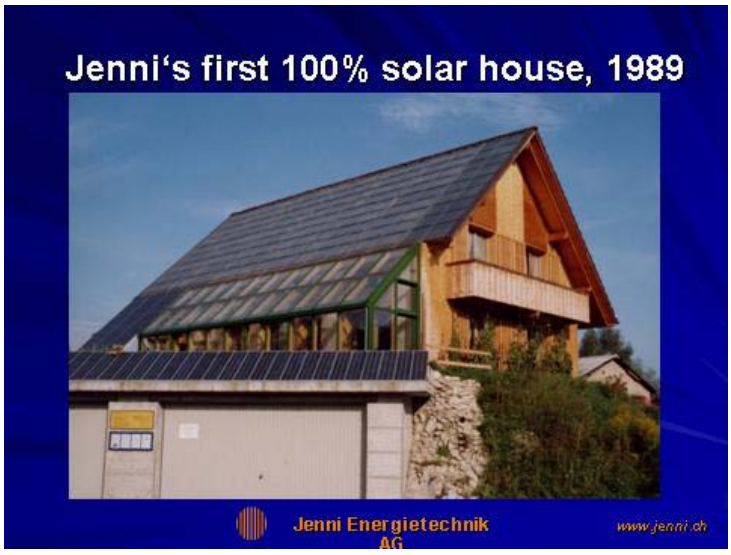


Figure 10

[2] For information of Jenni AG see **http://www.jenni.ch**

The Jenny house relies entirely on solar energy, not just for space heating and hot water, but also for powering the electrical equipment.

Thousands of houses with this heat and warm water systems started to buy the technology of Mr. Jenni and his company.

Figure 11, 12, 13, 14

The concept of these houses was tested over the last 20 years and the basics are quite simple.

As a core system you have a very good insulation and one or more big storage tanks made out of steel with water inside. There-in the solar heat is stored.

Figure 15

These tanks are integrated right in the midst of the house at the start of construction. So the heat radiation or losses of storage stay right within the building.

Figure 16

The storage tanks are connected to the solar roof:

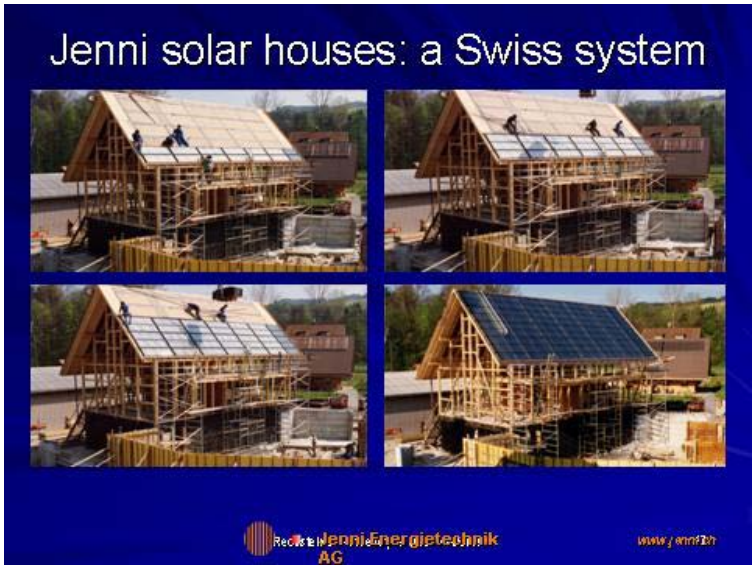


Figure 17

In practice there is a variety of systems, sometimes accompanied by a small wood stove.

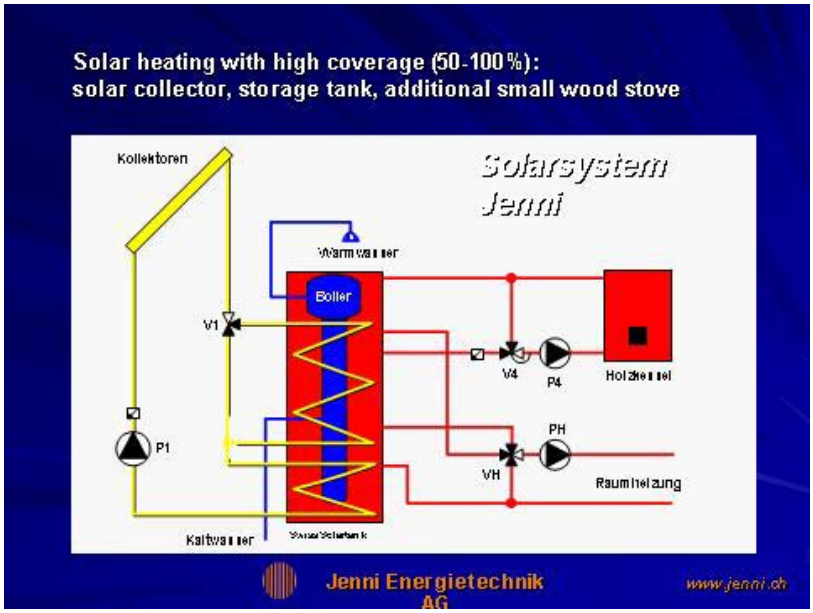


Figure 18

The system works also for multifamily residences.

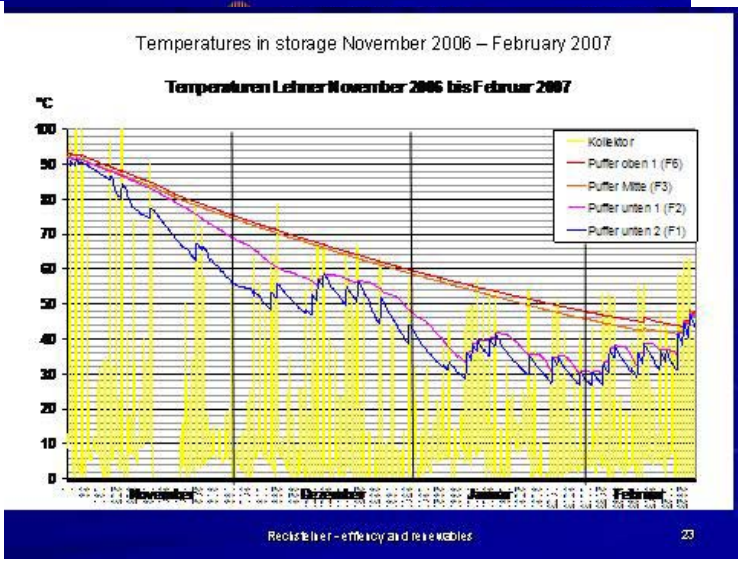


Figure 19, Figure 20, Figure 21, Figure 22

As you can see from the chart, the temperature inside the solar storage tank reaches more than 90° Celsius in the month of November. In winter time the sun is rarely seen in the Swiss Midlands. The temperature in the storage then sinks to some 40° to 50° Celsius in the upper regions of the storage tank.

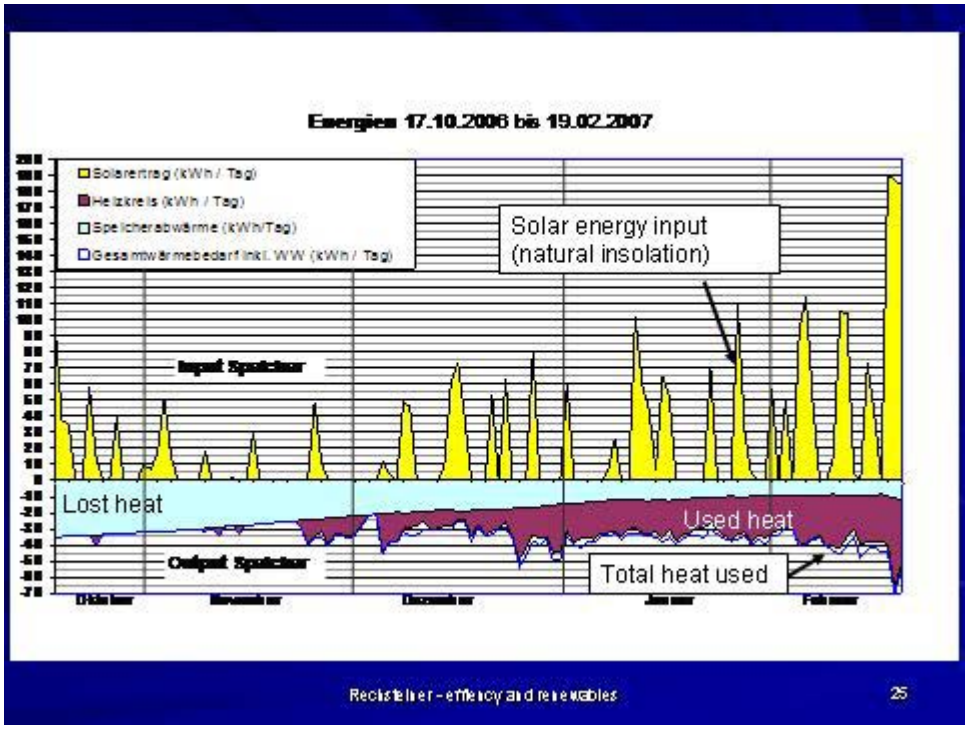


Figure 23

By February though the sun's light already is adding net energy to the storage and the temperature then rises again.

The whole year over these houses work without oil or gas. For extremely cold temperatures there might be a small wood stove to avoid all risks.

As can be seen, the Jenni systems are exported. And Mr. Jenni is teaching the system technology to other companies and received for his innovations the German Solar Price.

Figure 24

Figure 25

In Switzerland there is a broad movement toward introducing more efficient building technologies and Renewables. The Swiss Parliament has endorsed this policy by introducing

Figure 26: Swiss Energy and Climate policy

- **A Tax on carbon emitting heating oil & gas**
  - **0,09 CHF/ 0.06€/Liter heating oil**
- **Tax reduction for**
  - **Solar systems**
  - **Biofuels and nat gas fuels**
- **Feed in tariffs for electricity from**
  - **Solar, wind, biogas, small hydro, geothermal**

Stricter efficiency measures are announced.

In view of the expensive price for oil and gas, many architects are adopting the so called Minergie-standards which call for annual consumption of no more than 3 - 4.5 Liter of oil a square meter of built space.

Figure 27

These houses need a good insulation, solar panels and ventilation with heat recovery. Together with a solar photovoltaic system these houses turn out to be energy self-sufficient.

Figure 28

The insulation needed in these houses is 20 to 35 cm; there are energy efficient A-Class appliances and windows with three glass layers

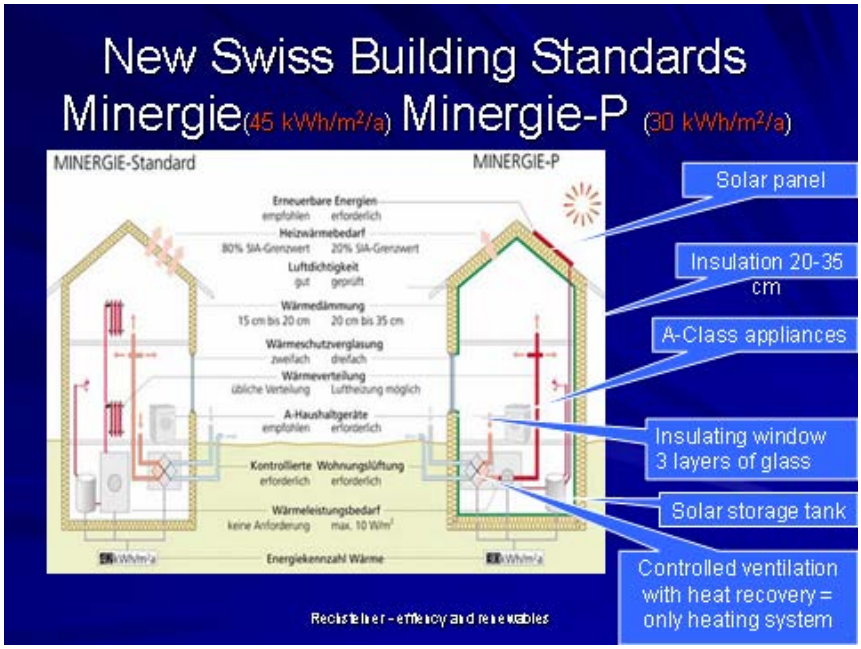


Figure 29

If we manage to reach the new Minergie-standards, we easily can reduce oil and gas consumption by 80%. A main problem though is the huge stock of old buildings.

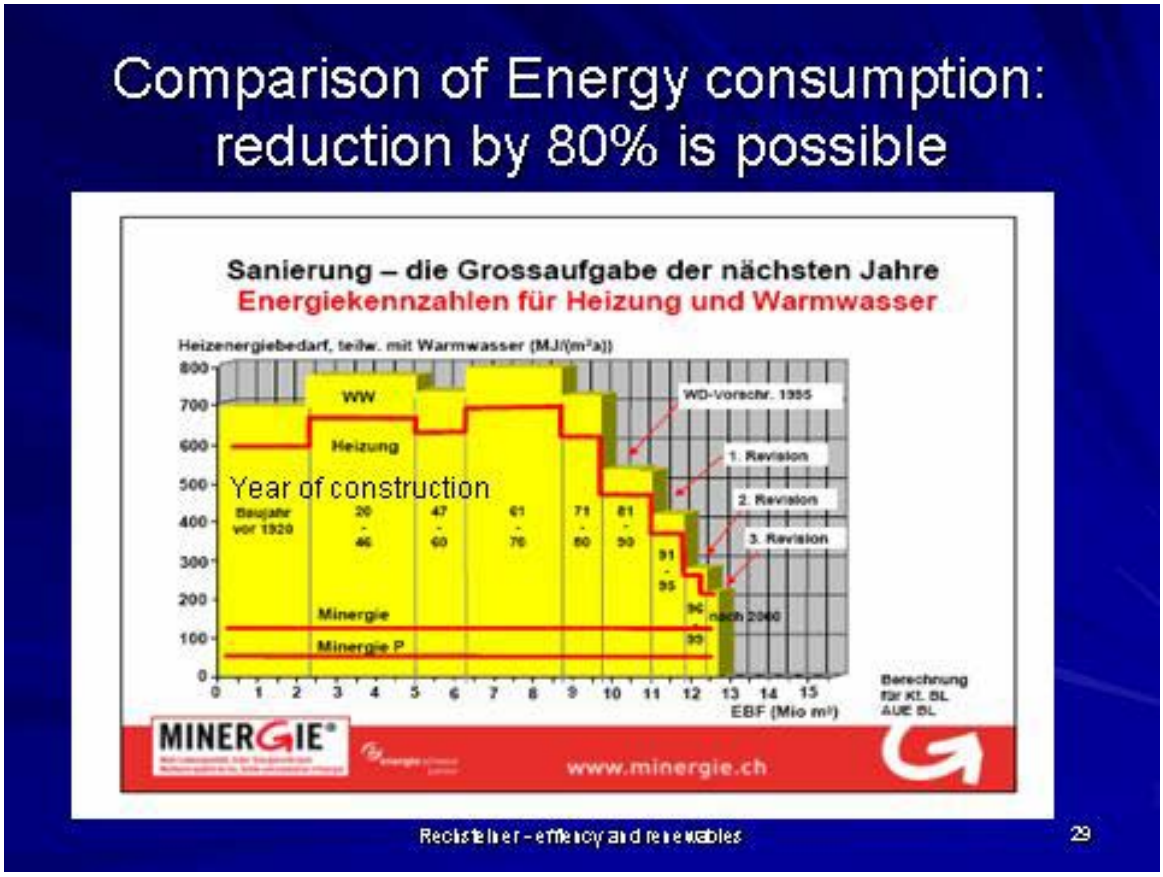


Figure 30

Additional renovation programs are needed to realize these huge potentials for energy savings. The rate of renovations is crucial.

Rapid innovation is possible also in the car sector. Modern hybrid cars such as the Prius can reduce gasoline consumption by some 30%. More is possible with a bigger battery. Imagine a system where cars drive their first 100 km daily driven by batteries loaded from the electrical grid.

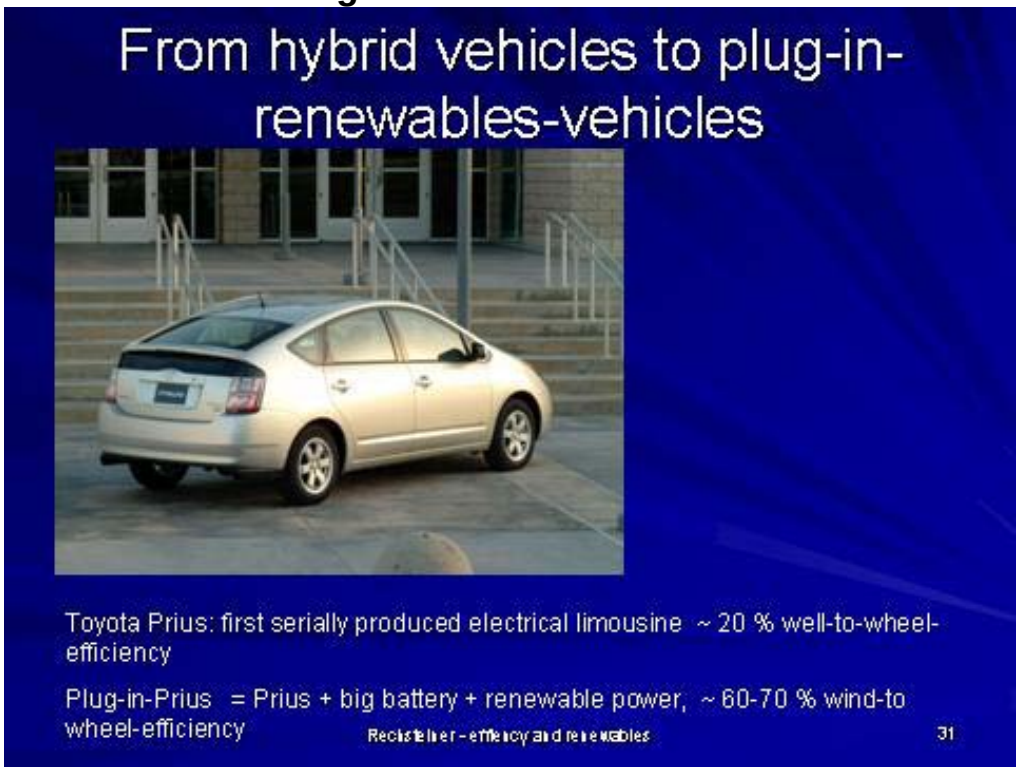


Figure 31

And imagine that renewable electricity instead of thermal generation is the source of that power. System efficiency levels of 60% or more are attainable in this way – "well-to-wheel" – compared to the 20%-efficiency of the internal combustion engine.

3. The Drivers of Renewable Energy

From a Russian point of view, in view of its urgent economic needs, it makes entirely sense to export oil and gas, to sell it at the highest price possible and to nationalize the earnings.

The motives for renewable energy, for efficiency and for climate protection are not anti-Russian.

Oil and gas will keep a key role for decades to come. And Russia will stay an important source of energy and other products. But a new trend is emerging: renewable energy. To understand this trend we have to analyze some key factors:

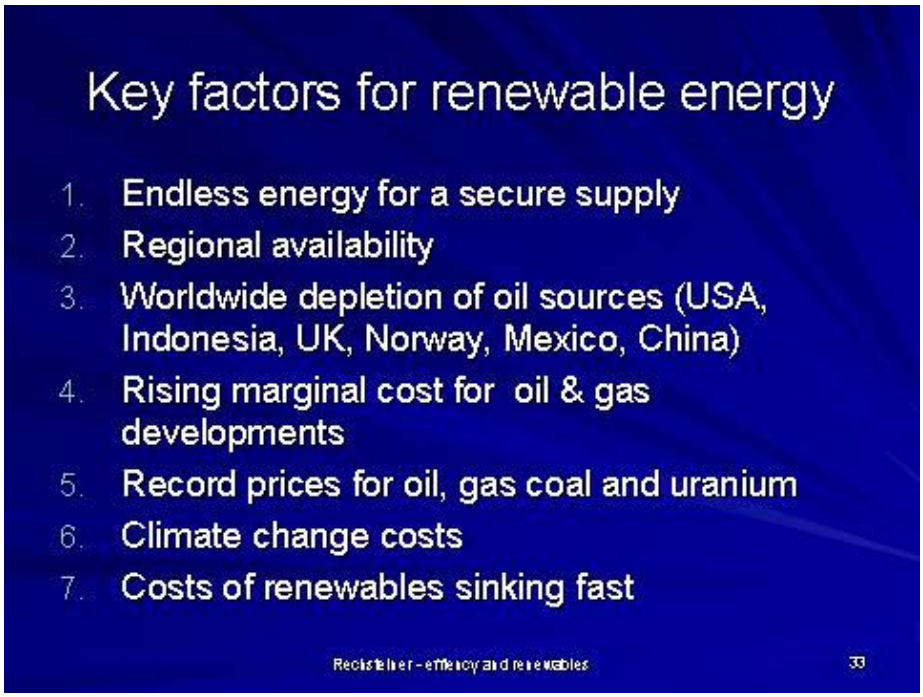


Figure 32

1. **No nation wants to be entirely dependent on other nations in terms of energy... The Ukraine gas crisis was a trigger for more cautious behavior, and security of supply became a main concern. Renewable energy is an endless source and as such more secure than non-renewable energies.**
2. **Solar, biomass, wind and geothermal sources are locally or regionally available. It means re-localization of energy sources.**

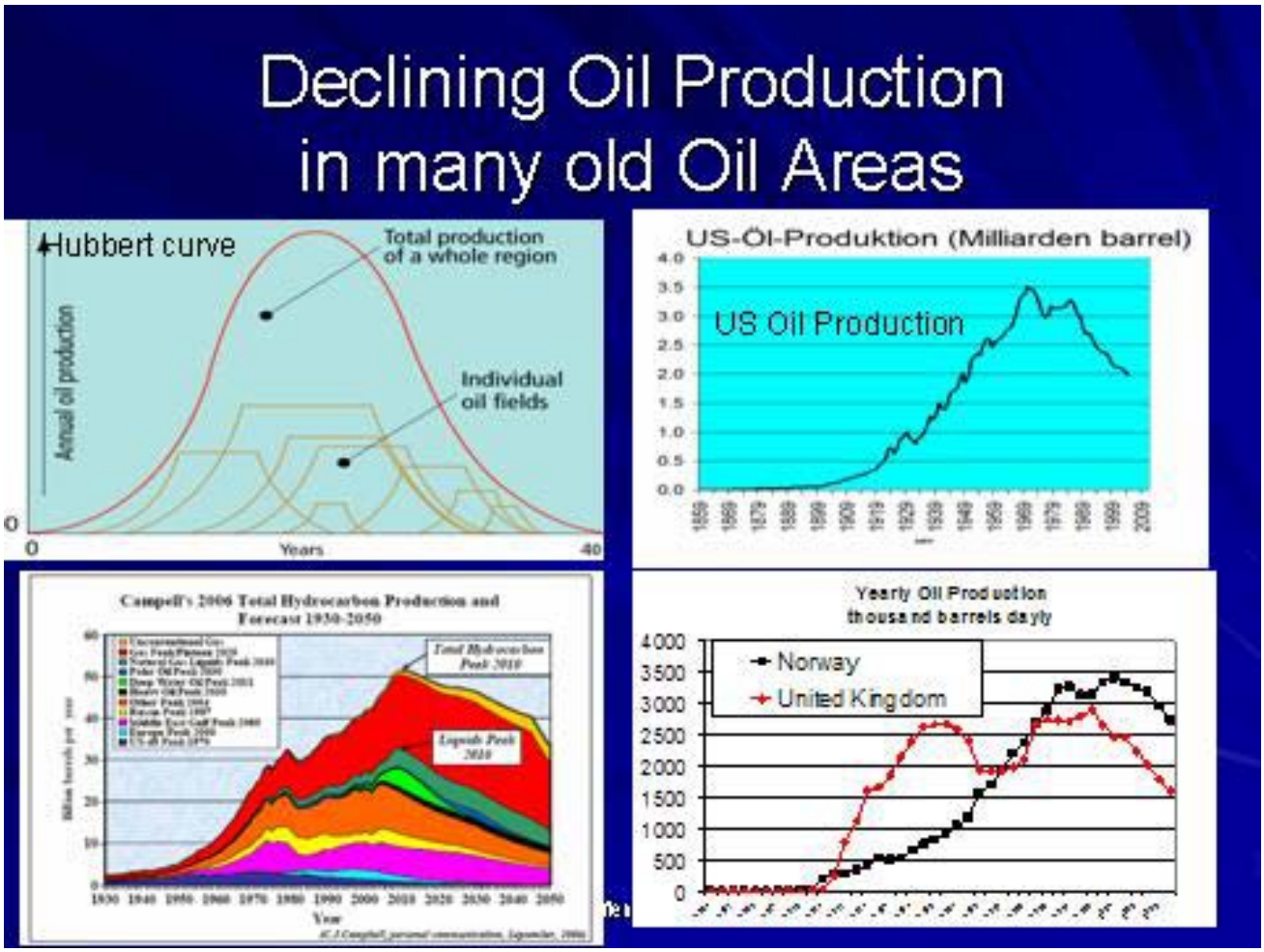


Figure 33

3. Many export nations such as the US, Indonesia, Norway, UK or Canada show a declining production of conventional oil and gas. In Russia too, the time of production growth seems over. World peak of oil liquids and gas is expected around 2010.

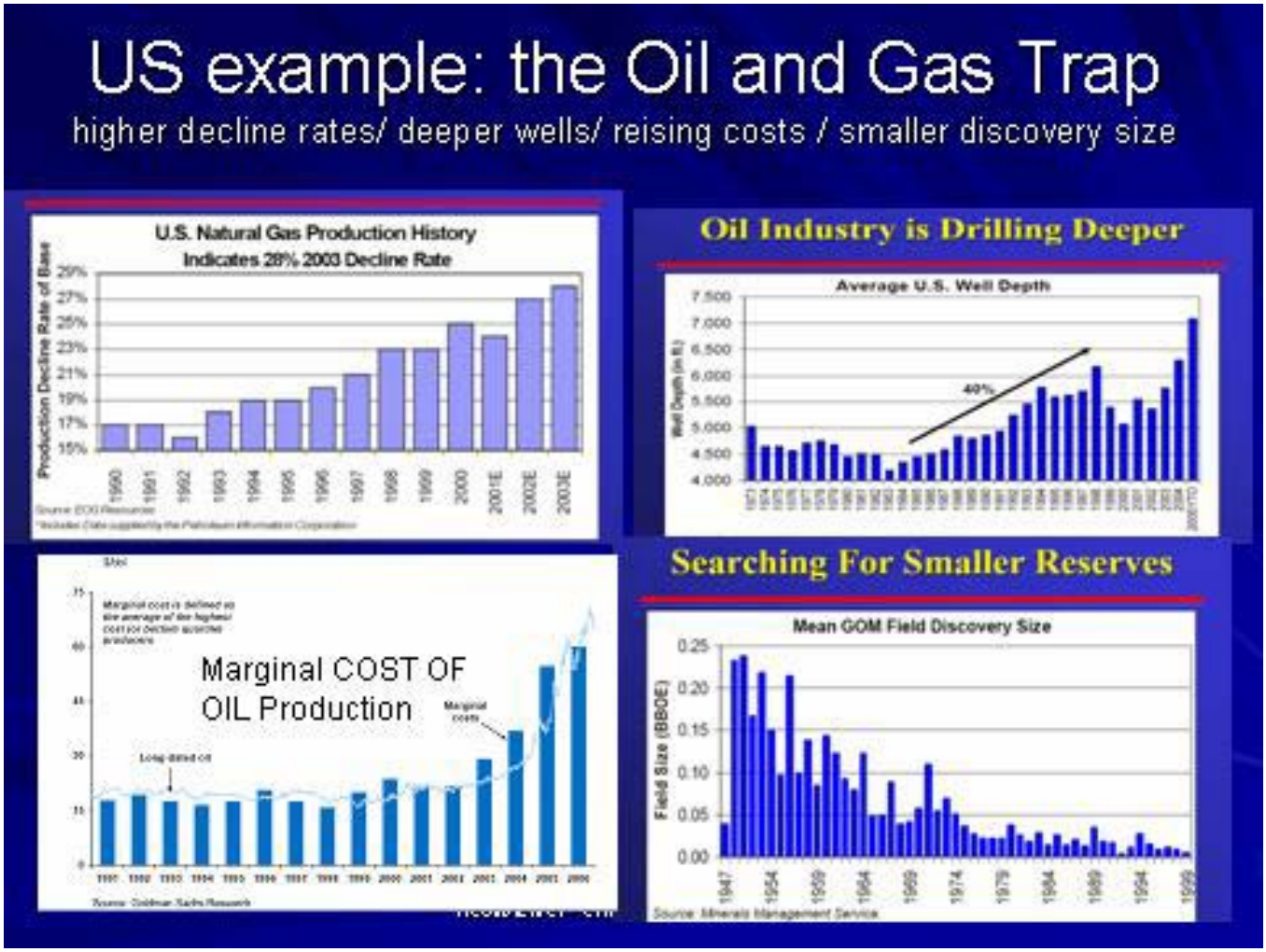


Figure 34

4. Oil and gas companies face the same problems: a sharp drop in well output, deeper wells, smaller size of oil fields and rising marginal costs of new oil or gas prospects.

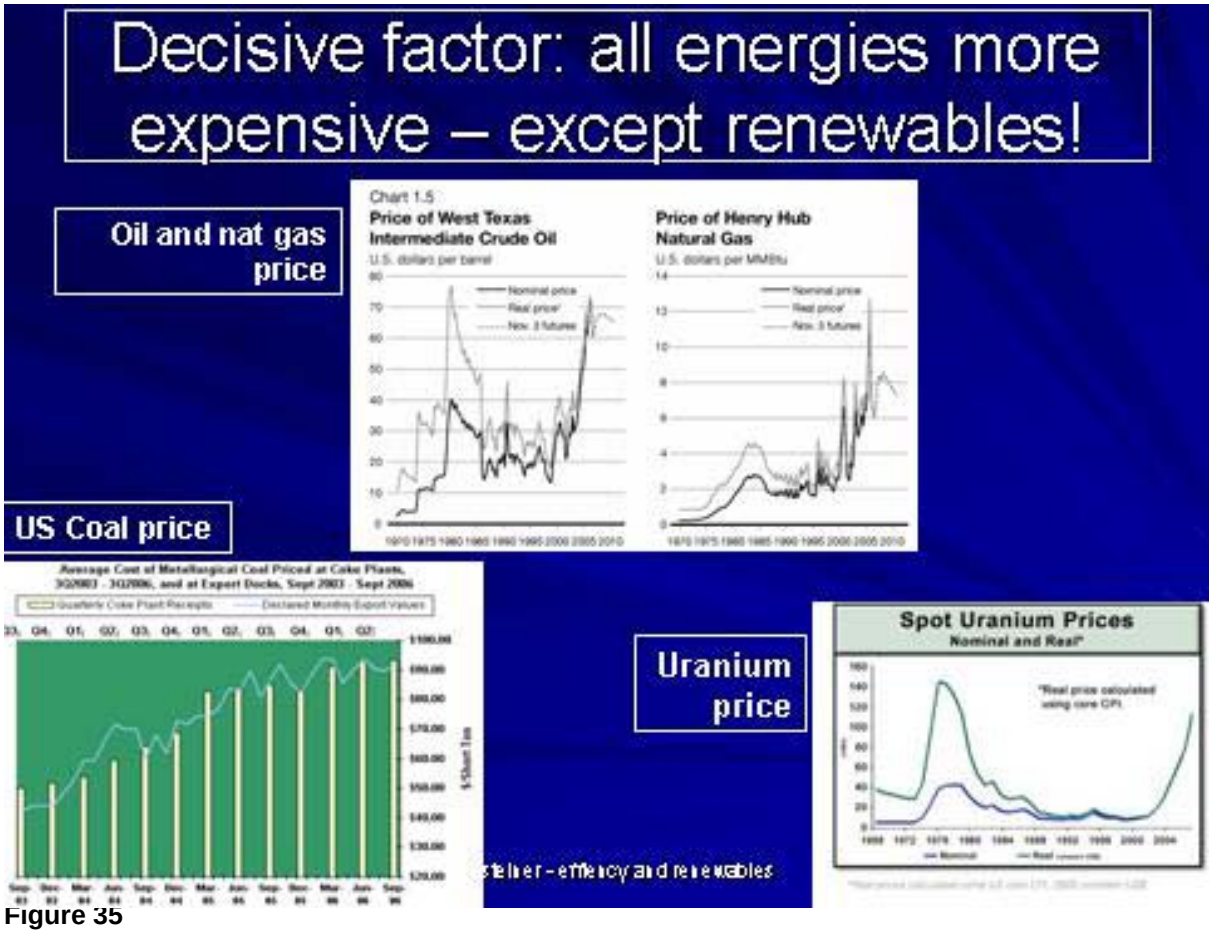


Figure 35

5. **Since 2000, primary energy from all sources except Renewables has gotten more expensive. It is the case for oil and gas, but also for uranium, and to a lesser extent for coal. These record prices of last summer are unforgotten and volatility persists. Many governments prefer to build their own energy system instead of financing others.**
6. **Then we had the British Stern Review last fall and the IPCC report in spring 2007. They all say that the costs of Climate Change will be dramatic.**

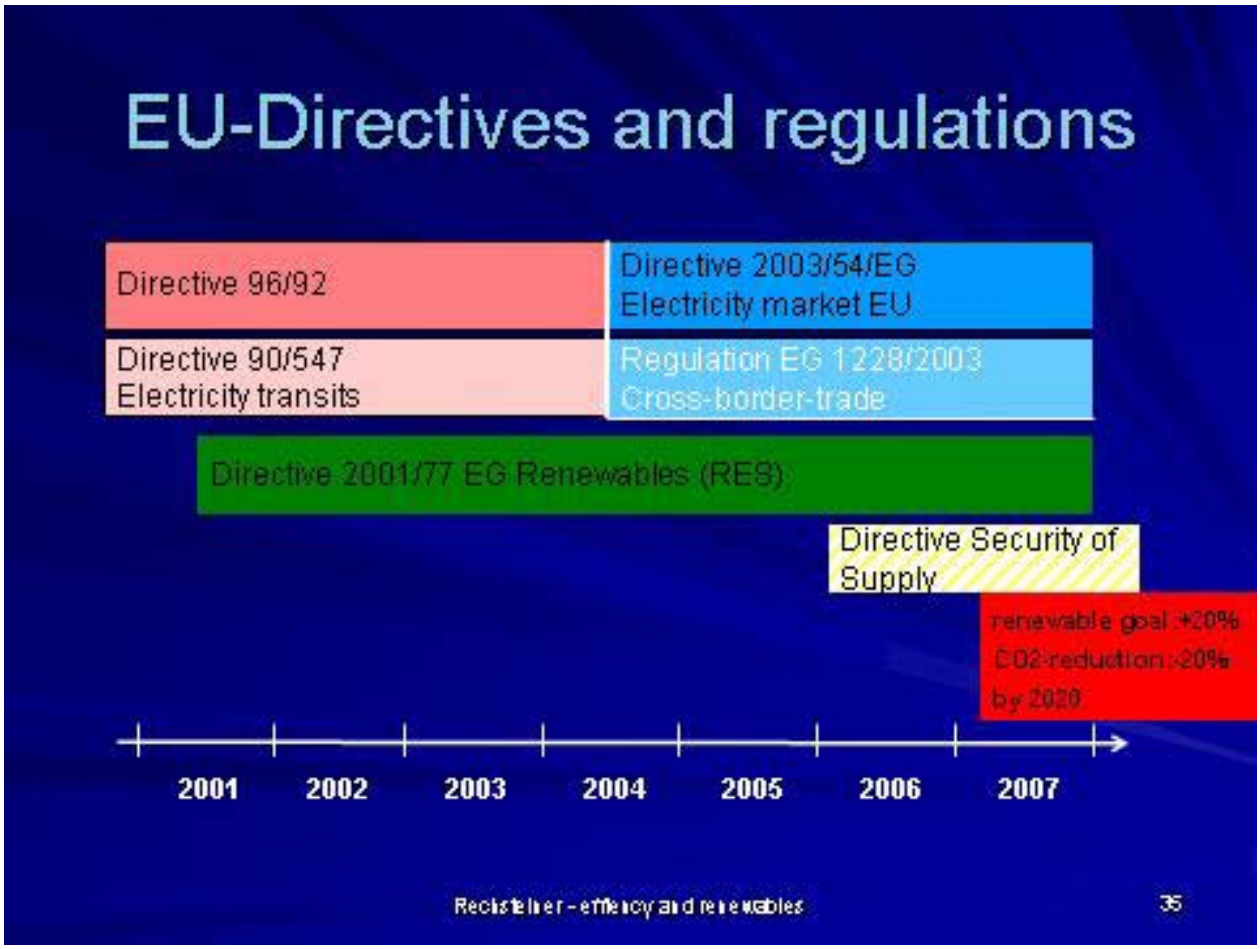


Figure 36

It is no wonder that the European Commission and the Council of Ministers defined a new EU energy policy which tries to reduce greenhouse gases by 20% and to push Renewables to at least to 20% by 2020.

Electricity reforms such as unbundling, open access to the grid, competition, cross-border-transmission and renewable energy goals are key elements of a strategy where in the end a more efficient and environmentally friendly system can prevail, supposed though that external costs such as pollution, accidents and waste sufficiently are reflected in the price of energy.

4. Risks of nuclear Power

Why did the European Commission not push nuclear energy?

There are many factors: nuclear energy is highly controversial. The polls clearly show that a majority of the people rather want wind and solar power with 80% and 71% in favor. Nuclear power is the

most unloved energy source with just 20% in favor and 37% opposed.[3]

From a private investor's view, the high costs of nuclear power can not be recovered in open competitive markets.[4] There are long planning and permission periods. The security of uranium supply is not assured long term. And the disposal of radioactive waste stays a problem form many generations to come.

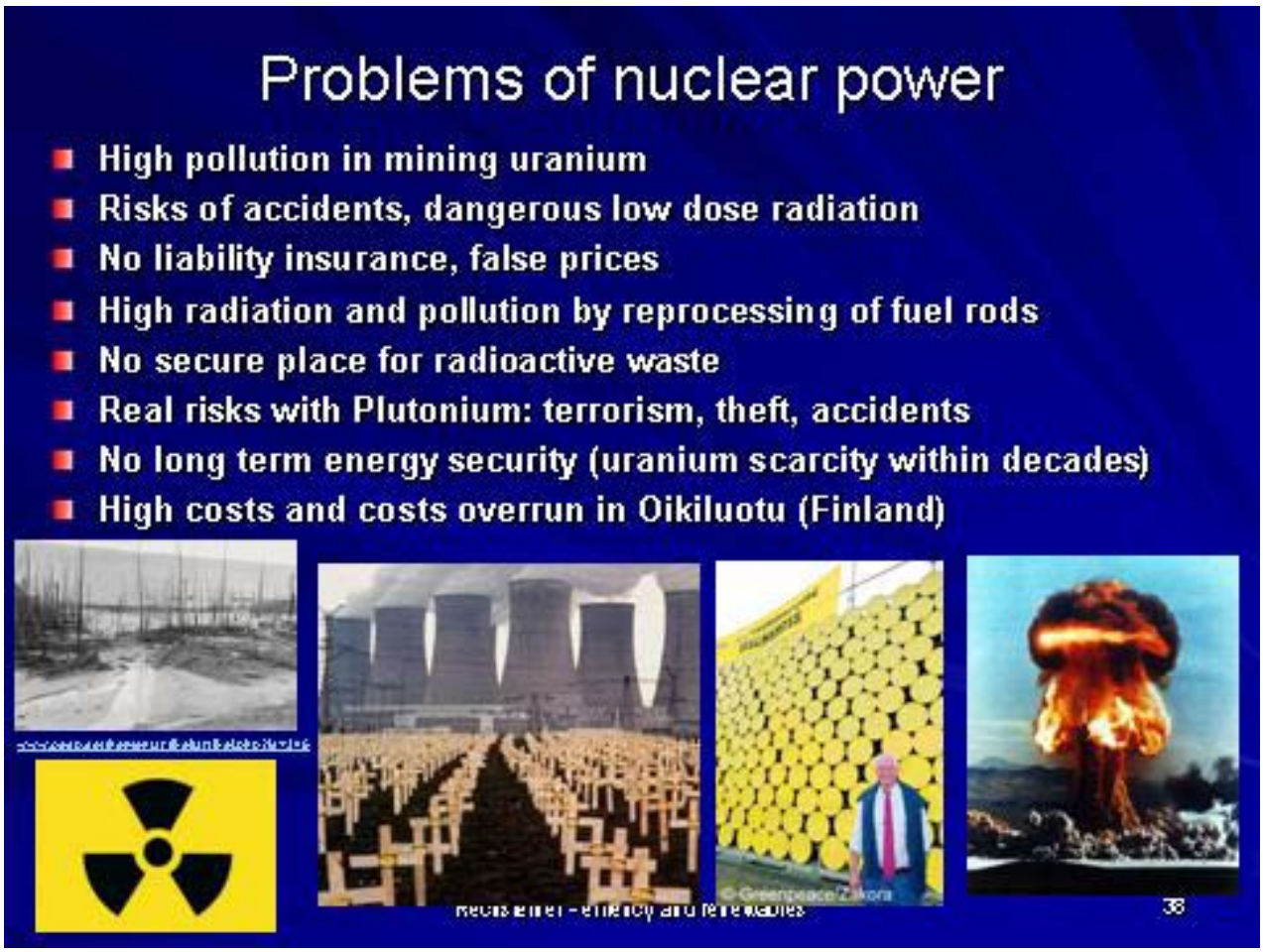


Figure 37

Since the accidents in Chernobyl and Three Mile Island there is a standstill of nuclear investments in most nations with nuclear power. And the arguments against the nuclear technology are well known.

[3] Windpower Monthly 4/2007 p.60

[4] Noted energy expert Amory Lovins has said separately that nuclear power plants are simply too costly to build and maintain relative to other available options. "Nuclear power has no prospects in market-driven energy systems, for a simple reason: new nuclear plants cost too much to build. In round numbers, electricity from new light-water reactors will cost twice as much as from new windfarms, five to ten times as much as distributed gas-fired cogeneration or trigeneration in buildings and factories (net of the credit for their recovered heat), and three to thirty times as much as end-use efficiency that can save most of the electricity now used," wrote Lovins and colleagues in the Rocky Mountain Institute's ***Winning the Oil Endgame: Innovation for Profits, Jobs, and Security***. "New nuclear plants are simply unfinanceable in the private capital market, and the technology will continue to die of an incurable attack of market forces—all the faster in competitive markets. This is true not just in the U.S., where the last order was in 1978 and all orders since 1973 were cancelled, but globally." **http://news.mongabay.com/2007/0404-nuclear.html**

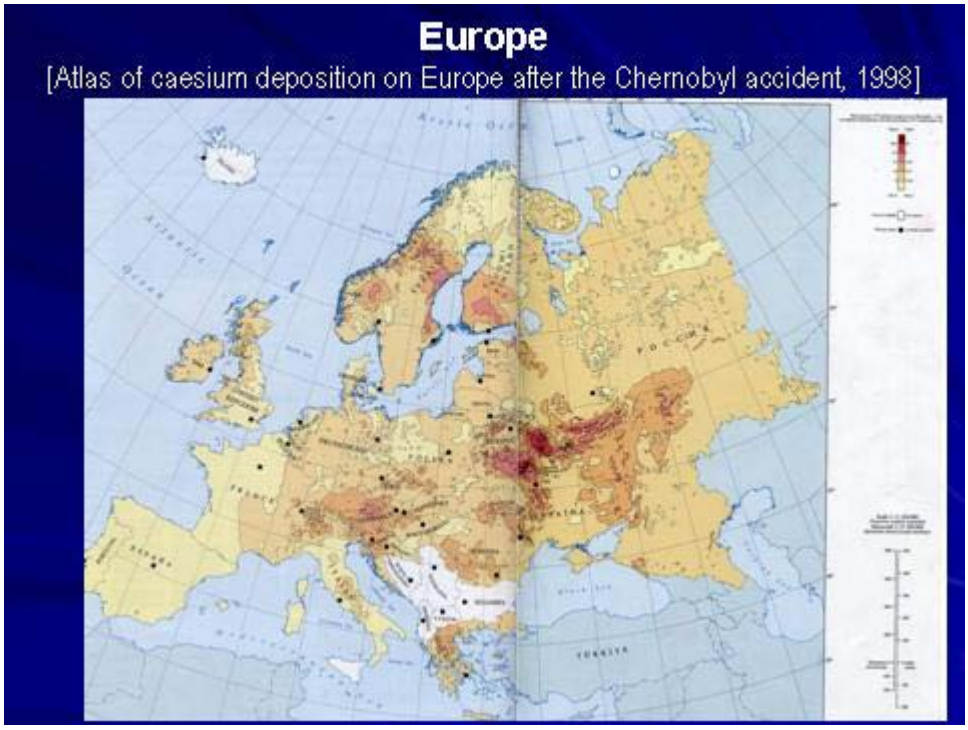
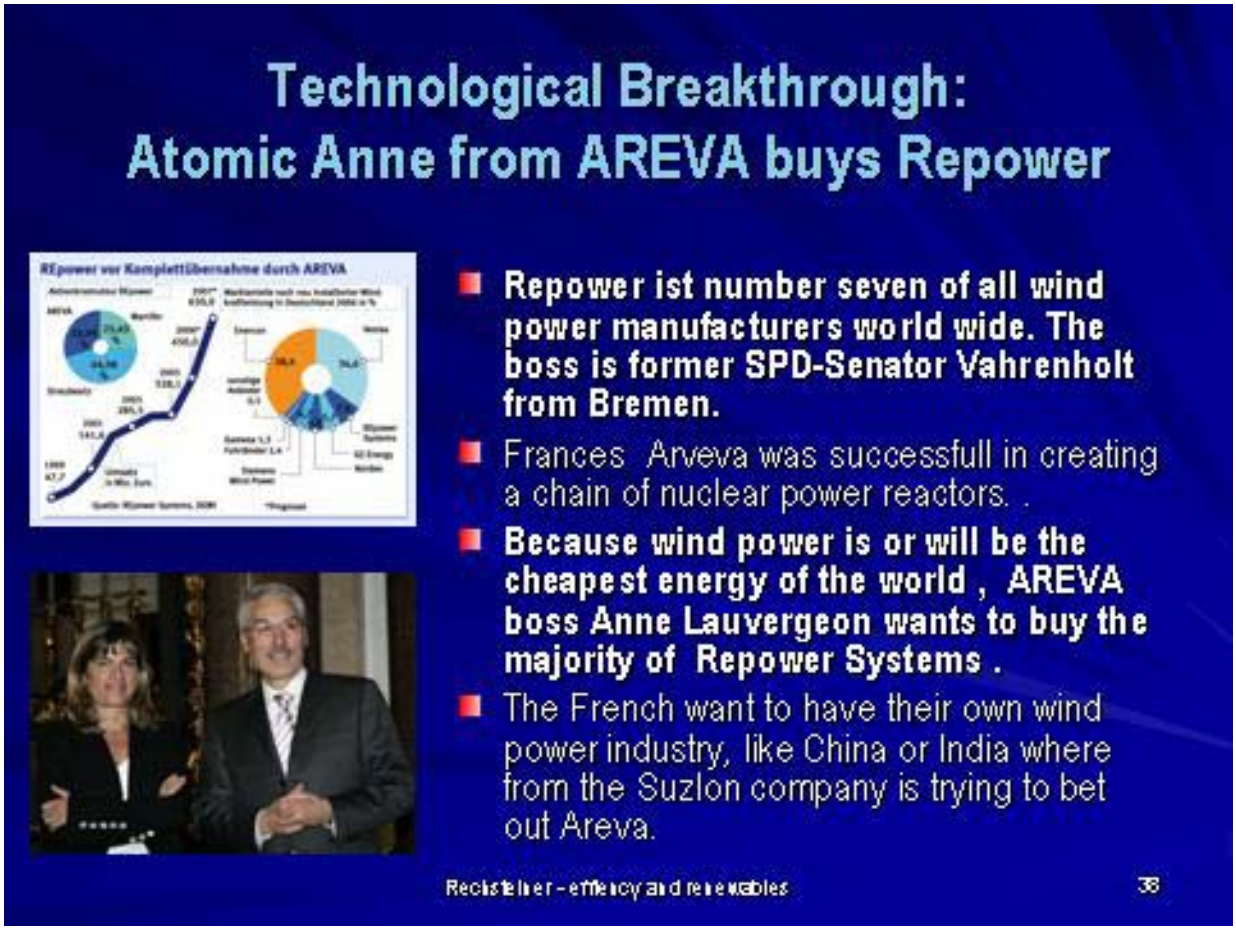


Figure 38

The radioactive implications of Chernobyl persist and are unforgotten. The people's movements against nuclear power in nuclear friendly countries such as France are growing.

Nations such as Italy, Austria, Germany and Sweden have left the nuclear technology and seriously are pushing renewable energy. Astonishingly this trend is found meanwhile in France, too.

Figure 39



The French state Nuclear Power Company Areva tries to acquire the German wind energy company, Repower.

They want to exploit the huge wind resource in France and the same can be seen in nations like China[5] or India where demand for wind components is "not growing but exploding".[6]

5. Key Technologies for today and tomorrow

Since the accidents of Three Mile Island and Chernobyl, renewable energy began its success story.

[5] On the situation of wind power in China see http://biz.yahoo.com/prnews/070412/cnth009.html?.v=10

[6] SKF-boss Karlsson: "We are very positive about development in China, it's not just a growing industry there, it's exploding." The Bearing Manufacturer's View, in: EWEA: Wind Directions January 2007 p. 31

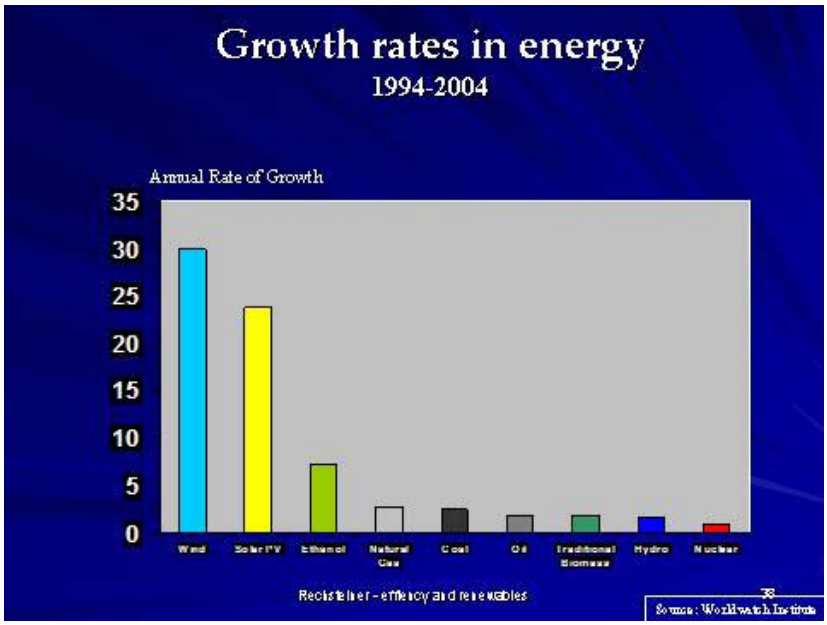


Figure 40

The growth rates tell the real story. Solar, wind and biomass show highest growth world wide, nuclear is in stagnation.

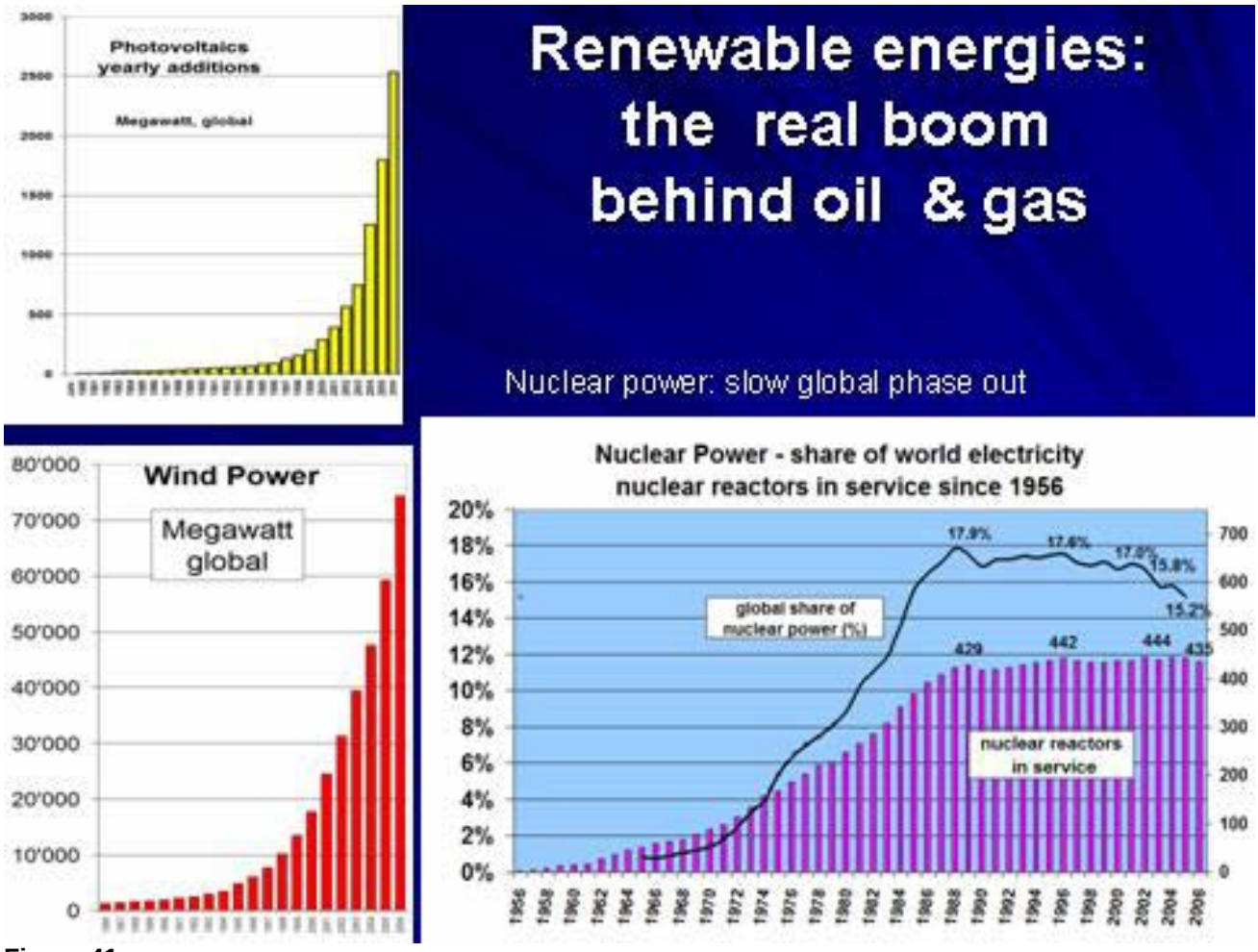


Figure 41

The output of wind power is doubling every three years. Solar power is doubling every two years world wide.

Nuclear shows some start of a phase out with a net shut-down of eight reactors last year, despite some minor additions in East Asia.

So what is next? What technologies will prevail beside efficiency?

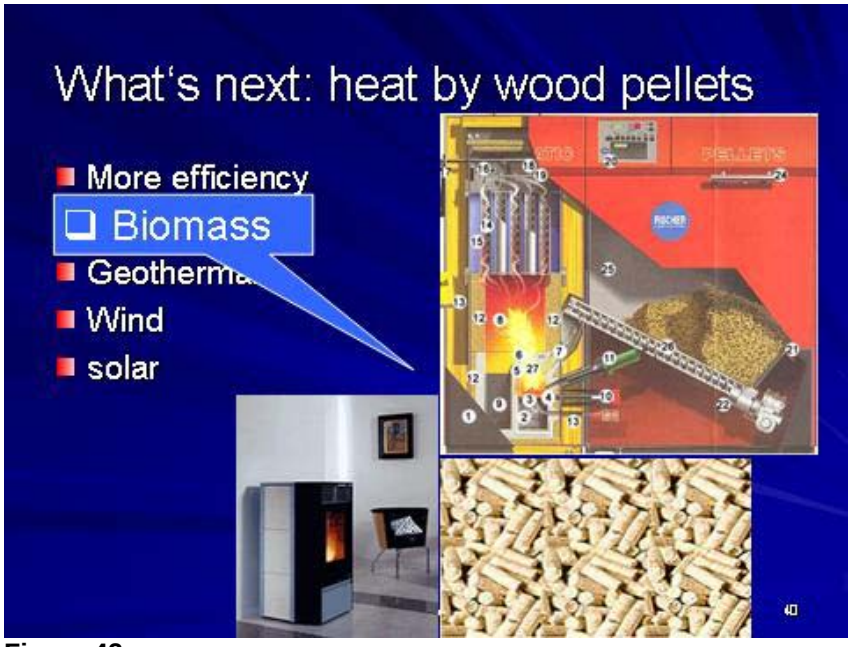


Figure 42

Since a few years there is a boom for wood pellet technologies in Switzerland and else. Pellets now are cheaper than oil. These stoves can be operated automatically.

Figure 43

Then there is biogas, produced by farmers from biomass waste and compost. This technology brings heat and power and is promoted by minimum feed in compensation.

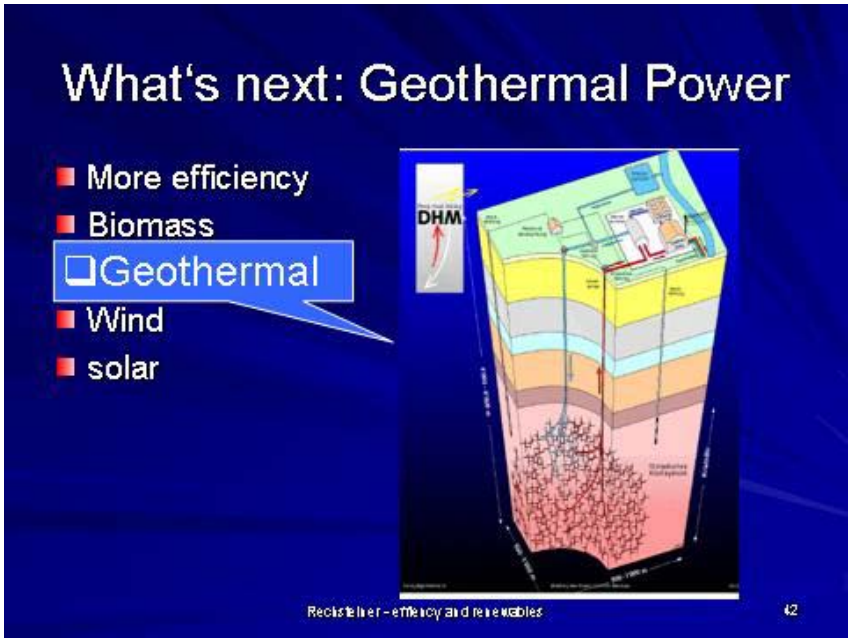


Figure 44

Another boom technology is geothermal energy in combination with heat pumps or geothermal systems for electricity generation; the latter is in its test phase yet. The real success story though is wind and solar energy.

Figure 45

You find wind energy almost everywhere, but some areas are more prolific than others. In these places you find a specific cost of less than 6 €C. /kWh for new installations.

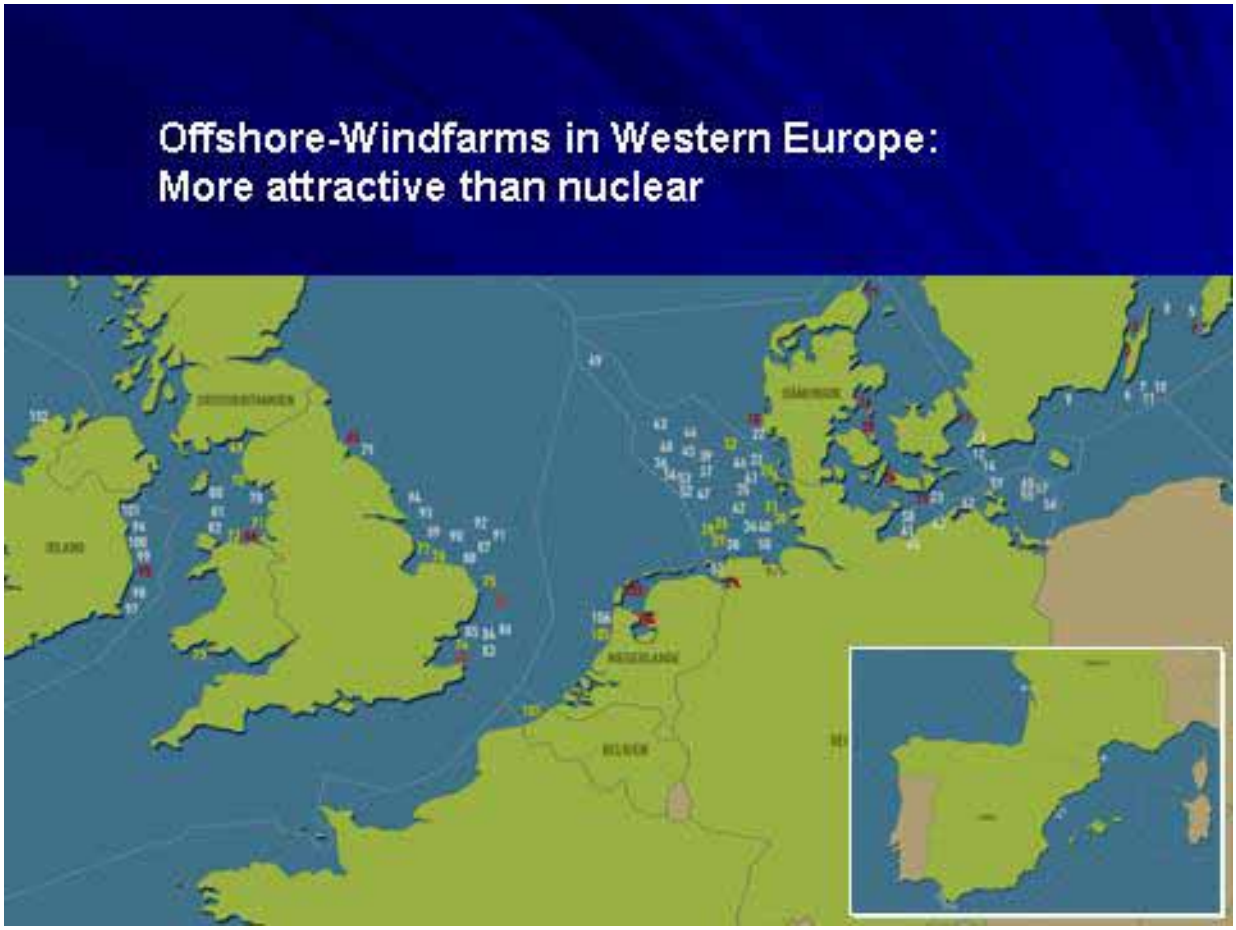


Figure 46

Beside the ongoing onshore boom in countries like the US, Spain, Portugal, China or France, offshore installations will play a key role in the next decade in countries such as Germany, Denmark, the UK and China where good onshore sites in densely populated areas are more difficult to find.

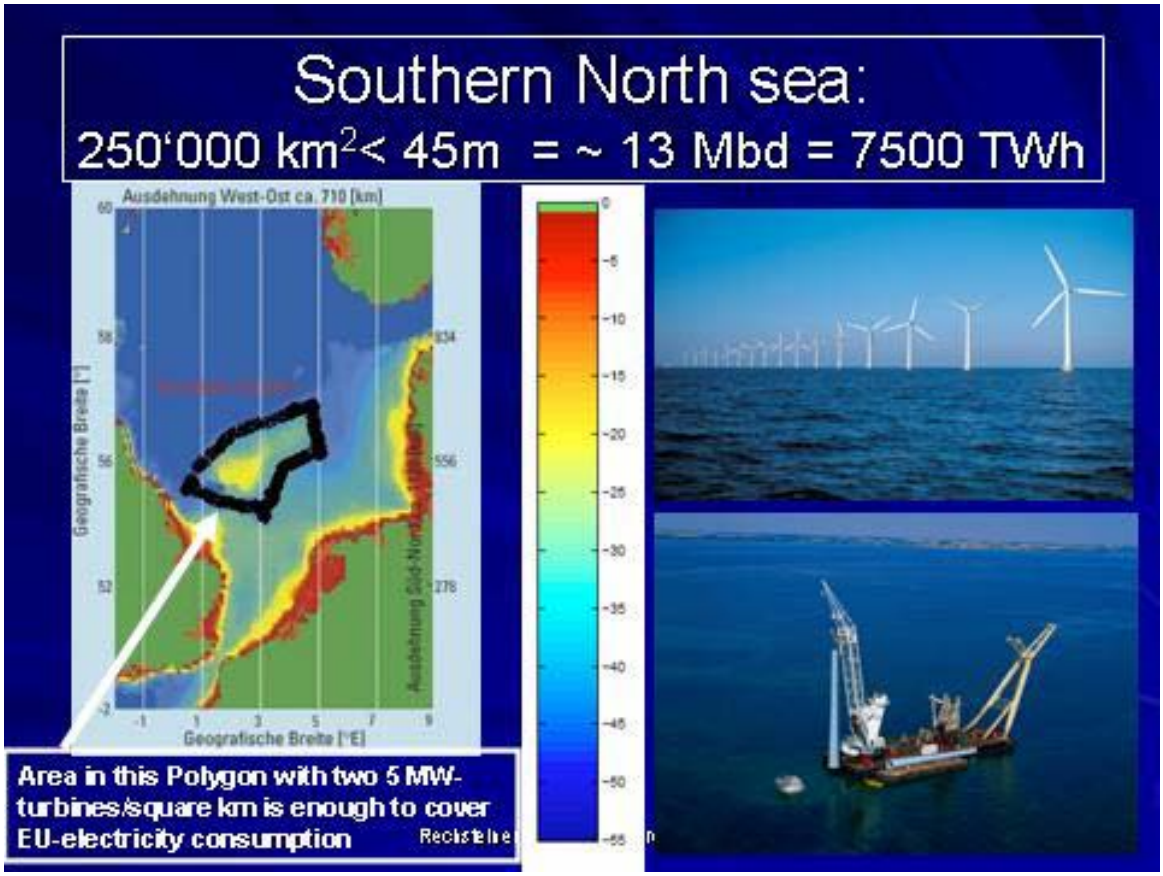


Figure 47

We must be aware that some 60'000 km^2 of offshore wind farms with some two turbines, rated at 6 MW, each square kilometer, are able to fill the entire electricity consumption of the European Union.[7]

These wind turbines never will be positioned in one area but over the whole continent. To smooth out the fluctuations of the wind and solar resources we need to strengthen the interconnection between different weather zones, and this point is exactly where Russia can play an important role as part of an interconnected grid system, as an exporter and storage place of wind power (by hydro storage for example).

Russia has a very good wind resource in the St. Petersburg region, in the North coastal regions as well as in the south and east of Moscow.

[7] See Gregor Czisch: sea bed profiles in some areas in and around Europe **http://www.iset.uni-kassel.de:80/abt/w3-w/folien/Windenergie/offshoreflaechenauswahl_2.pdf**

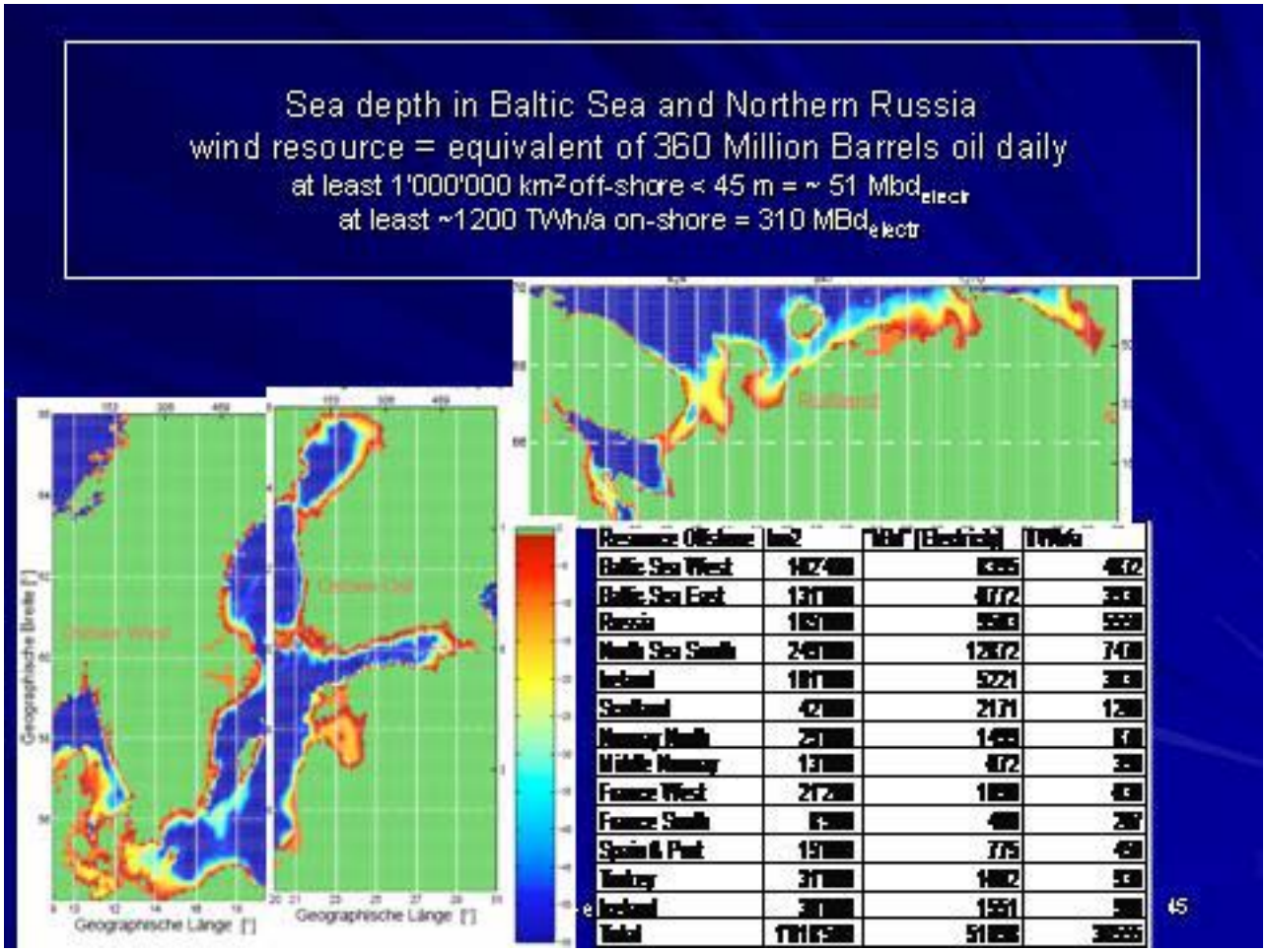


Figure 48

The capacity additions of wind power show a solid growth. There is no doubt that wind power will continue to grow in an exponential rate.

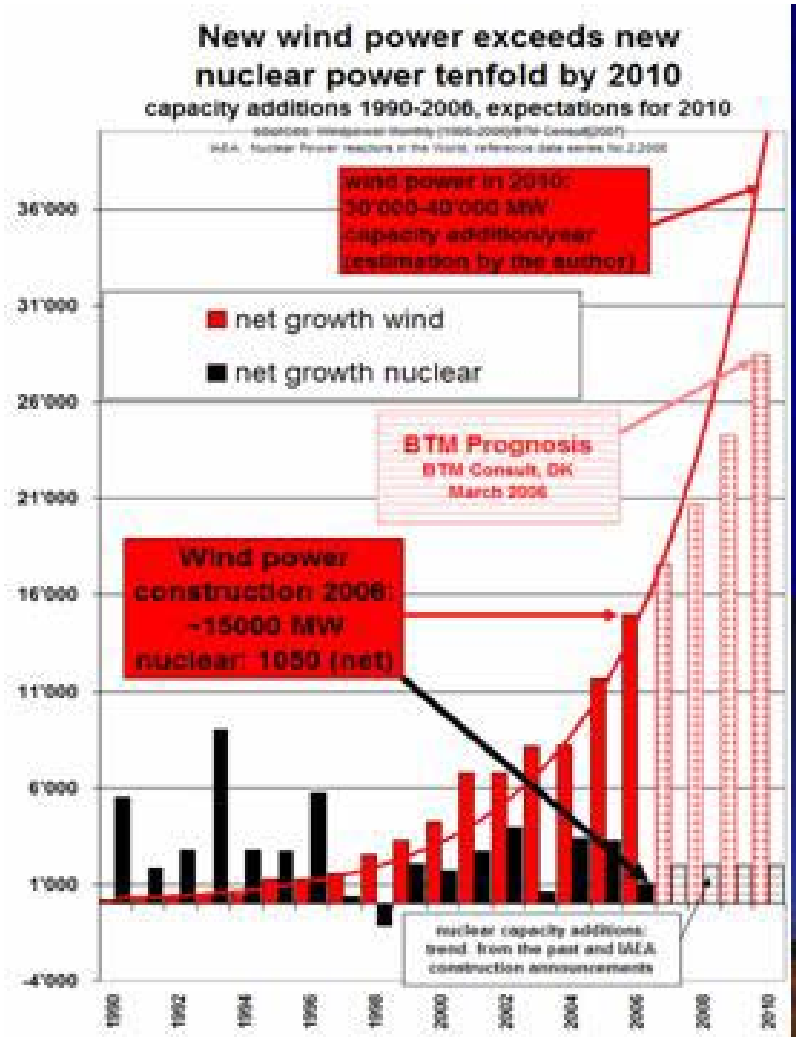


Figure 49
Figure 50

Official growth projections were ever too low. New added wind power capacity will reach – in 2007 – some 20'000 Megawatt, some ten times bigger than nuclear capacity additions. In terms of base load it means that new wind power exceeds new nuclear by a factor of three now and by 2010 it could be a factor of 6.

Renewable sources are so huge that they can satisfy human demand many times; in the short and in the long term there is no crowding out of prices due to growing demand and there is no pressure on prices due to growing demand, and there is no "wind cartel" capable of manipulating the price of wind-generated electricity.

Local communities and farmers get good earnings: up to 10'000$ a year for each turbine for farmers and tax incomes for provinces.

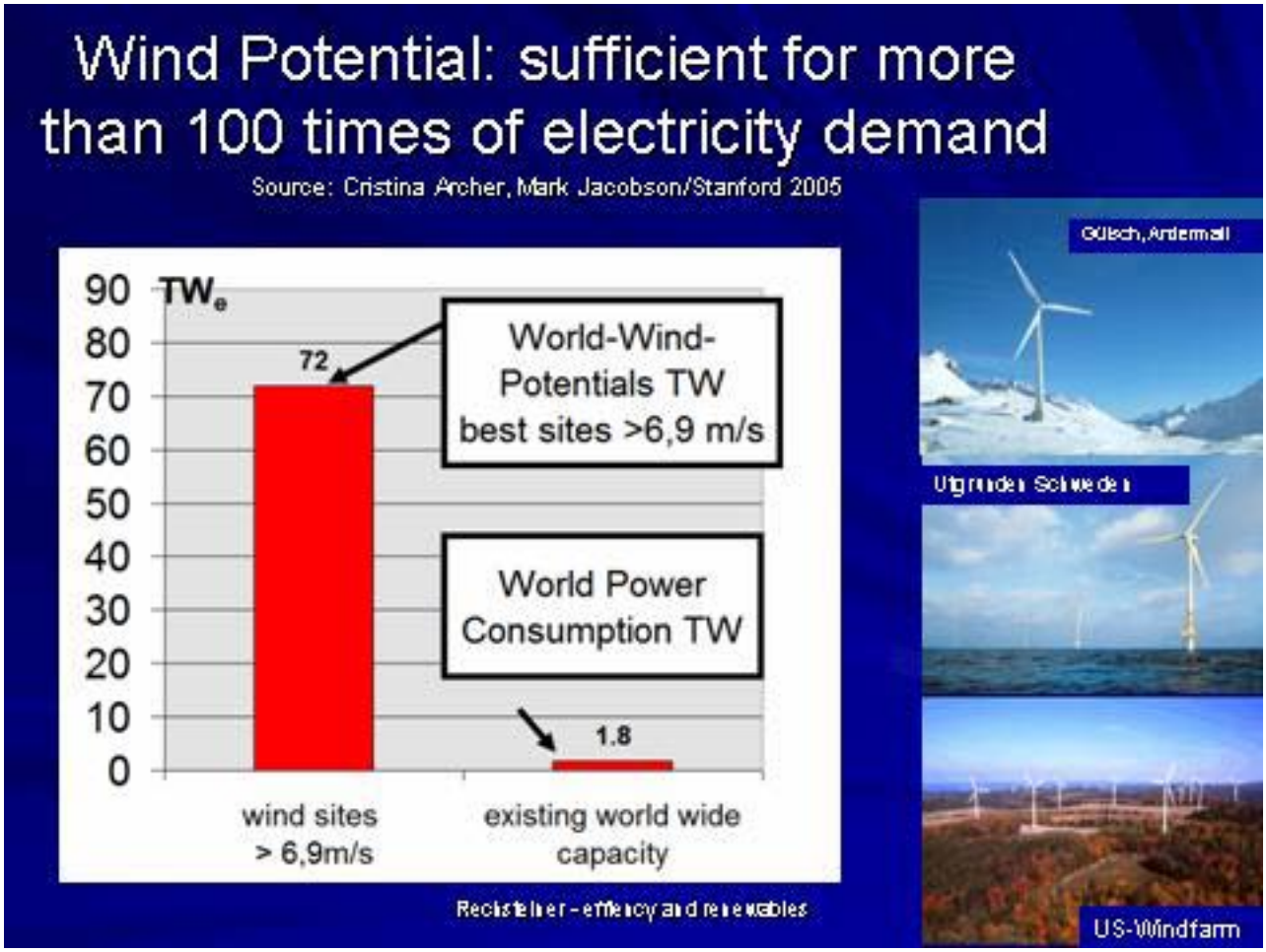


Figure 51

The fundamentals behind this strong growth are driven by economics rather than by politics. To judge the cost of this infrastructure we should remember the benign character of renewable generation. Once the capital cost is paid off these installations work for years with very low variable costs and no fuel.

After ten to twenty years or so, when the debts for the original construction have been paid off with the yields of, wind mills turn into cash cows, like hydro plants which after years of operation have generation costs of less than 1-2 Euro-Cents/kWh.

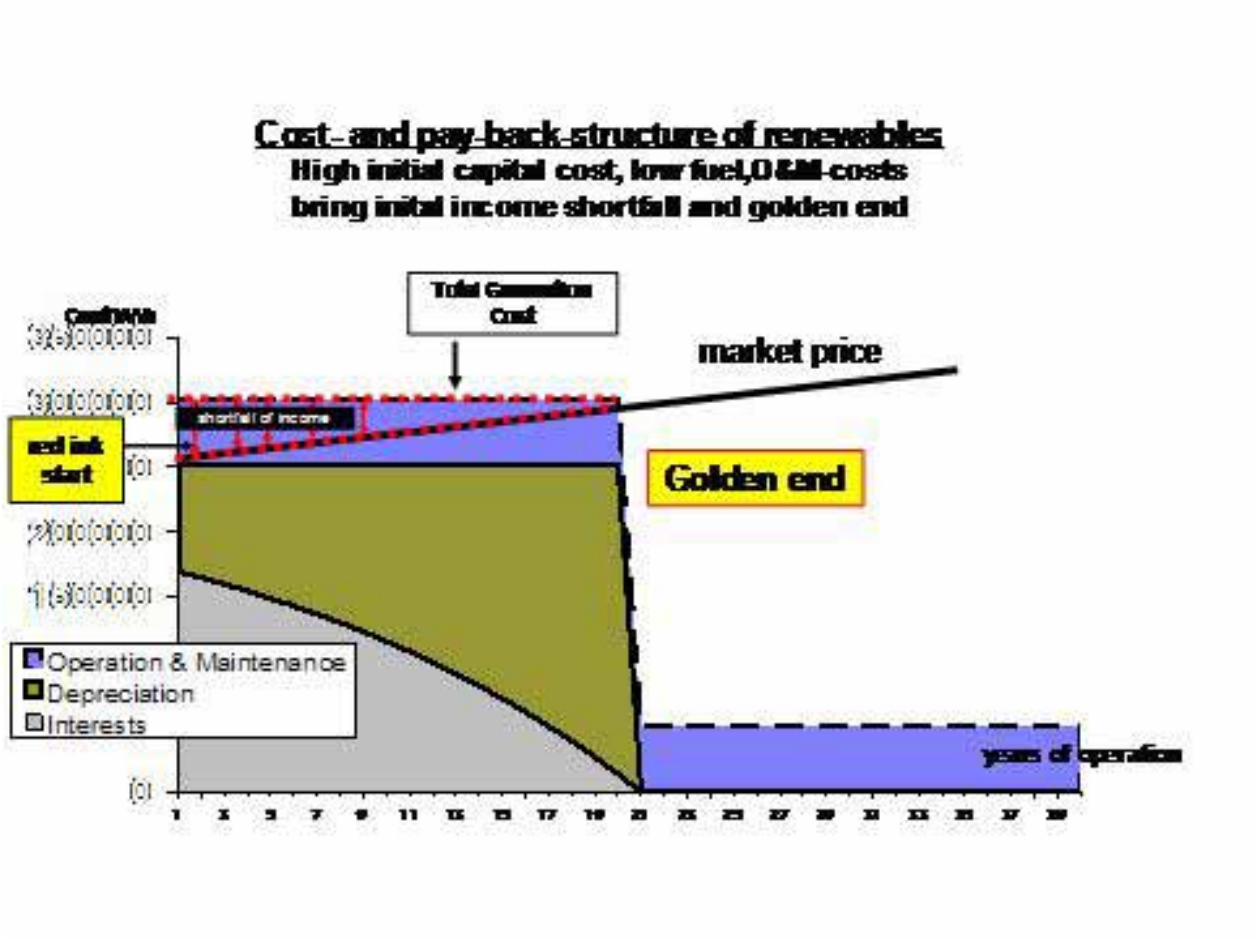

Cost- and pay-back-structure of renewables
High initial capital cost, low fuel,O&M-costs
bring inital income shortfall and golden end
Total Generation Cost
market price
shortfall of income
red ink start
Golden end
Operation & Maintenance
Depreciation
Interests
years of operation

Figure 52

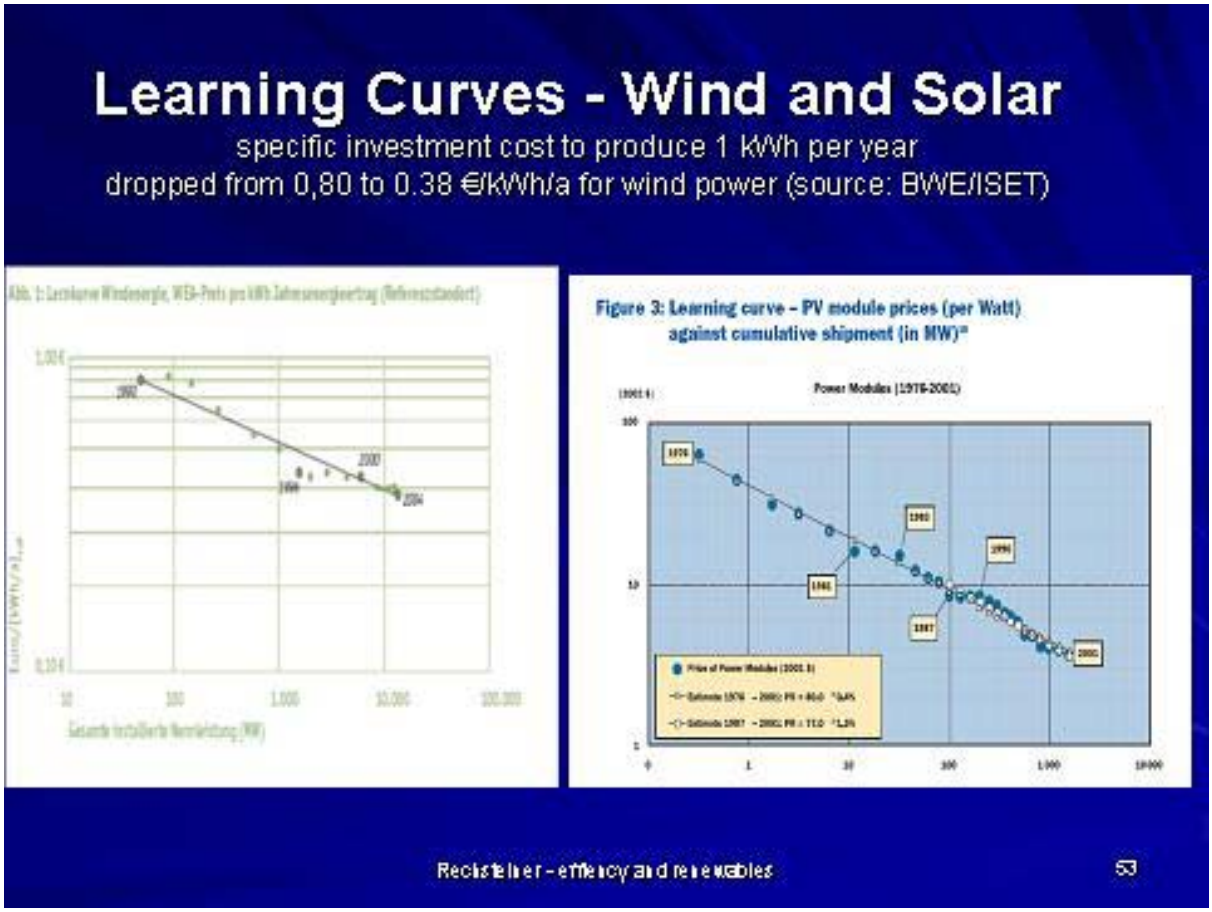


Figure 53

New Renewables are on a steep learning curve, with yearly cost reductions over the prior year's installations between 3-4% for wind power[8] and 5-8% for photovoltaic[9].

The primary energy of renewable energy is free, due to natural flows. Beside the user cost of the installations there is no fuel price and no volatility risk.

The technology is advancing fast; new progress is reached for offshore and low wind sites.

[8] T. Neumann, C. Ender, J. P. Molly: Studie zur aktuellen Kostensituation der Windenergienutzung in Deutschland 2002, DEWI Magazin Nr. 21, August 2002

[9] The feed in tariff of photovoltaic power from open land based facilities underlies a yearly nominal reduction of 6.5% which in real terms equals some 8% a year.

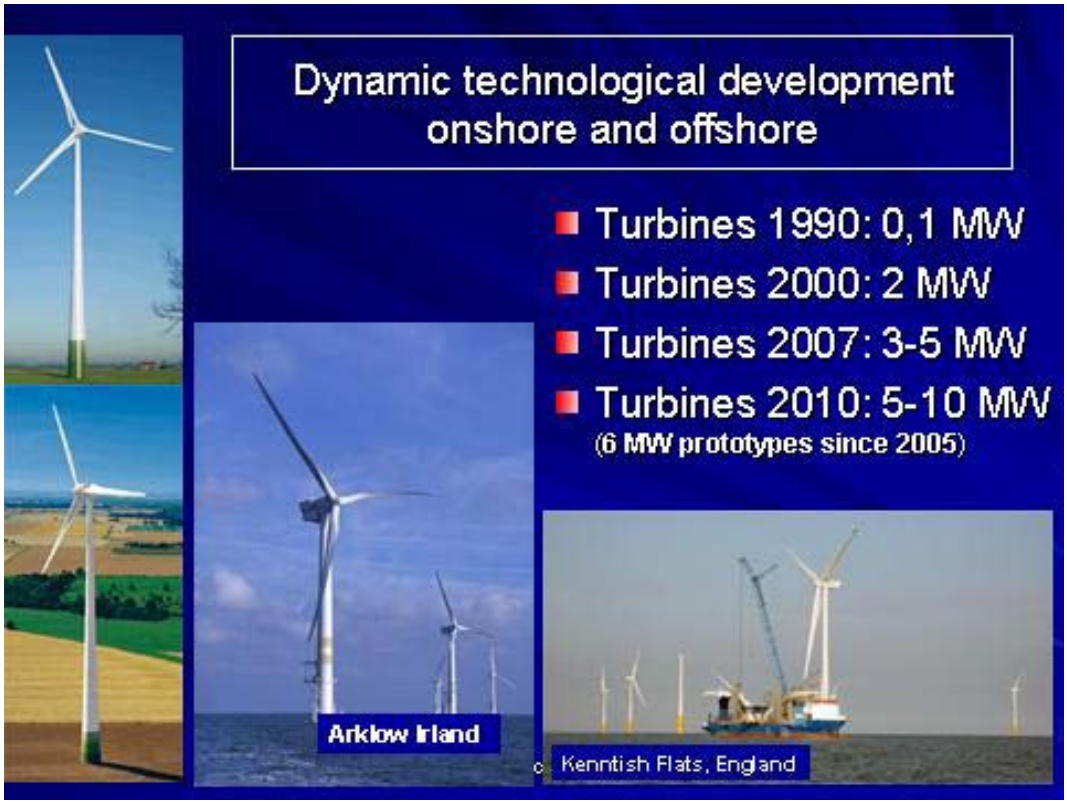


Figure 54

Renewable energy delivers endless, reliable earnings and this is why its growth is so big all around the world.

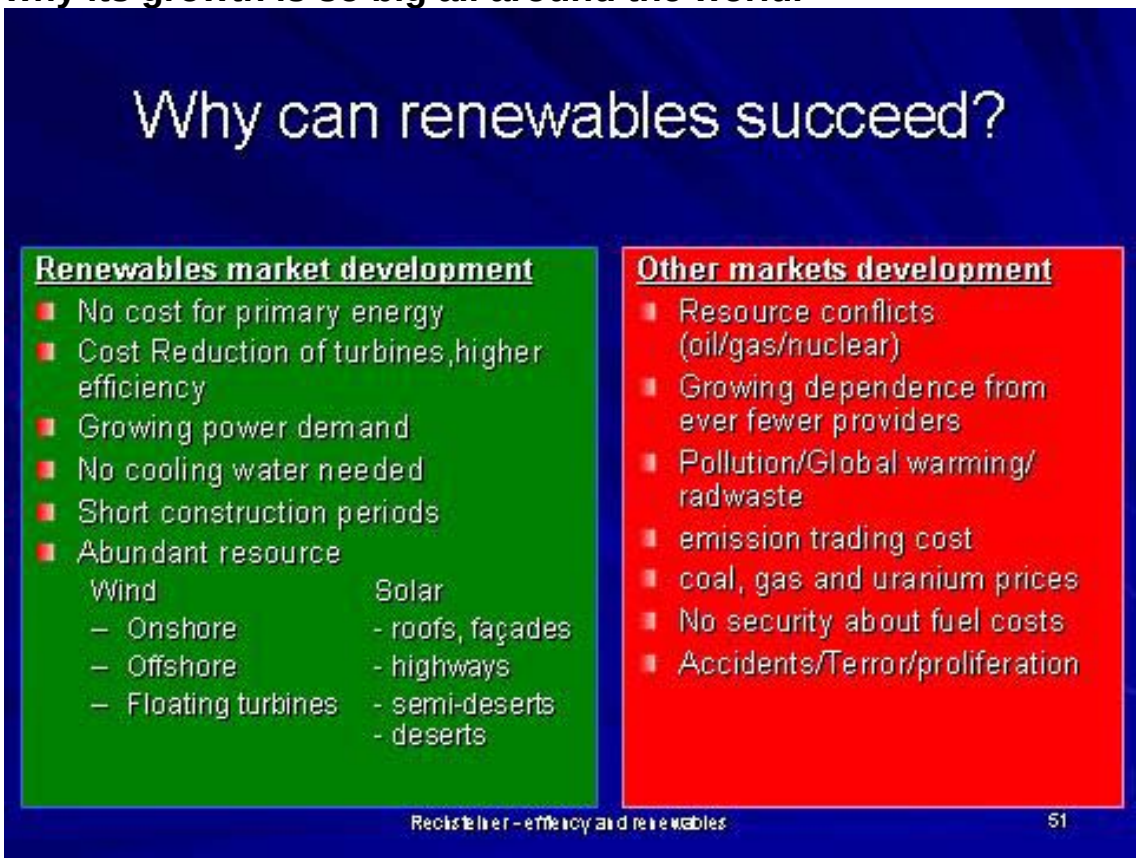


Figure 55

We find two sorts of cost reductions: reduction of investment cost per kW and higher productivity of installed MW capacity, due to better technology.

In many regions of the world, wind power is competitive with new coal-fired and much more so with nuclear plants, and cost reduction will continue.

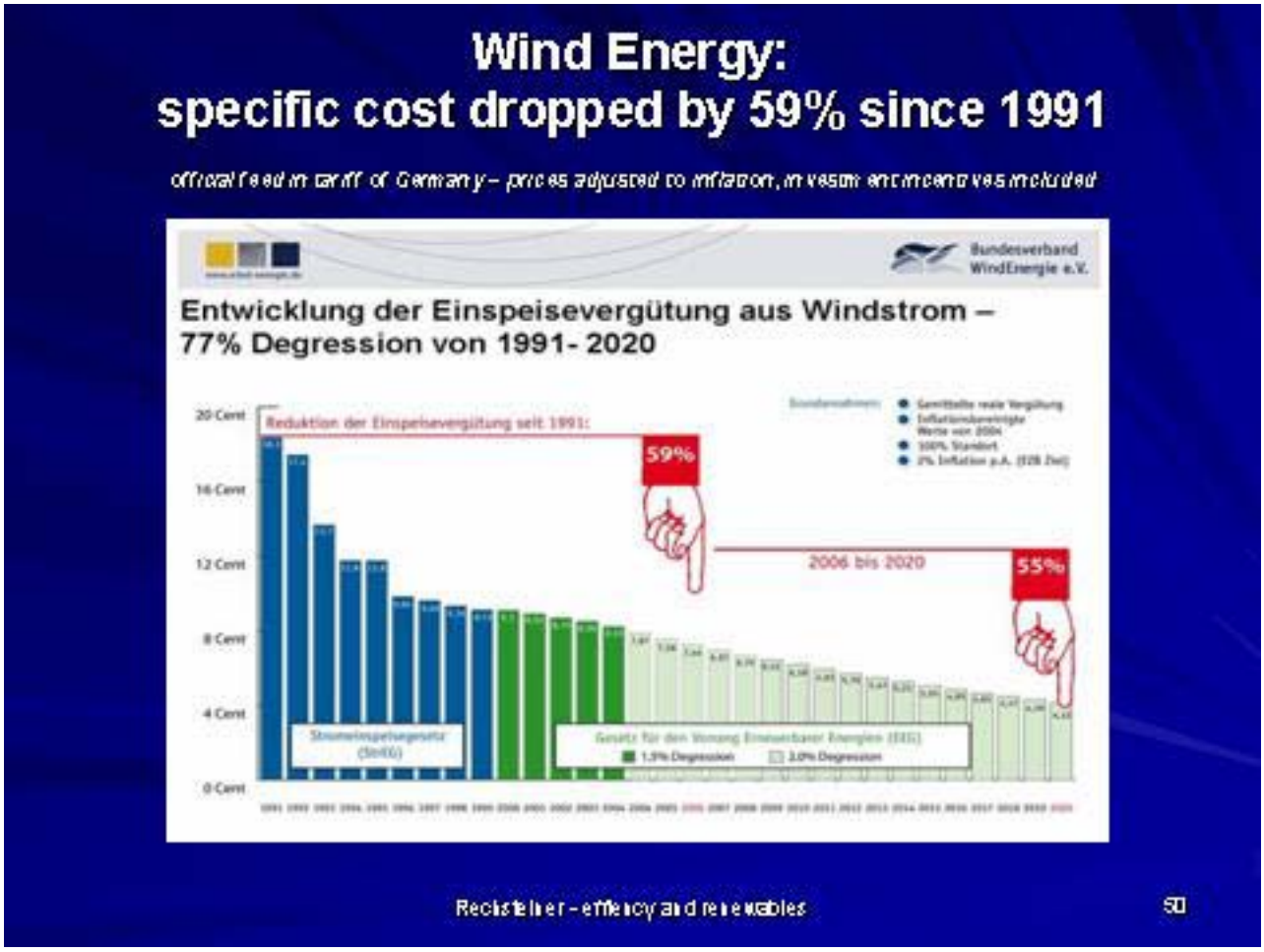


Figure 56

In 1990 wind power feed in minimum compensations[10] in Germany were three to five times higher than the price of power from old coal power stations.

It seems probable that new Renewables soon will outrun traditional technologies such as nuclear or hydro, and some have done so already if we analyze the annual investments for new power equipment.

[10] In the kWh cost figures included are investment subsidies launched in Germany as part of a broad program (Marktanreizprogramme). Cp. BWE **http://www.wind-energie.de/de/publikationen/folien-sammlung/**

Figure 57

To integrate new variable sources of energy we need better grid systems and system integration elements such as High Voltage Direct Current (HVDC) lines and hydro storage.

These long distance power lines are not exotic because the technology is there.

For Russia and for Europe as a whole it could be very attractive to have stronger interconnectivity and more trade of electricity from renewable sources.

Direct current lines are able to transport renewable electricity over very big distances as is shown by new constructions in China or Norway.

Figure 58

Network reinforcements and new grid installations are underway now in the US and in many other parts of the world.

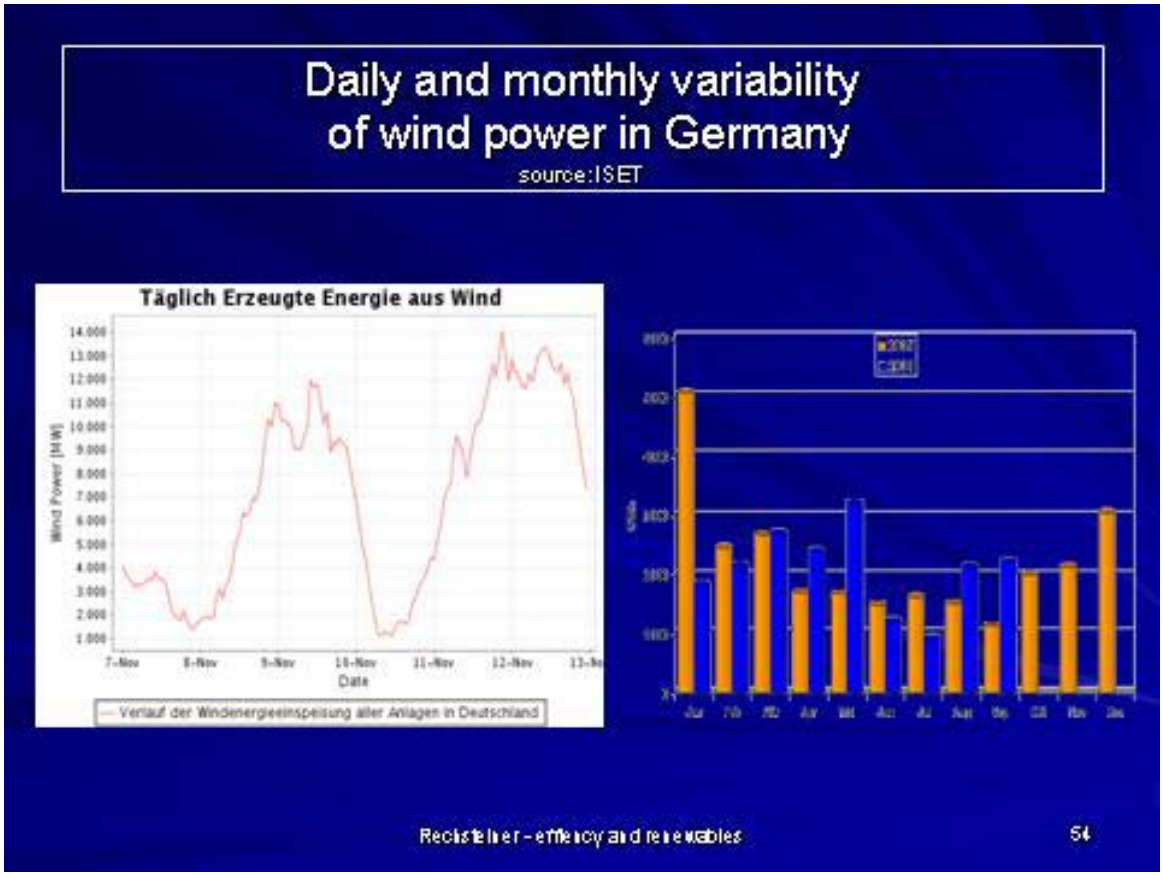


Figure 59

Wind is a very solid, reliable resource. The daily load though the daily load, however, experiences large fluctuations. Interconnection over big areas to a large extent can smooth out this variability.

Distribution of power generation over vast areas and interconnection will transform fluctuating resources into base load power.

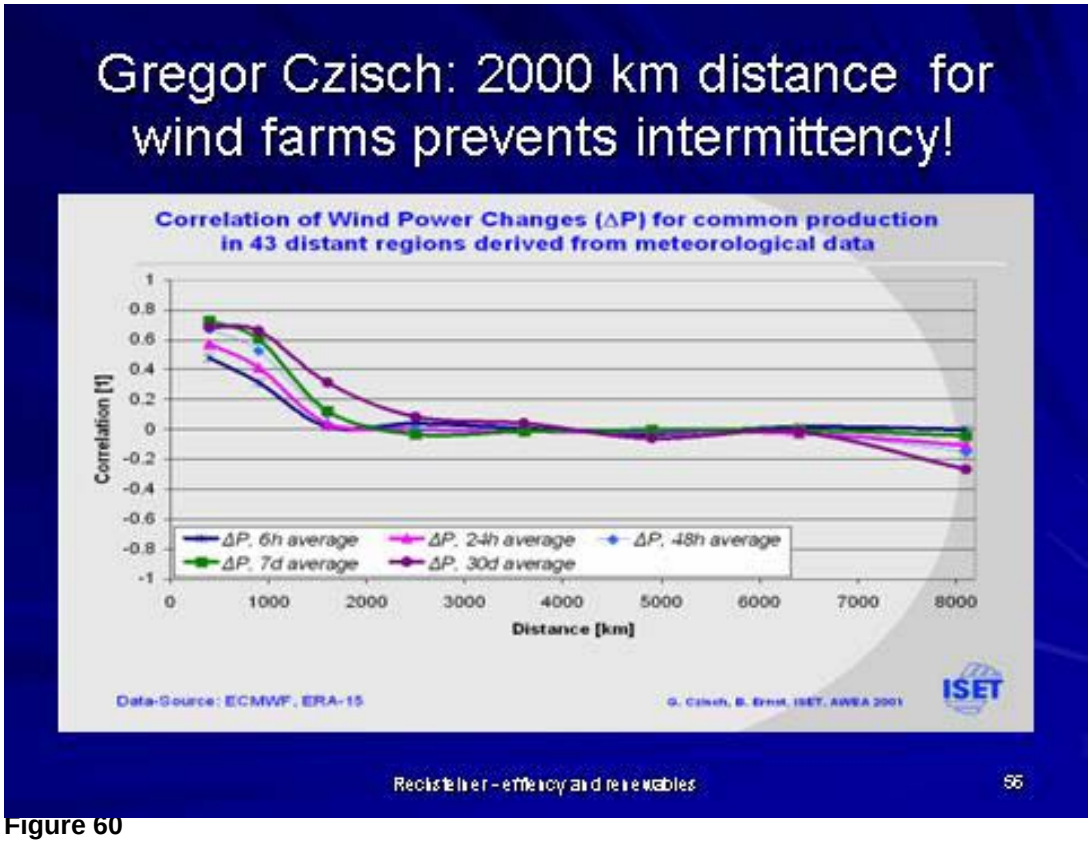


Figure 60

As has been shown by the German Institute for Solar Technologies (ISET, Kassel), a variety of wind farms deployed over 2000 km distance prevents intermittency.

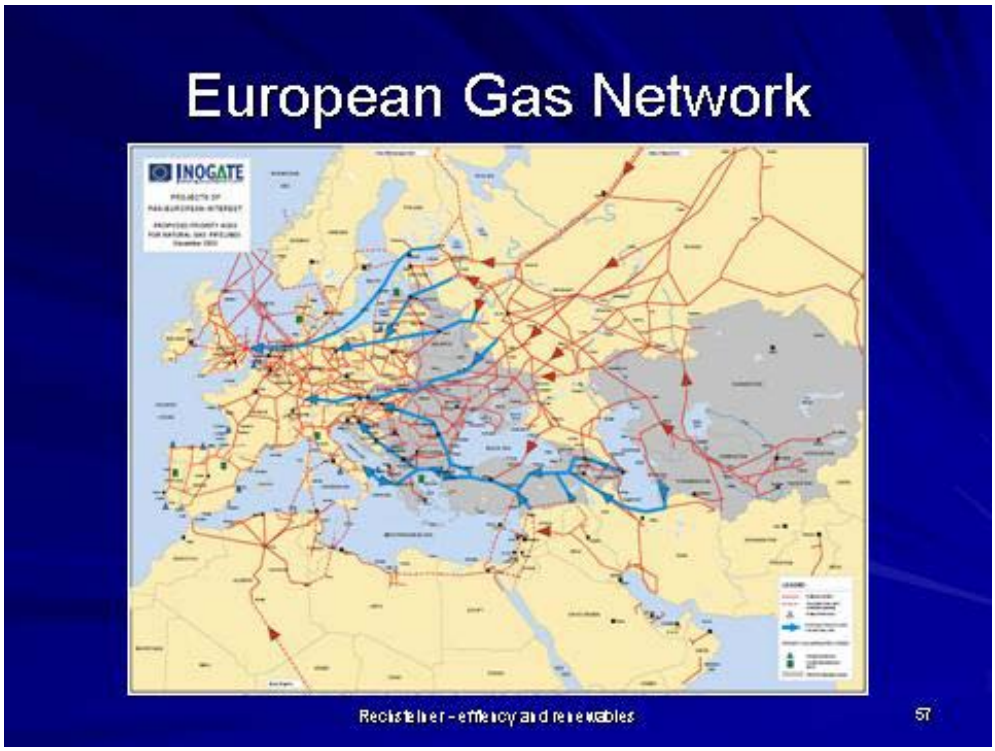


Figure 61

Just remember the huge gas network all over Europe and you understand that a combined wind network works the same and might be cheaper.

The costs of the natural gas network were huge but now it is paying off for Russia.

The costs of renewable power are lower wind power will never run out, and investments will pay off as handsomely as those made earlier for natural gas!

Wind and gas work well together. Running wind and nuclear power though is fraught with problems, since both have high capital costs and low or no fuel costs. That means both require "must run" status to pay off their capital costs within an economic time frame. And both must have guaranteed access to additional generating capacity to cope with daily or seasonal load, such as hydro storage.

6. Conclusions

Conclusion I (Figure 62)

- **Climate Change is a real problem that should be tackled by cooperation:**
  - **Russia should export less oil and gas**
  - **Doing so Russia could sell at a higher price**
  - **Doing so Russia could sell over a longer time**
  - **Doing so Russia will earn more money!**
- **New growth business of the future**
  - **is efficiency and renewable energy**
  - **These technologies should be adopted by Russian academia, science and industry**

Conclusion II (Figure 63)

- **There is a huge demand world wide for oil & gas**
- **Rather than squandering it at home, Russia should maximize its export – over the next five decades.**
- **For efficiency reasons, oil-&gas-price should be correct:**
  - **International price levels in the long run**
  - **Revenue sharing of oil income**
  - **personal or regional distribution**

- **Energy efficiency**
  - **is good for the economy**
  - **Is good for everybody‘s health**
  - **Should be adopted with incentives and legal frameworks**

Conclusion III (Figure 64)

- **Renewable energy is a world wide trend**
  - **There is a general interest for a continental, low cost, clean wind and solar energy system**
  - **To smooth fluctuations of renewable resources interconnection different weather zones**
  - **wind and solar are a new important source of income for any region adopting these technologies.**
  - **Cost reductions will continue. Russia should buy or create its own wind and solar sector.**
- **Energy security based on renewable energy is a peaceful affair for mutual prosperity.**

More contributions of the author in English: **http://www.rechsteiner-basel.ch/On-Energy-in-english.12.0.html**