

Power Supply 2020 – How to reach a modern energy economy

The renewable energy industry's development forecast
for the power sector

(As per: 28th January 2009)



Contact:

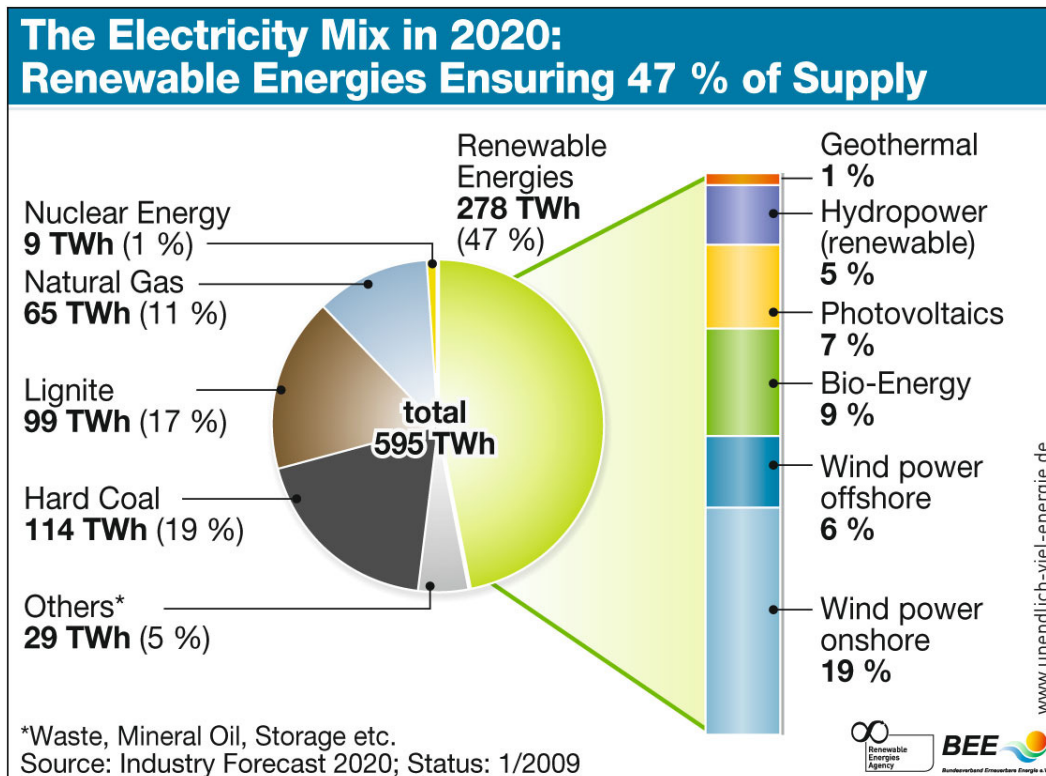
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Central results of the industry forecast

The industry forecast 2020 describes the development of renewable energies which industry experts in companies and associations expect, if the current legal framework is retained and further developed. The forecast is based on the analysis of the previous development and well-founded future assumptions about the future development of renewable energies, power consumption, conventional power plants and network infrastructure. This leads to the following results:

- All renewable energy sectors can undergo dynamic further development by improving efficiency, developing new potential and modernising existing systems.
- The forecast quantity of power produced from renewable energies for 2020 already equals 47 percent of the gross electricity production. Renewable energies will therefore guarantee a secure and affordable power supply.
- In 2020, renewable energies will make up a total of 278 billion kilowatt hours (kWh) of the overall electricity production. The installed capacity will grow to 111 gigawatts (GW).
- Renewable energy power plant capacities and power production will almost triple by 2020, the average annual growth is over 9 percent.
- Even if conservative assumptions are made, there will be a sufficient amount of secured power production at any time in 2020. This include times of annual peak load.
- About two thirds of the power produced from renewable energies (189 TWh) will be supplied by the fluctuating sources wind and solar radiation. The supply behaviour of the remaining fossil and nuclear power plants and the use of existing storage hydro power plants will increasingly depend on the supply of renewable energy.
- The capacity utilisation of all standard power plants without combined heat an power will drop. Contrary to a widespread opinion, the need for natural gas for power production will decrease.
- Above and beyond those already under construction in 2008, no additional fossil power plants will be required to guarantee a secure power supply in Germany in 2020.
- In the year 2020, renewable energies will avoid more than 200 million tonnes of CO₂ in the power sector alone. This makes them climate protector number 1.
- The development of renewable energies will greatly relieve the general economy. In the year 2020, they will reduce the external costs of environmental and climate damage by 6.3 billion Euros, and they will save fossil energy imports totalling 22.6 billion Euros. This far outweighs the costs for the development of renewable energies in the power sector. As a result, the incremental costs for the renewable energy feed-in law in the year 2020 will only amount to 2.4 billion Euros.



Conclusions

The following conclusions for the current energy-related political discussions can be drawn from the central results of the industry forecast:

- The development of renewable energies in the power sector will make an important contribution to achieving the overall goal set by the EU for Germany, which states that 18 percent of the energy consumption in the year 2020 must be produced from renewable energies.
- Already today, there is enough flexibility in the power plant park to ensure the complete integration of renewable energies by 2020 without compromising supply security.
- The legally and economically based priority grid access and dispatch for electricity from renewable sources will result in a lower grade of utilisation for thermal power plants . This factor needs to be taken into account when investing in new power plants.
- Therefore it is not necessary to delay the phase-out of the German nuclear power plants. For the renewable energies industry, the phasing out of the nuclear energy is an important part of the investment security for the development of the capacities outlined in this forecast.

The dynamic development of the renewable energies in the power sector will continue after 2020. Eventually, power supply needs to be completely shifted to renewable energies. This demands a much higher level of flexibility in the electrical power system and therefore the primary goal of the political and economic deliberations must be to develop new storage capacities based on different technologies and to improve the access to existing ones. Therefore targeted support mechanisms for renewable energy combined power plants should be developed and load management should be improved by means of load-variable power tariffs and usage charges (smart-metering). In addition, the use of power sector surpluses in the heat and mobility sectors will increase after 2020.

Assumptions and results in detail

1. Basic assumptions

The industry forecast 2020 is based on the analysis and estimates of all sector associations which are organized under the umbrella of the German Renewable Energy Federation (BEE). The sector expertise with regard to production capacities and technological development is the basis for the assumptions made about the development of renewable energies and for future development of the power plant park. Industry assumes that the positive framework conditions, such as the Renewable Energy Law, will be upheld and further developed. The forecast also takes into account the billions of investments made in recent years for the development of renewable energies in Germany. At the same time, the assumptions are conservative and contain a safety margin.

Development of the power consumption levels: The net power consumption in Germany in 2007 was 539.5 billion kWh. There are great efficiency-saving potentials. According to the EU Directive on end energy efficiency and energy services, member states must reduce their energy consumption by a total of 9 percent over a period of 9 years. The implementation is described in the National Energy Efficiency Action Plan (NEEAP). In the industry forecast, a conservative assumption has been made that the annual reduction of power consumption will only be a quarter of the amount stated above, i.e. 0.35 percent per year. Net power consumption will therefore only drop minimally to 521 billion kWh.

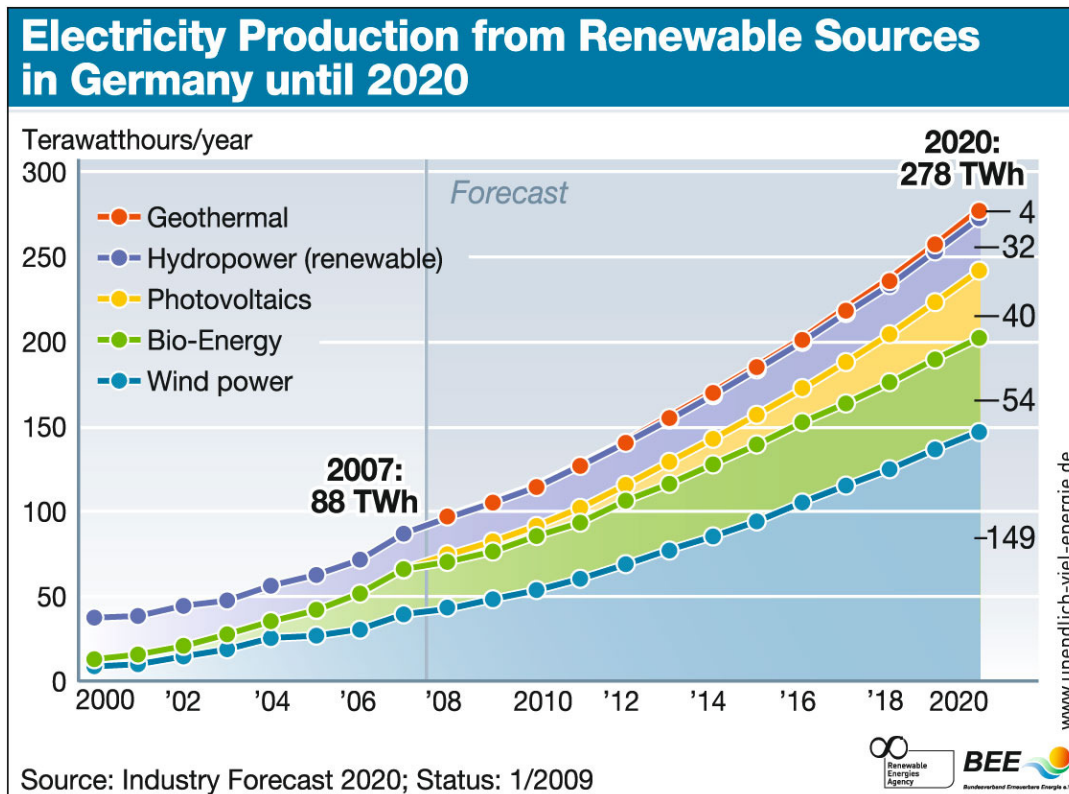
Raw materials prices: It is assumed that the price for a barrel of oil will increase to 200 US-Dollar₂₀₀₈ in the year 2020 and that as a result natural gas will also become more expensive. The prices for coal and uranium will increase significantly in line with the past trend.

Available space for energy plant cultivation: The industry forecast has gone along with the assumptions of the leading study by the Ministry of the Environment which forecasts that an area of 3.2 million hectares will be available for energy plants without competing with food stuff production. The industry forecast 2020 also does not include any imported agricultural raw materials. Palm oil or soya will not be imported in significant quantities until a reliable certification system for sustainability criteria has been installed.

2. Renewable energies will continue to grow rapidly

In the year 2020, even if energy efficiency gains are only moderate, 47 percent of the power used in Germany will come from renewable energies. This figure has already taken into account grid losses, pump flow costs for storage power plants and the own consumption of conventional power plants (gross power consumption). The installed capacity and the power yield will triple to 111 GW or 278 billion kWh compared with today's figures. Wind and solar energy, bio-mass, hydro power and geothermal energy will become distinctive features of the power supply system.

How realistic this rapid development really is can be seen if we look at the past: In 2007 already, the goal set by the government in the year 2000 to reach a share of 12.5 percent for renewable energy of the total power consumption had been exceeded. The goal of 20 percent envisaged for 2020 will probably already be reached in 2011.



The individual sectors:

Wind power

Wind energy remains one of the largest power producers in the renewable energy field. By 2020, industry expects that it will about 149 billion kWh will provide a quarter of the total German power consumption. In theory this could cover the total power needs of Bavaria and Baden-Württemberg together. Wind power is mainly produced on shore. The industry assumes that today's installed capacity of approx. 24 GW will almost double to 45 GW. As numerous old wind turbines will be replaced by new and more efficient ones ("repowering"), the number of the onshore wind energy systems will remain constant at around 20,000. With regard to the offshore development of wind parks, industry assumes that the goals of the government to reach an installed capacity of 10 GW by 2020 will be reached.

Bio-energy

The renewable energies industry foresees an increase of installed capacity in the bio-energy sector to 9.3 GW (2007: 4.1 GW) for 2020 and thus a doubling of the power generated from biomass to around 54 billion kWh. The major share will be made up by biogas, followed by solid biomass (in particular wood, residual substances) and far behind, liquid biomass (plant oil CHP) and sewage gas and landfill gas. Electricity from bio-energy will therefore be the second largest column in the power mix of the renewable energies in 2020. Due to permanent availability, bio-energy will provide the greatest contribution of all renewable energies to secured power supply.

Photovoltaics

The contribution of photovoltaics to power production will increase almost ten fold from 4.3 billion kWh today to almost 40 billion kWh by 2020, as will the installed capacity (2020: 39.5 GW). This is therefore the fastest growing of all renewable energy sectors, just behind offshore-wind and the geothermal energy. By 2020, it will provide 7 percent of the generated power. The reasons for this are the progress made in the efficiency of the technology and resulting cost reductions. The industry expects increasingly dynamic growth in the middle of the next decade, when the so-called grid parity will be reached. This means that the power generated from solar panels on the roof will be cheaper than the power purchased from the energy supplier.

Hydro power

In the so-called small hydro power, industry expects a greater increase by 2020 than in the past due to new economic incentives in the EEG 2009. Also, investments in large hydro power plants will become more attractive due to increasing fossil fuel prices, and therefore the forecast predicts an increase of installed capacity. In total, the power production from large and small hydro power will increase to 32 billion kWh in the year 2020 with an installed capacity of 6.5 GW (2007: 4.7 GW).

The industry believes that conflicts between nature conservation and hydro power can be easily solved, in particular due to the improved regulations in the EEG 2009. They can additionally be combined with support programmes for nature conservation and landscape protection. Therefore the industry forecast assumes a high potential through modernisation of existing installations and reactivation of the closed down power plants in combination with ecological improvements, such as the installation of fish ways.

Geothermal

At present, the installed capacity amounts to around 7 MW with an annual power production of 150 million kWh. The renewable energies industry foresees a steep increase in power and heat production from deep geothermal projects: By 2020, the installed capacity will increase to more than 600 MW with almost 4 billion kWh of generated electricity. The driving force behind this development will be the stable framework conditions that have been considerably improved by the EEG 2009. The deep geothermal projects can also receive extra funding from the government's market incentive programme, which covers part of the risk. Today there are already around 150 "permission fields for searching for underground heat" in Germany. Some of these are of a size which would allow several projects to be realised. Experience gained from the initial projects will facilitate the realisation of subsequent projects.

3. Security of supply is granted

The demand for power in the year 2020 will be covered by a diversified power plant park in which renewable energies are the dominant element. The growing share of renewable energies will, however, change the basic structure of power production. By 2020, around two thirds of the power produced from renewable energies (189 TWh) will be generated from the fluctuating sources solar and wind.

The industry analysis shows that even under conservative assumptions there will always be sufficient secured capacity available at any time, even at for the maximum load (annual peak load).. This will be guaranteed due to the strong increase of installed capacity of power plants based on renewable energies, as well as by increased storage capacity.

A secure power supply means that at any time power production will be sufficient to cover the actual demand. Fluctuations in demand (e.g. peaks at lunchtime) or in the available power supply (power plant failures, fluctuating wind availability and solar radiation) always need to be compensated. This is precision work and requires a constant source of available power plant capacities. The share of all power plant capacities that, from a statistical point of view, will almost certainly be available at times of maximum demand is called "secured capacity". The difference between this and the annual peak load is called "remaining capacity". It is practically a "buffer solution" which is available as a reserve for extreme situations (e.g. unusually cold periods), an above-average power plant failure rate and eventually as an export capacity.

Even if around 10 large power plants of 1,000 megawatt capacity had failed at the same time during the annual peak load in 2007, the power supply would still have been reliable without any imports. In reality, at this time Germany even exported 5,000 megawatts. The industry forecast 2020 expects a moderate reduction of the gross power consumption to 595 billion kWh by 2020; this not only includes the demand, but also grid losses, pump flow costs and the power consumption of the power plants. Accordingly, the annual peak load will also slightly drop to around 76 GW.

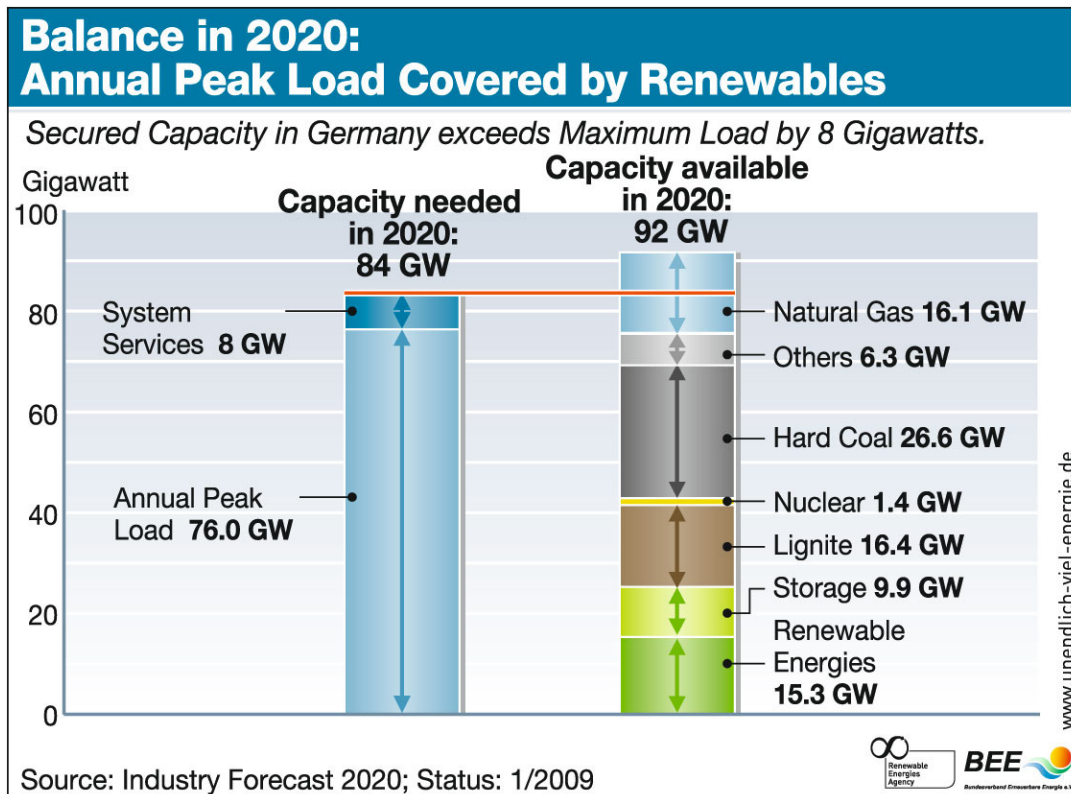
	2005	2006	2007	Industry forecast 2020
Gross power consumption (billion kWh)	612.1	617	617.5	595
Annual peak load (GW)	76.7	77.8	78.5	76.0
Hourly secured net capacity (GW)	82.7	86.2	89.3	83.9
Remaining capacity („Buffer“) (GW)	6	8.4	10.8	7.9

Sources: Bundesnetzagentur, AG energy balance calculations, own calculations

Germany's current power supply system is much more flexible than is generally known. 10 gigawatts of storage and pump storage hydro power plants are available for the German grid. This equates the output of twelve coal-fired power plants. Pump storage stations accumulate power quantities at high production levels and they can supply them in a few seconds on demand. By 2020, this value will presumably increase to around 13 GW. However, the industry forecast has used a conservative estimate of only 10 GW storage capacity for the year 2020. In addition to this, the dispatchable bio-energy capacity will grow from 4 GW today to 9.3 GW.

Today, the existing hydro power storage plants are primarily used for night storage of the power generated by the fossil and nuclear base load power plants which is not needed during this period. With further growth of renewable energies, the need to store the power when there are optimum wind and sunlight conditions will also be growing. Germany currently has hydro power storage plants of around 6,200 MW generation capacity and 6,000 MW pump output. In addition, German power suppliers have property or long-term power acquisition rights to foreign pump storage power plants with around 3,400 MW capacity in

Luxemburg and Austria (Vorarlberg and Tirol). These plants are connected via direct lines to the German power grid and are used for the needs of the German system. Therefore they can and must be handled as domestic systems in the capacity calculations. In combination with these, the power plant park in 2020 will be able to deliver an adequate secured capacity at any time.



4. The changing power plant structure

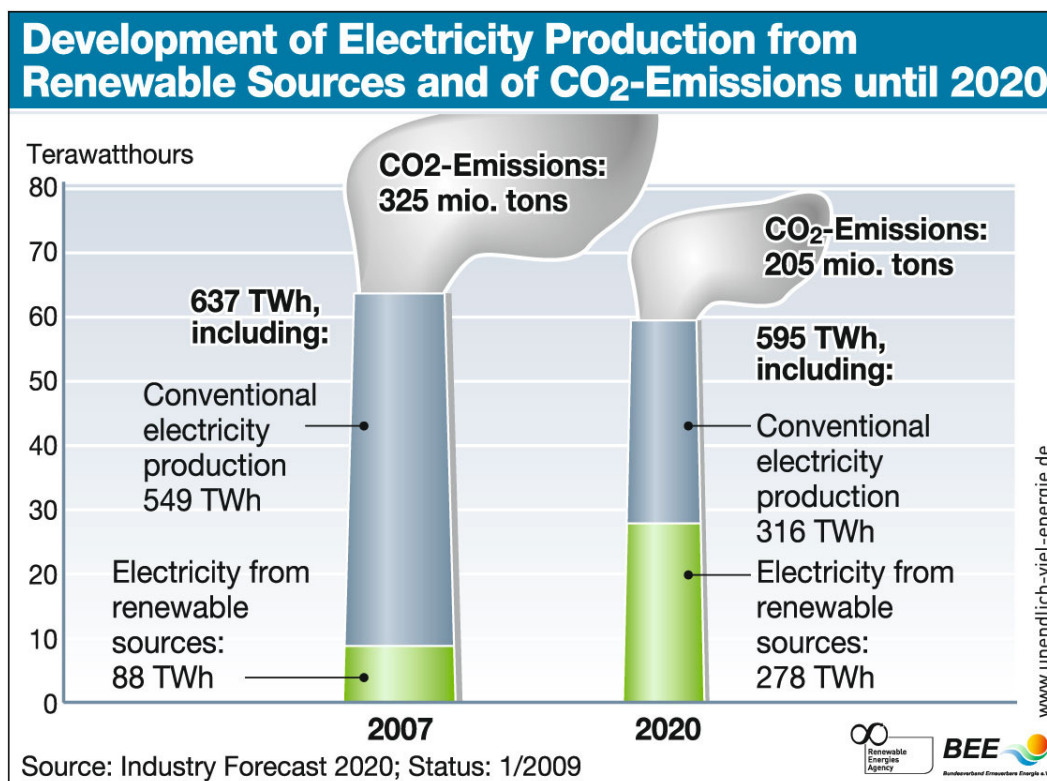
Increasingly, the supply behaviour of the remaining fossil-nuclear power plant capacities and the use of the existing storage hydro power plants will be determined by the supply from renewable energy sources. As a result, the load factor of fossil power plants will decrease by about 30 percent. This means that in contrast to a widely held opinion the need for fossil fuel imports and the dependency on natural gas in the power sector will drop: Under the given assumptions and taking into account the changes in the conventional power plant park, there will be a reduction of 37 percent for lignite, of 21 percent for hard coal and 12 percent for natural gas. The power generated from nuclear energy will drop by 94 percent compared to 2007.

Above and beyond the power plant projects under construction in 2008, no more fossil power plants are required to guarantee a secure power supply in Germany in 2020. It is not necessary to delay the phase-out of the nuclear power plants. According to the Federal Grid Agency, around 12 gigawatts of power plant capacity is under construction. Investments worth 39.7 gigawatts are planned. This is much more than is required against the background of the planned shutdowns and the development of renewable energies.

In contrast to what many people from the incumbent energy sector and some political circles have just recently been claiming, the dependency on natural gas for the power production will not increase due to the growing share of the renewable energies. On the contrary: According to the industry forecast, the power generated in the natural gas power plants will have dropped by around 12 percent in the year 2020 compared to today. The so-called "Dena Grid Study I" also concluded in all scenarios that there would be a reduction of power production from natural gas due to the deployment of wind energy systems.

5. Climate protection by means of clean power

Renewable energies significantly reduce the emission of the greenhouse gas carbon dioxide in the power sector. They are indispensable to achieve the climate protection goals. The growing share of renewable energies in the total power supply, increases their contribution to climate protection at the same time. In the year 2020, renewable energies will reduce emission by more than 200 million tonnes of carbon dioxide in the power sector alone. That is almost three times as much as in 2007 (75 billion tonnes) and equals the overall emissions of German industry and households today. Renewable energies are therefore the climate protector number 1 and without them the German and European climate goals would not be feasible.



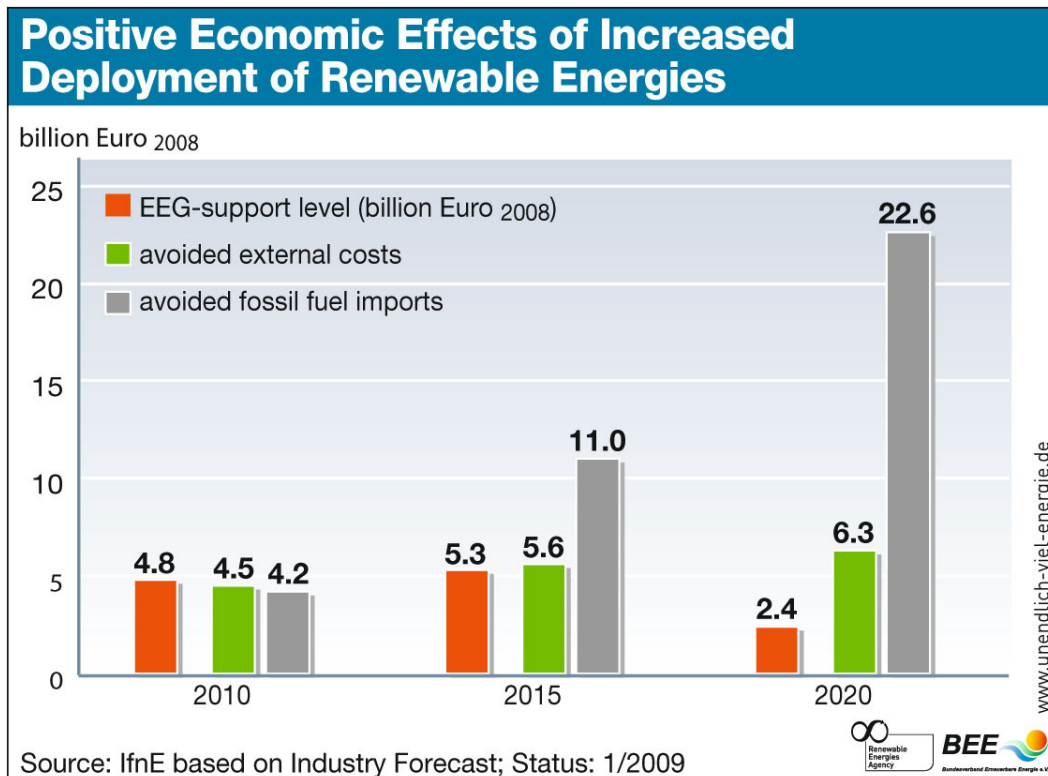
6. Renewable energies are good business

Within the scope of the industry forecast, a costs-benefit analysis was performed based on the regulations of the EEG 2009 and an assumed average annual inflation rate of 2 percent. The forecast assumed that the oil price would increase to 200 US-Dollars₂₀₀₈ per barrel in the year 2020.

The results show that renewable energies with a 47 percent share of the power consumption seriously relieves the economy. The costs of climate change are only partially covered by CO₂-certificates. In the year 2020, renewable energies will avoid additional external costs of 6.3 billion Euros relating to the production of power. The incremental costs caused by the

EEG supply remuneration in 2020 will only amount to 2.4 billion Euros according to the industry calculations (incremental costs comprise the difference between the amount of the EEG remuneration payments and the power purchase costs of the energy supply companies that are avoided due to the EEG power production).

This means that renewable energies have a positive balance sheet with regard to the economic aspects. And the benefit for the labour market has not even been taken into account: Industry assumes that the number of jobs will rise to 500,000 by the year 2020, which is twice today's figure.



The growing share of renewable energies in the electricity supply also relieves consumers. The rising prices of fossil energy sources will lead to a significant increase of electricity prices. This is counter-balanced by the growing use of renewable energies, because a growing share of power from renewable sources is generated at lower costs than power from other energy sources.

Furthermore, renewable energies continuously lower the dependency on imported fuels. They would not only have a strong negative financial impact on the economy and on consumers, but would also mean increasing dependence from a decreasing number of producing countries.