CLIMATE ADAPTATION: IMPACTS OF CLIMATE CHANGE ON THE ENERGY SUPPLY IN GERMANY?[1]

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Overview

The structure of German energy supply faces a fundamental and long term change. Renewable energies will gain importance regarding energy and especially power supply. By the middle of the century greenhouse gas emissions caused by energy conversion shall be reduced for the most part. In the same period, the global climate will start to change in a visible manner. In future, government and private business in Germany will experience a rising need for adaptation (Mahammadzadeh et al., 2013). The effects will be felt in Germany as well including impacts on the energy system. Climate change will alter the scenery of energy generation and distribution in Germany in two ways: supply shall be based primarily on renewable energies, which is climate change induced, furthermore climate change will affect mining for raw materials and transport, energy conversion and distribution.

Considering the presumed future energy mix, it can be shown that during the next 20 years climate change induced risks will slightly weight out corresponding chances. As expected, power supply is more prone to climate change than the overall energy supply. Restructuring the energy system has only minor effects, because the risks of conversion of non-renewable energies, that is bound to cooling water, is substituted by risks especially deriving from the use of biomass.

Methods

In order to determine and to quantify the physical impacts of climate change on energy supply, the Cologne Institute for Economic Research (IW) has developed the IW-climate-risk-indicator for the energy industry. It is based on a series of expert interviews performed in the middle of 2011 and can be applied to various energy mixes in different segments of energy supply. For this study expert interviews serve as data basis. In 2011, experts for the most important resources as well as experts of power plant grid technologies were interviewed. They were asked about energy production processes and the respective strength of the impact of climate change. At the end of 2011 the results were discussed and modified during a workshop with scientists and representatives of the energy sector.

Results

Climate change and its consequences are significant to the energy industry. Its influence varies by primary energy sources, secondary energy carriers and conversion technologies (Umweltbundesamt, 2011). The infrastructure is especially threatened by storms: The pressure of the wind on power lines will become stronger and bent or damaged trees could fall on streets and tracks. Hail is a threat to the production of biomass. A lack of cooling water in hot summers can become a problem for thermal power plants, as long as they don´t have cooling towers. Additionally, there are regulations which define a maximum temperature of watercourses in order to guarantee a good water quality (Rothstein et al., 2008; Rothstein and Parey, 2011). Another problem is that power lines are less efficient at high temperatures.

Climate change has the biggest impact on steam power plants which are used for the production of power from oil, natural gas, methane hydrate, hard coal and nuclear energy. Sinking river water and groundwater levels as well as rising temperatures of watercourses restrict the availability of cooling water during heat waves. During these times power plants often have to reduce their output or shut down in order to protect nature. That is why in the future experts expect stronger seasonal variation of the energy production from affected power plants. According to the experts, the risks still stay at a medium range, because most of the times only certain power plants are affected by these extreme conditions. That is why there is no danger for the whole power supply. Moreover, there are more and more power plants which have cooling towers. The problem with the cooling water rarely applies to lignite fuelled power stations, because mostly they are not cooled by water from a river. Instead they use drained water from the open pit mine for cooling. In case of high outdoor temperatures efficiency might be reduced. The loss of efficiency is

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not very high, but still economically noticeable. Increased outdoor temperatures play a role when it comes to the power generation from natural gas. The higher the outdoor temperature, the lower is the possible efficiency of the power plant. That is why the power generation by gas power plants is more influenced by climate change than other types of power plants. Yet, one advantage of gas power plants is that they can bridge bottlenecks in the energy supply in the short term.

Not only energy production from fossil fuels is affected by climate change. Renewable energies will also experience the impacts of climate change. Solar energy is the renewable energy with the biggest variations in yields. Solar thermal plants depend very much on the sunshine, while photovoltaic systems can still supply energy when the sky is cloudy. Because of climate change, it is expected that the output of these plants in Germany will be low in the winter months and high during the summer months. An important factor for the yields from solar energy is the global radiation. It includes the direct solar radiation as well as radiations components like scattering which strike the earth caused by clouds. According to experts there will be local differences, but the global radiation in general will not change because of climate change. Also experts do not expect extensive consequences of variations in temperature on the plants. In general, neither photovoltaic nor solar thermal energy systems are to present knowledge affected by climate change. Technically, the potentials of solar energy are known and experts do not expect a considerable change through climate change. There is still a slight vulnerability of the plants because of extreme weather events such as storms and hail. Among the renewable energies, wind power stations and biomass are affected by climate change. Up to now some plants have to be switched off in case of storms in order not to endanger their functionality. Experts say that these problems occur only for two or three hours a year which is economically irrelevant. Nowadays engineers work on techniques, which make it possible to let the systems run with lower capacity during a storm. The impacts of climate change on the energy supply from wind power stations are in general little.

Conclusions

Climate change has a lot of physical impacts. Extreme weather events can have negative impacts on energy supply. However, most of these risks are well known, but extreme events will occur more often. This applies for example to all possible bottlenecks of the provision of cooling water for thermal power plants or the danger of wind throw for power lines. There are additional risks for the supply of biomass because of deteriorated growth conditions caused by extreme weather events. At the same time it is possible to get access to new deposits of fossil fuels because of the global melting of ice layers.

In total, climate change has a negative impact on the energy supply: the risks outweigh the potentials clearly. The risk can still be seen as moderate. This applies especially to the energy mix in total, but also to the power supply where the IW-climate-risk-indicator is still within the moderate range. For Germany, there are no dangers for the energy supply expected caused by climate change, which cannot be addressed. The changes of the climate will be noticeable in several decades. In the same period of time the energy supply in Germany shall be shifted to a renewable energy based supply. The impact of the energy turnaround on the security of power supply is larger than the overall moderate impact of the climate related changes. However, certain risks will gain importance especially regarding the availability of biomass. The energy turnaround can generally be seen as neutral in regard of the climate risks.

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