Energy: problems related to mitigation and adaptation

The energy sector is on one hand one of the biggest source for GHG but on the other hand also affected by climate change in a lot of ways. The energy systems are different in European countries and as a consequence the vulnerability too. Very often there are good solutions for both adaptation and mitigation but it means a new approach in delivering energy. A lower energy demand reduces the vulnerability. In some cases adaptation measures will lead to higher GHG-emissions.

1. Lack of cooling in big power stations during droughts

Thermal power stations can just produce electricity if there is enough water for cooling the process. In the case of heat waves and droughts the quantity of water available will be reduced and the water temperature will be higher. As a consequence the energy efficiency and the power will be reduced probably.
During the drought period of the summer 2006 a lot of power stations (nuclear or fossil based) could not deliver the full amount of energy especially in France, Germany, Spain and Italy. The lack of precipitation in the period autumn 2006 till spring 2007 lowered the level of the river Po in Italy up to 6 m less. There was discussion weather it is better to reduce the production of electricity or the water supply for agriculture. It is obvious that additional thermal power stations caused by higher energy demand will make the situation worse. Saving energy is the main pillar to secure the energy system in a sustainable matter.

Smaller power units can be cooled by heat exchanger but bigger one by means of cooling towers producing steam. In the first case the quantity of water will not be reduced but the temperature will rise. By legislation there is a limitation for the water temperature to avoid critical levels to do not harm ecosystems. Higher temperature reduces the oxygen content. As a consequence the population density of aquatic animals can be affected in a negative way. Higher water temperatures can also change the spectrum of species being a natural threshold for certain species. This change has been measured for instance in Austria[1] and is a consequence of climate change but will be extremer if power stations contribute to the temperature stress too. The influence is depending on the special conditions like local climate, water-balance, strategies for nature protection etc. therefore have to be studied case by case.

Measures in respect with adaptation and mitigation:

- Master plan for the use of water including optimisation of locations for power plants including energy efficiency and the optimal size (combined heat and power stations; power calculated by the usage of heat)
- Use of the waste heat of power stations for district heating or cooling, agriculture, manufactories
- Higher efficiency in producing electricity for instance by retrofitting (fuel switch, new technologies)
- Use of renewable energy sources and energy saving

2. Problems in the electricity distribution system by severe storms and flooding

Energy supply companies are used to manage local problems of disconnected electricity supply in a fast way. Extreme weather events have the potential to affect a lot of places at the same time. Severe storms for instance appear more frequently since 20 years in Europe (for example Lothar 1999, Kyrill 2007). Also heavy snowfall like during the winter period 2005/2006 has to be considered. As a result of falling trees the electricity grid system is often broken especially in countries with mountainous regions. Up to several days regions and villages are cut off the grid, because the capacity for repairing is limited. During flooding events the electricity infrastructure can be destroyed, but often the connection has to be disrupted because of security problems.

Measures in respect with adaptation and mitigation:

- Electricity supply systems by cables integrated in the ground are better adapted in the case of storms/falling trees
- In the case of winter storms it should be possible to heat at least one room without the use of electricity. It has to be considered that most heating installations need electricity for pumps as aid energy. Biomass installations can be a solution.
- Forest management can lower the vulnerability (see chapter 4.)
- Because storms are often in the winter period, off road cars are better equipped for service teams of the energy companies.

3. Changes in the seasonal electricity production of hydropower and CHP installations

There are some countries in Middle-Europe with a high share of hydropower like Austria, and Switzerland. Until recent there is a perfect system including lower electricity supply by hydropower coupled with CHP installations for district heating during the cold period. During the warmer time the hydropower can deliver enough electricity so thermal power can be reduced. Higher precipitation in winter and a lower share of snow will raise the hydropower-electricity production during the cold period in the future. There is a good overlapping in the use of electricity in heat pumps. A greater problem is the decoupling to combined heat and power stations: In the summertime there will be a minus in the water-balance caused by lower precipitation, lack of water from glaciers, more extreme runoff by extreme rain. On the other hand there can be a higher demand for electricity for cooling buildings. More electricity will therefore have to be produced in power stations. One main problem will be that just a small amount of the waste heat can be used for example for district cooling systems.

Measures in respect with adaptation and mitigation:

- Storage hydro power stations are able to smooth the electricity demand and supply. There are limitations in respect with nature protection.
- Strategies to use waste heat also during the warm season.
- Energy saving especial to mitigate cooling in summer

4. Higher biomass use in combination with adaptation measures in agriculture and forestry

Climate change put additional pressure to forests especially if they are not well ecological balanced. Main problems are monoculture, lack of mixed age structures or inadequate species. For instance spruce monocultures are wide spread in low areas in Upper Austria. The temperature there is near the limit for that sort of tree. The roots are well suited for

mountainous regions but have disadvantage in low and flat regions. To change the management is a necessity but gives on the other hand an opportunity for enhanced biomass production. Biomass action plans are necessary to fulfil European and national targets too. There has to be a balanced strategy for the biomass yield and the demand so there is no negative effect on the prices. Extreme weather events can influence that strategy for instance by additional wood supply after severe storms or heavy snowfall. In Upper Austria the winter storm Kyrill made problems first because of the necessity to work up broken trees in a fast way to avoid harm by pest because of the comparable warm weather conditions. There were limitations especially in the transport system. Secondly the wood had to be stored which meant to keep it wet and to have storage capacities to avoid price dumping. Therefore better adapted forests can lower the financial risk too.
In some regions a change of agriculture management makes sense because of new market conditions but also climate change. There is a chance for providing bio-fuel or solid biomass for energy applications in the future.

Measures in respect with adaptation and mitigation:

- Master plan to identify critical locations and necessary measures to enhance the adaptation potential in forests including advice services and incentives.
- Action plan to optimise the biomass market concerning supply and demand including measures in the case of extreme weather conditions.
- Biomass action plan to enhance the use in all sectors

5. soil and water pollution caused by losses of oil during flooding events

Although legal standards are in force to prevent losses of oil from heating facilities experience from the flooding in the year 2002 showed enormous practical problems in Upper Austria. There were regional differences – problems were more in regions not used to have flooding events. As a consequence the legal framework was changed so the rules are more concrete now. Despite the facts there was no political will to ban oil heating systems in critical regions. But these systems are really rare installed in new houses because of prices and incentives for other energy sources like heat pumps, biomass installations and district heating. In some Austrian provinces grants for building new houses or dwellings are just provided, if the energy supply is based on renewable energy sources (with exceptions).

Measures in respect with adaptation and mitigation:

- Strategy to reduce the use of oil for heating applications including restrictions under aspects of adaptation and incentives for renewable energy sources

6. Power management by rapid electricity saving activities

More extreme weather extremes will raise the demand of electricity capacities, for examples caused by heat waves (air condition facilities) or cold winter periods, but can influence the supply in a negative way too (less hydropower during droughts). Liberalized energy markets have reduced reserve margins in many grids, shortfalls are more probable. On the other hand weather forecast provides information in higher quality nowadays and early enough to react by rapid energy saving activities, especially by using media to influence the behaviour of people. Experience has been made in some countries like Brazil, New Zealand and Sweden[2]. The durations of the actions were different, several month (droughts in Brazil and New

Zealand; safety problems in nuclear power stations in Japan) or just one weekend (cold Monday in Sweden). Rapid, temporary reductions of electricity consumption were achieved avoiding shortfalls. The best results were achieved in Brazil (minus 20% electricity demand), the effect was temporary but with influence for several years. A huge media campaign and a lot of technical measures were the pillars. In New Zealand a reduction of 10% were achieved. In Sweden, the effect was calculated in minus 4% electricity consumption.
Although in the long term effects are negligible the short effect reduces the necessary electricity power and therefore crisis in the power supply. In the future such activities will play a major rule as adaptation measure taking into account the higher risk of extreme weather events.

Measures in respect with adaptation and mitigation:

- Development of a regional strategy for rapid electricity saving activities (local authorities, energy supplier, energy agency, media).

[1] Fishclim
[2] More information see book “Saving Electricity in a Hurry”; www.iea.org