

Summer Course on Sustainability, River Basin Management and Climate Change in the Baltic Sea Region

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course: Ecology and Environmental Protection

**Dealing with the
challenge of climate change in the Baltic Sea Region
Using the example of the German Baltic Sea Region**

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The global climate change is by far one of the biggest problems of our time and the whole humanity is faced with big challenges. The worldwide temperature increase and the increase of floods, dryness and storms are signs of this climate change. Today, scientists assume that the relatively rapid warming of the terrestrial atmosphere is first of all due to the increased output of carbon dioxide by the use of fossil fuels like coal, oil and natural gas.



picture 1: Baltic Sea Region

Also, the Baltic Sea Region, as an important ecological system, is affected by this process immediately. As an intercontinental sea in the north of Europe the Baltic Sea

is surrounded by nine countries, the so-called bordering states. These are Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Denmark and Germany. The big Baltic islands Fehmarn, Rugia and Usedom belong to Germany. Only about the northwest runner, the Kattegat, the Baltic Sea is connected to the North Sea, an edge sea of the Atlantic Ocean. The Baltic Sea is the inland sea which separates the Scandinavian peninsula from the European mainland.

The Baltic Sea is considered to be the biggest brackish water sea on earth, containing moderately salty water. More than about 200 rivers join into the Baltic Sea, which delivers fresh water into it. The salty water reaches only to about the Kattegat sea. The salinity of the Baltic Sea shows weather-dependent variations and strong regional differences. The different living spaces make the Baltic Sea so particularly distinct from the stratification of the lighter fresh water compared to the heavier salted water. The coastal regions of the Baltic Sea are very valuable ecological systems. For many animal species, the coastal stripe provides an important living space. This high value is being mirrored by the fact that big coastal surfaces are already expelled as nature reserves. The unique signs of the Baltic Sea and its special

environmental problems require a macro regional beginning to prevent that these circumstances worsen in the long-term perspective.

The Baltic Sea area is in economic, ecological and cultural regard a very heterogeneous space, all bordering states are still concerned by environmental damage. Particularly the excessive entry of nutrients in the Baltic Sea which leads to eutrophication and alga bloom, overfishing, environmental pollution from the country, excessive navigation and mass tourism endanger the Baltic Sea. Increasingly the question of the adaptation to the climate change also positions itself.

According to a report by the Research Centre of the Society for Nuclear Energy Utilisation in Shipbuilding and Navigation (research centre GKSS) the Baltic region warms up exceptionally. The warming of the Baltic Sea in the previous century was amounted to about 0.85 °C, in comparison, the worldwide warming only amounted to about 0.75 °C. In particular, in the spring and winter seasons, it is now warmer than it used to be in earlier times. For 20 years the climate change are clearly perceptible on the Baltic Sea particularly in the winter. In the southern Baltic Sea, a decrease of ice floes is being reported. In the past three decades it has rained in the Baltic region more than before. In the whole Baltic region spring and winter have become more humid. In summer, less rain fell compared to the past three decades.

Given the situation that clear climate protection measures should not succeed, it would be possible in the opinion of the research centre GKSS that air temperatures could rise at the end of this century around up to 6 °C. This milder climate would lead to a decrease in wintry ice coverings of the Baltic Sea to up to 80 percent. The experts expect that the winter precipitation increases around up to 75 percent, in summer, in contrast to it, a decrease around up to 45 percent is estimated. Warmer Baltic Seawater and a decrease in its salinity would have a big influence on the Baltic Sea flora and fauna. By this the whole ecological system would be affected by bacteria and commercially used fish kinds. For a longer period of the year, the region for vacationers becomes more attractive, therefore, more storm floods, floods and coastal demolitions will be the result. Thus, protection of the climate is important, especially for the Baltic region. In doing so it is necessary to use the potentials of the Baltic Sea thoroughly. In many places, the removal of wind energy is suited particularly.

The use of wind energy by means of wind turbines is an energy source that has been known since antiquity.. To win energy, the kinetic energy of the wind is changed by the rotor sheets of the arrangement in a rotary movement which drives a generator inside of the gondola. The mains connection of the wind strength arrangement occurs by an inserted direct current circle. The energy net operators are obliged by the energy feed law for the decrease of the generated energy. On account of the unsteadiness of the wind, the electric energy won with wind energy arrangements can be used only in the group with other energy sources or in very small energy nets with storages for a continuous energy supply. The fluctuating energy production is compensated by feed and exchange in and between the German transference nets in teamwork with other power stations, like the normal consumption variations.

Wind energy belongs to the sustainable, environmentally friendly energies. It is classified as clean energy, because the production of the electric energy produces no exhaust gases which damage the environment for a long term. To fulfill the Kyoto Agreement, the amount of regenerative energy among the entire energy consumption is an important size. By 2020, the amount of the renewable energy among the entire energy consumption of the European Union

up to 20 percent should be raised. In Germany, renewable energy amounts already 14 percent of the energy in 2007. 45 percent of it are wind energy. It is the fastest growing energy source of the world and Germany is the world market leader. In this country, wind power delivers 6.4 percent of the energy and hence 26 million tonnes CO₂ are saved. Therefore, wind energy is promoted since 2000 by the government, in 2010 still with 6.18 ct./kWh.

The production of wind power on the mainland is called onshore wind power production, on coasts and the seaside it is called offshore. The potential onshores are used as much as possible, only old arrangements will be substituted in future with more efficient ones (repowering). The greatest opportunities are offered by offshore constructions. In the Baltic Sea, offshore wind farms are already located in the waters of Denmark and Sweden. In future, offshore wind energy constructions shall also make an important contribution to the energy supply in Germany. The high average wind speeds on the sea provide vast energy potentials. Wind turbines on sea produce about 40 percent more energy than wind turbines in country due to the strong breeze. Modern wind turbines are produced efficiently, easy installable and at a reasonable price in mass production. The biggest turbines are up to 200 metres high, have an installed capacity of five megawatts (MW) and can produce enough energy for up to 7,000 households.

Germany, in comparison to countries like Denmark or Sweden, has almost exclusively locations with relatively deep waters (up to 40 metres) and wide coastal distances (more than 30 kilometres). The reasons for that lies in intensive use of the German coastal waters by navigation, as a practise area for navy and air force, as a fishing and gravel dismantling area, tourism as well as the nature conservation. These conditions still provide big technical and economic uncertainties. The strong physical charges by wind, waves and salinity of the air make high demands for foundations, enclosure of the gondola and used materials. Furthermore, the transport of the big energy amounts to the mainland as well as servicing and service work are expensive. Offshore wind farms deliver their energy via sea cables to the coast. From there, the energy joins the general energy net.

The German Federal Government established in the late summer of 2009 a regional plan after which could be generated up to 25,000 MW about offshore wind power in the North Sea and the Baltic Sea until 2030. Already for several years wind farms are being planned, however, their construction had been delayed over and over again because of technical and financial problems. The offshore wind use in Germany makes high demands for technology, net integration and ecological compatibility. Various technical and nature conservation-related data come into the planning and approval phase of the offshore wind farms. On the one hand, data are collected to offer access to the possible effects of offshore wind energy constructions on the marine flora and fauna and on the navigation. On the other hand, the project developers collect the data which are evaluated for the planning of a sure installation and the choice of the right technology. Three measuring stations are already pursued in the Baltic Sea. These are the measuring posts SKY 2000 and Arkona-basin-southeast, as well as the research platform FINO2.

The platform FINO 2 near the wind farm of Kriegers flak in the Baltic Sea to the north of Rugia was put into operation in May, 2007. Essential aims are the investigation of the ecological, meteorological and hydrologic conditions in the western Baltic Sea, the inquiry of effects of the offshore wind energy constructions on the marine flora and fauna and the acquisition of basic measuring data under spatial points of view. Furthermore, declarations

should be made to the energetic yield, for the protection of the sea, its subsoil and the environment as well as the coastal defence and traffic protection.



picture 2: platform FINO2

The measuring mast SKY2000 should collect meteorological and hydrographical data in particular for a smoothly establishment of the offshore wind farm SKY2000.



picture 3: measuring mast SKY2000

Since 1997, offshore wind farms are planned. For the exclusive economic zone the applications for approval are made with the Federal Office for Sea Navigation and Hydrograph. Within the 12-sea mile zone the wind farms are applied with the federal states Schleswig - Holstein and Mecklenburg-West Pomerania. In December 2004, the Federal Office for Sea Navigation and Hydrography first turned down two planned offshore wind farms in the Baltic Sea before Rugia. The parks Adlergrund as well as Pommersche bay are affected. The decision with the possible ecological effects was made.

Although quite extensive research projects were carried out, there are still many uncertainties with regard to the effects on the sea environment and birds. Hence, a gradual removal of the

offshore wind energy is aimed. Positive results concerning the environmental compatibility and physical compatibility of the first pilot's arrangements are a condition for the other removal.

In February 2006, the first German offshore wind power construction Breitling near Rostock took up work. The construction with a turbine capacity of 2.5 MW per year can supply approximately 1,800 households with energy. With a height of 125 metres and a water depth as deep as 2 metres the construction has been built under conditions which are comparable with those on the coast. The wind power construction Breitling should bring more knowledge about the work of offshore constructions to the involved enterprises.



picture 4: wind power construction Breitling

The wind farm Baltic I is approved to be the first German offshore wind farm completely up to the feed point. At the same time by courtesy of the technical draft of a common grid connection with the Swedish Offshore wind farm, the power supply line of Kriegers Flak is completely authorised. The offshore wind farms under construction should be established till the end of 2010 and be put into operation. It is located approximately 16 km before the coast of Mecklenburg-West Pomerania, to the north of the peninsula Fischland-Darß-Zingst.

In the wind farm Baltic I 21 wind energy constructions with an installed overall capacity of 48.3 MW and a transformer platform are established. Yearly approximately 180 million kilowatt hours (kWh) of energy can be generated from there in future for more than 57.000 households. The average wind speed amounts about 9 m/s. The triangle-shaped area has a surface of approximately 7 km². The single construction has a height of 125 to 163 metres maximum. The water depth amounts to 16 to 19 metres. Through a high voltage power wire the generated energy is conducted to the transformer station Bentwisch near Rostock.



picture 5: position of Baltic I



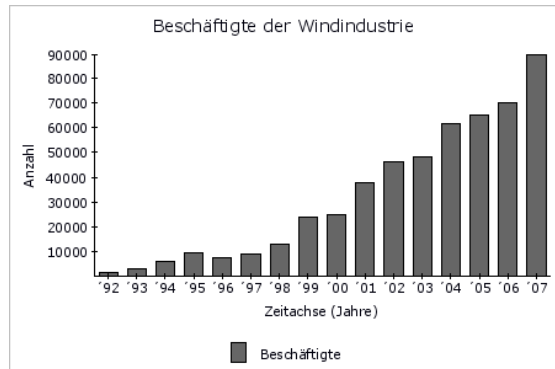
picture 6: wind energy constructions at Baltic I

Other wind farms like SKY2000 are in the proceeding relating to permission or are already in the first construction step. According to the German energy agency (dena) an offshore potential exists in the medium term in the Baltic Sea of 1.700 MW. According to the Federal Government of Germany offshore wind farms in the North Sea and the Baltic Sea should be installed with a capacity of 25.000 MW till 2030. These would cover about 15 percent of today's German energy need.

Modern wind energy constructions are a recent technology. The improvement potentials are opened only by the industrial research and manufacturing. Thereby the originating add-on costs are still reflected in the investment prices at the moment. Based on the attainable income by sales of the generated energy, a wind energy construction requires relatively high investments. With an investment potential of 45 billion € during the next 20 years the chances are gigantic for the regional development. Wind energy will become the most important economic factor of the Baltic region in the future.

The wind energy branch has changed within the shortest time from a niche market to a respectable industrial branch. In the future market wind energy not only professional planning offices and engineer's offices have specialised, but also service providers from the service sector. Even quite new branches like tower builder or rotor sheet manufacturers have

originated. Besides, it protects jobs of the steel industry from mechanical engineering and investment construction to electrical engineering. Mainly medium-sized producers and suppliers have benefited from the growing demand for wind turbines.. Thus, the innovative competence centres have been founded among the coasts in the area of wind energy which give a new economic boost to the region.



picture 7: employers in wind energy branch

The wind energy branch of the Baltic Sea region offers changes in the political structure and the job market. Enterprises from project engineering to investment construction, the ancillary industry and the servicing industry, create positive future perspectives in this underdeveloped region. The wind energy branch has developed during the last years to a job machine in Germany. About 90,000 people are employed in planning and construction of wind power constructions and its administration. Until 2020, the branch will have generated even 112,000 jobs.

With a sales volume of about 9.7 billion € in 2007, Germany is one of the worldwide biggest markets for wind energy constructions. German manufacturers and suppliers dominate over one third of the world market for wind energy constructions. 7 percent of the German constructions and components are exported. In short and medium term Europe will remain a main outlet of German manufacturers and suppliers. However, there is also a big potential in North America and South America, Asia as well as in Australia. The export share of investment manufacturers and suppliers of the wind industry adds already up to about 60 percent, as a realistic aim, 70 percent are to be expected in the medium term.

Especially the tourism branch on the German Baltic Sea coast has protested in recent years against the wind power constructions. The claim, this development would have significant bad effects on the tourism in the region, however, does not correspond to the facts. Empiric investigations of tourism research institutes have meanwhile given enough evidence that this is not the case. Wind energy constructions are visible signs of the climate protection and the ecological progress. A considerable image profit develops for the region, because most vacationers support the fact that active environment protection is carried out in their holiday resort.

Furthermore, the North German local authority districts profit terrifically from the wind energy. In some communities wind farms contribute even up to 45 percent of the trade tax amount. According to a study of the economic institute of Prognosis every megawatt of installed wind energy power produces more than 100,000 € in trade tax payment in its 20-year-old term.

The use of the wind energy in the Baltic Sea offers huge chances for the future in Germany and particularly the region of the Baltic Sea. With it the region becomes independent of the energy supply and offers to its inhabitants security of supply. The economic power of the wind energy is immense, with the generation from of up to 120,000 jobs, the regional economic growth by orders to local crafts and the export potential is the most important factor of the regional development of the Baltic Sea region. Besides, it delivers an essential contribution to the climate protection.

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