# Windenergy

## Contents



## 1 Vocabulary

common carrier - Netzbetreiber
stall - Strömungsabriss

# 2 Windmills

## 2.1 Slow-Rotating-Windmills

This kind of windmill is used in the USA very often. The typical of this windmills are the rotors which consists of many wings. This is nescessary to provide a high torque even with very slow wind speed. So this windmills are used to do mechanical work for example to pump up water. But with the slow rotating speed it is not possible to produce electricity with high efficiency. So the electricity is generated with Fast-Rotating-Windmills.

## 2.2 Fast-Rotating-Windmills

Fast Rotating windmills are the most commen windmill in germany. They are build with 1 to 4 wings. The most windmills in germany are build with 3 wings. But there are two different types of power connexion, the direct and the indirect.

1. The direct power connexion means, that the produced power is directly fed in the electricity network. Therefore the axle which powers the generator must have a certain rotation speed, that the produced power have a frequency of 50Hz. That fact leads to a difficult transmission to make sure that the axle has the right speed even there is high or low wind speed.
2. The indirect power connexion do not need difficult transmission systems, but it needs more difficult electronic devices. The principle is to transform the generated alternating current with any frequency into direct current and transform it back into alternating current with a frequency of 50Hz.

Because of that the most windmills are connected by indirect power connexion, so a higher range of windspeed can be used more efficiencly than with direct power connexion.

# 3 Actual Situation of the use of wind-electricity

## 3.1 History

From 1990 until 2000 the windenergy-production increased about 200 times in comparison to the production of 1990. So in 2002 windenergy provided 3% of the whole energyconsumption in germany. Two years later there were windenergymachines installed with a capacity of about 16.000 MW. This is about 1/3 of the world wide windenergy-capacity. So in this year the provided windenergy increases to 4% of the whole energyconsumption. This high increasing rates are caused by the EEG (renewable-energy-law). The EEG consists of 3 important points concerning windenergy:

1. Renewable energy must be payed by the common carrier with 8,7 ct/kWh (onshore) or 9.1 ct/kWh (offshore) for at least 5 years. After the 5 years they must pay 5,5 ct/kWh (onshore) and 6,19 ct/kWh (offshore) until 20 years are over.
2. The common carriers must pay the extansion of the electricity network which are nescessary to connect the wind farm.
3. The common carrier must have at least a certain amount of renewable energy in his whole energy. (2204: 8,3%)

But the EEG is not only the important for the actual situation, but also for future development of renewable and therefore of windenergy.

## 3.2 Future

In the EEG it is planed to rase up the amount of renewable energie to 12,5% until 2010 and up to 20% until 2020. That means an installed windenergy capacitiy of about 50.000MW. The most of that power will be produced by offshore wind farms. So at the moment the companies try to develop big windmills with about 5MW or more and optimize them to work in offshore wind farms. That means the machines must be run long times without service under very hard conditions.

# 4 Problems with windenergy

With windenergy have many problems apppeared. First there are the generally problems of the efficiency of producing electricity from wind. The problem is, that windmills can use maximal 59,3% of the kinetical energy of the wind. But to reach that efficienc the rotor speed must be controled, because the efficiency depends on the windenergie and the frequency of the rotor. The regulation is done by two mechanisms.

1. The wings are rotated a little bit out of the wind, so that the speed of the rotor goes down or rotated a little bit into the wind, so that speed of the rotor increases.
2. The regulation is done by planed stalls, which is done by a special wing design.

An other problem is the naturally low energy density of only $300\mathrm{W}/m^2$ (300 J crossing 1 $m^2$ per 1s). Then there are the problems that common carriers have. Their main problem is that windenergy can not be planed (Figure 1 and 2).

In such cases the common carrier must have normal power plants which can be started very fast to produce that energy. That, so called energy reserve, is about 90% of the produced windenergy. This problem leads to an restricted future of the windenergy, because the more is windenergy of the whole energyproduction the less wind energy can substitute normal power plants. A study has found out, that in 2020 only 2.000MW of the prognosed 50.000MW will be used to substitue thermal energy. But there is not only a problem with the variation downwards. Also the variation upwards is a great problem. The problem is, that the wind farms produces as much electricity with strong wind, that the electricity network can be temporarly overloaded so the whole power supply may break down. To stop this risk, the wind farms are not allowed to fed in all the produced power if there are high windspeeds and the power is lost.

So all in all onshore windenergy in germany cannot be the preffered renewable energy because of the bed forecasting of power production. But wind farms which are build offshore may have a better future, because their are more constant windspeeds and so the forecasting situation and the efficiency is much better.

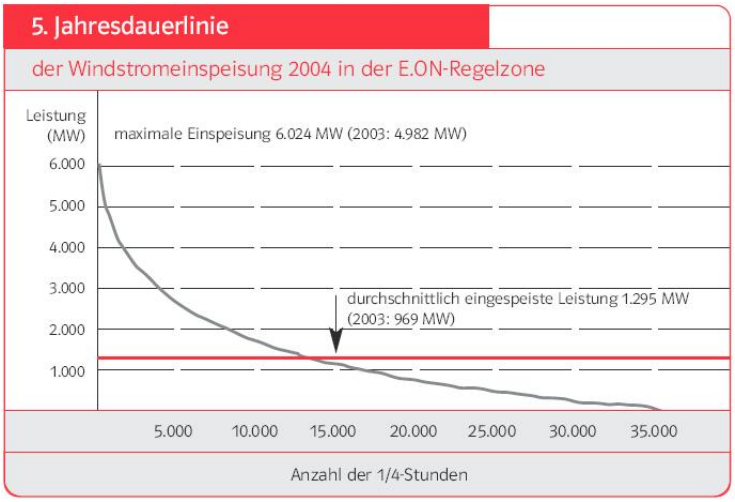


Figure 1: annual load duration curve [4]

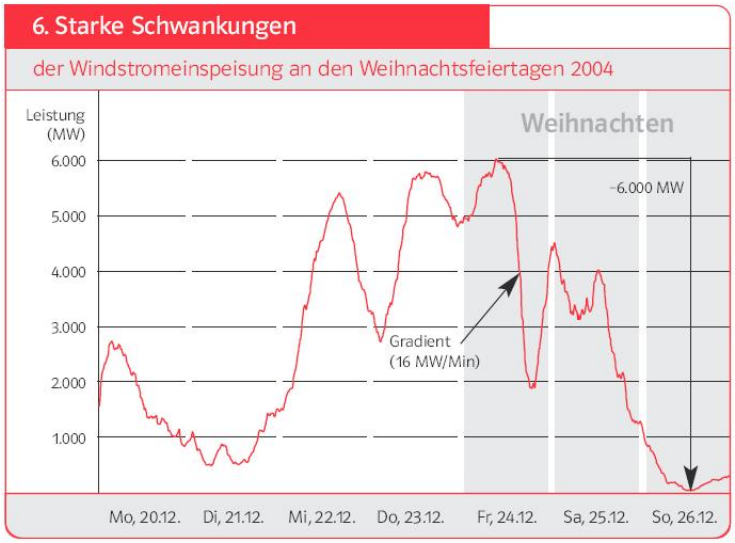


Figure 2: variations about christmas days [4]

## References


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