# Use of wind energy

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**Abstract:**

As the increasing of world's energy consumption but the sources of the energy are limited and damage the environment. The renewable energy source is therefore increasing in importance. The world energy consumption has still increased due to expected rapid increase of world population, especially in the third world and in new industrialized countries (NICs) because more humans also need more energy. Such a population increase will have a dramatic impact on energy demand, at least doubling it by 2050 [4]. Supplementing our energy base with clean and renewable sources of energy has become imperative due to the present day's energy crisis and growing environmental consciousness. Wind is one of the potential renewable energy sources, which can be harnessed in a commercial scale for various end-uses. This paper will present the world energy situation, the implementation of wind energy and the trend of using wind energy in the future.

## 1. Introduction to world's energy

The increasing of world's energy consumption (fig.1) and a prediction of the World Energy Conference 1986 in Cannes illustrated (fig.2), it points a global trend in the future.

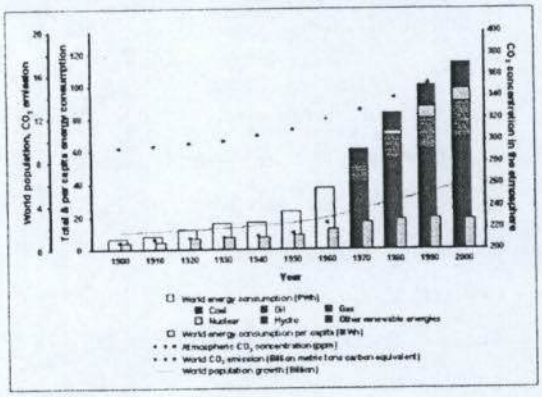

*Figure 1: World Energy situation [3].*

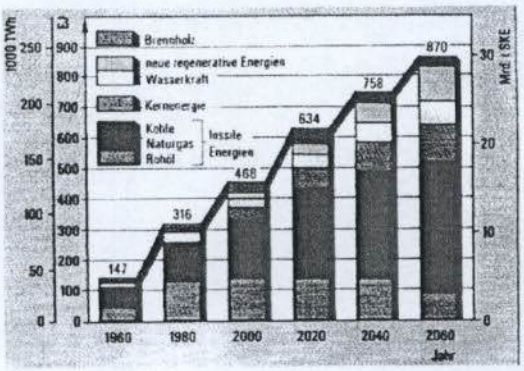


*Figure 2: Prognosis for future consumption [4].*

In order to be able to cover the requirement in the future, the non-fossil energies must be carried out as soon as possible. One prognosis points a conceivable development of the world energy consumption in the future illustrated in figure 3. Despite of increase in energy requirement, the fossil energy production would decrease whereas the renewable energies would be produced in upward extent and could reach half of the requirement in 2050.

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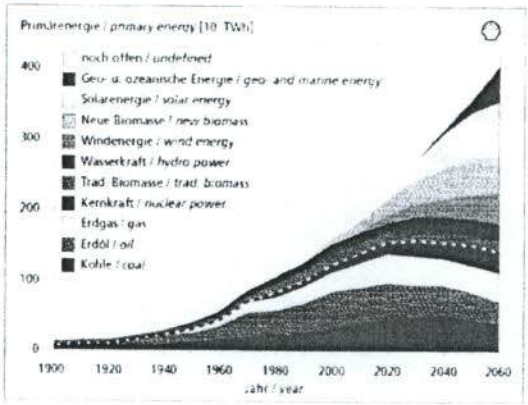



*Figure 3: Development of world energy consumption [shell].*

Furthermore it has been found that primary energy resources have not been evenly consumed worldwide. At present the world energy reserves are most imbalance used: approx. 1 billion altogether, 20 % of world population, who live in the industrialized nations consume almost 80 % of the available energy whereas 80 % of world population must be satisfied with 20 % of the available energy [4]. Figure 4 gives a further overview about electricity consumption.

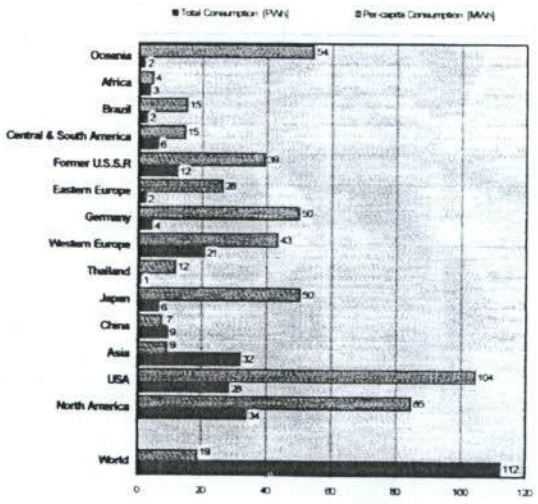



*Figure 4: per-capital electricity consumption [4].*

It is to be considered that about half of the world population lives today in countries, which do not have even sufficient energy reserves. The world will need a new, safe, clean and economical source of energy to satisfy the needs of both developing and developed nations. *Renewable energies are nearly unlimited energy sources. Moreover they are available prevailing inland or local and therefore secure. The problem is that without financial support, renewable energies cannot normally compete with fossil energies. However this does not mean that it is not important to promote renewable energies according to market economic criterions in order to get even more profit from reduction in costs with mass production and from experiences with their increasing application [4].*

**2. Wind Energy Consumption**

The use of wind power has taken an enormous rise and is on the step to a large-dimensioned technical use (fig.5).

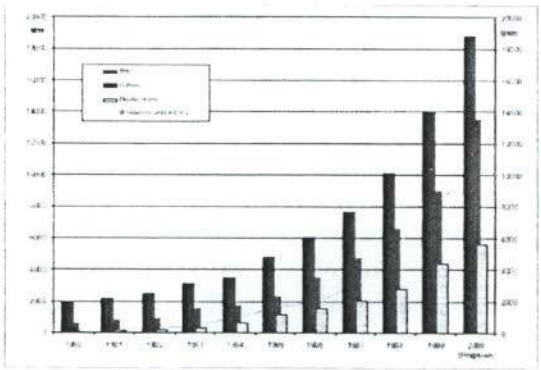


*Figure 5: Wind Energy Consumption [2].*

This development was started by the progress in wind power plant technology and is characterized by an increase of output that linked with a reduction of costs and remarkable improvement of reliability

### 3. Grid connected with Wind turbine

Larger wind power plants (0.5 MW - 2.5 MW) and wind parks in the range from 10 to 100 MW are connected even to weak grid areas in order to exploit the available wind potential. The grid connection of a wind energy plant is in figure 6 [2].

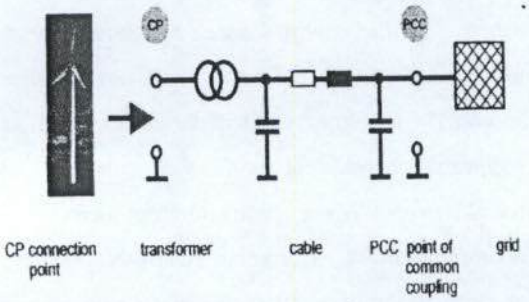
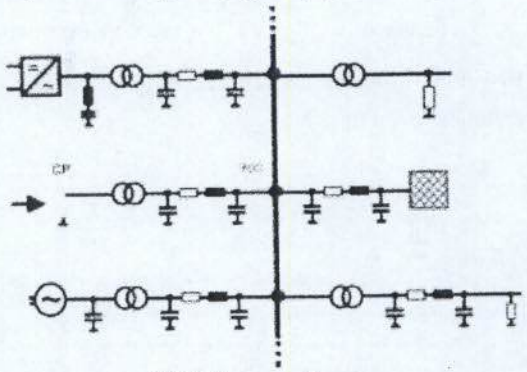
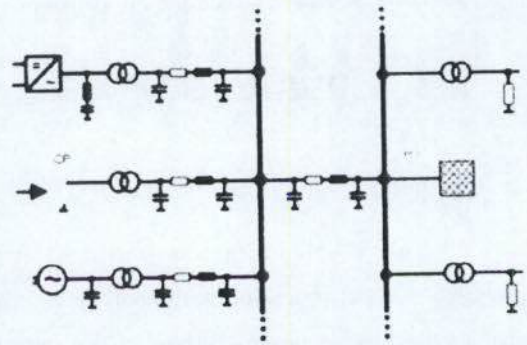



*Figure 6: Grid connection of wind power plant.*

Effects of wind power plants on the grids are determined. Its short circuit power is dependent on the transformer, the transmission line, and the super-ordinate grid (Fig.7 a, b).



(4) Common bus bar



(b) Separate bus bar

*Figure 7: Grid connection of power plant and load [2].*

### 4. Status of Wind Power Plant Technology

The development of wind power plants of the modern type led from the plants of the 10 to 50-kW class in the early eighties to converters ready for series production with a rated power of 500 to 2,500 kW quite 15 years later (Fig. 8).

So far, in plants up to 1000-kW systems with three-blade rotor, power limitation by stall effect, and asynchronous generator with fixed grid coupling have become clearly predominant. The prices for those plants well-approved and long established in the market vary from 1,500 DM/kW to 1,800 DM/kW rated power or 550 DM/$m^2$ to 750 DM/$m^2$ rotor circle area (1.9DM=1EUR). Energy yields of 600 to 800 kW/$m^2$ and can be attained in inland areas and mountainous regions of medium height, and 900 to 1,200 kWh/$m^2$ can be achieved on the coast in Germany [2].

For the time being, the corresponding costs are still higher for those plants that are being presently introduced to the market and belong to the 2,000 kW nominal rate type. Pitch control and variable speed plant operation are dominant especially in these systems. Strong tendencies towards gearless drive train conceptions and double fed asynchronous generator can be recognized currently. Differences in price are determined among other things by varying conceptions, rotor diameter and hub heights (e.g. coast or inland type).

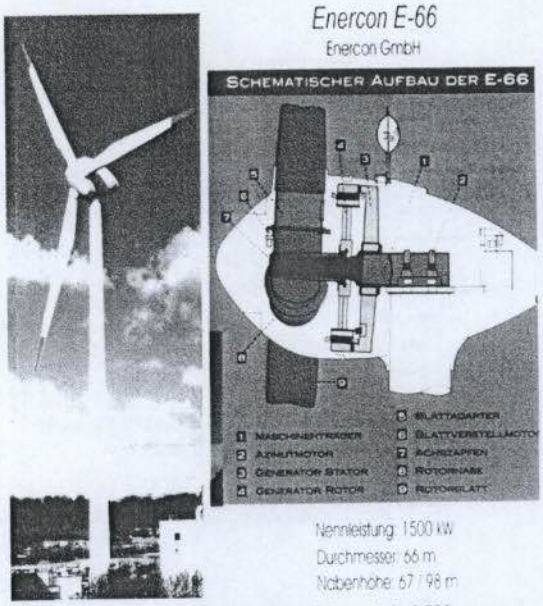



*Figure 8: Wind turbine 1.5 kW*

## 5. Characteristics

The electric power of a wind power plant is subject to periodic fluctuations which-due to converter conception - are transmitted directly, or after a short-term interim storage smoothened, to the grid. These power changes bring about corresponding voltage variations in the mains, which can be noticed e.g. as flickers.

Periodic power fluctuations, which are induced especially by high wind gradients, tower-created-turbulence effects, play a subordinate part particularly in speed-variable plants as to voltage influences. In contrast to that the power and voltage fluctuations caused by short-term and long-term wind velocity changes reach dominating values. The switch-in of the generators also produces accordingly high switched currents and so in consequence voltage fluctuations. Figure 9 shows the characteristic of the wind turbine. Its cut-in speed is approx. 2.5 m/s, rated power is reached at 11.5 m/s, and cut-off speed is 22 m/s and 19 m/s respectively.

**Sound Level LW 99.9 dB(A)**

(imission-relevant **Sound level**

calculated at 10 m/s in 10 m height)

Minimum clearance to centre of mast base

| hub height: | 60m | 70m |
|---|---|---|
| Mixed area 45 dB(A) : | 205m | 205m |
| Residential area 40 dB(A) : | 325m | 335m |
| Exclusively residential area 35 dB(A) : | 485m | 495m |

## 6. Use of Wind power pants

Worldwide, wind energy is almost exclusively used for producing electricity. Figure 10s show the various realistic wind power plants.

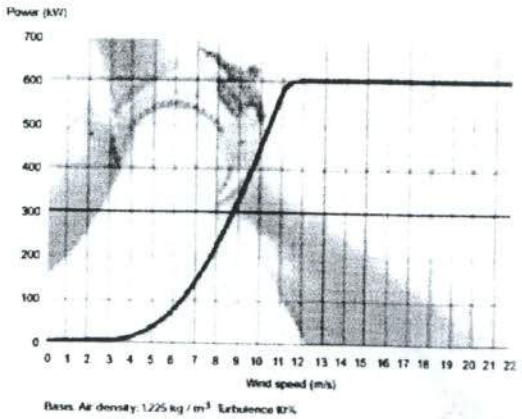



***Figure 9:*** *Characteristic of wind turbine 600 kW, rotor diameter 46m [1].*

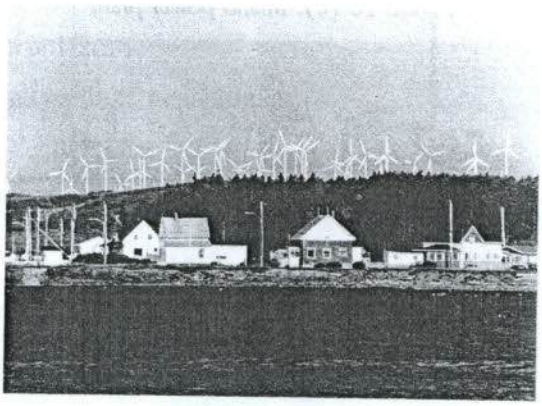


*Figure 10 (a): Coastal location*

*Figure 10 (b): Offshore power plant*

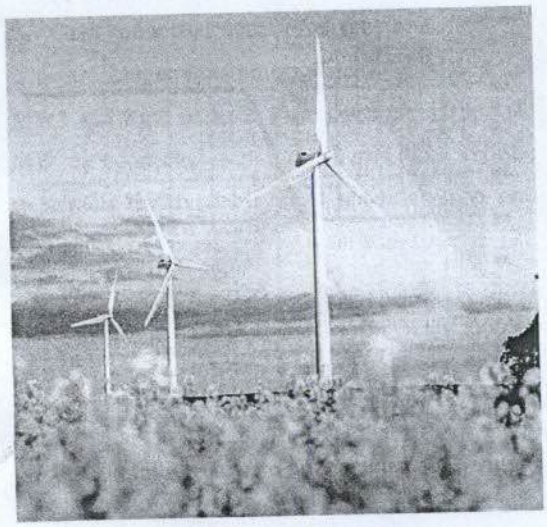


*Figure 10 (c): Inland power plant*

*Figure 10 (d): Mountain region*

***Figure 10:*** *Various wind power plants [1].*

## 7. Outlook

According to the increasing of the wind power plant technology, the market potential for the grid control system with renewable energy plants is considerable. The implementation of grid control system particularly offers advantages. Technical improvements can be achieved through grid support, higher grid compatibility, etc. It also offers excellent economical perspectives, through the elimination of grid extension costs and a possible compensation of the reactive power control in comparison to the small additional costs.

## 8. Summary

As the increasing of world's energy consumption, the renewable energy is more important. In this paper, a grid control system for wind power generating plants is introduced. The advantage of using wind energy is considerable. We can not deny the renewable energy for the future. Therefore now is the time to implement and consider the renewable energy.

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