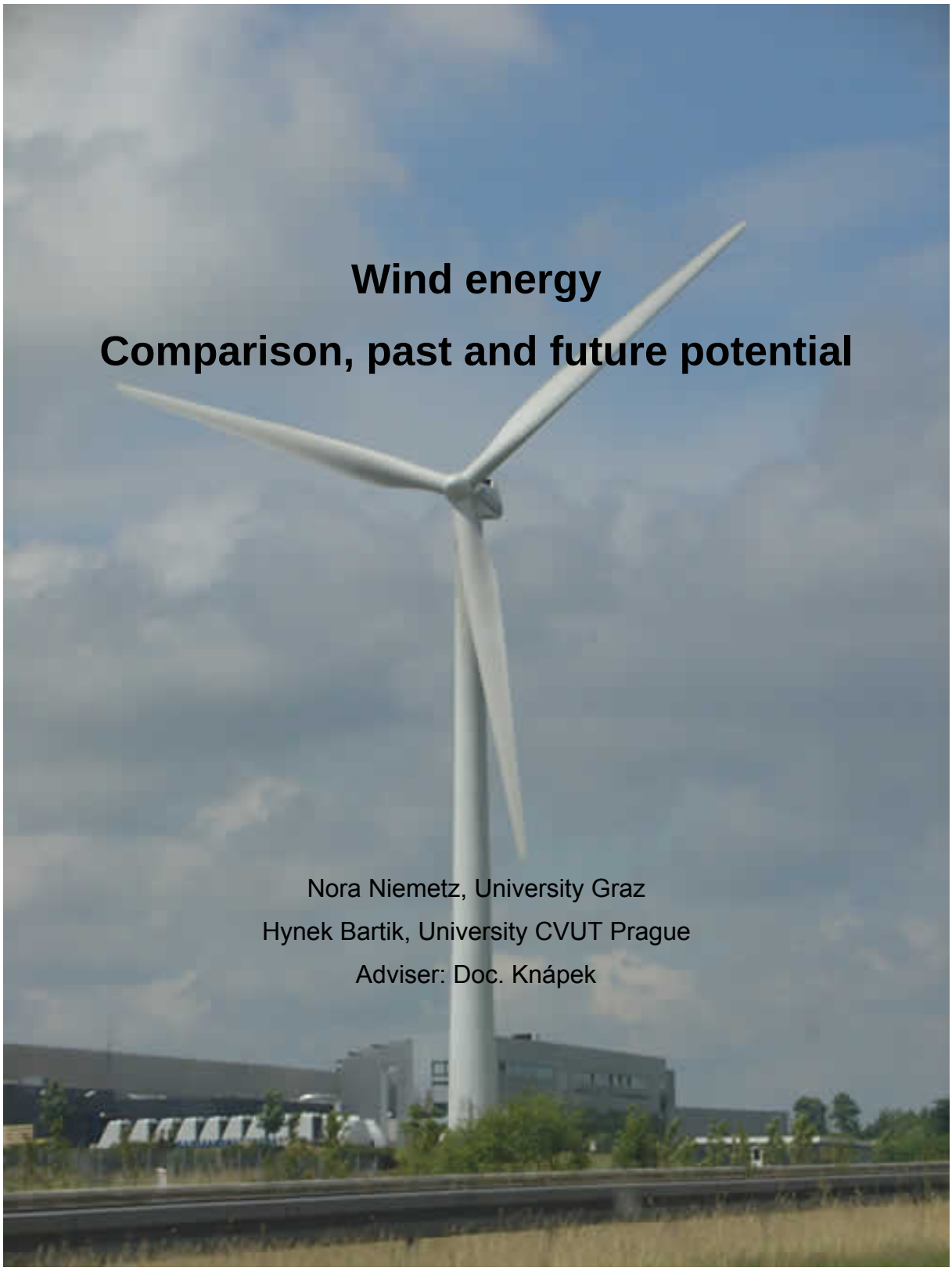


Wind energy

Comparison, past and future potential

Nora Niemetz, University Graz
Hynek Bartik, University CVUT Prague
Adviser: Doc. Knápek

1 Introduction

2 Austria

2.1 Past

2.2 Nowadays situation + Legislative frame

2.3 Future

3 Czech Republic

3.1 Past

3.2 Nowadays situation, legislative frame

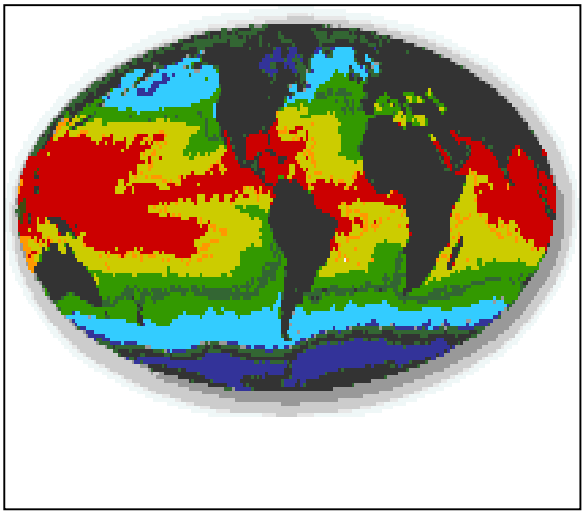
3.3 Future

4. Abstract

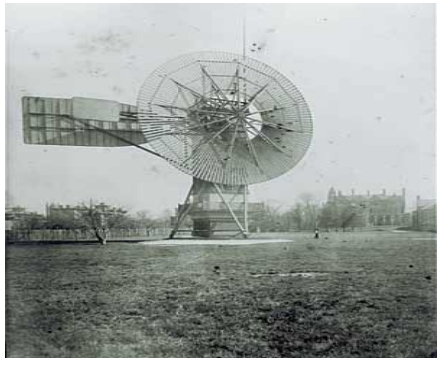
5. Literature

1 Introduction

In this introduction part of our paper we used information from Danish Wind Industry Association (DWIA) web page www.windpower.org.



We can say that all kinds of renewable energy, except tidal and geothermal power, and the energy in fossil fuels come from the sun which radiates the power of $1{,}74 \cdot 10^{17}$ W to the Earth. About 1-2 % of the energy coming from the sun is converted into wind energy.
The principal of the sun energy conversion into the wind energy is based on temperature differences. The difference in temperature generates pressure gradient which makes the air move.
We differentiate two kinds of wind - global and local winds. We call the air circulation in the atmosphere global winds. The circulation of air above the surface of the ground is called local winds. But the reason of air masses movement is still the same.
For illustration: the air that rises from the Equator is heated more than the air that gets up on the rest of the globe. Hot air is lighter than cold air and will rise into the sky until it reaches approximately 10 km (6 miles) altitude and then spreads to the North and the South. If the globe would not rotate, the air would simply arrive at the North Pole and the South Pole, sink down, and return to the equator.

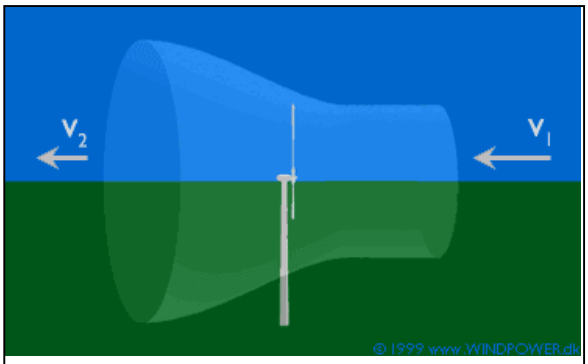


Long time before wind has been a very important source of energy it has been used for wind mills or to run water pumps. Since 1887, when Ch. F. Brush built his first wind power plant, research of new technologies, materials and construction solutions have been continuously made. Nowadays the manufacturers are able to produce turbines with 5 MW of installed power and with towers higher than 80 m.

Usage of wind energy became very popular in the seventieths of the 20th century.
By that time usage of fossil fuels was on it's rise and therefore the CO_2-concentrations were continuously increasing. Global climatic changes became a real threat. Also the fear of an exhaustion of nonrenewable sources of energy appeared.
The world energetic crises in 1973 can be stated as the start of wind energy usage for electricity production. Energy prices jumped up and too high dependence of developed western world became clear. The options of wind power usage became an important topic.

The production of electric energy in wind power plants is based on a conversion of wind kinetic energy on mechanic energy of wind turbine and it's consequential transition on electric energy in electric generator.
The amount of electric energy we are able to extract from wind depends on air density, speed of wind and diameter of the rotor area. The diameter of rotor area is mostly constructed 1:1 with the tower.
This amount could also be influenced by many positive facts e.g. hill effects or tunnel effects (air's acceleration due to shape of the ground) or on the other hand negative facts as air turbulences caused by uneven surface, obstacles, wind turbine operating ahead. Also wind speed could be reduced due to high roughness of terrain – off shore power plants situated in the sea are able to operate more effectively due to smooth surface of water areas.

On the third picture it is possible to see how the air comes through the rotor area. The amount of air coming to the rotor must be the same as the amount of air leaving the rotor area. Therefore it takes larger area, because the kinetic energy has been kept by the rotor of the turbine. This fact and rotational motion of rotor causes the turbulences.



Picture 3
circulation in front and behind the turbine;
Source: DWIA, www.windpower.org

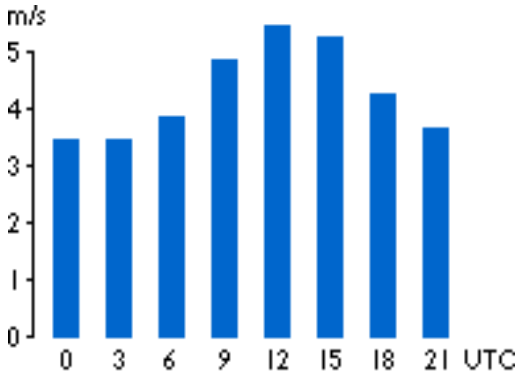
Wind power has different pros and cons.
There are two serious disadvantages of wind power plants.

1.) To become a supporter of "wind electricity" production and consumption, the country has to have suitable areas which offer high average wind speeds during the whole year. But even if the country has some areas like this, the problem lies

mostly in the position. Suitable areas are often situated in mountainous terrain with small population density therefore with an insufficient transmission system. There could also be a problem if those suitable areas lie in protected territories.

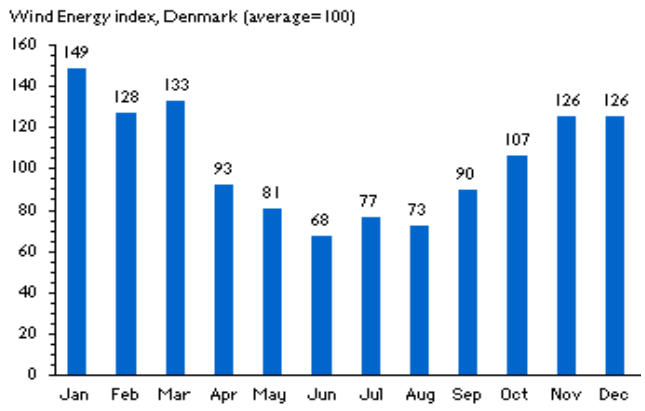
2.) Another negative fact is the unstable character of wind as the electric generator driving force. The outcome is also an unstable production of electricity.

A good thing about wind power usage definitely is its regular behavior – we can state that there is a pattern in it, which can be found in day and year periods. The wind blows stronger during the day and slows down in the night, caused by decreasing temperature gradient. Also winter months are rich for quick winds.



Graph 1 – wind speed pattern day, night

Source: DWIA, www.windpower.org



Graph 2 – annual wind speed pattern

Source: DWIA, www.windpower.org

A very important information to show the character of the wind is its probability resolution which is described by the WEIBULL probability.

This contributes to the BETZ' law formulation which says the maximal amount of wind energy which can be used is 59 %.

The technical potential of wind energy is defined by the nominal power, which is the total expected amount of annual production of wind power plants. This potential depends on the development in technologies and it changes during the time.

The usable potential is the technical potential regarding to the plan of area development. This parameter shows the potential of a certain area very exactly.

Austria has the seventh highest installed wind power in the whole Europe.

The Czech Republic's installed wind power is 35 times lower.

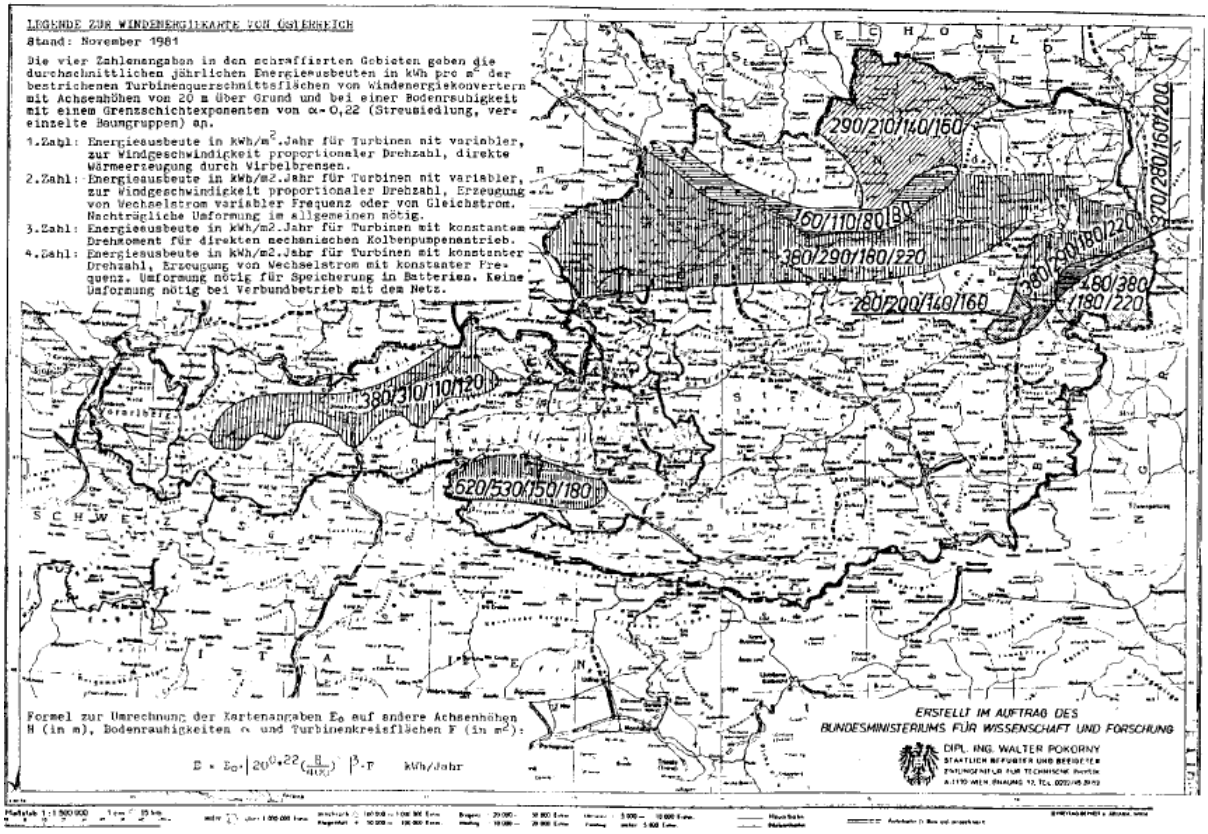
Now we want to show the situation of wind power in both countries more in detail.

2. Austria

2.1 Past

In Austria wind power experienced the first boom during the oil crises in the 1970s, but it was first in the 1990s that science and technology made such enormous progress and wind energy became an important economical factor.

The research in Austria was concentrated at the beginning on small wind plants, there were big efforts, but without any success. This and other reasons were responsible for an almost completely stop with Austria's wind power research and development in the 1980s. For a long time it was also taken as given that there is not enough wind potential in Austria to use wind power plants. But the first wind measurements, which were carried out in the 80's, showed surprisingly good results. It was the study "Das österreichische Windenergiepotential - Windenergiekarte von Österreich" from W. POKORNY that showed in the year 1981 the incredible technical annual usable wind potential of 6.600-10.000 GWh. But there were still some uncertainties, mainly caused by the sketchy meteorological data base.



Picture 4: Wind power map from Austria, November 1981; Source: Jungbauer A., by Pokorny W.

In 1991 the discussion about feed-in tariffs began. In 1994 the first funding programs came into action:

- 30% of investment costs were financed by the Österreichische Kommunalkredit AG. The funding was granted according to a call for proposals system.
- a higher tariff was paid for the first three years in operation which doubled that which the utility paid.

This made it possible in 1995 to build the first larger wind turbine in Marchfeld with a total power of 150 kW. In 1995, what is now today the WEB Windenergie AG, erected the first "Citizen Wind Turbine" in Michelbach, NÖ. It was owned by over 100 private shareholders. In 1996 this funding program expired and in February 1999 the new electricity laws came into effect.

The ElWOG 1998 – 2000:

The new electricity laws (ElWOG) set down the following regulations for the operators of distribution networks and the share of clean energy (wind, water, biomass, solar) which they must offer their customers:

- as of 1. October 2001 a minimum share of 1%.
- as of 1. October 2003 a minimum share of 2%.
- as of 1. October 2005 a minimum share of 3%.
- as of 1. October 2007 a minimum share of 4%.

The utilities had to accept the clean energy out of wind power plants into the grid without any limits. These agreements were a success, in the end of the year 2000 the installed power had already increased from 42MW to 77MW. That means 90 GWh electricity, the largest part of it was produced in Lower Austria (61 GWh).

In Austria each of the provinces set down its own feed-in tariffs. These had to be coupled on the average production costs. When the expenditures exceeded the profits, the grid operators had the possibility of regaining these costs. It came to the liberalisation of the electricity market in the year 2000. The ElWOG 1998 was changed a little bit and the new ElWOG 2000 was adopted.

The "Green-electricity" Act

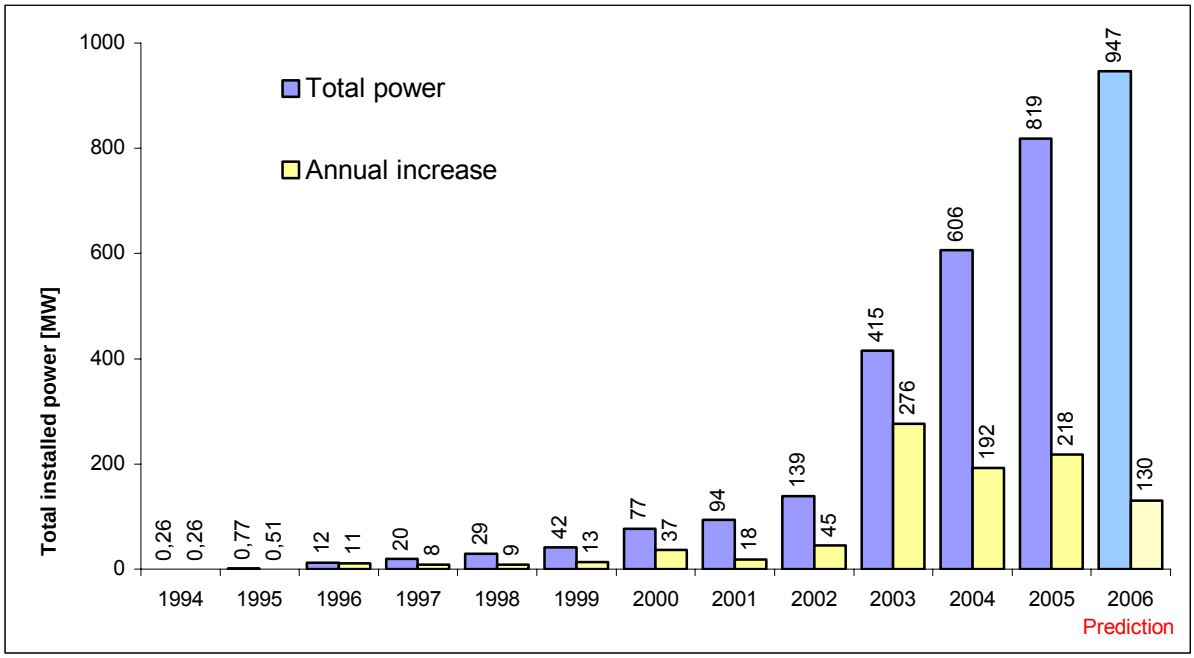
After a while the government recognized that reaching the green electricity targets would be easier and efficient if there would be a law for the whole country. Therefore the Green Electricity Act (Ökostromgesetz) which was passed on 10. July 2002 came into effect on 1. January 2003. Aim of this law was to raise the percentage of

renewable energy to an amount to 78.1% of Austrian electricity consumption by 2010. The act required 4% of the country's electricity to come from these eligible renewable energy sources (not including hydro power) by 1. January 2008. This meant a set back in meeting the goals of the electricity laws (ElWOG). A quota arrangement for electricity suppliers and a system of premium payments would support the production of green electricity.

Until this time the ElWOG allowed feed-in tariffs to vary from state to state. The Green Electricity Act, which came into effect on 1 January 2003, set the tariff for wind power at a flat rate of 7.8 cent/kWh and applied to all projects which had received their permits by 31. December 2004. It also guaranteed this tariff for 13 years. Old wind turbines kept the tariff according to ElWOG.

In the year 2003 a boom started, caused by the Green Electricity Act, because the investors and owners of wind power plants had at least a 2 year guarantee. 276 MW had been installed in this year. The totally power triple from 139 MW in the end of 2002 up to 415 MW one year later. Austria fastened in Europe onto the third place, directly after Germany and Spain, worldwide Austria was on 5th place of the wind power extend disassembly. In 2004 the increase continued, 192 MW came to the grid and Austria had 424 Power plants with a total installed capacity of 606 MW.

Last year the government planned an amendment of the green electricity law, there where many protests, but at the end it was passed. There could be some problems with the new law and it is also doubtful if the growth in wind power plants will go on as it did the years before.

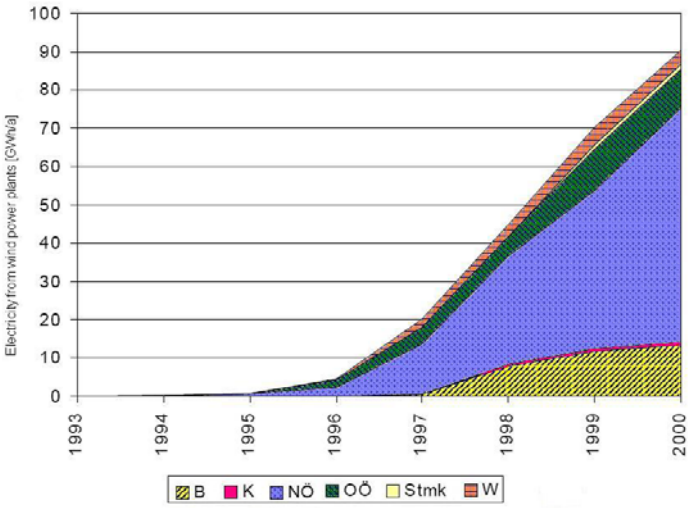


Graph 3: The development of wind power in Austria from 1994-2006 (prediction); Source: IG Windkraft

2.2 Nowadays situation + Legislative frame

Table 1: **Wind Power in Austria 2005** Source: IG Windkraft		
State	Power [MW]	Plants
Lower Austria	377.3	264
Burgenland	369.2	206
Styria	37.1	25
Upper Austria	26.4	23
Vienna	8.4	12
Carinthia	0.5	1
Austria, total amount	818.9	531

In 2005 built 117 new wind power plants were built with a total installed power of 217.8 MW, therefore the total capacity grew up to 819.5 MW (531 plants), that means 1.6 TWh realistic average annual production in electricity, which is 2.3% of the complete consumption of electricity in Austria or you can also say electricity for 470,000 Austrian households. Actually there are 564 wind mills with a total production of 882 MW, which is used in 504,181 households.

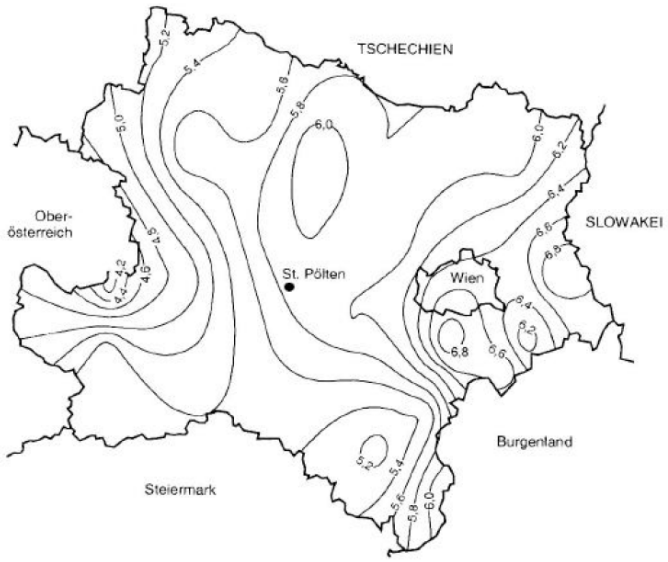


Graph 4: Development of wind power in the provinces

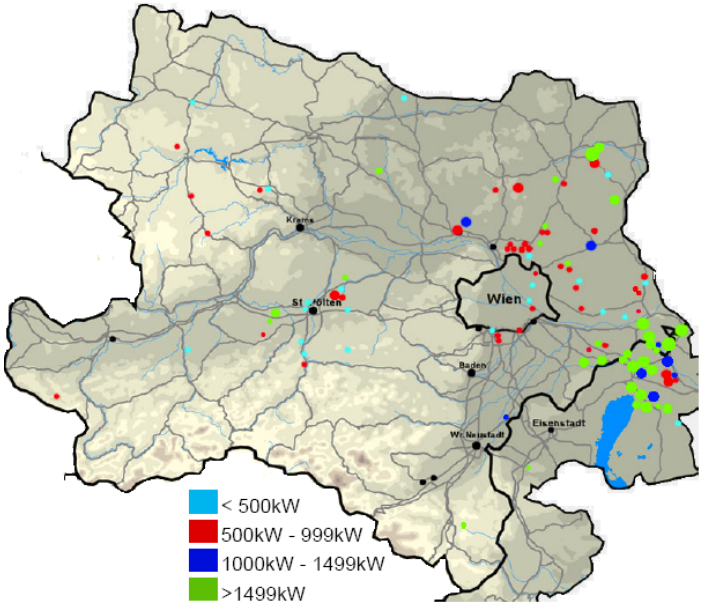
Source: Strategien für erneuerbare Energieträger, by Haas R. et al.

Most plants are in Lower Austria and in the Burgenland, where also the usable wind potential is higher than in other parts of the country. The wind plants in Lower Austria produce the electricity for one third of its inhabitants. In the picture we can also see the huge increase during 4 years in six provinces.

In Austria the wind speed is measured on different locations but there is no land register for it, merely in Lower Austria we can find this kind of map. As we can see there are many locations with an annual average wind speed that is higher than 5 m/s, which is ideal for wind power usage. Optimal wind ratios are in the south and in the east of Vienna.



Picture 5:
Wind speed map of Lower Austria;
Source: www.wwf.at



Picture 6 : Wind power plants in Lower Austria; Source: IG Windkraft

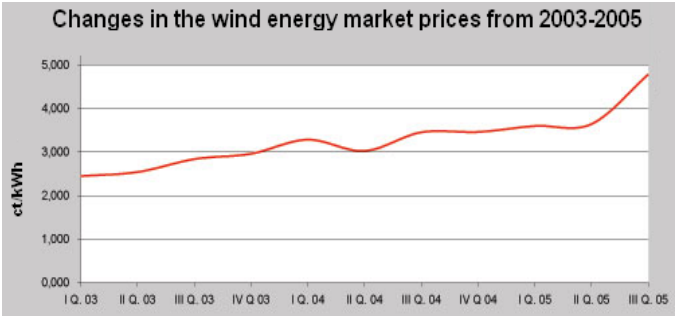
In the picture on the left side we can see a map of Lower Austria and with a small part of the Burgenland. Here is the biggest concentration of wind power plants in Austria. But there is still enough potential for further new plants, e.g. on the Parndorfer Platte or in the Marchfeld.

The eldest wind mill in Lower Austria was built in 1722 near Retz.

The legislative frame for Austria is still the Green Electricity Act which amendment was determined in the parliament on the 7th June 2006. That means for wind power:

1. Only 50-70 MW new wind power installation every year.
2. Uncertainties, also caused by the law, with new projects.
3. Full subsidies are offered for ten years, after that time they are abbreviated. Before the amendment the subsidies were guaranteed for 13 years.
4. Also the feed-in tariffs for Green Electricity will be changed in the year 2006.

Experts are afraid of a huge decrease in the next time, caused by the change in the act, which makes wind power more unattractive for investors.



The market price in Austria is growing continuously and has nearly doubled within three years. Nowadays the situation still looks positive for investors and operators.

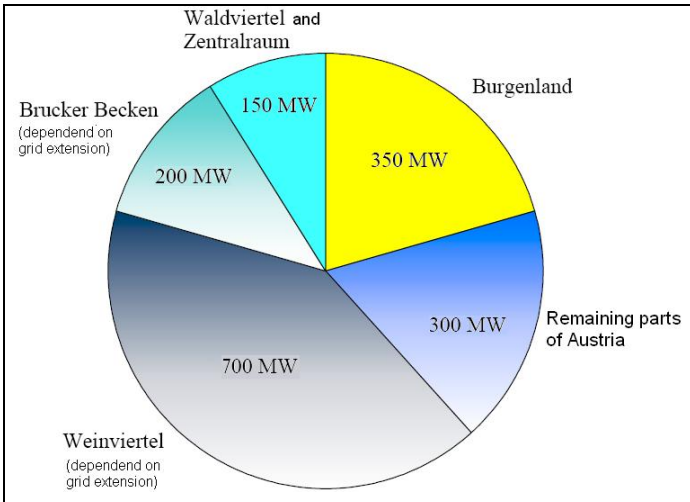
Graph 5: Market price of Wind energy in Austria; Source: Energy Agency Austria

Concerning[1] the various types of enterprise providing services for the wind power industry the service sector is, in contrast to 1996, dominating. Services comprise site assessments, planning, wind measurements, and counseling. The production sector includes infrastructure, parts and components as well as measuring technology. The data of 2001 reflect a continual increase of this industrial sector in Austria. Total turnover in the year 2003 was €72.2 million, which corresponds to an increase of more than 100% compared to 1998. In 1996, 27 enterprises (of a total of 35 included in the survey[1]) reported 113 employees. In 2000, 295 worked in 31 enterprises, which constitutes an increase by a factor of more than 2.5.

2.3 Future

But what about the future of wind power in Austria? There have been many researches to find out the regions, which could be used for new wind power plants.

The scenarios are different, but they all agree I one point: Lower Austria and Burgenland are the provinces with the highest potential for wind power usage in the future.



Graph 6: Wind power potential in Austria for the future

Source: Energie – Control GmbH

Bundesland	Kury, Dobesch	VEÖ	Pokorny, Neu-wirth
	Ertrag [GWh/a]	Ertrag [GWh/a]	Ertrag [GWh/a]
B	568	470	560
K	75	580	-
NÖ	1.605	1.700	2.700
OÖ	295	1.000	2.500
S	150	320	800
Stmk	150	690	1.400
T	150	380	900
V	30	50	
W	17	18	-
SUMME	3.040	5.208	-

Table 2: Wind power potential, different scenarios

Source: Energie – Control GmbH

The potential in Tyrol, Vorarlberg and Vienna is very low. The scenarios differ; in Lower Austria might be technical problems, caused by the grid, which also will have to increase.

There is a great number of studies that analyzed the employment effects to be expected from a more intensive use of wind power use. If we look at the economic factor of wind power we can find out very interesting facts[1]:
Using plant operators' data on investment and operating costs the study worked out prognoses for the development until 2020. Macroeconomic effects were determined primilary by operating costs. Expenditure through operation will amount to €631.7 million until 2026, in Austria, which means 10,897 employed in the industry, while investment costs in the wind power sector will be only €193.7 million, corresponding to 3,435 jobs. Each million € spent for wind power thus creates 11.1 jobs on average.
But it is also important not to forget that wind power will become a well established technology only if we succeed in creating stable economic framework conditions as well as in creating and maintaining social acceptance of the construction of wind power plants.[2]

3 Czech Republic

3.1 Past

In this part of our paper we referred the information from source number 2 – JOSEF ŠTEKL'S and JIŘÍ HOŠEK'S Wind potential of Czech Republic and options of it's usage.

In deep history there has been a relatively high usage of wind energy in the Czech Republic, mainly in wind mills. The first known mill was built in 1277 in the garden of Strahov monastery. The largest boom came in the fortieths of the 19th century in Bohemia and in the seventieths in Moravia. Altogether there were about 880 mills.

During the communism regime electroenergetic conception of the Czech Republic was based on power plants driven by fossil fuels and nuclear power. The problem of air pollution became more and more serious but there was no will to act. Therefore we can't speak about a usage of renewable sources till 1990.
The opening of the borders after the revolution contributed to a relatively quick growth of wind power engineering in the Czech Republic. The growth continued from 1990 till 1995. 24 power plants, over 50 kW each, were built during that time. These machines had overall 8,220 kW of installed power. In the second half of the nineties an unexpected situation occurred on the Czech wind energy market. Whereas in

[1] Nachhaltig Wirtschaften, Forschungsforum 2/2003: Macroeconomic impact of renewable energy sources in Austria

[2] Nachhaltig Wirtschaften, Forschungsforum 1/1999: Social acceptance of wind power in Austria

Germany and Austria there has been a huge increase in installed wind power, in the Czech Republic it stopped by the end of 1995. Later on an increase started and continued till the year 2002. This growth was mainly caused by disassembly of five machines with an installed power of 925 kW. Also many other power plants were out of work. The economic situation wasn't as good as the growth of wind energetic would require. There were mostly no investors to put money in business with electricity produced by wind. This was the reason of malfunction of many machines which were mostly home made. These turbines were cheap but on the other hand they were not able to pass through probationary operation and were susceptible to failures.

A very important reason of this long lasting growth was a pretty low purchasing price of electricity produced by wind power plants. This price was between 0.9 and 1.13 Kč/kWh (about 0.03 – 0.04 €/kWh). The price was so low that investors were not able to repay their contractor's credits and debts.

From December 2002 till 2005 there have been 15 wind power plants in operation in the Czech Republic. Their installed power was altogether 9,865 kW (~ 9.9 MW).

The total nominal power installed in wind power plants by the end of 2004 was 17,160 kW.

The ninetieths were also remarkable by establishment of Czech based manufacturer of wind turbine towers in Ostrava. At the beginning the factory produced towers for Tacke Company. After this they developed their own 75 kW and 315 kW power plants. These machines were pretty cheap.

Year	Overall power [kW]	Nr. of machines	Growth in power	Growth in machines
1990	150	1	150	1
1991	150	1	0	0
1992	300	3	150	2
1993	1580	9	1280	6
1994	5800	19	4220	10
1995	8345	24	2545	5
1996 - 2000	7660	19	-685	-5

Table 3: Trend in wind energy in the Czech Republic from 1990 – 2000; Source: J.Štekl

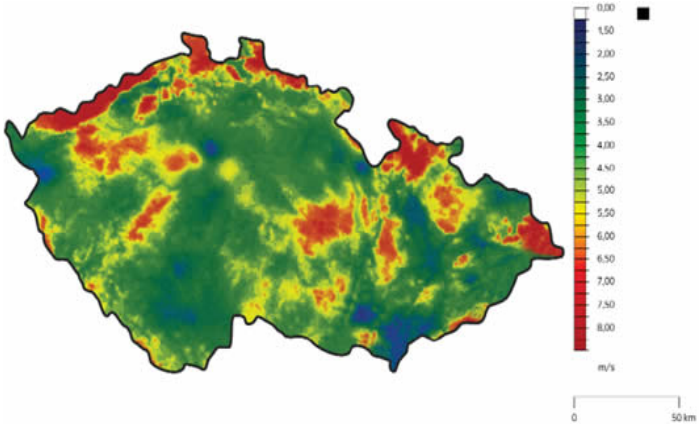
As the first part of this industry growth in the Czech Republic was motivated by enthusiasm from new market based situation after the revolution, the second part has been motivated by the growth in purchasing prices of wind energy. In 2002 it went down from 3 Kč/kWh (~ 0.11 €/kWh) to 2,6 Kč/kWh (~ 0.09 €/kWh).
Apart from the low purchasing prices the core of the bad trend in the second half of the ninetieths can bee seen in a very low political and economical support from the government for power plant producers. But there have been even more problems. These were for example value of credits, insufficient subsidies for renewable sources of energy and no support for producers who were without any capital for the development. These mistakes led to the situation that there was no chance to establish the market with wind power plants. Therefore in this situation the manufacturers went bankrupt.
The problem with low purchasing prizes was caused by the difference between Czech, German and Austrian markets. If we mentioned a price of 1.13 Kč/kWh (0.04€/kWh), in Germany the price was set as 3.38 (0.12€/kWh) and in Austria the price was between 1.63 and 5.55 Kč/kWh (0.06-0.19€/kWh). So the assumptions of rising prices made by the investors from the beginning of the ninetieths were wrong and most of them also went bankrupt.

The situation seemed to be like a circle, because inactivity of government and no support was explained by low quality of Czech power plants. But these machines were popular among investors which can be due to the low prices. But they did not work (they worked just 50% of possible time) and this was declared as the problematic factor in giving support. 29% of machines in CR were unsatisfying.
In this first stage of development of wind turbines many failures were also maid in basic steps of planning. Investors did not have experiences with turbine sitting which is a really difficult event. Therefore the annual production was lower than the possible one. A very interesting information was about the altitude of placing of turbines.[3] Altitudes from 31% of locations were lower then 500 m, 23% were in an altitude between 500-700 m, 31% between 701-1 000 m and 15% were situated higher then 1,000 m. Surprisingly the number of locations lower then 500 m was pretty high.

[3] J.Štekl - Zhodnocení činnosti větrných elektráren na území ČR v období 1990 -99

3.2 Nowadays situation, legislative frame

The Czech Republic is an interior state with continental climate which is not advantageous for usage of wind energy because it's remarkable by seasonal wind speed fluctuations. This is caused by global winds that are typical for northern and middle Europe. This is not a good fact because the wind speed is the most important parameter for the use of wind energy.



Picture 7: Wind map of the Czech Republic; Source: ÚFA AV ČR [4]

We can see a wind speed map in picture number 4. The largest part of the Czech Republic is exposed to winds with speeds under the technical minimal limit of turbines (about 4 m/s) and it's the minimal speed to drive the rotor. In fact there are only 3 areas optimal for usage of wind power plants.

The importance of wind as a source for energy is growing nowadays. Mainly it is because the wind is simpler to convert into electric energy. Thanks to this fact and the growing importance of renewable sources of energy the support activities of government are logical outcome.

This situation comes out of common European policy which is resulted into directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market of the European Parliament and of the Council. The main points of this directive are national indicative targets of each member state. These targets express which share of consumption of electricity from renewable sources on the total consumption should be reached in each state. These targets were set in regard to reach common global indicative targets of 12 % of gross national energy consumption by 2010 and in particular with the 22.1 % indicative share of electricity produced from renewable energy sources in total Community electricity consumption by 2010.

In the Czech Republic this European directive has been integrated by law 2005/108 on support of electricity production from renewable sources. Czech Republic`s national indicative target was set to 8%.

The law on support of renewable sources sets the obligation to purchase all energy produced by renewable sources to operators of distribution systems and to operator of transmission system in the Czech Republic. The operators have to connect every renewable source of energy to their system if the investor asks to and if his source fulfils all terms. This law nowadays offers very advantageous terms for investors and motivates them to plan new projects and to restart bigger growth of Czech wind industry. The problem is still in suiting new wind power plants or even bigger wind parks. There are many refusing resolutions from environment specialists, zoologists, officers and also citizens while making statements to new projects.
This attitude complicates the situation. It lowers the amount of suitable places for new projects even though their number is naturally low anyway.
We can state that this kind of attitude is completely different from the majority of people living in Germany, Denmark or Austria and is based on misapprehension of the problem and missing experiences with technological progress represented by all kinds of parameters of wind power plants as visual effects, noise, ultrasound emissions, etc.

Nowadays we can see an other trend in new projects. Investors often decide to build one big power plant instead of smaller machines. This comes from low potential character of wind in lower altitudes above the surface. They rather built big machines about 3 MW with a rotor which is 100 m above the ground. These machines with 45 m diameters rotor area are able to use the air circulation in more effective way than machines with lower towers do. But this fact creates again new problems because higher machines are unpopular mainly among citizens. But the paradoxical thing about it is the fact that a bigger rotor works at slower rotational speeds.

According to the information from the operator of the transmission system of the Czech Republic the installed power of wind power plants was about 17 MW by the end of 2005. This power was led only to low and high voltage systems.
But the assumptions are predicting big growth which should start in 2006. This should be caused by an impact of new laws about support of renewable sources.

Whole area of CR			
Wind speed (m/s)	**4 - 5**	**5 – 6**	**> 6**
Area (km²)	23059,2	4297,6	1268,5
% fromCR	29,24	5,45	1,61
Without protected areas			
Wind speed (m/s)	**4 - 5**	**5 – 6**	**> 6**
Area (km2)	19381,5	2757,2	885,1
% fromCR	24,58	3,50	1,12
% From 1st line	84,05	64,16	69,77
Without protected and forest areas			
Wind speed (m/s)	**4 - 5**	**5 – 6**	**> 6**
Area (km2)	7098,6	765,7	111,5
% fromCR	9,00	0,97	0,14
% From 1st line	30,78	17,82	8,79

Table 4: Potential areas in CR; Source: J.Štekl [7]

ŠTEKL[4] shows areas that have a potential to be used for power plants. There are different sizes of areas with average annual wind speeds that vary between 4-5 m/s, 5-6 m/s and with more than 6 m/s. We can see that in the Czech Republic we can use maximum 36% of the country's area. But this is just a theoretical number.

Mr. Štekl decreased areas by the number of environmentally protected areas and forest areas . In practice only 10% of the whole arae of the Czech Republic can be used for wind power plants.

Renewable source	Technology	Accessible potential	Technical potential	Actual usage
Solar energy	**Solar liquid systems**	17 000 TJ	25 000 TJ	0,4 PJ
Solar energy	**Photovoltaic systems**	5 500 GWh	23 000 GWh	0,03 GW
Wind energy	***Wind power plants over 60 kW***	***4 000 GWh***	***16 324 GWh***	***4 GWh***
Geothermal and hydrothermal energy	**Hydrothermal > 130°C**	3 500 MW	35 000 MW	
	Hydrothermal < 130°C	25 MW	250 MW	0,2 PJ
	Thermal pumps	4 000 MW	30 000 MW	
Water energy	**Large hydropower plants (>10 MW)**	1 165 GWh	13 100 GWh	1 850 GWh
	Small hydropower plants (<10 MW)	1 115 GWh		705 GWh
Biomass - fuel consumption				
Biomass (bio fuels)	**Wood**	44,8 PJ	77,6 PJ	22 PJ 420 GWh
	Cultivated biomass	136 PJ	275 PJ	
	Bio fuels and bio gasses	16 PJ 1 200 GWh	33 PJ	2,5 PJ
Thermal energy overall				25,1 PJ
Electricity overall				2 979 GWh

Table 5: RES potential in CR; Source: J.Štekl [7]

[4] Perspektivy využití energie větru pro výrobu elektrické energie na území ČR [01.01.2005] Výzkumná práce ÚFA ČSAV, RNDr. Josef Štekl, CSc. a kolektiv

The share of RES on consumption of electricity in CR is about 3.5% which is about 67,000 GWh per year.

Speed	Power (MW) Production (MWh)	
4,1 - 5	2 571	2 236
5,1 - 6	8 208	12 312
> 6	888	1 776
Technical	11 667	16 324
Accasable	3 000	4 000

Table 6: Wind power potential in CR; Source: J.Štekl [7]

ŠTEKL also made a research of energetic wind density by combining VAS and WAsP models. The most convenient areas according to his essay are in Krušné Mountains, Krkonoše Mountains and Jeseníky mountains. There are also locations with high speed winds in Beskydy Mountains, Jizerské Mountains and Šumava.

3.3 Future

There have been many calculations, but precise calculations have been maid mainly for areas of Krušné Mountains. 288 places have been chosen that fit for wind power plants with an overall installed power of 576 MW a annual production of 1.5 GWh.

As we wrote before, there were 14 locations with 16 MW of installed power. In 2006 operators of distribution and transmission systems expect a growth of 170 MW in about 30 localities in the whole Czech Republic. Till the end of 2012 they expect another growth between 55 and 90 localities with an installed power between 1,520 and 2,400 MW.

4. Abstract

We can clearly see that there is a big difference in wind power utilisation between the Czech Republic and Austria.

This fact can be ascribed to historical, social, economic and environmental predispositions. We think the biggest advantage of Austria lies in its natural conditions. Even though Czech Republic has the economical environment and potential to catch up with Austria's pace of investments into wind energy, there wouldn't be enough of wind power to run the turbines.

Also big difference we can see in energetic policies made by the governments. While Austria was always led to produce electricity carefully regarding to its nature, Czech Republic has been “equipped” by coal and nuclear power plants.

This caused, that Austria is concentrated more on renewable sources of energy but because of their relatively low potential it is forced to import a lot of energy.
And on the other hand, the Czech Republic is able to produce more energy than it is necessary. This predetermines it to export electricity. So it is not concentrated too much on renewable sources, but according to European law the Czech Republic will need to do something with it.

5. Literature

1. DWIA www.windpower.org
2. Větrný potenciál České republiky a možnosti jeho využití, JIŘÍ HOŠEK, JOSEF ŠTEKL, Printed: Vesmír 84, 332, 2005/6
3. EWEA
4. UFA AV +CR
5. J.ŠTEKL - Zhodnocení činnosti větrných elektráren na území ČR v období 1990 -99
6. ED 2001/77/EC
7. Perspektivy využití energie větru pro výrobu elektrické energie na území ČR [01.01.2005] Výzkumná práce ÚFA ČSAV, RNDr. Josef Štekl, CSc. a kolektiv
8. Nachhaltig Wirtschaften, Forschungsforum:
    a. Macroeconomic impact of renewable energy sources in Austria 2/03
    b. Social acceptance of wind power in Austria 1/99
    c. Wind Power in Austria 1/95
9. Technische Universität Wien

    HAAS R., ET.AL., 2001: Strategien zu weiteren Forcierung erneuerbarer Energieträger in Österreich unter besonderer Berücksichtigung des EU Weißbuches für erneuerbare Energien und der Campaign for Take-off Endbericht, 225 S.
10. JUNGBAUER A., 1998: Windenergienutzung in einem regenerativen Energiesystem, Diplomarbeit an der Technischen Universität Graz, 151 S.
11. Studien im Auftrag der Energie – Control GmbH; www.energie-control.at
    a. Auswirkungen des Windkraftausbaus in Österreich, August 2003, 188 S.
    b. Ökologische Leitlinien für den Ausbau von Ökostromanlagen in Österreich, durchgeführt von WWF Österreich, März 2003, 91 S.
12. Energie Verwerungsagentur; www.eva.ac.at

    Daten zu erneuerbarer Energie in Österreich 2004, Juli 2004, 39 S.
13. IG Windkraft; www.igwindkraft.at
14. Tauernwindpark; www.tauernwindpark.com