Czech-Austrian Winter and Summer School
Comparison of energy systems in Czech Republic and Austria

Oliver Pichler, Michaela Lachmanová

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CONTENT

1. Abstract

At the beginning of the 21st century the world is facing huge challanges in the field of energy production as well as energy consumption. Effective strategies to guarantee security of supply and to mitigate climate change are more important than ever.

Due to this framework conditions, it is essential to find out varieties of energy systems of different countries, especially this countries are situated side by side. Therefore this current paper, written as part of the "Interdisciplinary Bilateral Winter and Summer School on 'Energy Systems in Austria and the Czech Republic' ", tries to figure out historical, geographical and socio-economical differences of both countries regarding their respective energy system. Focussing on the aspects of centralisation and decentralisation, key divergences are demonstrated and opportunities and potentials are highlighted, how to overcome these structural and geographical drivers in a sustainable way.

Keywords: Austria, Czech Republic, energy systems, centralisation, decentralisation, sustainability

2. RESEARCH QUESTION

Main research question is what the differences between Czech and Austrian energy system are and what kind of role plays centralisation/decentralisation in development of energy systems.

We would like to compare both systems and look for possibilities of centralised/decentralised development.

3. CZECH ENERGY SYSTEM

Czech energy system is one of the most integrated and connected system in Europe with long history and many elements involved. Due to position of Czech Republic in Central Europe and industrial history of region, the system is very complex.

3.1. A historical approach

Due to location of the region, Czech lands always were important and strategic part of Europe.

Due to invention of steam engine in 18th century and beginning of The Industrial Revolution, consumption of primary energy sources had increased. Many inventions were made and many sources became necessary for industry or transportation. During 19th century Bohemia as a part of Austro-Hungarian Monarchy became centre of The Industrial Revolution. It was especially because of deposits of coal and other sources. Development of rail transport and construction of tracks across Bohemia led to construction of factories and development of industry. Many breweries, chemical factories were built. River transport was used to carry coal, wood, limestone, soda. At the end of 19th century the largest port in Austria–Hungaria was in Ústí nad Labem.

The expansion of production of electricity in our country is linked to František Křižík. He improved arc lamp and arranged installation of electrical public lightening.

He contributed to construction of first streetcar line in Bohemia; his company had supplied equipment to power stations. He managed to rail electrification and started to produce electric locomotives. Electricity had become a very important part of life.

Small power plants were gradually built as little sources for lightening or powering factories. First plant producing electricity to supply and sold was built in Praha – Žižkov in 1889. At the end of 19th century, Czech lands were the most industrialized part of Austria-Hungary.

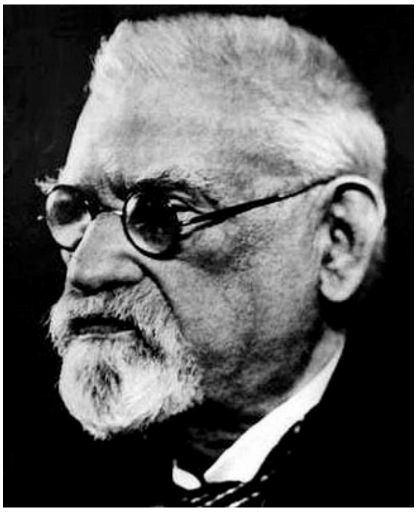

Illustration 1: František Křižík, Source: ČVUT (CTU)

Illustration 2: The arc lamp, Source: West Bohemian Museum

After WWI at 28.10.1918 Czechoslovakia was established and Austria-Hungary ceased to exist. At 22.6.1919 the Law about electric companies entered into force. Due to this law electric companies had to provide electrical supply to people who requested. Twenty companies were found and electric system was introduced and unified as well. The trend was clear – in first quarter of 20^{th} century idea of one integrated system covering all demands of society was obvious.

After 1948 the nationalization of electric companies brought about one energy establishment. This establishment arranged all elements of consumption of energy – production, distribution and trading with electricity. Development of transmission system was managed and controlled by state authorities. In 1955 whole territory of Czechoslovakia was electrified. Due to reorientation of industry to heavy industry in 50´s consumption of electricity increased and turning off of electricity to households appeared. The construction of high voltage transfer lines had started. In the beginning of 60´s many of coal plant were constructed. Electricity generation based primarily on coal is caused by long tradition of coal mining and also political decision.

In 50´s Czechoslovakian uranium mines were opened and after several years big resources were found and Czechoslovakia became a significant exporter. Most of uranium was exported to USSR. Now the only uranium mine in Europe is in Czech Republic, still producing ore.

At the end of 80´s Czechoslovakia was exhausted. The landscape had been destroyed by mining and pollution, economics wasn´t working. Planned economy caused ineffective resource allocation and market imbalance. After 1989 whole electrical establishment was divided to different companies – heating plants, power station and later also ČEPS as a Czech transmission system company was found.

3.2. Description of Czech energy system

Now the trade is completely divided. In Czech Republic ČEZ is major producer of electricity. ČEPS is transmission system operator and there are four companies responsible for distribution of electricity.

3.2.1. Production

Czech Republic is fully self-sufficient in production of electricity and heat. Well-diversified portfolio of power ensures security and quality of supply and also allows export.

ČEZ as the biggest conglomerate in Czech Republic is major producer of electricity, owned by Czech Republic (National property) by almost 70%. The rest of shares are traded on the Prague and Warsaw Stock Exchanges. Business field of this conglomerate is much bigger; ČEZ is one of three biggest suppliers of heat and it deals with many other interests – nuclear research, mining, planning.

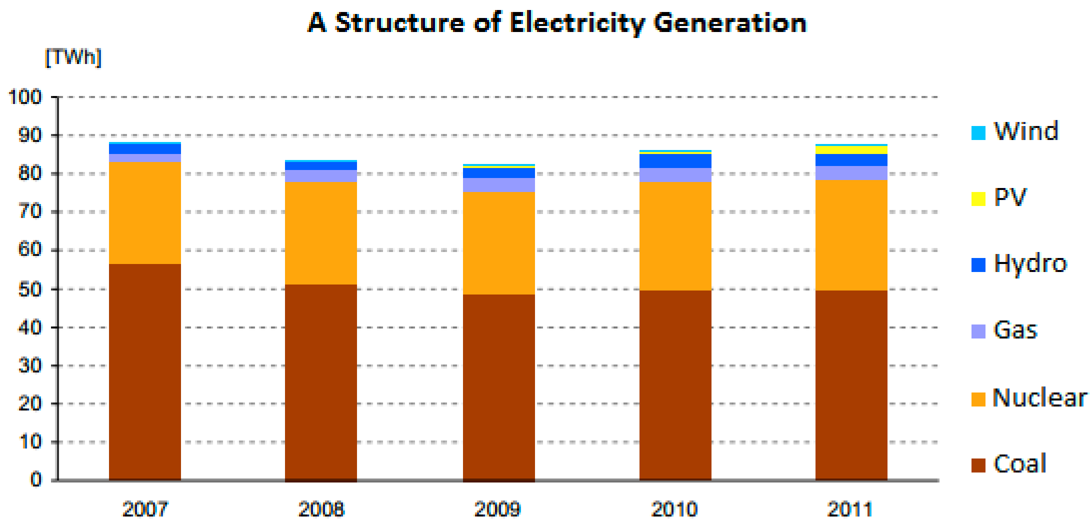

Illustration 3: Structure of electricity generation, Source: ERÚ (Energy Regulatory Office)

This structure is due to natural resources and type of landscape. There´s not lot of options to use water energy as in Austria.

Coal plants

As we can see on the previous graph, the major part of generation is ensured by coal. It is caused by historical influences, as said before. The biggest coal plants are for example Tušimice, Dětmarovice, Prunéřov, Mělník and all coal plants are supplied with coal mined in the Czech Republic. Most of them are built close to coal mines.

Such a large share of coal-fired power plants meant interference in the environment. Exhalations were very dangerous before desulphurisation. Acid rains almost destroyed all land around plants. For example forests in the mountains Krušné hory and Krkonoše have been almost destroyed by acid rains caused by coal plants.

Most of Czech coal plants have to be replaced soon because of their ending service lifes. The average installed capacity is about 400-500 MW, so the searching of new sources of energy is very important for future development of energy system.

Illustration 4: Coal plant Prunéřov, Source: novinky.cz (internet news)

Nuclear plants

In Czech Republic there are two nuclear plants – Temelín and Dukovany. For both plants fuel is supplied by Russian company TVEL.

Temelín has been finished at 2002 with installed capacity 2000 MW. There are two reactors VVER 1000 producing almost 14 000 GWh/year. Nuclear plant Dukovany produce electricity since 1985. There are four reactors VVER 440 with 4x400 MW installed capacity. Production of year 2011 was almost 15 000 GWh.

Temelín is going to be completed in the coming years. Now a competition for suppliers is announced and two companies compete. Nuclear power plants represent a great contribution to the reduction of exhaust.

Water plants

The biggest water plants are pumped storages Dlouhé stráně (650 MW), Dalešice (450 MW) and then Vltava cascade.

Illustration 5: Dlouhé stráně, Source: Energotis, s.r.o

Large water resources are used to cover peak, especially Dlouhé stráně as the biggest hydro in Czech Republic. Potential water use is nearly exploited, mostly by small hydros.

3.2.2. Transmission system

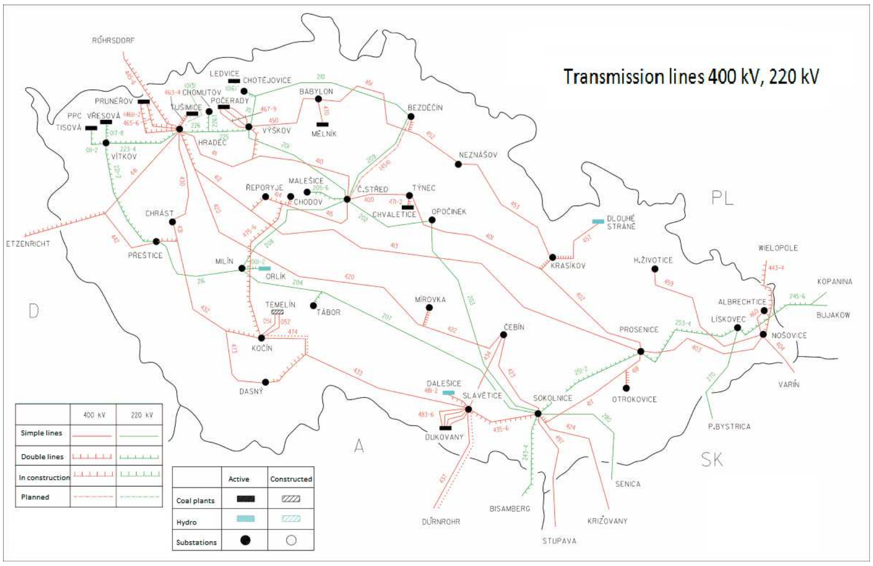

Illustration 6: A map of transmission lines of high voltage, Source: ČEPS, a.s. (Czech transmission system)

Electricity is transmitted at very high voltage (400 kV, 220 kV) for long distances. This high-voltage grid is interconnected to secure supply, while distribution grid (110 kV, 22/35 kV) is radial to cover entire country.

Czech transmission system began to be built in 1950´s. Since then the net of lines became very dense and left – right oriented. Now the grid is one of the densest system in Europe.

If we summarize it, the production of electricity in Czech Republic is provided by sources of energy with high performance – less sources to cover energy consumption. Related to this and structure of transmission system, we can see that Czech energy system is much centralised.

3.2.3. Renewable energy

Czech Republic as a member of EU has to observe the fuel gas limits and limits of CO_2. Czech Republic is significant producer of CO_2 (12 tons of CO_2/person per year). This led to orientation to renewable sources. In past years, coal – focused production was great producer of CO_2. After 1990 due to regulation Czech Republic dramatically reduced production of CO_2.

In 2005 a law to support RES was passed. Later some acts to set purchase prices were passed and the way these acts have been written caused large increase of renewable sources, especially PV plants.

In 2009 Czech Republic noticed significant increase of photovoltaic sources. It was caused by wrongly set prices, too high. That led to construction of enormous PV fields to earn big amount of money. Lot of businessmen took advantage of it and ensured large earnings.

To ensure quality of power, balance of production and consumption in time is very important. So the increased amount of unpredictable PV electricity in system is very dangerous. In each moment consumption needs to be covered by production, so when solar systems stop to produce electricity, missing energy has to be paid. This regulatory energy is very expensive, so people pay to owners of PV fields and also to producers of energy to cover missing PV energy.

On next graph we can see increasing amount of PV share.

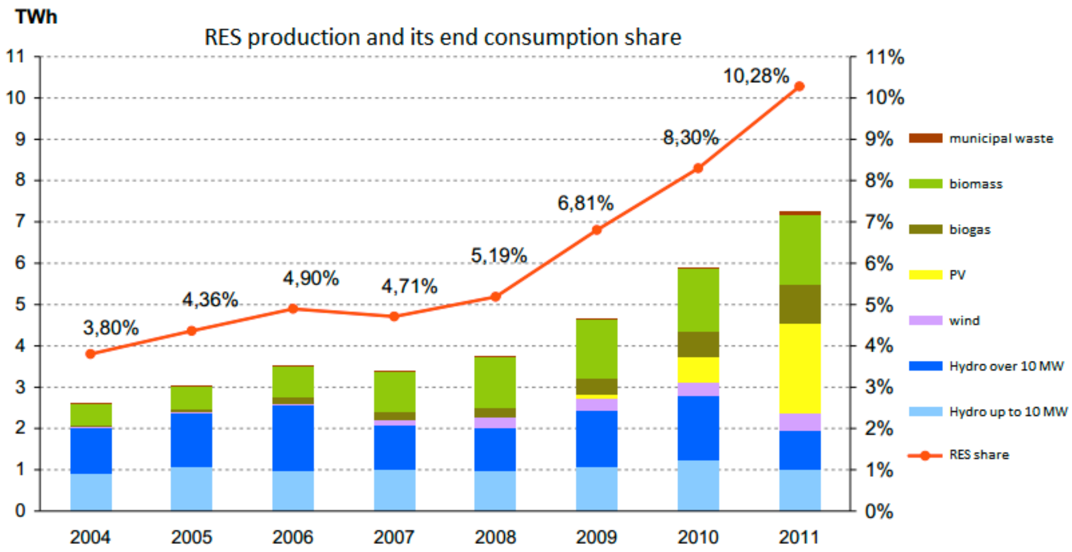

Illustration 7: Course of the production since 2004, Source: alternativni-zdroje.cz (Alternative sources)

Now it´s a big problem to deal with, because people pay less than 47 % of total cost of electricity for power energy and almost 53 % is for distribution and RES support.

4. AUSTRIA

4.1. A short geographical Approach

Austria is located in Central Europe, the geographic coordinates are 47 20 N, 13 20 E. Austria’s national territory is comparatively to the biggest states in Europe small with 83,870 sq km. In the western and southern areas, there are mostly mountains. Eastern and northern territories are mainly flat or gently sloping. The lowest point of Austria’s surface is the Neudsiedler See with 115 m, the highest mountain is the Großglockner with an absolute altitude of 3,798 m.

In the same way as the structure of the surface differs, Austria's climate is dominated by fluctuations on the local and regional level. In general, the climate is determined by the wet and warm influence of the Gulf Stream as well as the arid conditions of the continental influence, so the climate is moderate and temperate with lot of precipitation due to the alps and hot and dry conditions due to the continental influence especially in summer in eastern regions[1].

In summary it can be said, therefore, that based on the high diversity of the structure of the landscape with high mountains and lowlands and the various climate conditions, in Austria exists a wide range of possibilities for energy production.

4.2. A short historical Approach

As human beings interact more or less intensively with natural resources and ecosystems trough economical activities, social, cultural and technical changes are therefore very important and interesting to evaluate the societal metabolism. As the former hunter-gatherer society and the agrarian society used mainly biomass and manpower, things have changed due to industrialisation. While hunters and gatherers had an energy input at an average of 10-20 GJ/cap.year, figures increased to about 65 GJ/cap.year for the agrarian society and reached its all time high for human beings with roughly 250 GJ/cap.year for industrialised people.

Till 1850, Austrias energy system was determined by the solar energy system. Biomass nourished humans and animals, firewood and low-efficient wind- and hydropower was used. So the system was characterised by a huge dependence on surface, it was considerably decentralised. The nature therefore was a constraint of groth for human beings.

Since 1830, fossil fuels were used. First, coal was won in Austria, which was used especially for iron production. Subsequently things changed dramatically. From then on, industrialisation was full in progress. Since about 1950, coal made way for oil and from now on, the Austrian energy system was totally uncoupled from landscape, as the transport of the energy carrier was easier to achieve. So the former growth limitations were no longer existent. At this time Austrians also started to use hydropower due to the wide range of rivers with enormous surface runoff. Caused by the oil crisis, gas power stations were also build since about 1970, the below-mentioned illustration 7 shows the development of the Austrian energy system from 1850 to 2000[2].

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[1] Geography of Austria - http://geography.about.com/library/cia/blcaustria.htm, 21/04/2013

[2] F. Krausmann: Eine sozialökologische Geschichte der Industrialisierung - http://www.univie.ac.at/igl.geschichte/umweltgeschichte/ws2003/krausmann_materialien.pdf, 22/04/2013

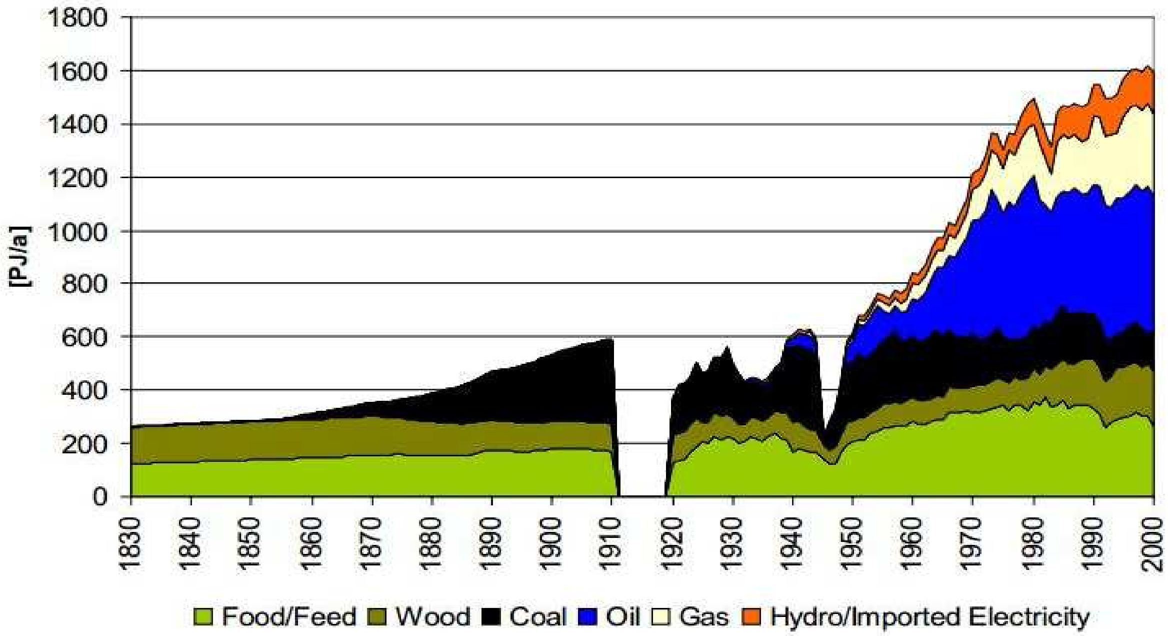

Illustration 8: Austrias Energy turnover from 1830 to 2000; Source: Abteilung Soziale Ökologie Wien

4.3. Global Warming and Greenhouse Gas Reductions

To achieve international goals and purposes regarding the fight against harmful climate change decided at the United Nations Framework Conventions on Climate Change (UNFCCC), Austria, as well as other EU member states, has to reduce greenhouse gas emissions and find a way towards sustainable development. As a consequence, the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) has built a guideline, which contains

- to create and assure the requirements for a high quality of life in Austria,
- a preventive conservation as well as responsible use of soil, water, air, energy and biodiversity,
- the support of environmentally friendly development and the protection of living environments in urban and rural areas and
- to ensure sustainable production in particular of safe and high-quality food as well as renewable resources[3].

As represented in the following graph, the energy production sector directly (16.9%), and also its indirect demand effects (space heating, mobility, industry, agriculture, etc.) play a big role in this matter.

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[3] Lebensministerium: Erneuerbare Energie in Zahlen (2010) - http://www.lebensministerium.at/dms/lmat/umwelt/energie-erneuerbar/ERneuerbare_Zahlen/Erneuerbare-Energie-in-Zahlen-2010_web0/Erneuerbare%20Energie%20in%20Zahlen%202010_web.pdf, 03/03/13

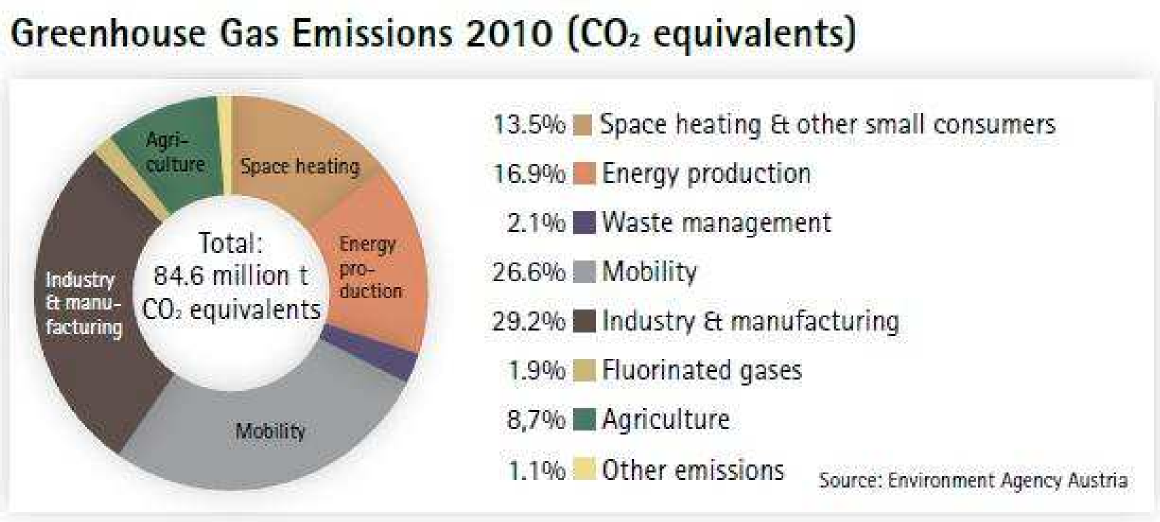

Illustration 9: Greenhouse Gas Emissions 2010; Source: Environmental Energy Agency

Austria emitted 84.6 million t CO2 equivalents. To reach the objectives of the Kyoto Protocol, Austria would have reduced its emissions by 6.2 million t CO2 equivalents, although flexible mechanisms and net forest growth are already considered[4]. To miss this target is expensive for the Austrian government and alarming concerning the threats of the global warming, therefore it is crucial to give the best to reduce energy-induced emissions[4].

4.4. Primary Energy, End Energy and the Energy Flow Chart

Annual developments have to be analyzed with care, due to the lower demand caused by the world economic crisis, but in general the figures for the last few years have not changed dramatically, so the authors use statistics for the year 2009 in the following considerations.

According to figures provided from the Statistics Austria, the gross domestic energy consumption of Austria for 2009 amounted to 1,354 PJ[4].

[4] Austrian Energy Agency: Basic Data Bioenergy (2012) –

http://www.enercee.net/detail/artikel/new-folder-basic-data-bioenergy-austria-2012-available.html?pager%5Bpage%5D=13&cHash=3a489fe5844d12675d571b393a96fbdd, 13/03/2013

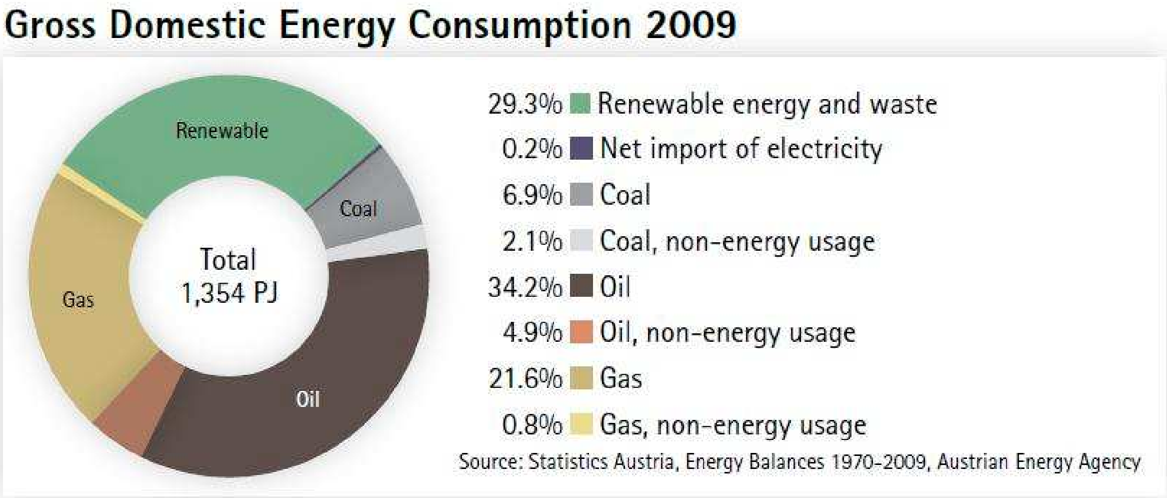

Illustration 10: Gross Domestic Energy Consumption 2009; Source: Statistics Austria

If we dig a bit deeper, we can see, that the biggest amount is provided by 70.5% fossil fuels (oil, gas, coal). The share of renewable energy sources amounts to 29.5% of the whole domestic energy consumption.

Compared to the gross domestic primary energy consumption, the domestic final energy consumption amounts to 1,057 PJ, therefore a difference of 297 PJ emerges (a detailed classification of this difference can be found on considering the below-mentioned energy flow chart). The following graph shows a detailed structure of the final energy consumption and indicates which field of application the individual sources of energy are used for. Apparent from the graph, renewable energy is primarily used for space heating, followed by the steam generation and process heat. Coal is basically used in industry, whereas oil is mainly used for mobility. Gas is basically used for space heating as well as in industrial furnaces (Austrian Energy Agency, 2012).

The following energy flow chart gives detailed information on where the adapted energy comes from and how it is used for. In Austria, the energy conversion process produces about 96 PJ annual losses. 311 PJ are exported, 25 PJ are used to fill the stocks and 107 PJ are used for non-energetical fields[4].

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[4] Austrian Energy Agency: Basic Data Bioenergy (2012) –

http://www.enercee.net/detail/artikel/new-folder-basic-data-bioenergy-austria-2012-available.html?pager%5Bpage%5D=13&cHash=3a489fe5844d12675d571b393a96fbdd, 13/03/2013

Final Energy Consumption 2009

Unit: PJ	Coal	Oil	Gas	Renewable Energy	Electricity*	District heat	Sum
Space heating, air conditioning, hot water	3.4	65.9	67.9	81.0	30.9	56.0	**305.1**
Steam generation	3.1	2.6	45.5	37.7	0.4	0.2	**89.6**
Process heat	15.3	12.0	53.6	25.0	46.9	7.4	**160.2**
Stationary engines	0.0	16.5	0.4	0.7	87.0	0.0	**104.5**
Mobility	0.0	325.5	7.9	21.4	11.9	0.0	**366.7**
Lighting, IT	0.0	0.0	0.0	0.0	31.0	0.0	**31.0**
Electrochemical purposes	0.0	0.0	0.0	0.0	0.3	0.0	**0.3**
Sum	**21.9**	**422.5**	**175.2**	**165.8**	**208.4**	**63.5**	**1,057.3**

Illustration 11: Final Energy Consumption 2009; Source: Statistics Austria

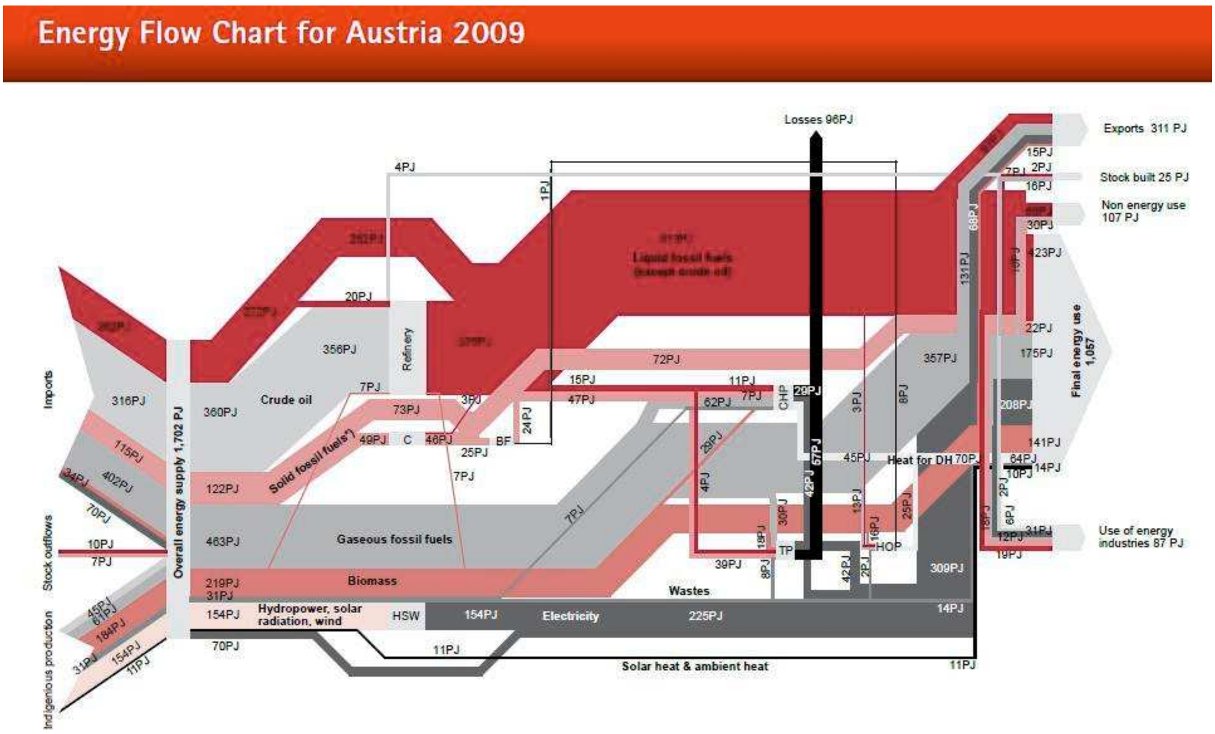

Illustration 12: Energy Flow Chart for Austria 2009; Source: Statistics Austria

4.5. Renewable Energy

The first section of this chapter deals with the historical development of different energy sources applied. Since 1970, the gross domestic energy consumption in Austria nearly doubled from 797 PJ to 1354 PJ. Considering, that the peak was reached before the economic crisis in 2005 with 1456 PJ. Improvements regarding energy efficiency were compensated by the rising energy demand. Focussing on the development of applied renewable energy sources, it can be seen, that the total amount has roughly tripled in the same period from 124 PJ to 397 PJ. The dominating role of the field of bioenergy is also obvious. The following illustration summarises the above-mentioned figures (BMLFUW).[3]

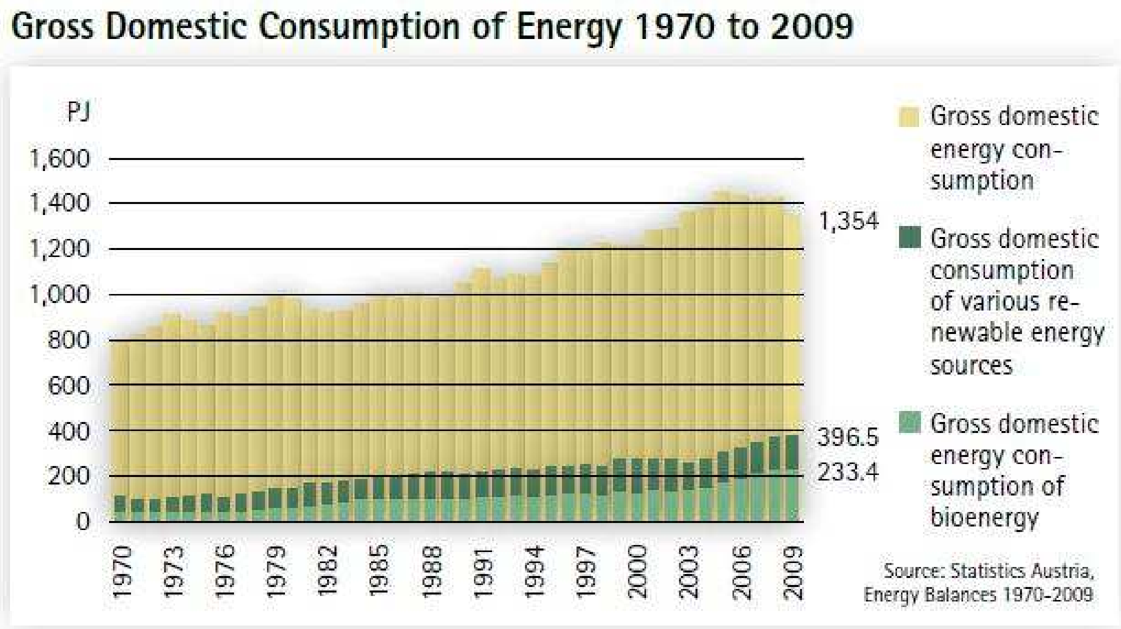

Illustration 13: Gross Domestic Consumption of Energy 1979 to 2009; Source: Statistics Austria

Focussing on the above-shown gross domestic energy consumption it can be seen, that the amount of used renewable energy came to 396,5 PJ (29,3%). In the following section of this paper, we want to consider the used renewable energy systems attentively.

[3] Lebensministerium: Erneuerbare Energie in Zahlen (2010) - http://www.lebensministerium.at/dms/lmat/umwelt/energie-erneuerbar/ERneuerbare_Zahlen/Erneuerbare-Energie-in-Zahlen-2010_web0/Erneuerbare%20Energie%20in%20Zahlen%202010_web.pdf, 03/03/13

The next graph shows detailed renewable energy sources to be used in Austria. Really prominent is the huge amount of bioenergy, which amounts to 58,9% of the whole 396,5 PJ and therefore is bigger than all the other renewable energy sources together. The sector of bioenergy is dominated by energy from wood chips, sawmill by-products, bark, logwood, combustible waste, black liquor from paper industry as well as bioethanol, biodiesel and vegetable oils. Bioenergy is followed by the usage of hydropower, amounting to 36.6%. As the usage of hydropower strongly depends on natural conditions, this amount fluctuates from year to year. Even though a run regarding to the new implementation of windparks has risen in the period before 2009, the total amount of installed wind power comes to only 7.1 PJ. Comparing to the major players of renewable energy in Austria, geothermal energy, heat pumps, solar thermal energy and photovoltaics play a subordinate role temporarily[4].

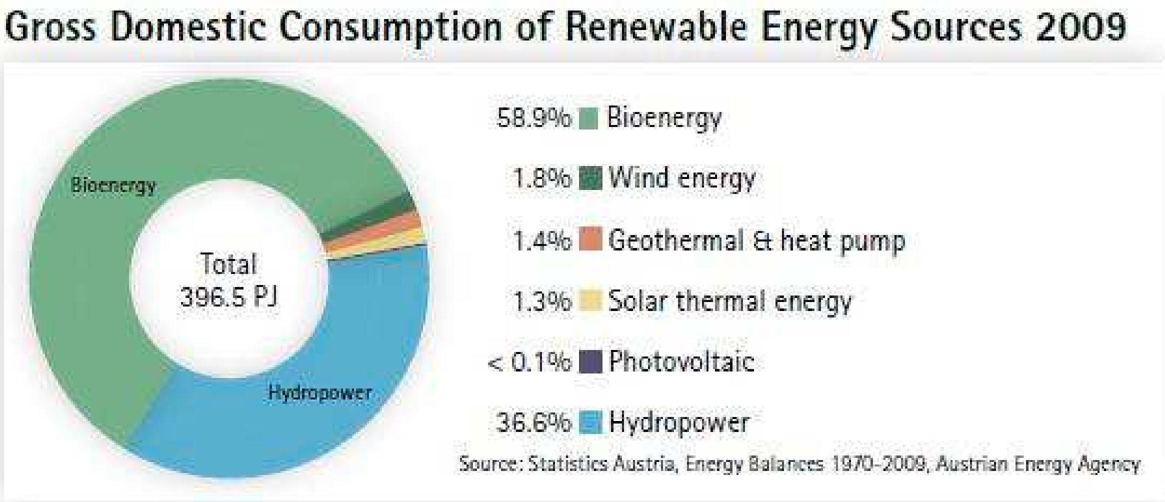

Illustration 14: Gross Domestic Consumption of Renewable Energy Sources 2009; Source: Statistics Austria

We can see the annual changes from 2009 to 2010 regarding to used renewable energy sources in the next illustration. According to that, the amount of installed photovoltaic plants increased from 49 GWh to 89 GWh (81,6%), followed by solar heating (+ 33,2%) and district heating (+ 18,4%). Due to alterations in the law concerning eco-power, the number of installed new wind parks nearly stagnated. We can also see, that the total amount of used renewable final energy rose by 5.4% within a period of one year[3].

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[4] Austrian Energy Agency: Basic Data Bioenergy (2012) –

http://www.enercee.net/detail/artikel/new-folder-basic-data-bioenergy-austria-2012-available.html?pager%5Bpage%5D=13&cHash=3a489fe5844d12675d571b393a96fbdd, 13/03/2013

[3] Lebensministerium: Erneuerbare Energie in Zahlen (2010) - http://www.lebensministerium.at/dms/lmat/umwelt/energie-erneuerbar/ERneuerbare_Zahlen/Erneuerbare-Energie-in-Zahlen-2010_web0/Erneuerbare%20Energie%20in%20Zahlen%202010_web.pdf, 03/03/13

Renewable Final Energy 2009 - 2010

in GWh

	Electricity		Heat		Fuels		Total		Change
SPARTE	2009	2010	2009	2010	2009	2010	2009	2010	2009 → 2010
Biogas	611	649	192	189	—	—	803	838	+4,3%
Biofuels	40	30	—	—	6.222	6.064	6.262	6.094	-2,7%
District Heating	—	—	7.138	8.451	—	—	7.138	8.451	+18,4%
Geothermics	1,5	1,4	78	89	—	—	79	90	+13,8%
Wood Fuels	2.599	2.674	27.744	29.511	—	—	30.343	32.185	+6,1%
Black Liquor	1.121	1.201	4.866	5.810	—	—	5.986	7.011	+17,1%
Photovoltaics	49	89	—	—	—	—	49	89	+81,6%
Solar Heating	—	—	1.429	1.904	—	—	1.429	1.904	+33,2%
Process Heating	—	—	1.335	1.381	—	—	1.335	1.381	+3,4%
Water Power	38.757	39.237	—	—	—	—	38.757	39.237	+1,2%
Wind Power	2.024	2.035	—	—	—	—	2.024	2.035	+0,5%
Totals	45.201	45.916	42.782	47.335	6.222	6.064	94.205	99.315	+5,4%

Source: Statistics Austria

Illustration 15: Renewable Final Energy 2009 – 2010; Source: Statistics Austria

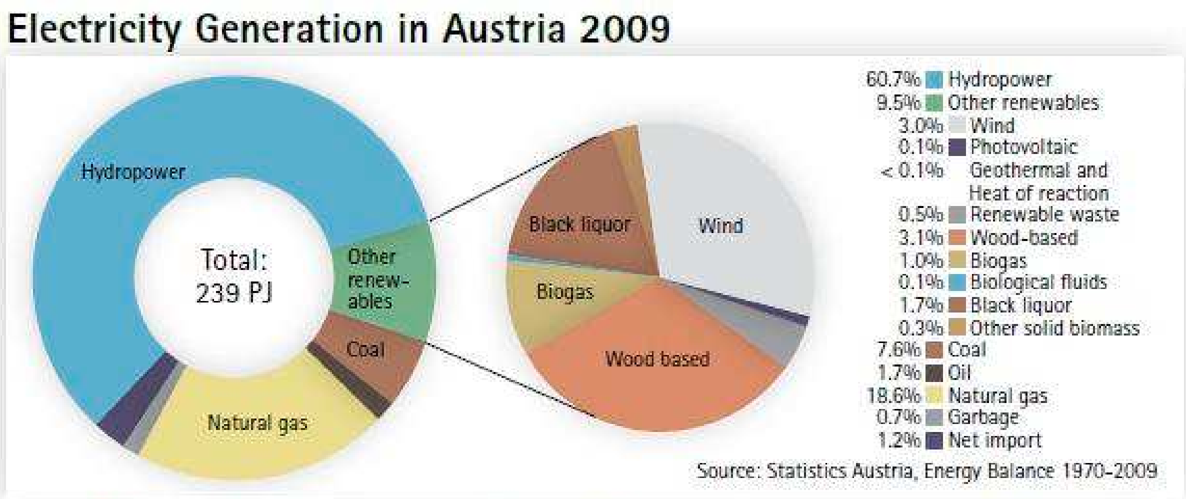

Illustration 16: Electricity Generation in Austria 2009; Source: Statistics austria

Considering the situation of electricity production, things look even better in Austria. More than 70% of the total electricity generation in Austria are covered by renewable energy sources. This is primarily due to the Danube flowing trough the Austrian state territory. The rest is mainly provided by natural gas and coal. Considering the right pie chart above-depicted, we can see, that the other renewables in electricity generation are dominated by

[4] Austrian Energy Agency: Basic Data Bioenergy (2012) –

http://www.enercee.net/detail/artikel/new-folder-basic-data-bioenergy-austria-2012-available.html?pager%5Bpage%5D=13&cHash=3a489fe5844d12675d571b393a96fbdd, 13/03/2013

wood, wind and black liquor. It can be also seen, that photovoltaics and geothermal energy play a minor role so far[4].

5. Centralisation vs. Decentralisation

Since Industrialisation the dominating energy systems are characterized by strong central aspects. As the distribution of fossil resources differs on the one hand, production and mining is/was confined to only a few regions in the world. On the other hand, consumption of energy is not limited to some hotspots, it is regionwide. Hand in hand to the centralisation of energy production there is a concentration of property structures in the meaning of the oligopoly emergence and its negative impacts. Within a central energy system, most of the sales revenues go to the production countries, which mean a huge loss in purchasing power. As many countries are dependent on deliveries of fossil energy carriers the energy importing countries are forced to earn money trough selling goods and products to be able to buy fossil energy carriers in the next period. So the constraint to import fossil energy carriers leads to a constraint to export goods and services. Renewable energy systems are more or less able to end up this situation. If the required energy is produced and used domestically, there is no constraint to export and so there is no transfer of purchasing power abroad. Aditionally, due to the strong dependent relation between fossil energy producing countries and their customers, these countries have a lot of power. This dependence can be avoided trough producing energy in his own country. Additionally new jobs can be generated domestically and grid losses can be reduced.

However it has to be mentioned, that renewable energy systems do not necessarily mean decentralisation, as huge wind farms or photovoltaic farms with its negative impacts show[5].

For the next section of the paper, decentralised power generation equipments are defined as equipments connected to medium or low voltage distribution grids and therefore are installed near to consumers and equipments for self supply. Decentralised power generation does not automatically mean, that the power generation is made in a renewable way.

5.1. Three Dimensions of Decentralisation

Regarding to requested changes in energy systems, the term decentralisation is often used by politicians. But what does it mean exactly? First of all it has to be said, that to differentiate between the terms centralisation and decentralisation is not so easy[6].

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[5] Energieregionen - http://www.regionalentwicklung.de/regionales-wirtschaften/technologien-rohstoffe/energieregionen-dezentrale-energieerzeugung-trifft-regionale-wertschoepfung/, 25/04/2013

[6] Division of Resource Economics: Dezentrale erneuerbare Energiewirtschaft - http://www.sid-berlin.de/files/2008_Ehlers.pdf, 26/04/2013

The existing fossil energy systems can be seen as more or less centralised systems, dominated by a few major players, who keep things firmly in hand. In order to understand the concept of decentralised systems, we have to distinguish three dimensions of decentralisation: the technical, the economical and the political dimension, which are more or less connected.

The technical dimension focuses on the “generation” of energy in many more or less small power generation equipments. The places are spatially divided and the generation and consumption happens on the same place.

The economical dimension considers the distribution of costs and benefits within a national economy and deals with the question, if centralised or decentralised solutions are more favourable. In this reflection, both approaches have advantages and disadvantages. Whereas centralised systems have positive returns to scale but information asymmetries, decentralised systems allow for a better consideration of local and regional conditions. But also the problem of unequal distributions exists.

The political dimension of decentralisation means a network of horizontal relations with splitted power. The problem in this context is, that modern states and companies are more or less built in a hierarchical way. The political advantages of decentralisation are sharing of power and the government is closer on the society, so there is a better relationship between them. The disadvantages are, that local elites have different interests, political populism and a vague control of the economy.

So therefore with clear rules, decentralisation can help to improve the existing system of energy supply and demand. The technical, economical and political site can not be separated easily from each other. For a working system with decentralised approaches, it is necessary to define clear positions and targets[6].

So to reduce dependence from fossil energy and therefore from the countries with occurence of fossil energy, to easy integrate renewable energy forms, to reduce power transmission ways and therefore lower losses, decentralised systems with energy management are necessary. But nevertheless, without centralised systems, a functioning energy system will not be possible[7].

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[6] Division of Resource Economics: Dezentrale erneuerbare Energiewirtschaft - http://www.sid-berlin.de/files/2008_Ehlers.pdf, 26/04/2013

[7] G. Brauner (2009): Energiesysteme der Zukunft - von zentralen zu dezentralen Strukturen? - http://eeg.tuwien.ac.at/eeg.tuwien.ac.at_pages/events/iewt/iewt2009/papers/P2_1_BRAUNER_G_V.pdf, 27/04/2013

5.2. Decentralisation in Austria

All together, in Austria a comparatively small amount of about 16 % of the total amount of electricity production is generated trough decentralised power generation equipments (DPGE). This means 11 TWh/a coming from small hydro power, biomass, photovoltaics, biogas, landfill gas, sewage gas and fossile thermal power plants. So more then 75 % of the whole amount of DPGE is produced in a renewable way. The following graph shows the above-mentioned figures and also demonstrates, that the installation of new DPGE stagnated from 2005 to 2009 due to bad subsidy conditions. Further trends are strongly dependent on subsidies policy, regarding to a amendment of the Austrian “Ökostromgesetz”, it can be expected, that figures will rise again. Promising applications for the future can be cogeneration units and photovoltaics. To allow stability of the energy grid and therefore security of supply, big challenges have to be managed in future, if the trend goes on. In this sense so called “virtual power stations” can be adequate solutions. Due to the geographic conditions of the surface of Austria’s national territory, the most important decentralised power generation equipment is small hydropower with 5.5 TWh/a[8].

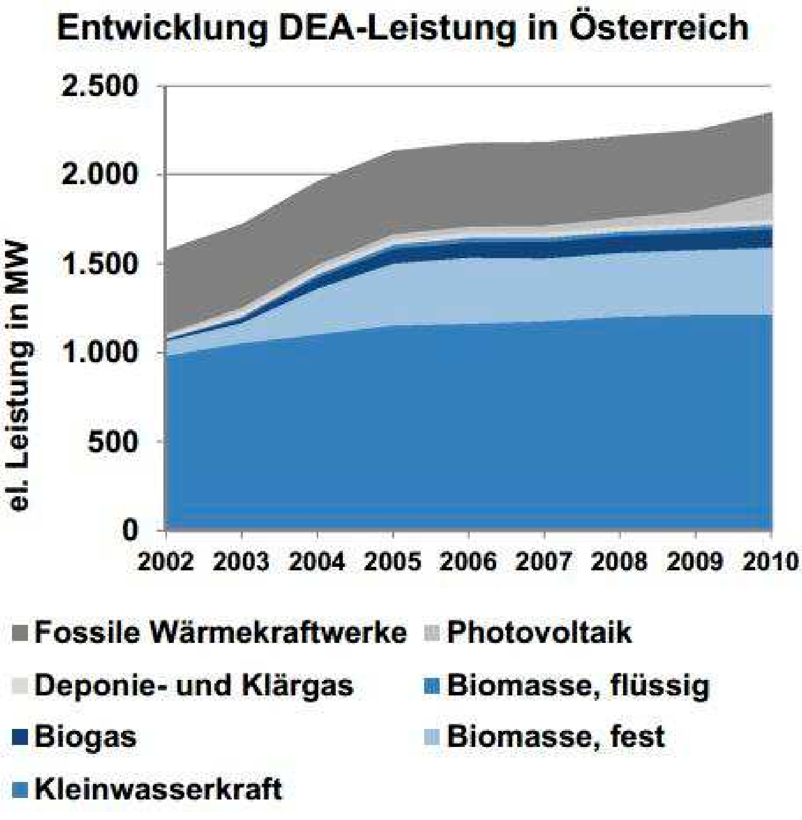

Illustration 17: Decentral Engery Generation in Austria; Source: E-Control

[8] E-Control: Dezentrale Energieerzeugung in Österreich - http://www.e-control.at/de/publikationen/publikationen-strom/studien/dezentrale-erzeugung, 28/04/2013

5.3. Decentralisation in Czech Republic

Production of electricity in Czech Republic is dependent on supplies of coal, gas, oil and uranium. Before the liberalization the industry was controlled by monopoly, now it is market-driven. This raises uncertainty, which hindered all investments in energy, because construction of large sources is economically insecure.

In the context of increasing power consumption and declining reserves of non-renewable energy orientation for new resources is necessary. Concept of system power is limited by the amount of non-renewable resources.

Solution to this situation could be the development of decentralised energy production. For the Czech conditions, we must first distinguish decentralized production of high power and low power. Decentralized sources of high-power would still require cover other sources. This would require the acquisition of additional resources. Therefore, this idea is inefficient.

Contrast to this the use of small resources either for the city or for individual houses has many advantages. Investment costs are not as high as for major sources and it brings energy self-sufficiency. So why decentralized production is not more widespread?

As mentioned in the previous text, Czech energy system is very intertwined, complex and dense. Possibilities of decentralised development are very limited. Dense grid and resources of high performance predetermine the system to be a single and unified.

But there are possibilities of using decentralised production. Now the trend in the Czech is about power solar panels, heat pumps to supply electricity and heat for households. This is due to the ever increasing price of electricity. Massive development is still hampered by the cost of purchase.

Decentralization of energy production will also undoubtedly help the development of electromobility in the country, but it is inevitably associated with large investments in storage facilities. Decentralized production does help with off-peak needs energy, which electromobility raises.

6. RESULTS, CONCLUSION

In this work we describe the systems in both countries and present the possibility of decentralized production, depending on the structure of the system. We found these findings.

Definition of decentralized production is very problematic and it is not easy to define. We can define it on different levels. Also it must be said that this is not just about renewable sources. This production can also be reached by fossil and renewable forms, but for sustainable development is meant mostly RES.

The use of decentralized generation has many positives. Decentralised systems are helpful to avoid energy dependence, to reach supply security and to change the system to renewable forms. It also challenges for energy management due to fluctuations.

At this time, in Austria little percentage is decentralised (16%), but compared to Czech Republic (10%) is the use higher. In the Czech Republic is due to the structure of the energy system and the orientation of the major sources. In Austria most of decentralised production is RES (small hydropower, biomass, PV, biogas,...).

Regarding the development of decentralization faces a number of problems. Development depends on subsidies policy. It is confronted with the question of ensuring the missing power or energy storage. There´s also economic issue, either investment cost or indirect costs induced by this. Also one must realize that decentralization brings certain limitations.

We cannot plan for decentralization in isolation. Sustainability of the different forms of energy systems has to be proven. For example it is necessary to consider land use for food before we use it for production of energy.

But we are optimistic. There are forms of decentralised energy systems, which are not so heavy connected to geographical conditions (PV, cogeneration units). That means greater usability especially for households or apartment buildings.

SOURCES

Literature

Wikipedia: History of the Czech lands -
http://en.wikipedia.org/wiki/History_of_the_Czech_lands

ČEZ - http://www.ČEZ.cz/cs/vyzkum-a-vzdelavani/pro-zajemce-o-informace/historie-a-soucasnost/historie-ceskeho-elektrarenstvi.html (20.3.2013)

Austrian Energy Agency: Basic Data Bioenergy (2012) –

http://www.enercee.net/detail/artikel/new-folder-basic-data-bioenergy-austria-2012-available.html?pager%5Bpage%5D=13&cHash=3a489fe5844d12675d571b393a96fbdd, 13/03/2013

Lebensministerium: Erneuerbare Energie in Zahlen (2010) - http://www.lebensministerium.at/dms/lmat/umwelt/energie-erneuerbar/ERneuerbare_Zahlen/Erneuerbare-Energie-in-Zahlen-2010_web0/Erneuerbare%20Energie%20in%20Zahlen%202010_web.pdf, 03/03/13

Geography of Austria - http://geography.about.com/library/cia/blcaustria.htm, 21/04/2013

F. Krausmann: Eine sozialökologische Geschichte der Industrialisierung - http://www.univie.ac.at/igl.geschichte/umweltgeschichte/ws2003/krausmann_materialien.pdf, 22/04/2013

Energieregionen - http://www.regionalentwicklung.de/regionales-wirtschaften/technologien-rohstoffe/energieregionen-dezentrale-energieerzeugung-trifft-regionale-wertschoepfung/, 25/04/2013

Division of Resource Economics: Dezentrale erneuerbare Energiewirtschaft - http://www.sid-berlin.de/files/2008_Ehlers.pdf, 26/04/2013

E-Control: Dezentrale Energieerzeugung in Österreich - http://www.e-control.at/de/publikationen/publikationen-strom/studien/dezentrale-erzeugung, 28/04/2013

Alternative sources - http://www.alternativni-zdroje.cz/jaderne-elektrarny.htm 28/04/2013

Decentralised generation - http://www.zelenykruh.cz/dokumenty/decentralizovana-vyroba-a-site-cityplan.pdf 28/04/2013

Energy regulatory office - www.eru.cz 28/04/2013

Illustrations