

Comparison in biomass production between Austria and the Czech Republic

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Core objective

European Union set an ambitious 55% target of its energy consumption from renewable resources 55% by 2050 according to Green Deal. The aim of this paper is to assess the contribution of solid biomass to renewables use in the Czech Republic and Austria. The article focuses on the determination of biomass potential on agricultural and forest land for energy purposes and it discusses the potential of biomass in the future in these countries. According to current analyses, which were provided, and articles about biomass it is possible to estimate for the Czech Republic and Austria that the potential of biomass from forest stands will have to be increased. The result of this paper supposed to be the comparison of two European countries like Austria and the Czech Republic with their inputs, current situation of the country with information about agricultural productivity and the amount of land available for energy crop production, and outputs, predictions of biomass development.

Abstract

Besides wind and photovoltaic energy, biomass represents one of Europe's most important and versatile renewable energy source, due to its possible applications in a solid, fluid or gaseous form.¹ However, because of the complexity and range of biomass production and applications, different countries have different policies and potentials of using it, due to their different preconditions regarding policies and topographies.

In order to analyse the summarized situation for Europe, this paper describes the situation of Austria and the Czech Republic, compares them where it is useful and also tries to find reasons for maybe different situations. Precisely, the circumstances around forestry, agriculture and in further consequence energy crops, are screened and compared.

Both countries already have a relatively high share of biomass in their energy profile but most interesting is the potential that is left. In Austria agricultural land is very restrained and as a result there is a high competition between food and feed supply and energy crops. On the other hand, there is quiet much potential for wooden biomass left, especially on the land which is owned by small farmers. In the Czech Republic the forests are mainly owned by the state and the agricultural situation isn't that crucial, therefore energy crops are where the most potentials lie.

Methodology

The methodology is based on a literature search where various scientific articles, static reports and models for the future development of biomass utilization are examined. For these purposes are used different journals and books via Elsevier journals that offer the latest peer-reviewed research papers on diverse topics for example on climate change, biodiversity, renewable energy and biomass. In order to evaluate the biomass potential in countries that were chosen for this paper is used statistical reports and tables as the aim to compare biomass uses and production. The conclusion identifies progress of countries in solid biomass development, where solid biomass consists of woody biomass, agricultural biomass and renewable waste fractions.

Introduction

In March 2020, the European Commission presented the European Green Deal and the Climate Act which is the goal to achieve climate neutrality in Europe and to move all Europe towards in all sectors including first of all energy consumption and reducing greenhouse gas

¹ [Bioenergie und Biomasse in Europa - Seemla](#)

emission. This goal has to put in practice to make the European economy climate neutral by 2050 using resources efficiently. It can be achieved by using also renewable energy source as forest biomass for energy production. In October 2022, the European Parliament claimed reducing emissions by 50-55% by 2030 compared to 1990. All sectors including forestry can help to achieve climate neutrality. Also, the REPowerEU plan to move away from energy dependence on Russia has been published recently and focuses on the enhanced use and production of green gases.²

Currently about 17% of Austria's energy demand is covered up with biomass, which mainly means wood in this context. This is equal to about 45% of Austria's total renewable energy sources and sums up to about 290 PJ.³

In Czech Republic, around 2,5 TWh of electrical energy is from biomass and it is the second most important renewable resource, after hydropower plants.

In 2017 the share of biomass in all forms (solid biomass - residuals from conventional crop, energy crop, wood and cellulosic residuals from the wood processing industry, liquid biofuels, biogas, biodegradable waste) was about 12,7% of the total percentage of RES.⁴

These numbers make both countries already leaders in the European Union when it comes to the share of biomass in the energy mix. However, regarding the climate goals of the Union and the countries themselves, it is crucial to use every economical potential there is of renewable energy.

So this paper tries to answer the question how much potential of bioenergy is left in both countries and furthermore what the EU can expect from this energy source in order to reduce its emissions.

To achieve this, the status quo about the situation of forestry and agriculture in the countries is monitored. Considered in particular is the current land use, utilizations for energy purposes and the harvested goods of forestry and agriculture. In further consequence analyses of other studies about the economical potential of bioenergy are reflected and reasons are searched, why the potentials are as high as they are.

² Potential of Forest Biomass Resources for Renewable Energy Production in the Czech Republic (2022)

³ Österreichischer Biomasseverband (2022)

⁴ Dynamic biomass potential from agricultural land (2020)

Forestry in Austria and the Czech Republic

Numbers about forestry stock

With about 40.000 km² Austria's forest area occupies around 48% of its total area, whereas this portion has grown continuously over the last 50 years or rather stood steady. This makes Austria to the country with the second highest area percentage covered up with forest, right behind Slovenia and compared to other European countries 82% of it is owned by private owners. About two thirds of these, so the biggest portion of the total forest area, are small farm forest.

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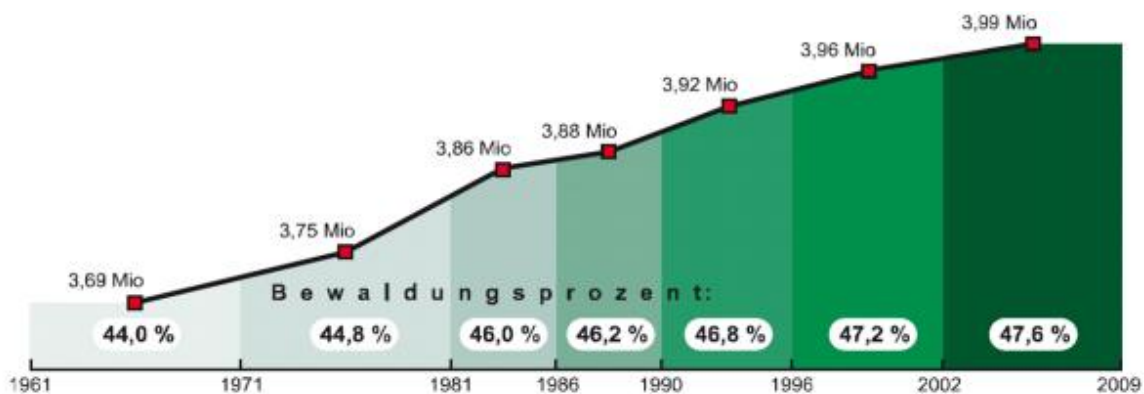


Figure 1 - Portion of forest area in Austria

In 2010, the Czech Republic had 32.200 km² of natural forest, extending over 41% of its land area. In 2021, it lost 56.3kha of natural forest. The highest value over the past 30 years was around 34.68% in 2020 and the lowest value was 34.02% of total forest area in 1990. Currently the total agricultural area has 4.2 Mha, extending since 2010.

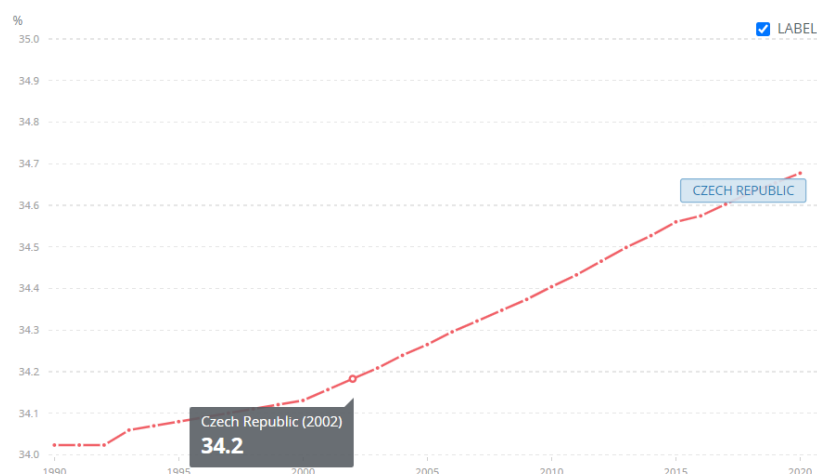


Figure 2 - Portion of forest area in the Czech Republic

With around one third of covered forest area, the Czech Republic remains the 20th country with highest forest coverage in Europe. The stock per hectare amounts to 268.64 m³.

Figure 3 - Forestry facts Czech Republic

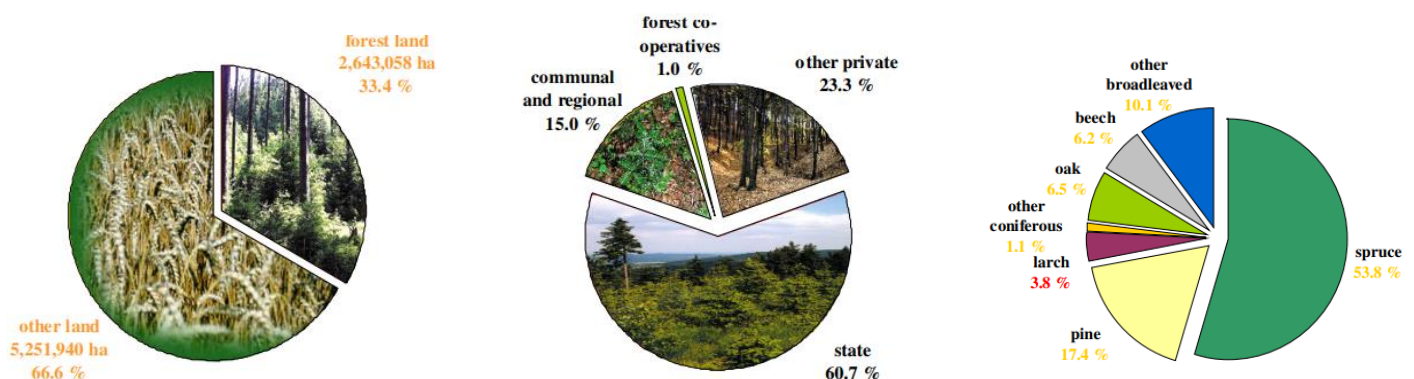
⁵ Gmeiner (2014)

Despite large areas which are caused by bark beetles calamities, the production in the industry increased in comparison with the previous years. The Czech Republic ranked 6th place in Europe with annual increment.⁶

Species composition and bark beetle calamity

The timber stock without bark exceeded 700m m3 in 2020 with the annual increment amount to 18m m3 per year. Around 70.4% of coniferous species take up, where is 48.8% of Norway spruce and broad-leaved species cover 28.2%. The Czech Republic has been trying to achieve correct species composition against insects and natural disasters. The total harvest amounted to 35,753m m3 with the annual increase by 3,168k m3. The harvest of coniferous and broad-leaved timber amounted to 34.486m m3 and 1.267m m3 respectively. Most of the harvested timber originated from salvage felling (33.912m m3), thereof spruce 90.3%, pine 4.2%, beech 1.6% and larch 1.5%. Coniferous timber amounted to 96.5% of the total harvest. In 2020 was a favourable and wetter year that for bark beetles slowed down their swarming and development and they influenced the speed of their development. After 2019, there were many bark beetles left able to attack new forest stands. But the comparison of timber harvested due to bark beetles in 2019 and 2020 show the same records due to fast logging of trees affected by bark beetles.⁷

In the Czech Republic, the share of all form of biomass (also biomass from agricultural production) is almost 90% of the total share of RES. Bioenergy as a renewable source of energy production has potential to reduce greenhouse gas emissions. In the Czech Republic the forestry sector represents approximately 0.77 million tons (2 million m3) of wood chips from primary forest residues, 1.5 million tons of cellulose extracts, and less than 5 million tons (7.5 million m3) of primarily produced fuelwood. In recent decades, occurrences of bark



beetles have caused a significant decline in commercial forests in Austria and the Czech Republic. As a result of the bark beetle calamity, the amount of the forest biomass for energy purposes in the Czech Republic is decreasing. As a prediction the availability of forest caused the bark beetle calamity is difficult.

Based on data the total available amount of biomass for energy production up to 2036 estimated at 7.65 million tons per year from primary production and 13.47 million tons from the total production. Its clear that the Czech Republic will not be able to achieve the new goal from forest biomass. According to different authors the case of biomass from forests, trunks, and forest residues, it is not possible to expect a sharp increase by 2030 (also caused by the bark beetle calamity problem and the large-scale deforestation).

⁶ Gmeiner, Philipp. "Wald in Österreich— eine statistische Bestandsaufnahme unter besonderer Berücksichtigung des bäuerlichen Kleinwaldes."

⁷ Lesnictví v ČR (2019), MARKET STATEMENT OF THE CZECH REPUBLIC (2021)

In comparison with different decades in 2013 the share of renewable energy sources in the total energy consumption was 13.93%. Between 2014 and 2017 this amount was around 16.24% representing a total increase of 2.31% with a stable share of forest biomass in the fuel mix. A more significant increase has been occurred since 2018 due the surplus of firewood and logging waste from primary production. This decline of forest stands is expected in 2022 caused by development of the bark beetle calamity and a temporary reduction in standing volume. As the result of the studies the total annual available volume of biomass for energy purposes is extending to 13.47 million tons until 2036. Until 2018 the annual amount was averaged 13.88 million tons. But is expected that the share of RES in the total energy consumption will increase of 5.76% annually, but currently the share of forest biomass from primary production in the fuel mix is at maximum limit.

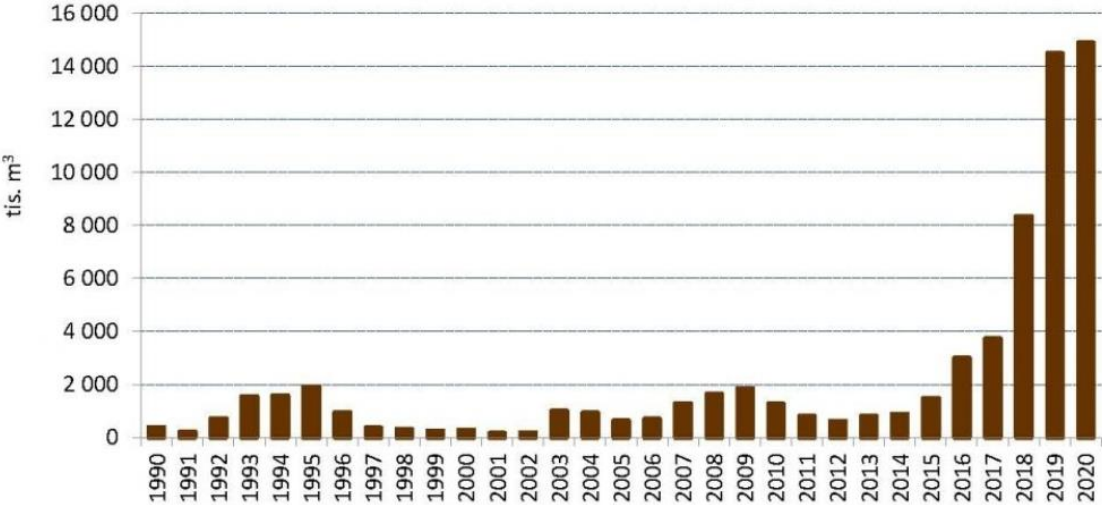


Figure 3 - Bark beetle damages in the Czech Republic

In Austria the bark beetles calamity also has raged. Over the past few years the resulting damages from it has been higher than the ones from storms and snow and for the next years there is no all-clear in sight.⁸

⁸ [Waldschutz-Situation 2020: Schäden durch Borkenkäfer weiter überdurchschnittlich hoch - BFW](#)

Schadholzmengen durch Sturm, Schnee und Borkenkäferbefall

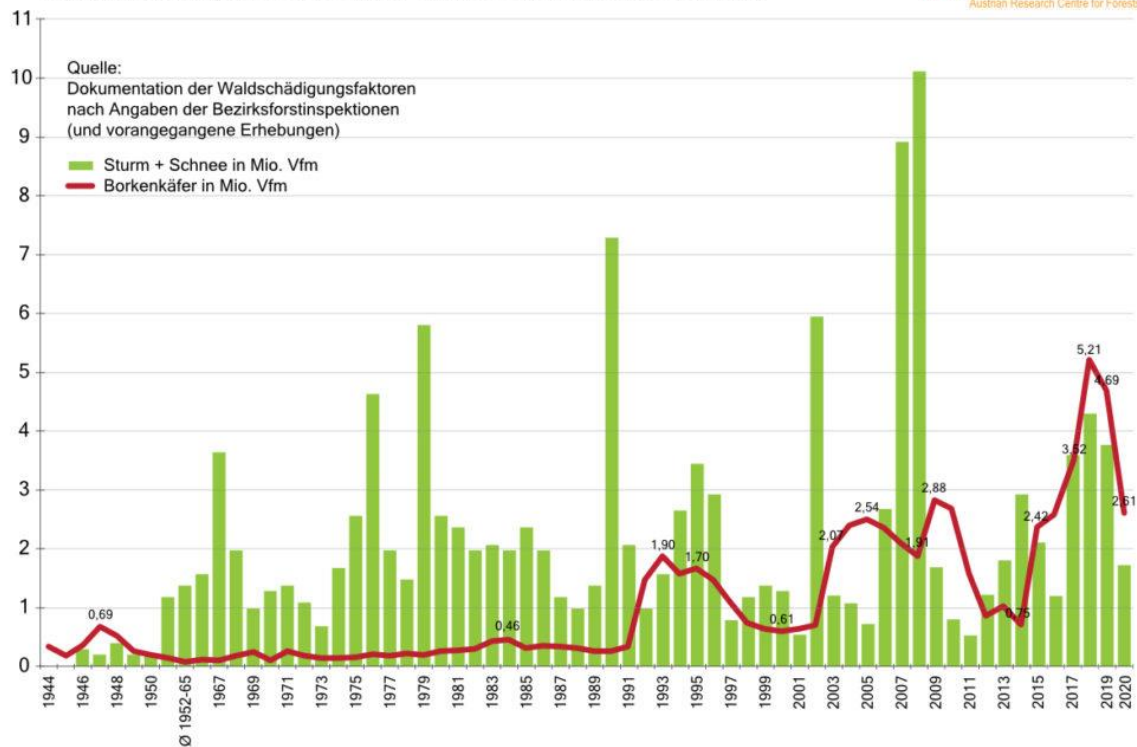


Figure 4 - Bark beetle damages in Austria

Distribution of forest land and growth potential

In Austria, whereas public and industrial owners mainly exhaust the potential of their lands, many of the small holders aren't that much interested in growing their woods due to economic reasons or because they prefer using the land for agricultural uses. As a result, the support of wood growth in Austria is quiet challenging and when it comes to intensify the usage of wood for energy supply the private owners must be motivated to exhaust their lands because that's where the most potential is left.⁹ This is shown in figure 8.

⁹ Forest Land Ownership Change in Czech Republic, Lesnatost na území ČR

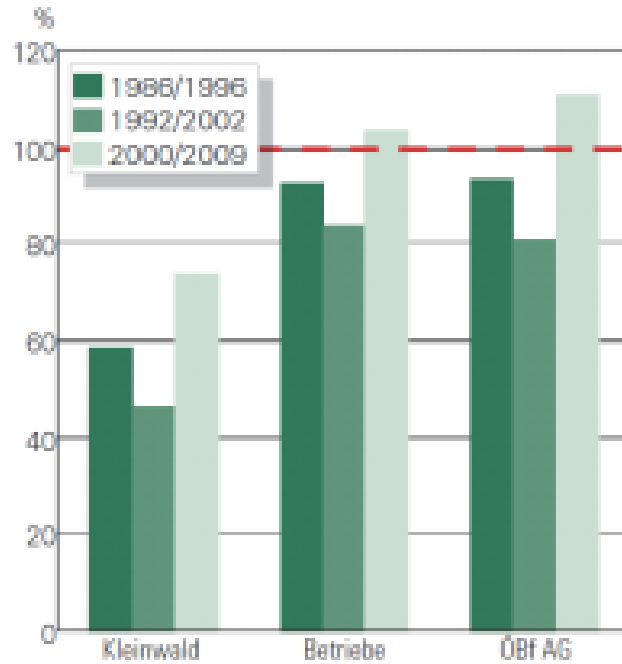


Figure 8 - Used forest area in different types of ownership in Austria

In the Czech Republic the Karlovy Vary and Liberec regions have the highest forest cover, while Prague and the South Moravian region have the lowest. Over the last ten years, 25800 hectares of forest have been added. The increase in forest area is around 0.3%.

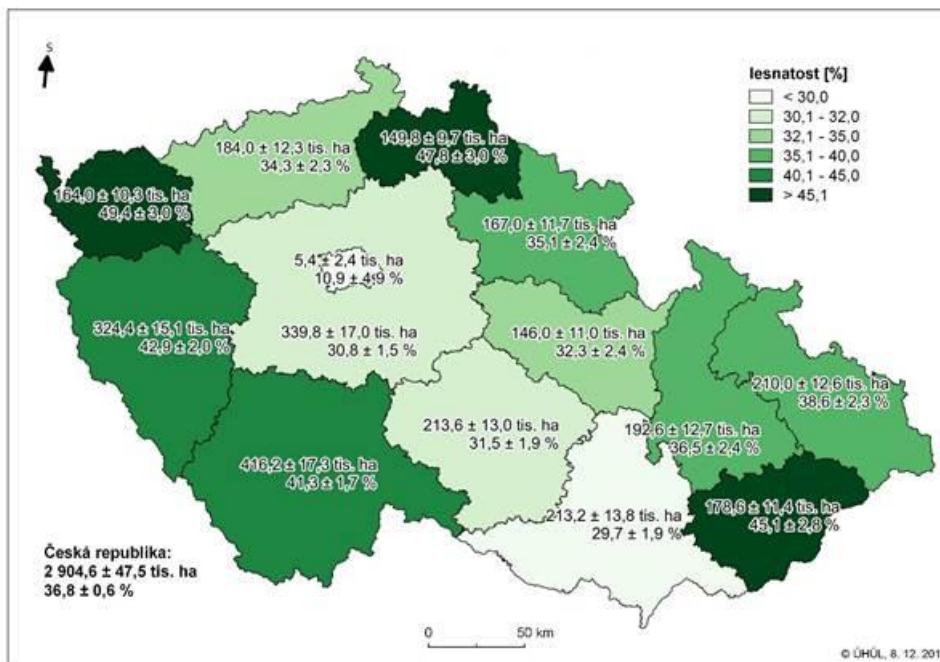


Figure 5 - Forest area in the Czech Republic

Also, in the Czech Republic it's important to motivate private owners, so the state provides services free of charge to help forest owners improve the standards of forest management and ensure forest protection against damaging agents. Within its consulting services, the state mainly supplies forest owners with up-to-date information concerning preventive protection of their forests and potential protective measures against damaging agents. Currently private owners are not enough motivated due a lack of awareness among owners

and managers of the ecological and economic aspects of biomass use. But the country is trying to support industry and using biomass with different projects. Forests in the Czech Republic are intensively managed and exploited and felling residues represent important potential to energetic purpose. Moreover, support on the part of state for development of energetic use of forest biomass is necessary, especially through legal measures and projects.¹⁰

In an European context forests cover over 43.5 2 % of the EU's land space. The European Commission claimed the New EU Forest strategy for 2030 that support owners and invest in the industry.¹¹ However, if you look at the situation in Austria and the Czech Republic, top-down forestry policies are rather hard to implement, due to the many private ownerships of forestry lands.

Agriculture

The described situation about Austria's forestry as well as firm forest laws, which literally prevent the rededication of forest land, have a severe impact on the country's land use potential. Furthermore, the settlement area in Austria is expanding constantly over the last decades, precisely with a daily enlargement of about 11,5 ha per day. This leads to a strong constraint of agricultural land in Austria and its potential is already fully claimed by now.¹²

Figure 9 also shows the limited agricultural areas in Austria due to topographic reasons. Only in non-mountainous regions in the north-east of the country agriculture is meaningful.

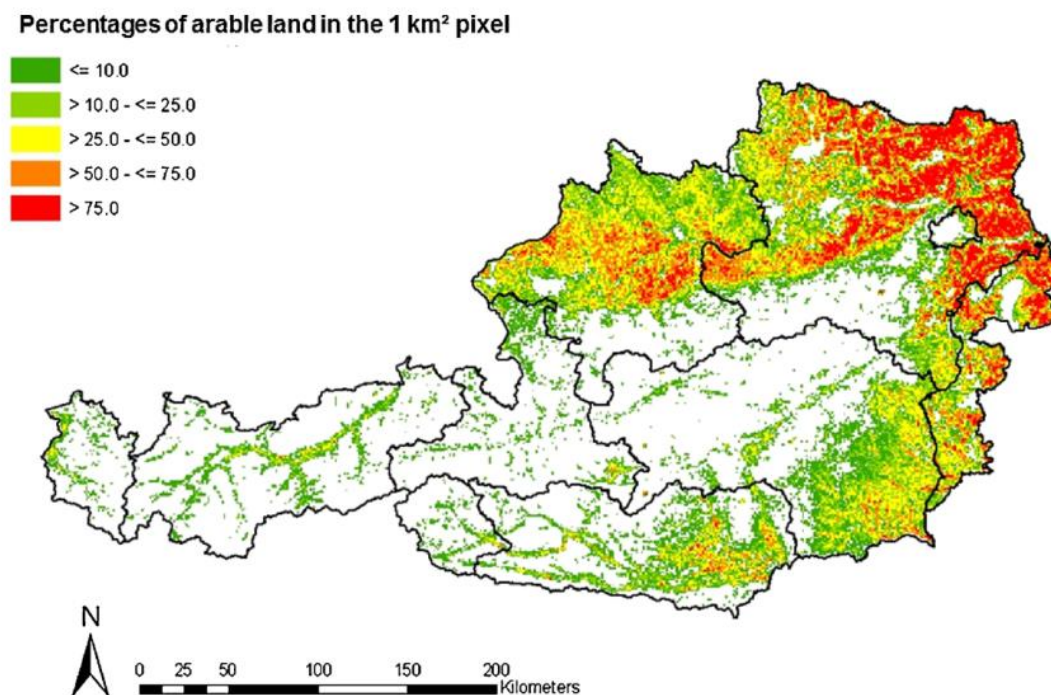


Figure 6 - Arable land in Austria

¹⁰ Biomass as Traditional and Local Source of Energy in the Czech Republic (2007)

¹¹ Potential of Forest Biomass Resources for Renewable Energy Production in the Czech Republic (2021)

¹² Stümer et al. (2012)

The Czech Republic is the country that has relative high area of agricultural land: around 54,2 % of total area and forests 38,5 %. Large area of country has specific restriction due to the environmental protection (8,4 % agricultural land and 16,0 % of total area of Czech Republic), which makes some limitation in intensive farming and forestry and provides chance for energetic crops plantation and wood utilization which is usually less intensive than convention management of farm and forest land.

In the Czech Republic, agricultural entrepreneurs currently farm around 54 % of the total area of the country. A decisive part of this area (3 mil hectares - 71 %) is arable land on which individual crops are rotated. Permanent cultures consist of grassland (978 thousand hectares), gardens and fruit orchards (209 thousand hectares), vineyards (19 thousand hectares) and hop fields (10 thousand hectares). More 50 hectares of agricultural land occupy 92.2% of the total area of the agricultural land farmed.¹³

¹³ ZPRÁVA O STAVU LESA A LESNÍHO HOSPODÁŘSTVÍ ČESKÉ REPUBLIKY V ROCE 2020

Energy crops

As a result of the restricted land availability, in Austria agricultural biomass for energy purposes can't be obtained by simply using more land area to grow it. Theoretical possible ways would be:

- The substitution of food and feed production
- The mobilization of fallow land
- The change of agricultural land cover (e.g. from grassland to arable land)
- The usage of residues or waste products
- The enhancement of the efficiency of the production by
 - Reducing losses
 - Planting crops with more yield
 - Employing more intensive production methods

In Austria the first-generation biofuels which are produced are mainly biodiesel and bioethanol. The raw material, which must be harvested for biodiesel is rapeseed, from which only 10% are domestically harvested. On the other hand, wheat, corn and sugar beets, of which bioethanol is made of, are for the most part directly harvested in Austria.

The covered land area of rapeseed fields used for biodiesel production sums up to 55,000ha and 80,000ha of wheat, corn and sugar beets.¹⁴

Table 1 illustrates the comparison of the used areas for energy purposes and the total areas.

Crop	Area used for energy purpose[ha]	Total harvest area (2021) [ha]	Portion [%]
Rapeseed	55.000 In Austria 5.500	28.189	19,5
Wheat	80.000	257.002	13,6
Corn		304.075	
Sugar beets		26.320	

Table 1 - Portions of energy crops in Austria

¹⁴ Stürmer et al. (2012)

Potential scenarios

Right now, biofuel production in Austria can only be profitable for the harvesters through policy exposure, i.e., subsidies.

Stürmer et al. have implemented an integrated modelling framework to analyse the biophysical and economic potential of bioenergy crop production, the resulting trade-offs of implementing promotional bioenergy crop policies as well as the potential of cushioning these trade-offs through the utilization of advanced technologies such as second-generation biofuels. The authors of the study presents its results in form of scenarios they implemented into their model.

Figure 2 shows their results for three scenario where a fixed area for arable land is estimated as well as that foreign energy crop cannot be imported. It shows how the number of subsidies influence the theoretical economical land area that could be used for energy crop production, either for first- or second-generation biofuels. It is important to know that this graphic only applies realistically for little subsidies because otherwise the profit-loss of the lost food and feed supplies would interfere more.

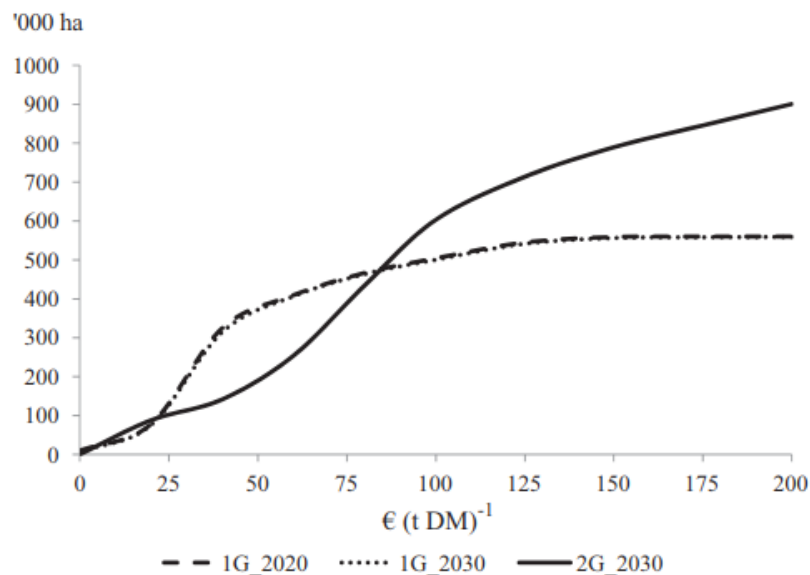


Figure 7 - Scenarios for biofuels in Austria

On the other site the Figure shows the changes in food and feed production at different subsidies levels with the scenarios of 1G,2020 (left) and 2G,2030 (right).

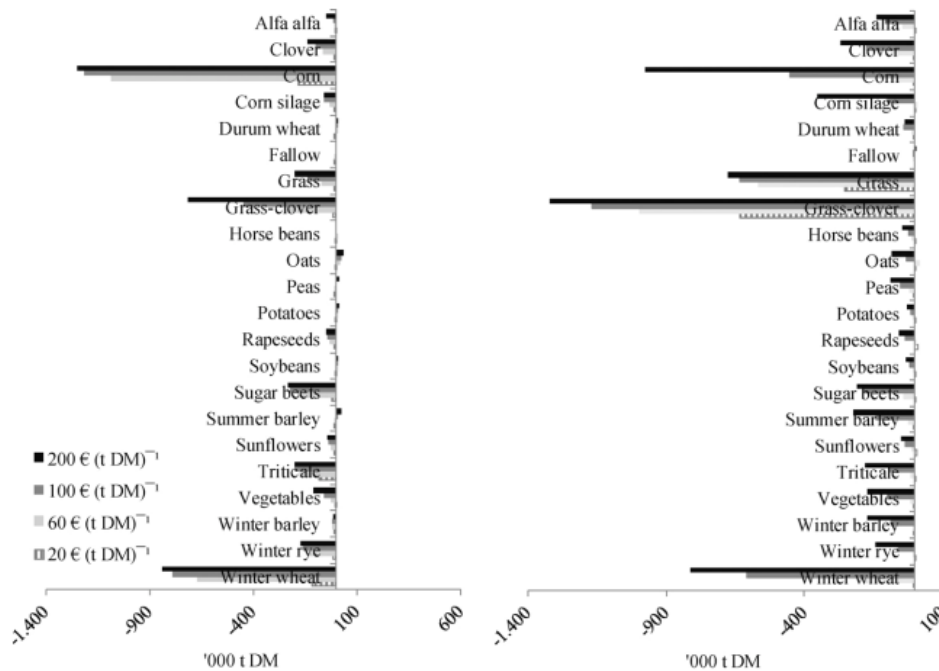


Figure 8 - Losses in food and feed production due to subsidies for energy crops (Austria)

As to be expected higher subsidies result in greater losses of food and feed production. This is related to the mentioned boundary conditions of this scenario. Also noticeable is the different distribution for the second-generation biofuels' scenario, where mainly crops are affected, which aren't that crucial for food supply.¹⁵

In the Czech Republic the slower development of biomass production and utilization is due to reasons such as the development over the past 7 to 10 years, which has been influenced by ambiguous state and departmental policies that have not allowed sufficient development of some forms of biomass. Several conflicts have also emerged, such as the conflict between traditional wood raw material (wood-plank, brick, paper) and energy uses of wood chips. Another conflict arose from the use of food crops (1st generation energy crops) to produce biofuels (bioethanol), which led to rising food prices.

In addition to various deficit land, including reclaimed land, traditional agricultural land can also be used extensively for growing energy crops. The surplus of food on the world market and in the Czech Republic is forcing farmers to put land to rest, which means that there is surplus land for food purposes. The approximate estimate of this surplus land is about 500 to 1 000 000 ha. It is clear that it is not possible to use all the surplus land immediately, but this situation creates good conditions for the gradual introduction of energy crops into the arable land, which would undoubtedly also contribute to the efficient use of this land, which is not needed for food production.

The importance of "biofuel" production therefore is not only to obtain a certain share of renewable energy, but also has other very important aspects, which can be briefly summarised as follows:

- efficient use of surplus land
- the creation of new employment opportunities in the cultivation, harvesting and processing of energy crops into biofuel
- maintenance of the cultural landscape, where fields will be regularly cultivated with purpose-grown plants

¹⁵ Stürmer et al. (2012)

- contribution to the reduction of greenhouse gases due to the use of carbon dioxide from the air by intensive vegetation of energy crops

Due to the reduced demand of production of food and feed it is expected that available land for energy crops can rise. It is also important to use such land to maintain landscape, employment, to contribute to sustainable development and to reach the aim for renewable electricity production.¹⁶

Biomethane in Europe

Due to its current relevance a short introduction to the biomethane policy of the European Union is now introduced. Green gases also play a very important role in the EU plan. In the area of biomethane and hydrogen production in particular, the Union's vision is very ambitious. The European Union is expected to produce 350 TWh of biomethane in 2030, almost 11 times the amount produced in the Member States in 2020. Today, the EU produces 3 bcm of biomethane, and increasing this to 35 bcm requires mobilising sustainable sources of biomass, mainly waste and residues. This would require the construction of around 5 000 new green gas plants across the EU. From a technical point of view, this is both feasible and profitable over the next eight years. The approximately €80 billion that will be needed for capital investment will make it possible to produce biomethane at a much lower cost than the price of natural gas has been over the last few months, even after deducting the price of CO₂ allowances. Biomethane could cover 5-10% of natural gas consumption in the Czech Republic in 2030. New biomethane stations will be built and existing biogas stations will be converted to produce this green gas.

According to the 'European Biomethane Map 2020' will be an increase to 51% of biomethane plants in Europe in two years. The analysis of the data collected shows that the number of biomethane plants in Europe has increased from the 483 plants (2018) to 729 units (2020).¹⁷

Conclusion

In Austria currently the best way to obtain more biomass for energy production is to motivate small forest owners to use their full growth potential of their land. This is because public forestry nearly already reached its full potential and is also in competition with the paper industry.

Austria's agricultural potential is fully occupied due to strictly limited land availability, so the usage of it for additional energy crop production always goes hand in hand with the loss of food and feed supplies. How severe this discrepancy is, depends on the number of subsidies as these make energy crop production profitable.

This competition could be defused through the import of energy crop or in future, through the deployment of advanced technology such as second-generation fuels. This might also be the only way to significantly rise Austria's bioenergy production from the current 290 PJ.¹⁸

Nowadays, the potential of biomass from forests for energy purposes is decreasing in the Czech Republic. Otherwise, biomass from agriculture and especially grown biomass according to the strategic document of the Ministry of Agriculture of the Czech Republic, the area of agricultural land will increase to 20% by 2030. It depends also on many factors, such as soil and climatic conditions. The biomass potential is given by the sum of the waste and residual biomass potential from the wood industry, waste and food residues, from forest harvesting and thinning and targeted crops.

¹⁶ The future role of biomethane (2021)

¹⁷ Biomethane Map 2021

¹⁸ Österreichischer Biomasseverband (2022)

Effects that are caused by climate changes will continue in effecting lands and decreasing of biomass potential. As was mentioned before the evidence of climate changes is significant effects of bark beetle calamity which is around 50-60% of total forest land caused sanitary logging. The result of study about prediction of the biomass potential in the Czech Republic to 2040 is expected increasing the amount of the land for energy crops up to 20% which can lead to increase of biomass potential by 39%. But the maximum potential is limited (around 29.6 PJ) that is according to the Czech State Energy Policy to achieve 60 PJ in solid biomass is not enough.¹⁹

Source of biomass	Technical potential (Pj)	Accessible potential (Pj)
Forest biomass	77,6	44,8
Biomass from agriculture	275	136
Biogas	33	16

Table 2 - Energy potential of biomass

All in all, Austria and the Czech Republic both already have a relatively high share of biomass in their energy mix. With the current technology available Austria still has some potential in its forests left by motivating forest owners to grow wood for energy purposes, whereas the agricultural potential for energy crops is rather used up. In the Czech Republic it's more or less the other way around. The most potential lies in additional biomass from agriculture and the forests aren't that promising, also due to the bark beetle calamity.

The reasons for these differences mainly lie in the land availability which is influenced by the topography, the climate and area zoning policies. Furthermore, subsidies play an important role in order to make different types of bioenergy profitable.

However, with advanced technologies such as second-generation biofuels the bioenergy potential can be risen on a general level because then the competition of energy crops with the food and feed supply can be evaded.

¹⁹ Dynamic biomass potential from agricultural land (2020)

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