Competitiveness between Energy Crop and Food in Biofuel Production Assessment in Austria and Czech Republic Case

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Introduction

- Fossil fuel negative impact on the ecosystem and GHG impact
- Biomass Promising form of energy
- Key policy concern

- Competition between the same resources, such as land, labor, water, and other investments, in this process of shifting from a food economy to a bioeconomy (Babu, S. C et.al 2019 and Arndt, C., et, al 2012)

Crops usage in Bioenergy

-For wheat, Maize, sugar beet, and vegetable oil around 4.05%,7.51%,12.48%, and 43.39%, respectively at Bioenergy production .

-Solid biofuels (for residential use, industry use, and use for transformation to power and/or heat) represent almost 70% of the biomass energy supply.

-Liquid biofuels ,Biogas, and renewable waste each represent around 10%.(Nikkhah Et.al 2020 and Leontopoulos Et.al 20219

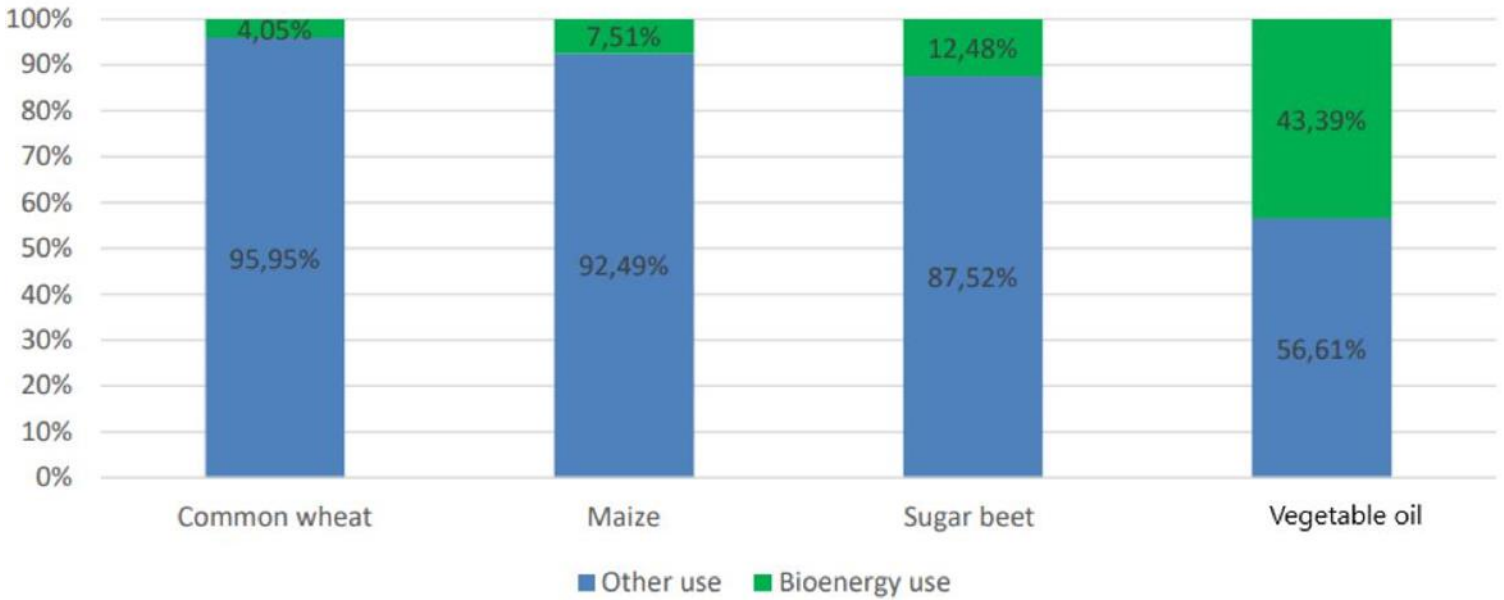
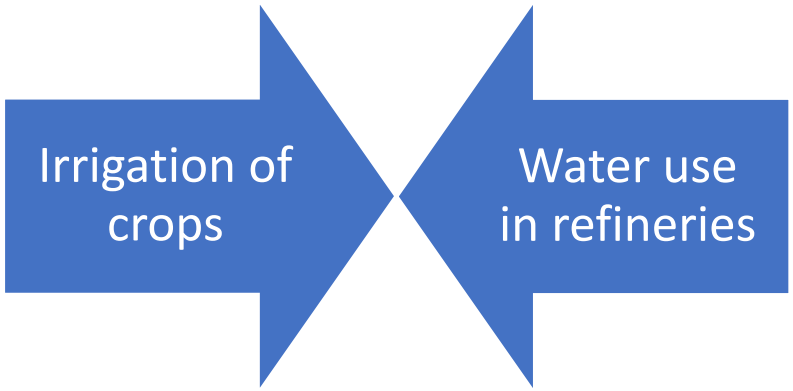


Fig1-share of the consumption of the main crops at the production of bioenergy in EU28 in 2015 (AEBIOM) Statistical Report -2017 European Biomass Association (AEBIOM). (n.d.). In www.bioenergyeurop.com)

Biofuel production

world's biggest biodiesel producers are in the EU. France, Germany, Spain, and the United Kingdom are among the continent's top four producers

bioethanol is quite a controversial type of biofuel:



https://afdc.energy.gov/fuels/biodiesel_benefits.html. (n.d.).

Biofuel Production Pathway

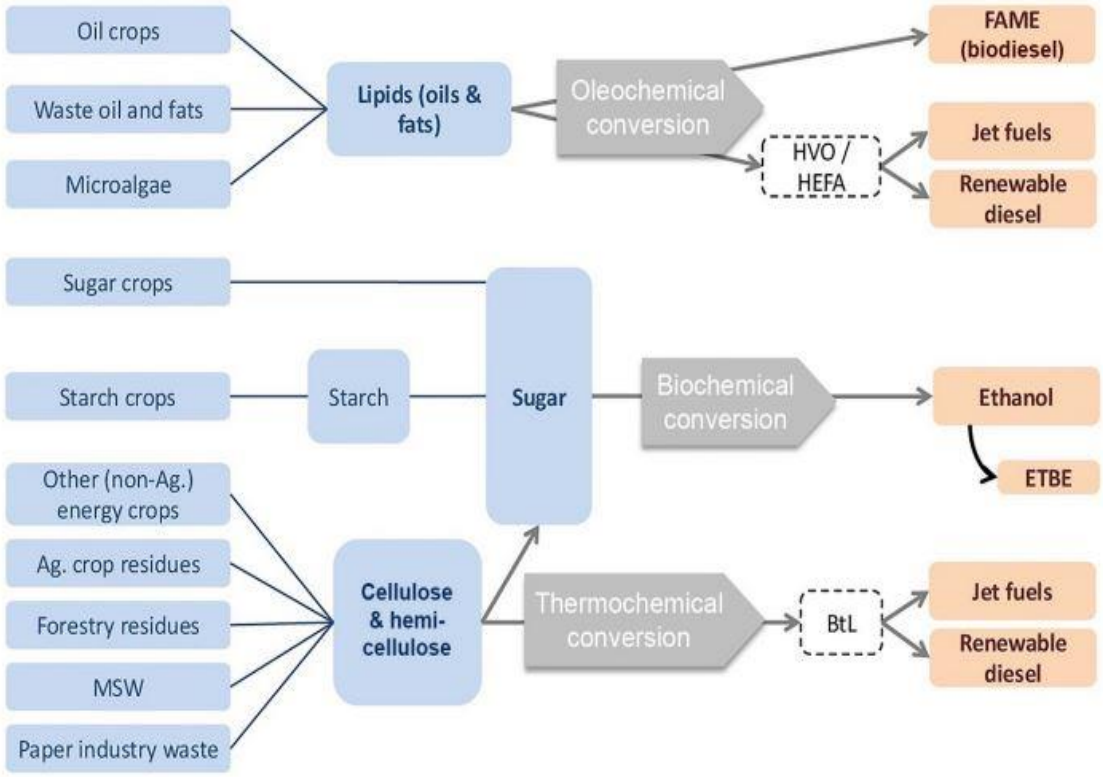
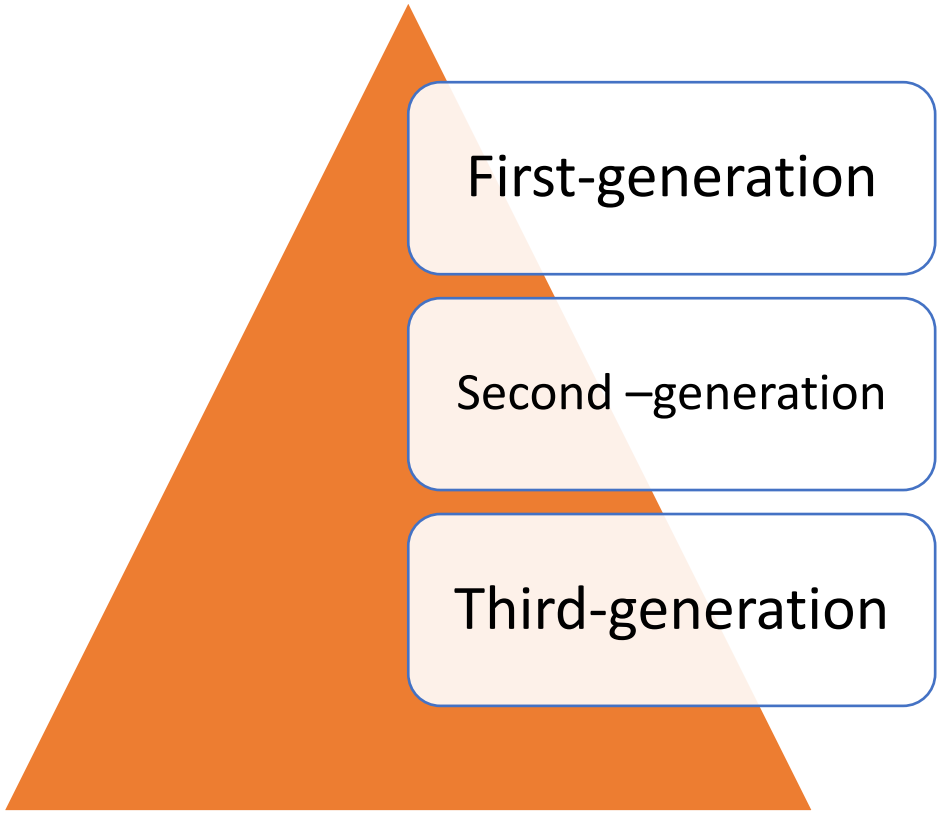


Fig2-Overview of the main biofuel pathways (Palandri, C., Giner, C., & Debnath, D. (2019). Technology, policy, and institutional Options. In Biofuels, Bioenergy and Food Security (pp. 23-41). Academic Press.)

General Classification of Biofuels

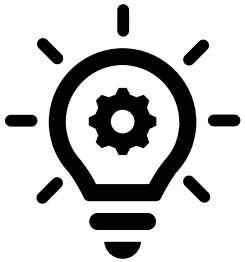


Methodology of Approach

To evaluate the impact of biofuel production on the food price two types of approaches have been chosen:

a) The underlying connection between production volumes, costs, and subsequent market prices.

b) A summary of the most significant literary works on the food and fuel debate



The most important factors regarding Biofuel production are the Conversion rate and yield of processes

Table 1-Biofuel yields in MT/ha (Debnath, D. (2019). From biomass to biofuel economics. In Biofuels, Bioenergy and Food Security (pp. 45-60). Academic Press.)

Crops/vegetable oil	Biofuel	Biofuel yield (MT/ha)
Maize	Ethanol	2.20
Wheat	Ethanol	1.11
Barley	Ethanol	0.54
Rye	Ethanol	0.55
Sugar cane	Ethanol	4.55
Sugar beet	Ethanol	5.06
Vegetable oil		
Soybean oil	Biodiesel	0.36
Rapeseed oil	Biodiesel	1.00
Palm oil	Biodiesel	4.45
Cottonseed oil	Biodiesel	0.27

Pros and Cons of food-based crops Transfer to Biofuel Production

Advantage:

-Lower CO2 release

- Job development in rural area

Disadvantage:

-Monoculture

- More Pesticides use and more pollution

-Decreasing soil fertility

-Rising price of conventional food crops

Roehr, MEt.al2001

Biofuel Production in Austria and the Czech Republic

30 % of primary energy production in Austria in 2019 had made from Renewable sources, and from this amount, 55% of them comes from biomass.

The usage of biofuel in the transport section in Austria is make up around 5%.

using 7% of biodiesel with diesel and 5% bioethanol with petrol has been done.

Implementation of bioenergy in Austria Report– 2021 update. (n.d.). In www.ieabioenergy.com.

Biofuel Production in Austria and the Czech Republic

solid biofuels make up (>80%) of bioenergy in Austria, which is fuel wood, wood chips, wood pellets, bark, and sawmill by-products. The share of other kinds of bio-energies is biodiesel (8%), biogas (4%), renewable MSW (3%), and bioethanol (1%).

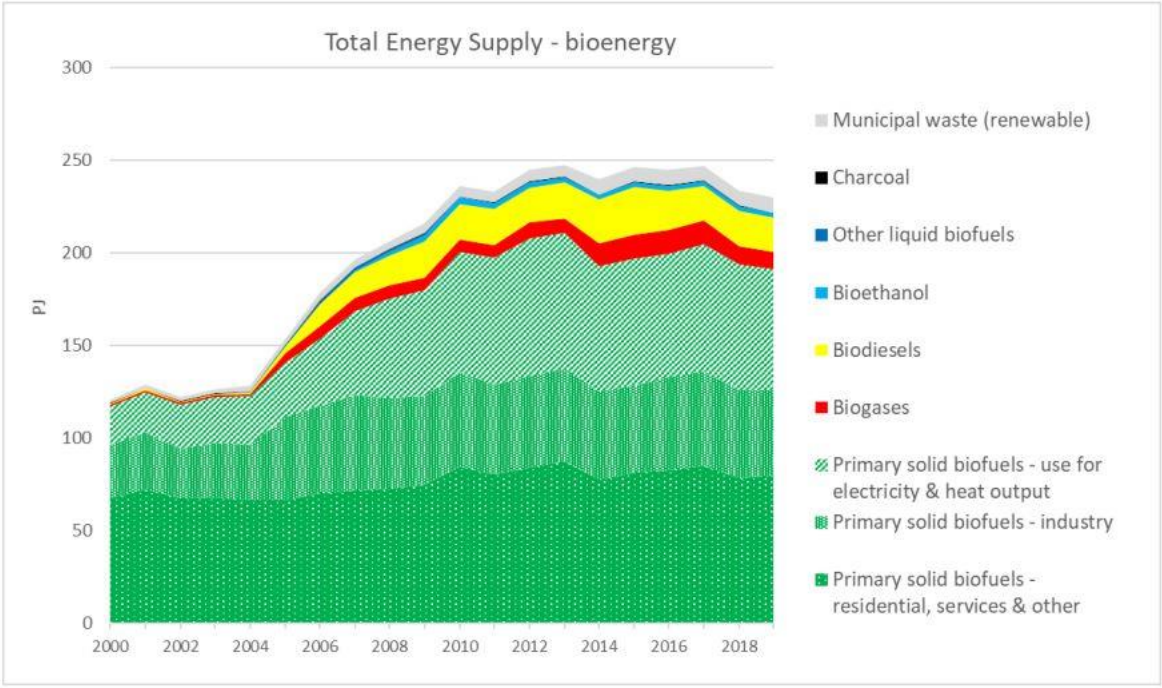


Fig2- Energy supply with a focus on bioenergy in Austria 2000 – 2018 (Implementation of bioenergy in Austria Report– 2021 update. (n.d.). In www.ieabioenergy.com.)

Biofuel Production in Austria and the Czech Republic

From years 2005-2009 in Austria, there is a significant increase in the usage of biofuel, however, this amount rather stays constant at around 5-6% of overall transport energy consumption

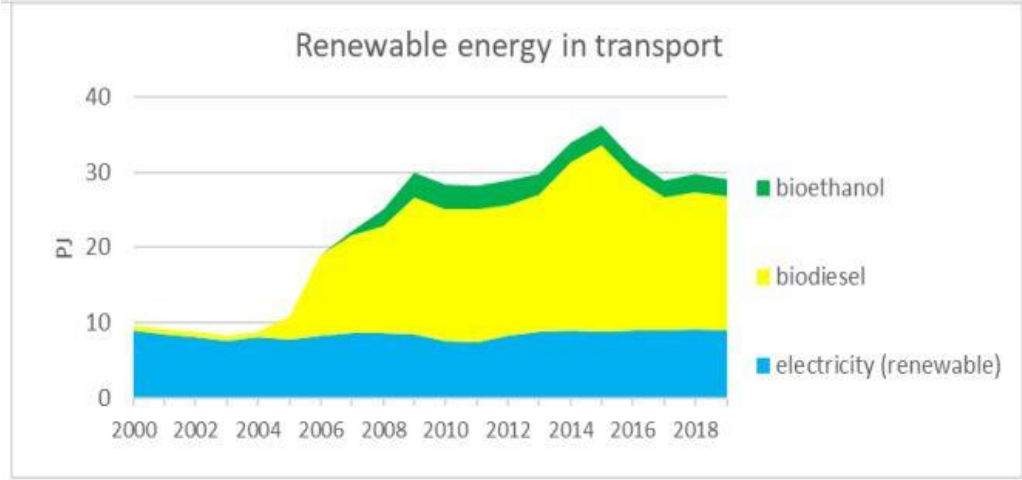


Fig3-Evolution of transport fuels in Austria (2000 – 2018) (Implementation of bioenergy in Austria Report– 2021 update. (n.d.). In www.ieabioenergy.com.)

Biofuel Production in Austria and the Czech Republic

-Biofuels are around 5%, and 91% of them are covered by oil. Only 2% of the energy supply in transportation is from electricity

-The biofuel consumption in the transportation section before 2008 is very low. Since 2009, the share of biofuel in transportation is considerable

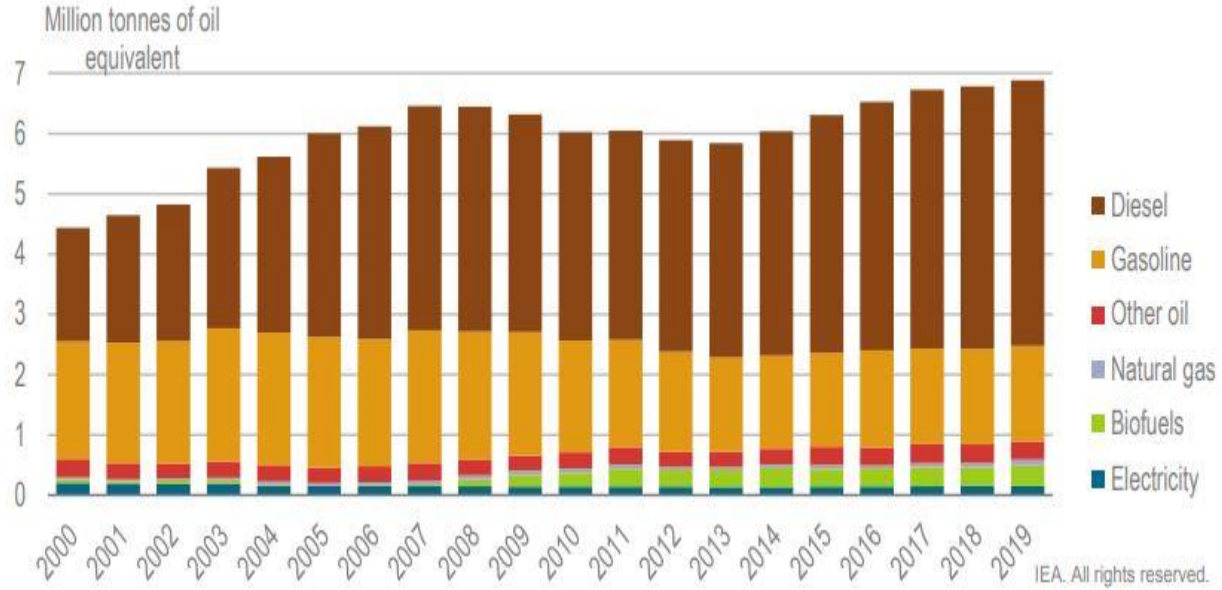


Fig4-Total final consumption in transport in the Czech Republic by source, 2000-2019 FAOSTAT, F. (2013). http//faostat3. fao. org/browse. Q/QC/E.: Access 18 May 2023

Biofuel Production in Austria and the Czech Republic

-Total liquid biofuel in Austria is around two times higher than in the Czech Republic

-The net import of total liquid biofuel for Austria 3 times higher than the Czech Republic

-Austria has a 35% dependency on biofuel imports and the Czech Republic 25%

Table 2-Primary production and net imports of liquid biofuels in the EU28 Member States in 2015 (ktoe) (AEBIOM) Statistical Report -2017 European Biomass Association (AEBIOM). (n.d.). In www.bioenergyeurop.com)

	Total liquid biofuel			Biodiese		Biogasoline	
	Primary production	Net import	Biofuel import dependency*	Primary production	Net import	Primary productior	Net import
EU28	13.660	930	6%	11.085	391	2.177	539
AT	445	236	35%	304	317	140	-80
CZ	216	75	25%	148	85	68	-11

Biofuel Production in Austria and the Czech Republic

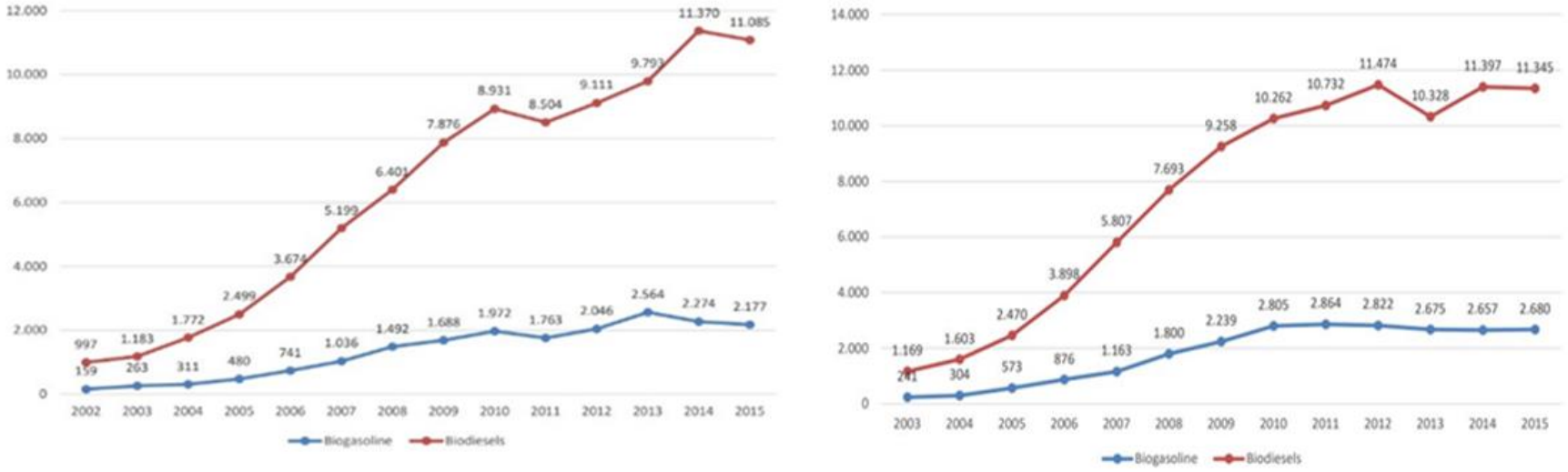


Fig5-Evolution of primary production of liquid biofuels in EU28 (ktoe) (left); Evolution of final energy use of liquid biofuels in transport in EU28 (ktoe) (right) (AEBIOM) Statistical Report -2017 European Biomass Association (AEBIOM). (n.d.). In www.bioenergyeurop.com)

Feed stock Price

-Between 2005 and 2015, the amount of biodiesel produced worldwide increased on average by 28% per year

-The surge in biodiesel production also coincided with a time when crude oil prices rose quickly

-Since the business has rarely been successful without extra financial support, even when feedstock costs have been low, these policies have nearly always been combined with other incentives for producers of biodiesel, such as tax credits and subsidies

-Palm oil is the only one of the three main agricultural feedstocks for biodiesel—soy, rapeseed, and—that has been cost-effective without subsidies for portions of the past decade

Naylor, R. L., & Higgins, M. M. (2018); Naylor, R. L. (2016); Naylor, R. L., & Higgins, M. M. (2017).

Feed stock Price

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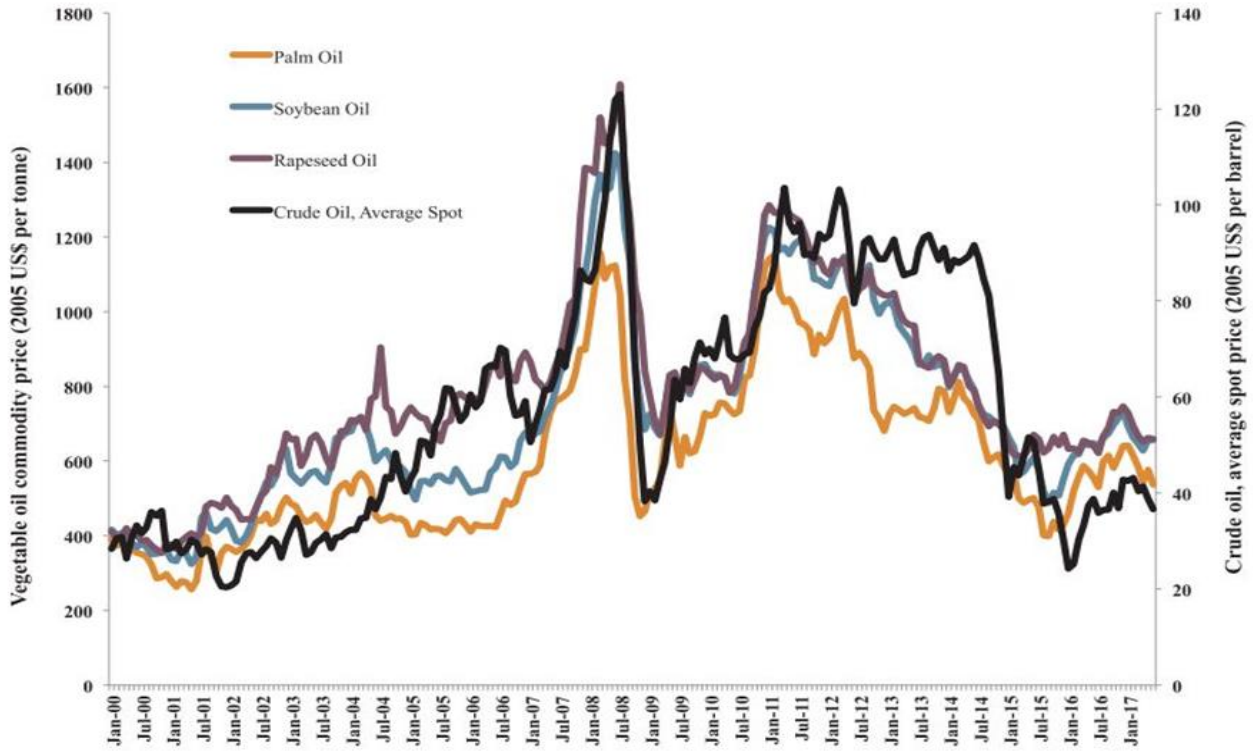


Fig6-Real prices of crude oil and major biodiesel feedstocks, 2000–2017 (Naylor, R. L., & Higgins, M. M. (2018). The rise in global biodiesel production: Implications for food security. Global food security, 16, 75-84.)

Feed stock Price

- Markets for oil crop by-products and substitutability of demand among vegetable oils are two additional elements that are crucial for determining the effects of biodiesel policy on vegetable oil pricing.

- global vegetable oil prices tend to move together; high amount of substitution of multiple other types of vegetable oils in global markets; in practice, this is not completely influential

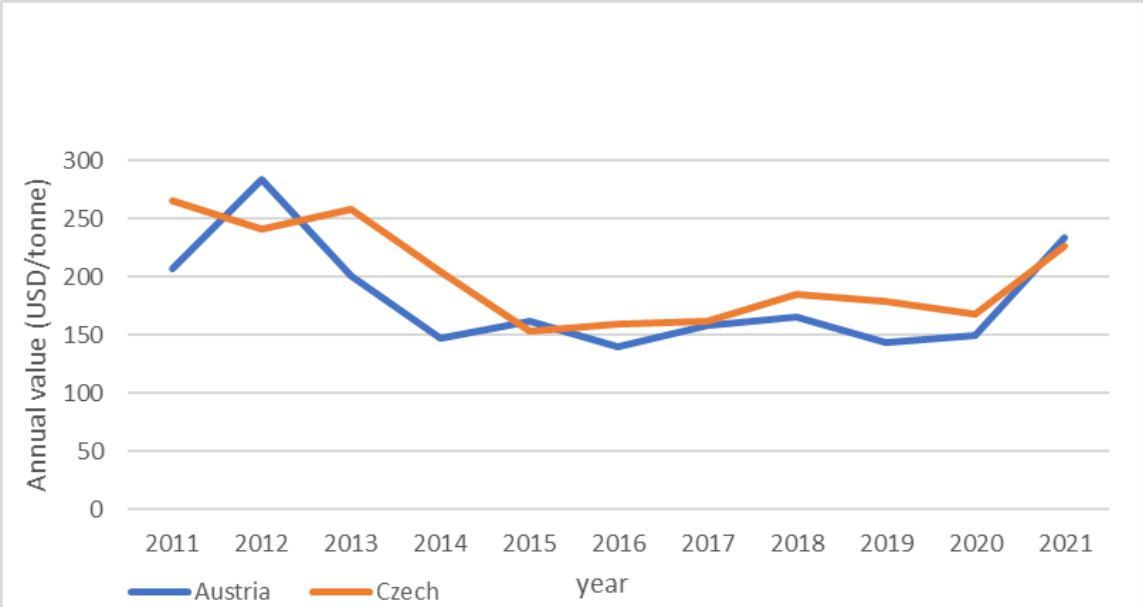
-With the expansion of biodiesel production, food security with consumer prices for vegetable oils will change

- About 75% of global vegetable oil demand is for food

-The high price of vegetable oil results in the deterioration of food security, especially for the net consumer from poor communities (15-20%)

Naylor, R. L., & Higgins, M. M. (2018)

Feed stock Price



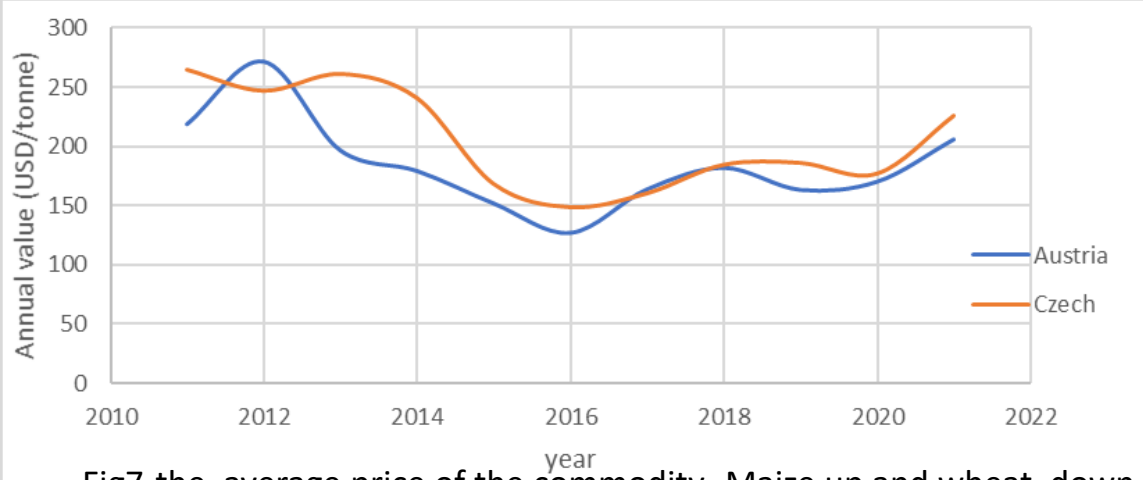


Fig7-the average price of the commodity- Maize up and wheat down (USD/Tonne) from 2011 to 2021 for the Czech Republic and Austria

https://www.fao.org/faostat/en/#compare. (n.d.): Access 18th May 2023

Feed stock Price

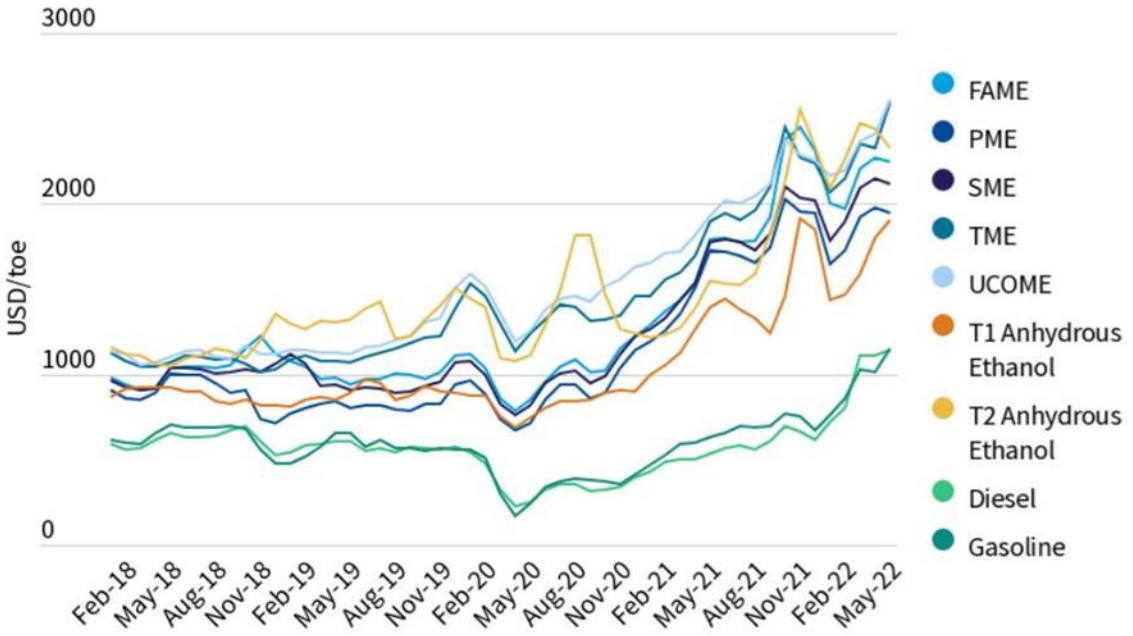
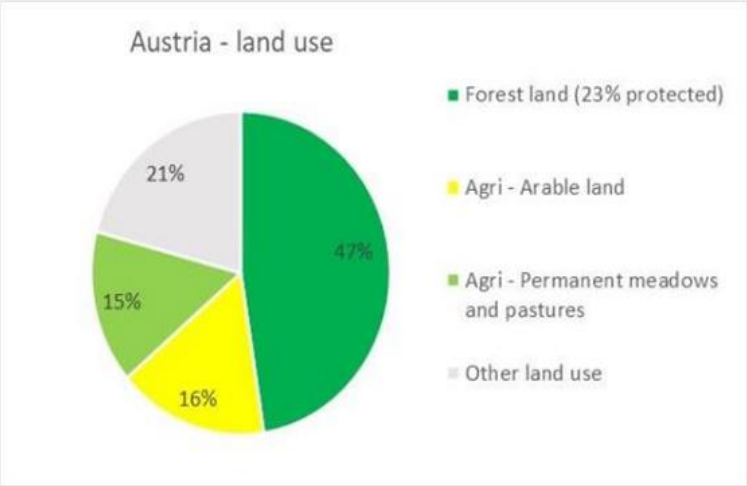


Fig8-Price of fuel in EU from 2018 to 2022 Billions wasted on biofuels Biofuels -Report transport and environment. (n.d.). In www.data.europa.eu.

Land Resources, yield, and water demand



. Austria's overall land area of 82,500 km2. 30% Agricultural, (47%((23% protected forest))

Agricultural 50%,30% forest Czech Republic

Fig9-Land use in Austria 2018(AEBIOM) Statistical Report -2017 European Biomass Association (AEBIOM). (n.d.). In www.bioenergyeurop.com.

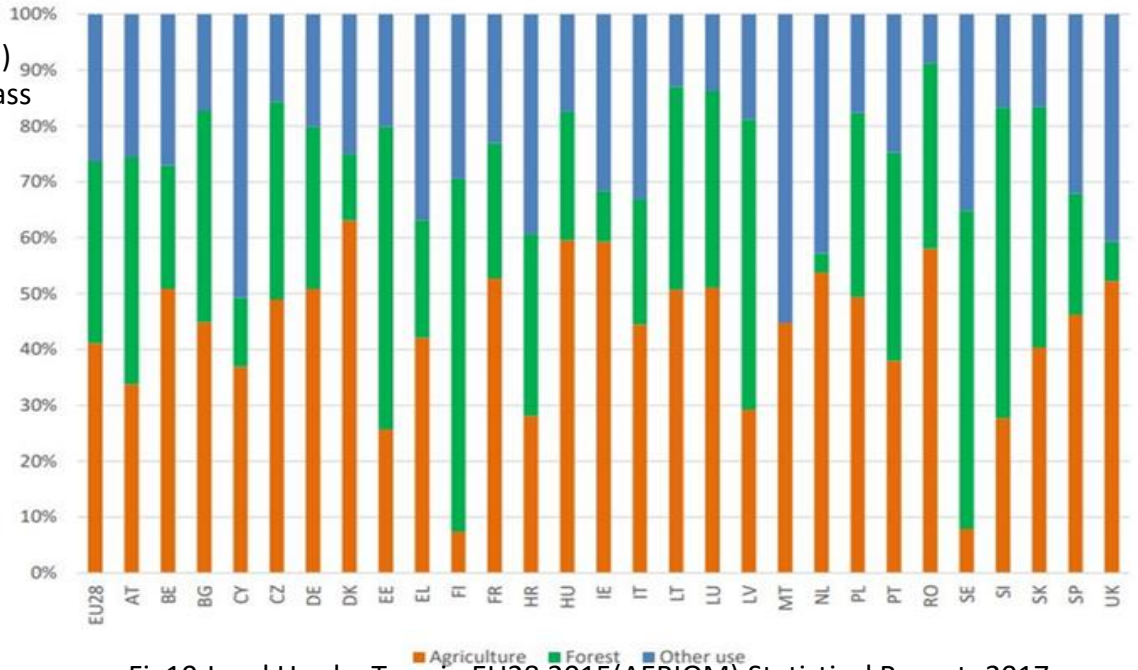


Fig10-Land Use by Type in EU28 2015(AEBIOM) Statistical Report -2017 European Biomass Association (AEBIOM). (n.d.). In

Land Resources, yield, and water demand

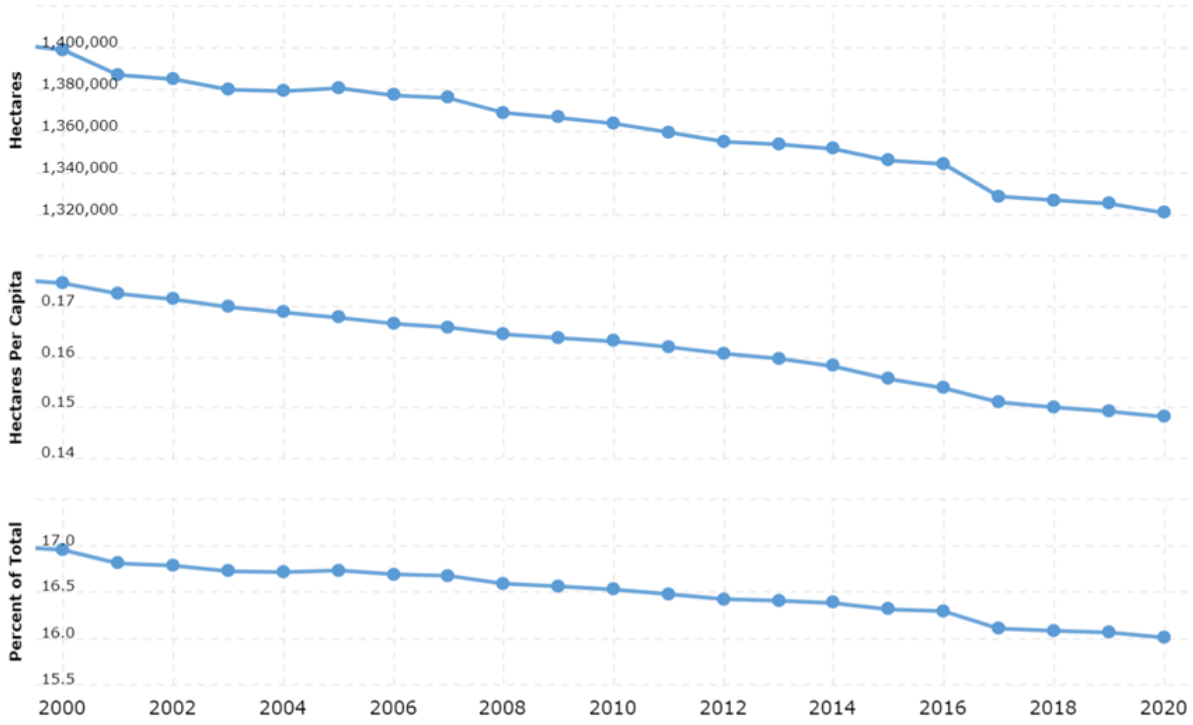


Fig11-Arable land availability in Austria 2000 2020https://www.macrotrends.net/countries/AUT/austria/arable-land'>Austria Arable Land 1961-2023. www.macrotrends.net. Retrieved 2023-06-11.

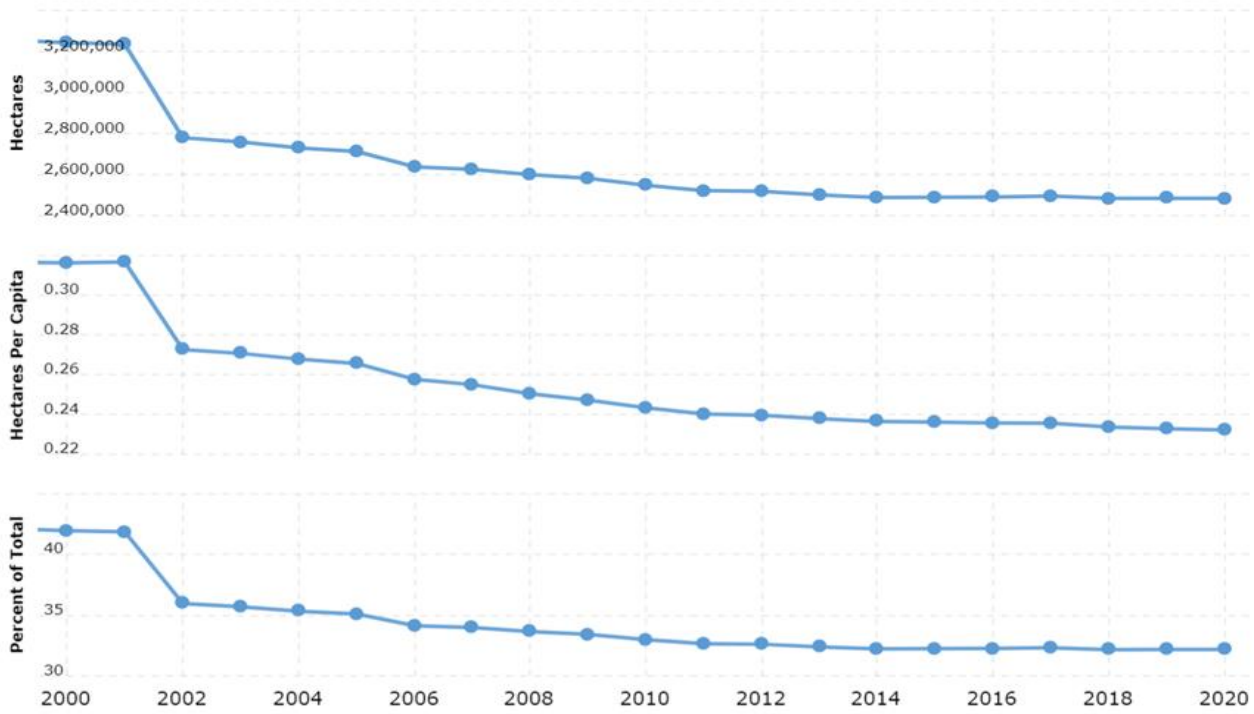


Fig11-Arable land availability in Czech Republic 2000-2020https://www.macrotrends.net/countries/CZE/czech-republic/arable-land'>Czech Republic Arable Land 1993-2023. www.macrotrends.net. Retrieved 2023-06-11.

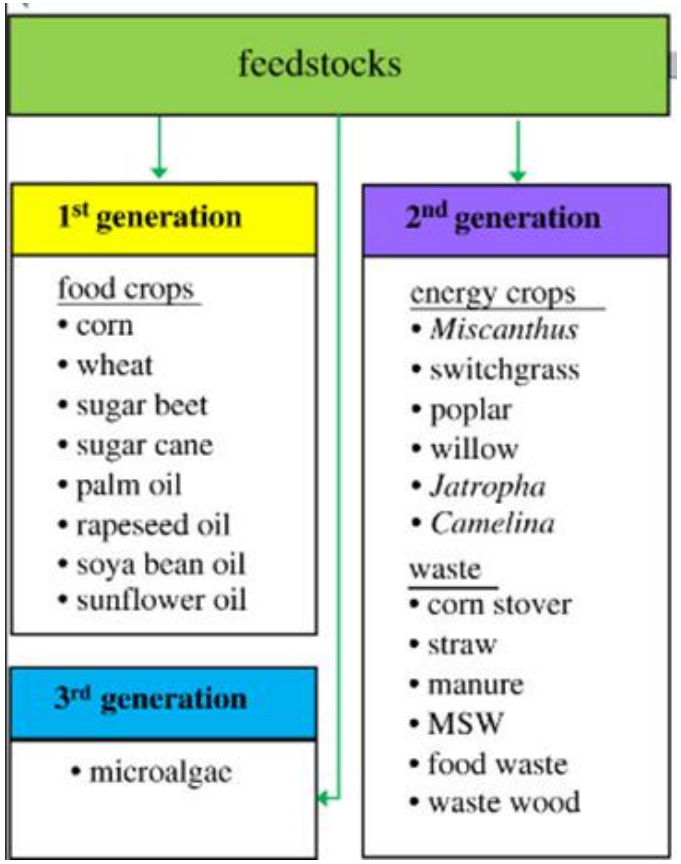


fig12-Three generations of energy crop Jeswani, H. K., Chilvers, A., & Azapagic, A. (2020). Environmental sustainability of biofuels: a review. Proceedings of the Royal Society A, 476(2243), 20200351.

In the case of growing energy crops, the category of energy crops matters.

Some types of energy crops are beneficial for their surroundings, they provide so-called ecosystem services (perennial energy crops). Of course, this cannot be applied to all of them (annual energy crop)

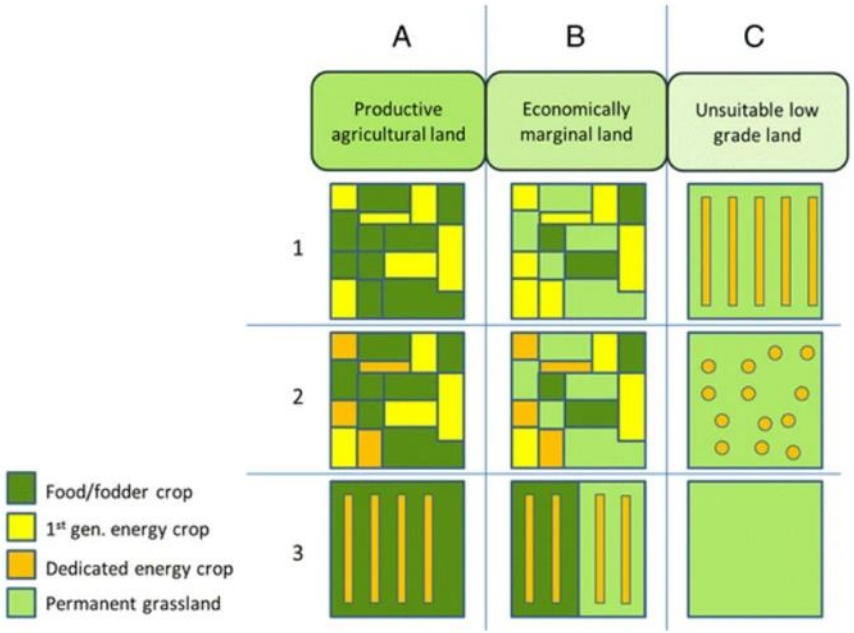


Fig13-Scenarios of integrating energy crop cultivation in open land varying in suitability for food production Whiteman, A. (2020). ENERGY PROFILE Austria.

Scenarios of integrating energy crop cultivation:

- “A1: First-generation energy crop production on productive agricultural land
- A2: Combination of first-generation and dedicated energy crops on productive agricultural land.
- A3: Strips of dedicated energy crops on productive agricultural land
- B1: First-generation energy crop production on economically marginal land
- B2: Combination of first-generation and dedicated energy crops on economically marginal land
- B3: Strips of dedicated energy crops on economically marginal land
- C1 and 2: Woody perennial crops on low-grade land
- C3: Biomass from (semi-)natural vegetation”

Dauber, J., & Miyake, S. (2016).

.Different approaches to energy crop production have varying impacts on soil biodiversity, pollinators, and water consumption.

. First-generation energy crops (e.g., rapeseed and corn) negatively affect soil biodiversity and provide limited benefits to pollinators.

. Combining first-generation and dedicated energy crops improves soil diversity, aids in regeneration, and reduces input requirements.

. Strips of dedicated energy crops, including trees and herbaceous crops, limit erosion, enhance biodiversity, and support natural pest control.

. Woody perennial crops are suitable for low-grade land and offer similar advantages as agricultural-forestry systems.

. It is crucial to choose sustainable practices to ensure positive outcomes

GABRIELOVÁ, Hana (2007). and Nepotravinářské využití zemědělské půdy [online]. December 2007 [cit. 2023-06-01

Conclusion

To conclude the impact of biofuel development on food prices, it should accept its impacts on the increment of the food price, because increasing in demand will push up the price this creates a complex network where the usage of energy crops for food, animal feed, and fuel purposes complicates the analysis of biofuel impact on food security.

Whenever there would be an increasing tendency for oil, there tends to be an excess supply of meal (a by-product of oil production), which leads to lower meal prices. In contrast, when there is a high demand for meals, there is an excess supply of oil, resulting in lower prices for vegetable oil.

Also, soil degradation is another downside of increasing biofuel production, not to mention water resources pollution, and a decrease in the amount of grassland and forest. However, using the 2nd and 3rd generation biofuels seems to be a solution to satisfy the downside of the production of first-generation biofuels.