WIFO
TEL. (+43 1) 798 26 01-0
FAX (+43 1) 798 93 86
ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG
AUSTRIAN INSTITUTE OF ECONOMIC RESEARCH
1030 WIEN, ARSENAL, OBJEKT 20 • http://www.wifo.ac.at
A-1030 VIENNA – AUSTRIA, ARSENAL, OBJEKT 20

Bioeconomy – Prospects for Agricultural Capacity – A European Perspective

Dr. Ina Meyer
Austrian Institute of Economic Research- WIFO
Research Unit Environment, Agriculture and Energy (FB5)

Ecosocial Forum Austria & Europa
Workshop: Bioeconomy – Motor for Sustainable Development in Rural Areas?
Challenges, Preconditions and Policy Options

October 22, 2019
Federal Institute of Agricultural Economics, Rural and Mountain Research, Vienna

The Bioeconomy in a Nutshell
Supply and Demand of Biomass

The bioeconomy is substantial and resource intensive.

Sectors supplying biomass:

Main sectors are **agriculture, forestry, fisheries, aquaculture** and **algae**, and with increasing importance biomass is/should be produced from **organic waste** coming from the agricultural, forestry and fishery sectors, but also from households or manufacturing

Sectors using biomass:

Food and Feed - food security is main societal challenge in a world with a growing population and occurring food crises (2008 and 2011 surges in global food prices),
→ SDG2 "Zero Hunger"

Bioenergy – use of renewable energy (incl. biomass, incl. 1st,2nd,3rd generation biofuels) to combat climate change, high biomass demand due to decarbonization of energy system

Bio-based chemical and materials – bio-based products including products traditionally made from biomass (like paper, textile) to substitute for fossil fuels, e.g. detergents, chemical building blocks and polymers, novel value chains such as fermentation and biocatalysis.

Given these interlinkages, any bioeconomy strategy has to reconcile **the synergies** (e.g. in terms of the cascade principle), **trade-offs and competition of the different sectors using and supplying biomass**

S: https://ec.europa.eu/food/sites/food/files/safety/docs/fw_lib_swp_jrc-bioeconomy-report_2016.pdf

Land - A common denominator and a (finite) resource of the bioeconomy

Global competition for land because land is a finite resource and most of the highly productive land is already exploited by humans

Growing demand for land use and land acquisition →intensify competition

Multiple drivers accentuate land scarcity in the future:
Socio-economic, technological and climate change-related drivers:

1) Growing population [growing to ~9.8 bn. people by 2050, 11.2 bn by 2100 from 7.7 bn Oct 2019, United Nations 2019]

2) Economic growth, growing global middle class (changes in diets towards higher meat and dairy consumption), **continued urbanisation** increasing pressures **on expanding crop and pasture area and intensifying land management.**

3) Climate Change – Mitigation and decarbonization of the economy
Increased demand for **bio-based** (carbon neutral) **renewable energy, Biofuels** made from **plant material**, i.e. corn, maize (bioethanol, biogas), rapeseeds (biodiesel), fuels for aviation, increased demand for land for large-scale PV power station (solar parks).

Concept of **using farmland to produce fuel instead of food** comes with **challenges**, solutions relying on waste or other feedstocks haven't yet been competitive in price and scale with conventional fuels. Target: Global biofuel output needs to triple by 2030 to meet the IEA targets.

S: IPCC Special Report on Climate Change and Land, 2019, https://www.ipcc.ch/report/srccl/

Example: Large Scale Land Acquisition (LSLA) and competition in land use

LSLA is **mainly** about the **competition between cultivation of energy crops** for the production of bioenergy and the **cultivation of food and feed crops** but also for other purposes such as mining for resources (metals, rare earth elements, fossil fuels etc.)

LSLA by investors **peaked in 2008 during the food price crisis**/the financial crisis and has also been linked to the search for biofuel investments.

In 2007/2008 world food staple prices skyrocketed. The prices of the four staple foods **rice, corn, wheat and soybean tripled** between **autumn 2005 and mid-2008.**

Price increase was inter alia attributed to **increased bioenergy demand and use of corn from Europe and the USA.** There were hunger riots in several countries, e.g. in Mexico due to increases in consumer prices of up to 40%.

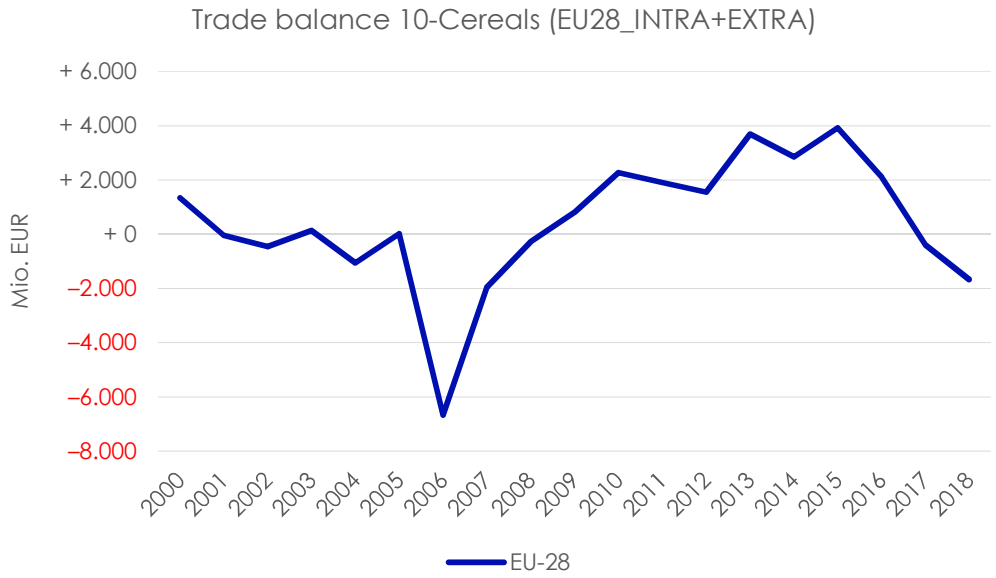
The LSLA phenomenon largely targets **agriculture**, it is widespread, including **Eastern Europe**, but above all Sub-Saharan-Africa, Southeast Asia, Latin America.

Since 2000, almost **50 million hectares of land** have been acquired, no signs of stagnation in the foreseeable future.

LSLA are **promoted by investors** and host governments on **economic grounds through** infrastructure development, employment creation, and market development but their **social and environmental impacts can be negative and significant**.

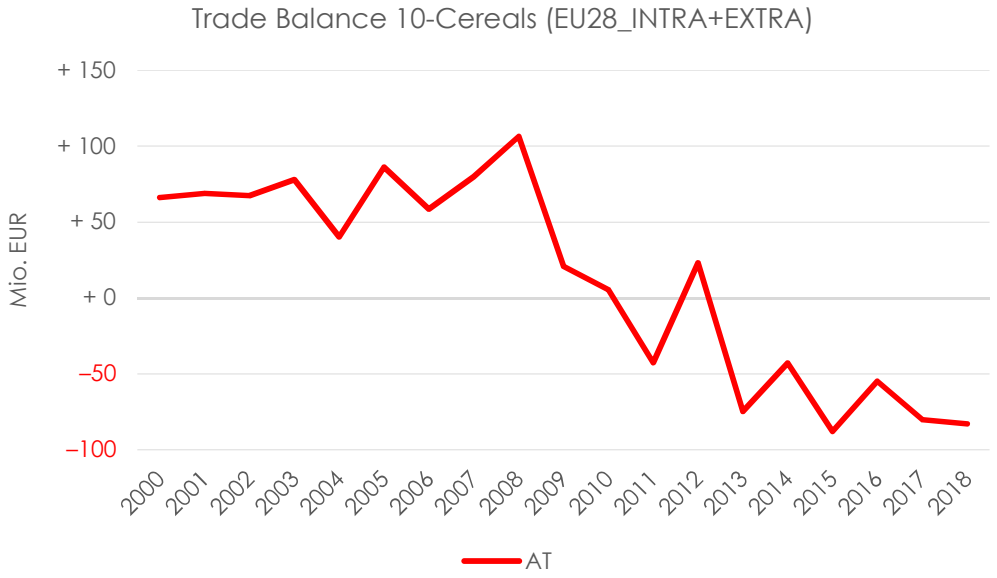
S: Dell'Angelo et al., 2017, https://www.sciencedirect.com/science/article/pii/S1877343517301756

Trade Balance Cereals (Export-Import) EU, Austria



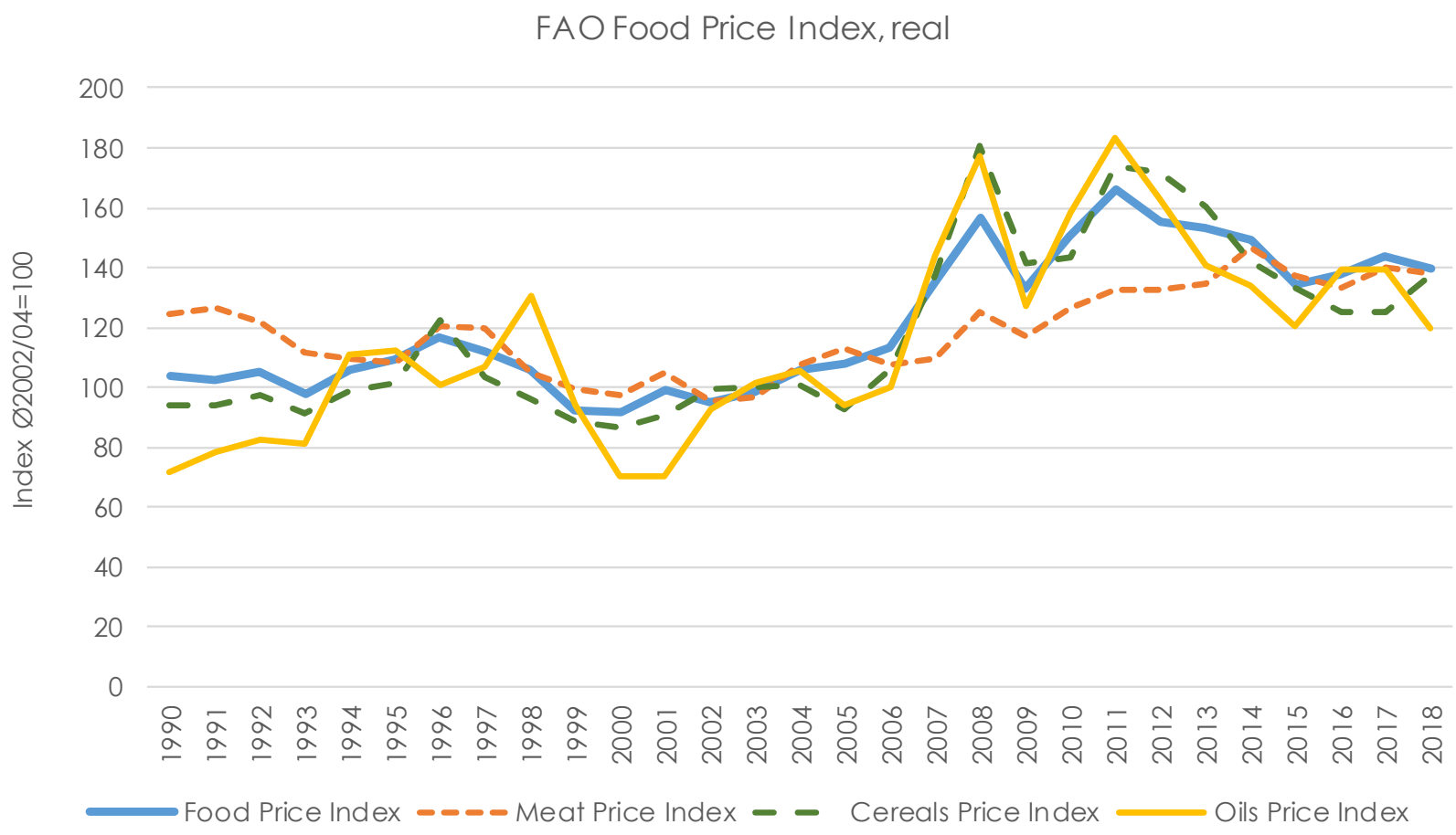
Since 2010 Austria became a net importer of cereals. This is driven by rising industrial demand for starch and biofuel production and less so for food and feed demand

In the run-up to the economic and financial crisis, the EU became a strong net importer of cereals



S: Eurostat

FAO World Food Price Index (2002-2004=100)



S: FAO, http://www.fao.org/worldfoodsituation/foodpricesindex/en/

Land ecosystems and climate change I – Agriculture as GHG source

Land ecosystems play a key role in the climate system due to their **large carbon pools** and carbon exchange fluxes with the atmosphere
Globally, the **land-based carbon sink** was estimated for the period 2008-2017 to be nearly **30% of total anthropogenic emissions**. Whether or not this sink will persist into the future is one of the largest uncertainties.

Changes in vegetation cover caused by land use and land use change – such as **conversion of forest to cropland or grassland**, can result in substantial releases of GHG emissions.
~1/4 of total anthropogenic GHG emissions arise mainly from **deforestation**, **ruminant livestock and fertiliser application cause methane and nitrous oxide emissions and have been rapidly increasing over the last decades.**

Interlinking agriculture and the energy system by mitigation through bioenergy crop production and material use in manufacturing industry bares the risks to result in **positive net GHG emissions** (example: deforestation in Amazon rainforest)**.**

Since **agricultural commodities are traded internationally**, a scientific assessment of a **sustainable quantity of bioenergy** can only be made on a **global level**. Bioenergy use in the EU or Austria is thus linked to global land use.

Estimates of Sustainable Bioenergy Potential Worldwide

~50 exajoule annually – which is equivalent to the current bioenergy use – up to several 100 exajoule ***(https://www.leopoldina.org/en/publications/detailview/publication/biomasse-im-spannungsfeld-zwischen-energie-und-klimapolitik-2019/)***

Sustainable bioenergy potential worldwide depends on:

Future increase in **agricultural productivity**
Estimates on the required **area of land necessary to secure ecosystem service** and **biodiversity** integrity
Estimates on area of available, unused and **degraded agricultural and pastureland** that could be used **for environmentally sustainable bioenergy production**
Future diets: Greater use of agricultural biomass is most likely to be achieved if global **meat consumption** will be significantly reduced.

The **growing demand for energetic and material use of agricultural raw materials** carries **considerable ecological and climate-related risks**.

These can only be reduced if, for instance, global **sustainability standards** for all forms of land use and all agricultural products are enforced.
In terms of **climate protection**, it is particularly important to **curb global deforestation**.
Otherwise, the use of bioenergy from agricultural raw materials **should not be increased. Instead, the use of residual and waste materials should be enhanced.**

Land ecosystems and climate change II
Impacts on Agriculture

Climate change affects land ecosystems in various ways and **may reduce agricultural productivity and food security in various ways (which is a primary concern)**

through **shifting rainfall patterns** and **reduced water availability** or excess water
Increasing temperatures
greater **frequency of some extreme** events like **droughts, floods**

2018 was the second year in a row with dryness-induced low cereal harvest in EU
Example: the Netherlands (Prins et al., 2018, Wageningen University and Research; https://edepot.wur.nl/458511)

Table 1 *Summary table of the yields in kilogrammes per hectare of the main arable crops in dry and hot years, calculated as change in % compared to the average yield in kilogrammes in the surrounding years*

	1976	1983	1995	2003	2006	Average	2018 (estimation)
Ware potatoes	-7	-14	-12	-11	-11	-11	-20
Seed potatoes	8	-26	-2	4	-3	-4	-5
Starch potatoes	-13	-15	3	-17	-13	-11	-25
Sugar beet	7	-15	-2	-4	6	-1	-12
Onions	-58	-16	-19	-14	-21	-26	-50
Winter wheat	-2	-3	3	1	-1	0	-2
Spring barley	1	-20	-5	9	2	-3	-2

Source: Farm Accountancy Data Network of Wageningen Economic Research

Strategies for Resilient Agriculture and the Bioeconomy

Agriculture and the food system are key to global climate change responses.
→ *Objective: Opt for climate change mitigation and food system resilience*

GHG reduction measures in agriculture, sustainable livestock management and forestry would have substantial climate change mitigation potential with co-benefits for biodiversity and ecosystem services.

> **sustainable land and soil management**, sustainable water management, managing manure and soil carbon as well as **organic agriculture** as an overall strategy to strengthen resilience
>
> Combining supply side actions such as efficient production, transport, and processing with demand-side interventions such as **modification of food choices**, and **reduction of food loss and waste**, reduces GHG emissions and enhances food system resilience
>
> (Meyer, Sinabell, 2011; https://www.wifo.ac.at/jart/prj3/wifo/resources/person_dokument/person_dokument.jart?publikationsid=42331&mime_type=application/pdf)

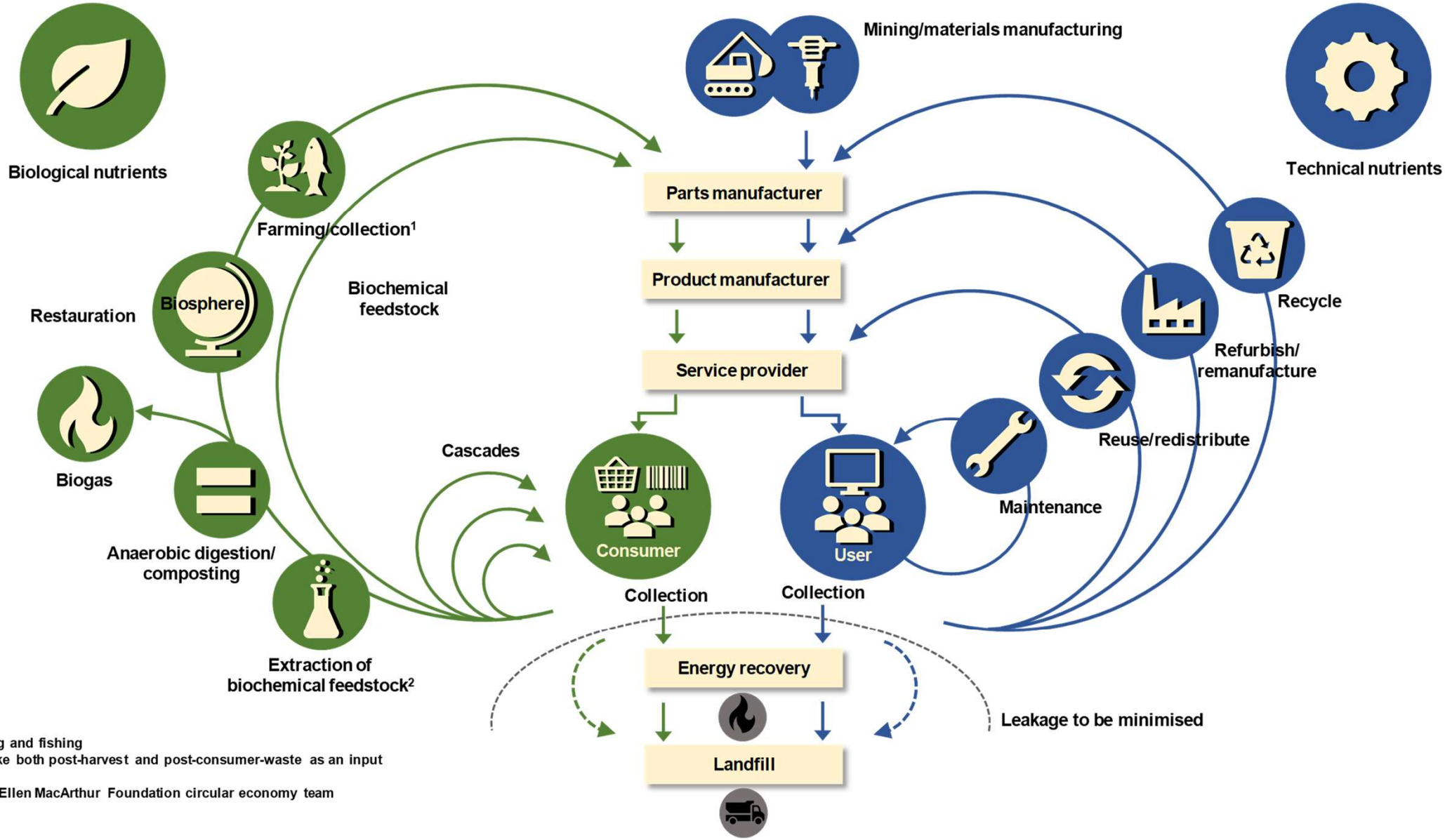
Circular economy and Bioeconomy – two complementary strategies

CE promotes the **enhanced use of organic waste and residues** in existing value chains, creates innovative value chains using **organic and food waste**. This will result in an efficient bioeconomy by **closing material loops** through **recycling** and **reuse of products and materials** reducing virgin raw material use and associated environmental pressures. This includes

> Prospects for **regional policies and regional value and employment creation**
>
> Prospects for **research and innovation and new business models**

S: https://www.eea.europa.eu/publications/circular-economy-and-bioeconomy

Bioeconomy as Circular Economy



1 Hunting and fishing
2 Can take both post-harvest and post-consumer-waste as an input

Source: Ellen MacArthur Foundation circular economy team

WIFO

Thank you!

Contact: ina.meyer@wifo.ac.at