



MATERIAL AND ENERGETIC UTILISATION OF BIOGENIC RESIDUES AND WASTE AS CONTRIBUTION TO CLIMATE PROTECTION IN GERMANY

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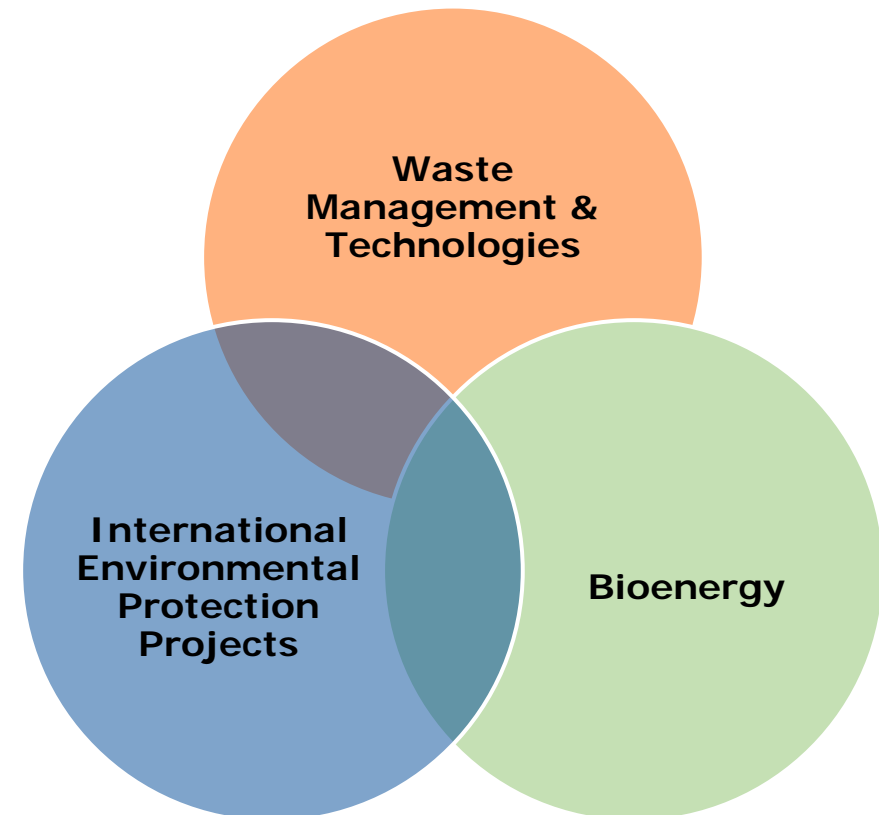
History:

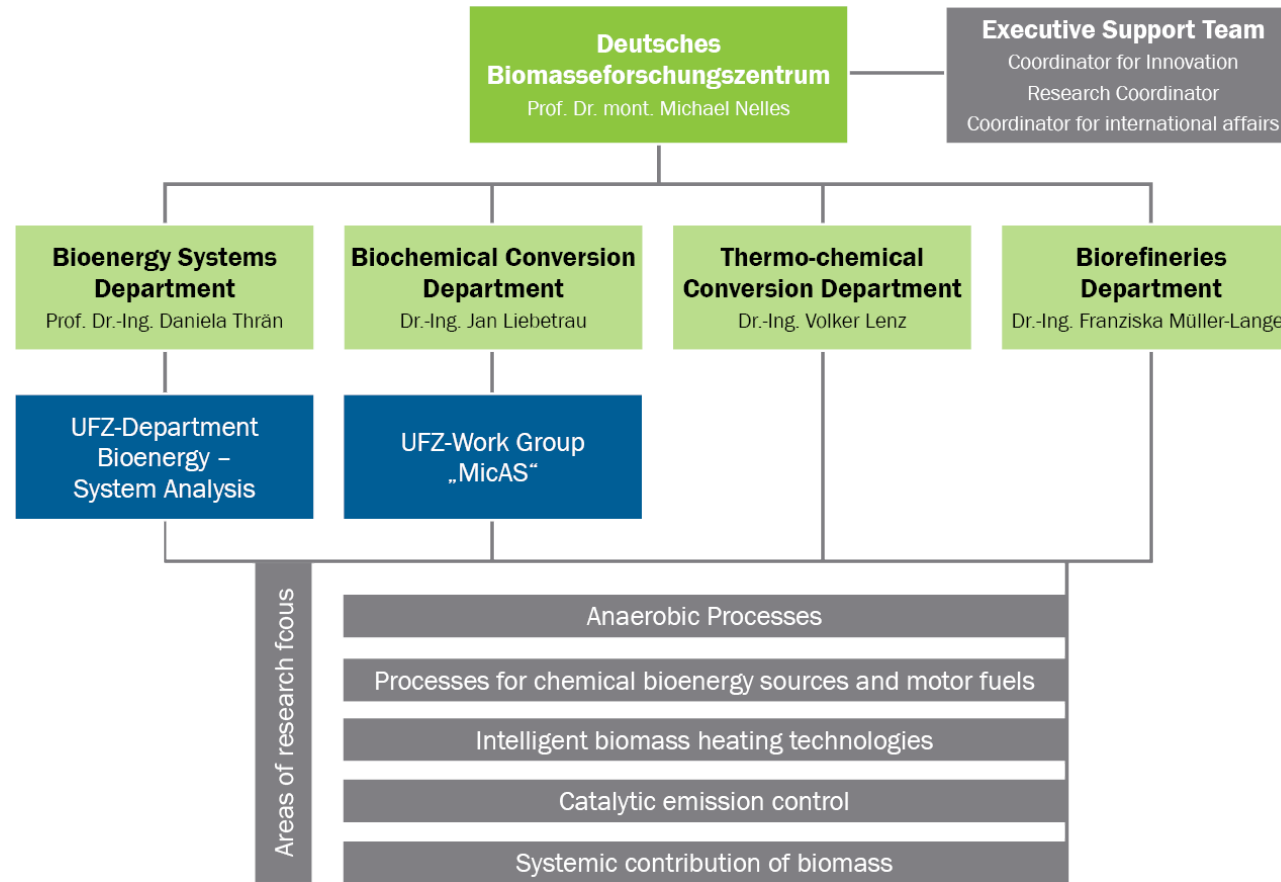
- Foundation of the oldest university in Northern Europe in the year 1419!

University of Rostock 2021:

- 9 faculties with **13,000 students** and 274 professors and 2,900 employees
- Around **1,550 foreign students** from 60 countries
- **Budget:** 180 million € per year and 67 million € Third Party Funding
- Environmental Engineering & Sciences is one R&D-Priority some faculties, particularly in the **Faculty of Agricultural and Environmental Sciences**

Department of Waste and Resource Management





DBFZ-Development:

- Foundation: 2008
- Location: Leipzig
- Turnover: > 20 Mio. €/year
- Staff: > 200
- Invest: > 60 Mio. € in phase 2 (2017-2021)

Climate-Neutral Society needs a 100% Renewable Energy System & a real Circular Economy!

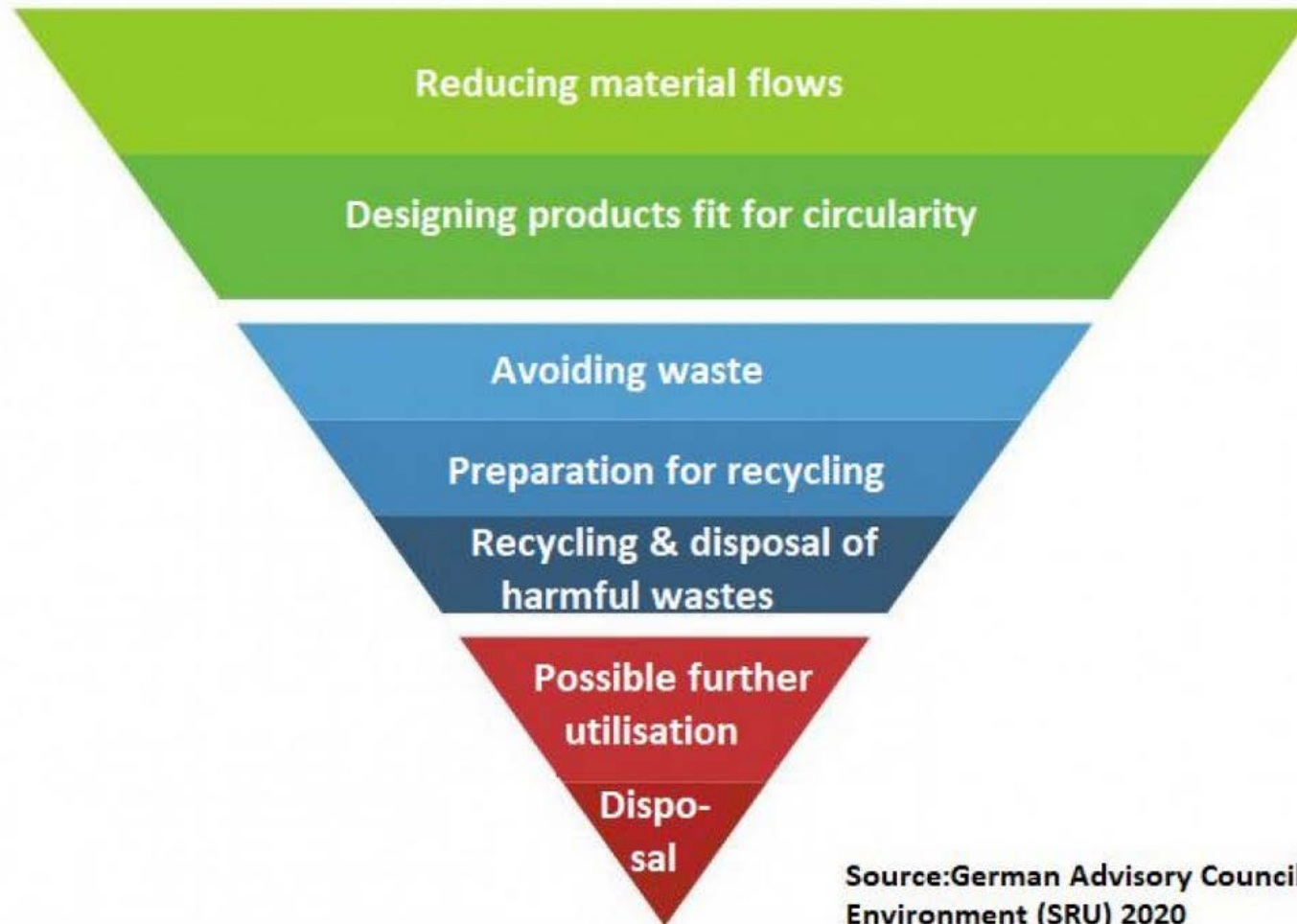


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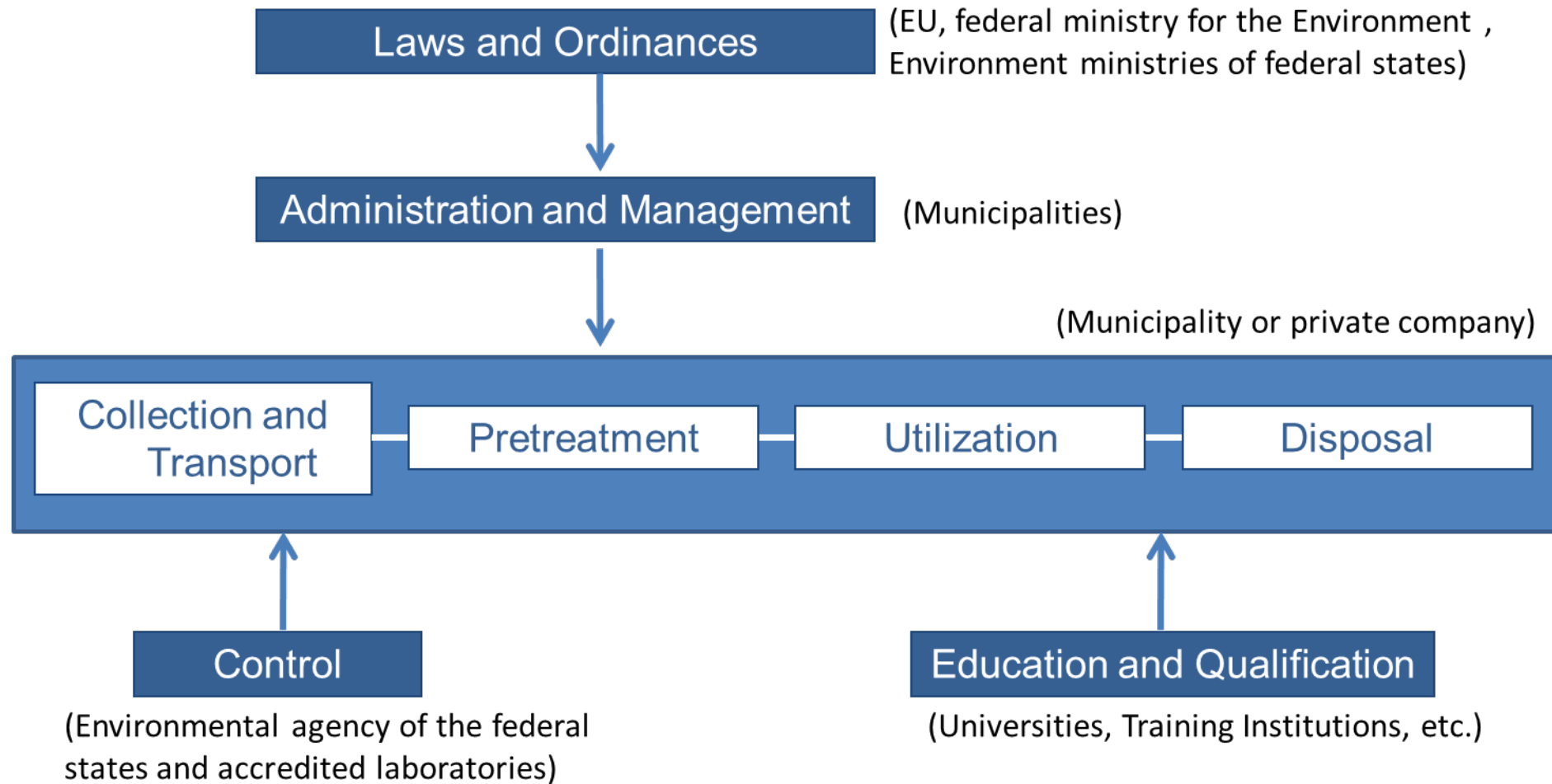
1. **Waste Management in Germany**
2. Biomass in the German Energy System
3. Energy and resources from organic waste and residues in Germany
4. Solutions for the future - the Smart Bioenergy Concept
5. Conclusion and Outlook

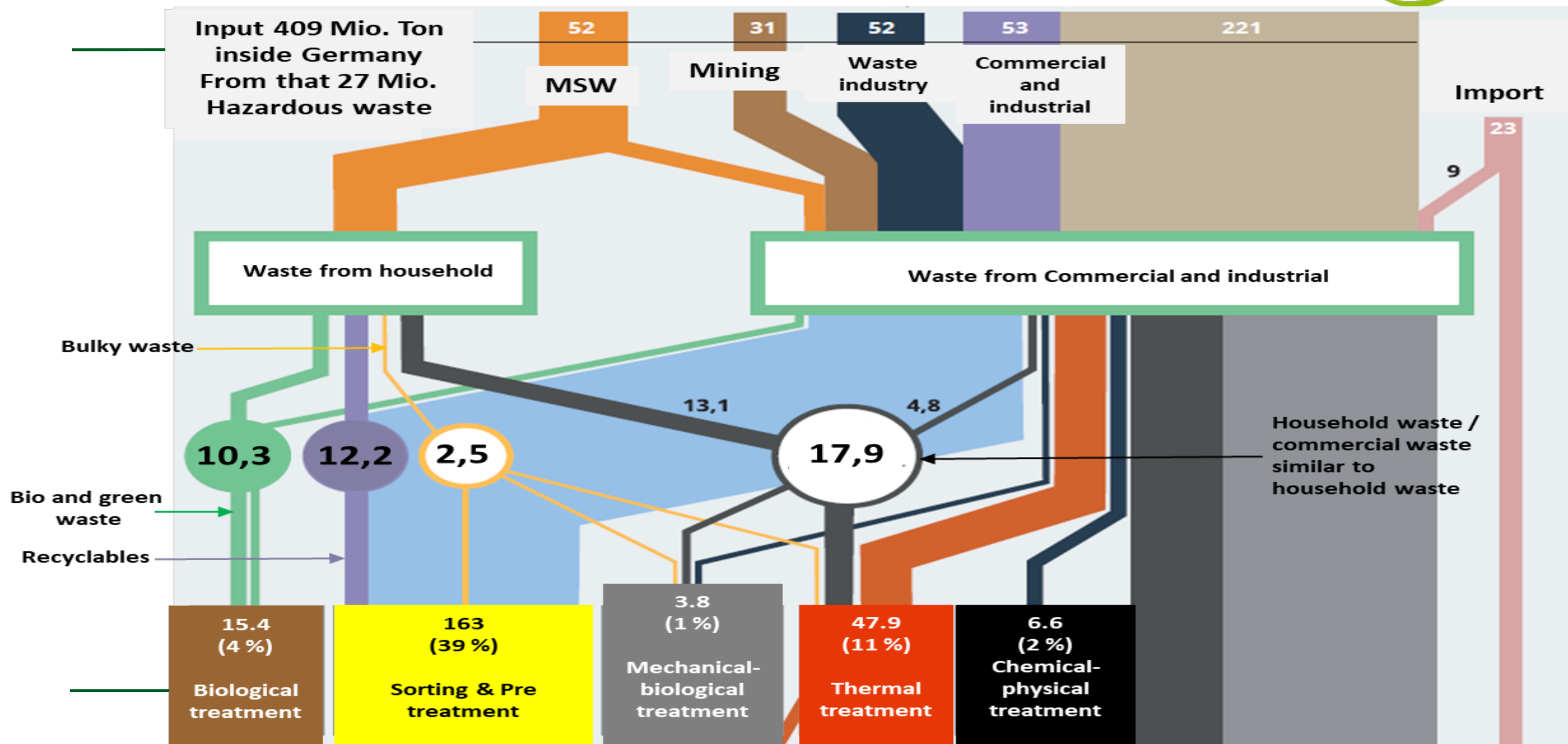


Waste Management Hierarchy towards Circular Economy

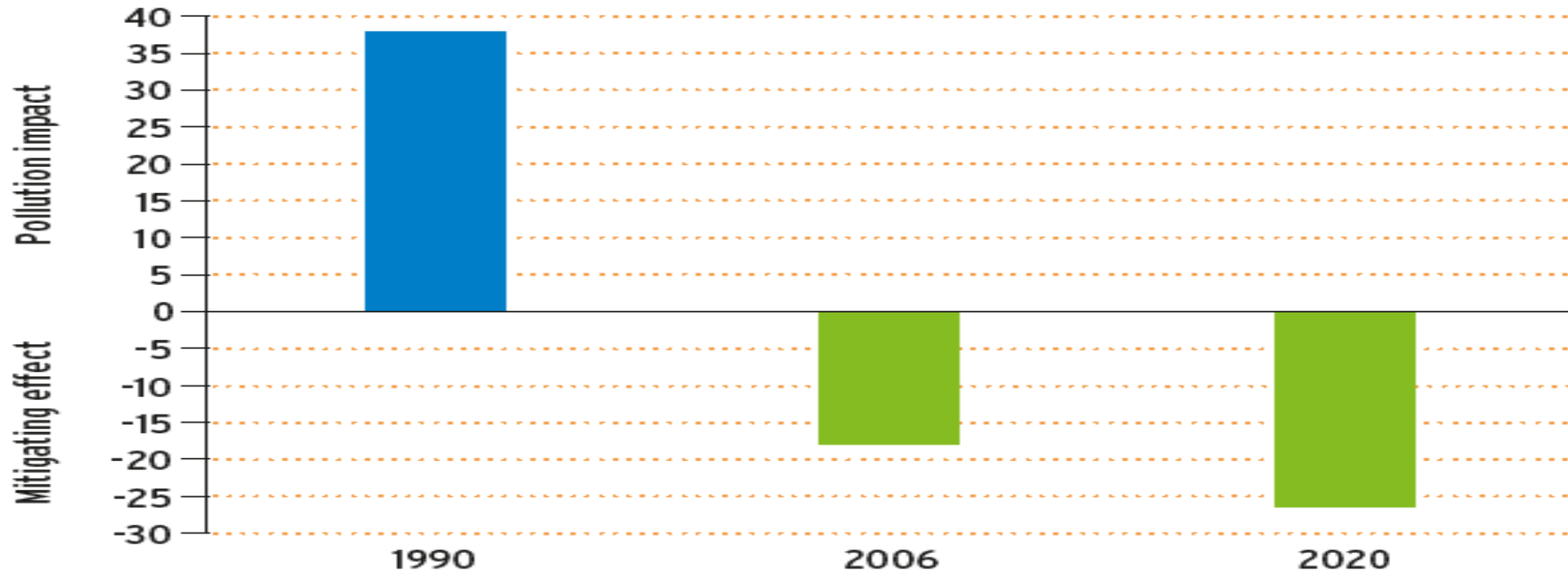


Source: German Advisory Council on the
Environment (SRU) 2020





Waste landfilled after 2005 emits almost no climate-relevant greenhouse gases



■ Emissions of greenhouse gases in million tonnes CO₂-equivalents

Source: IFEU Study 2010, Öko-Institute e. V.

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Energy crops

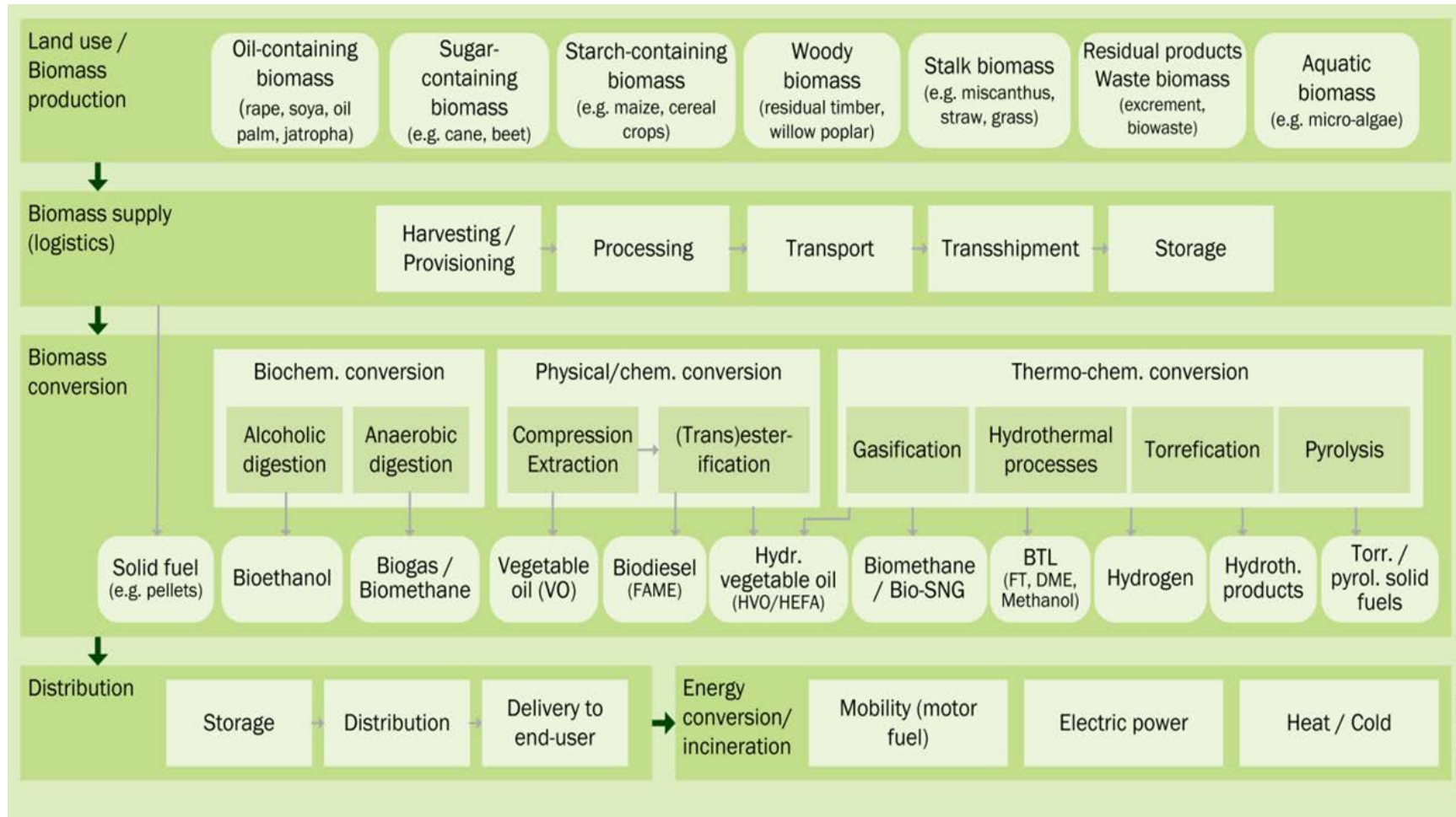


By-products & Residues

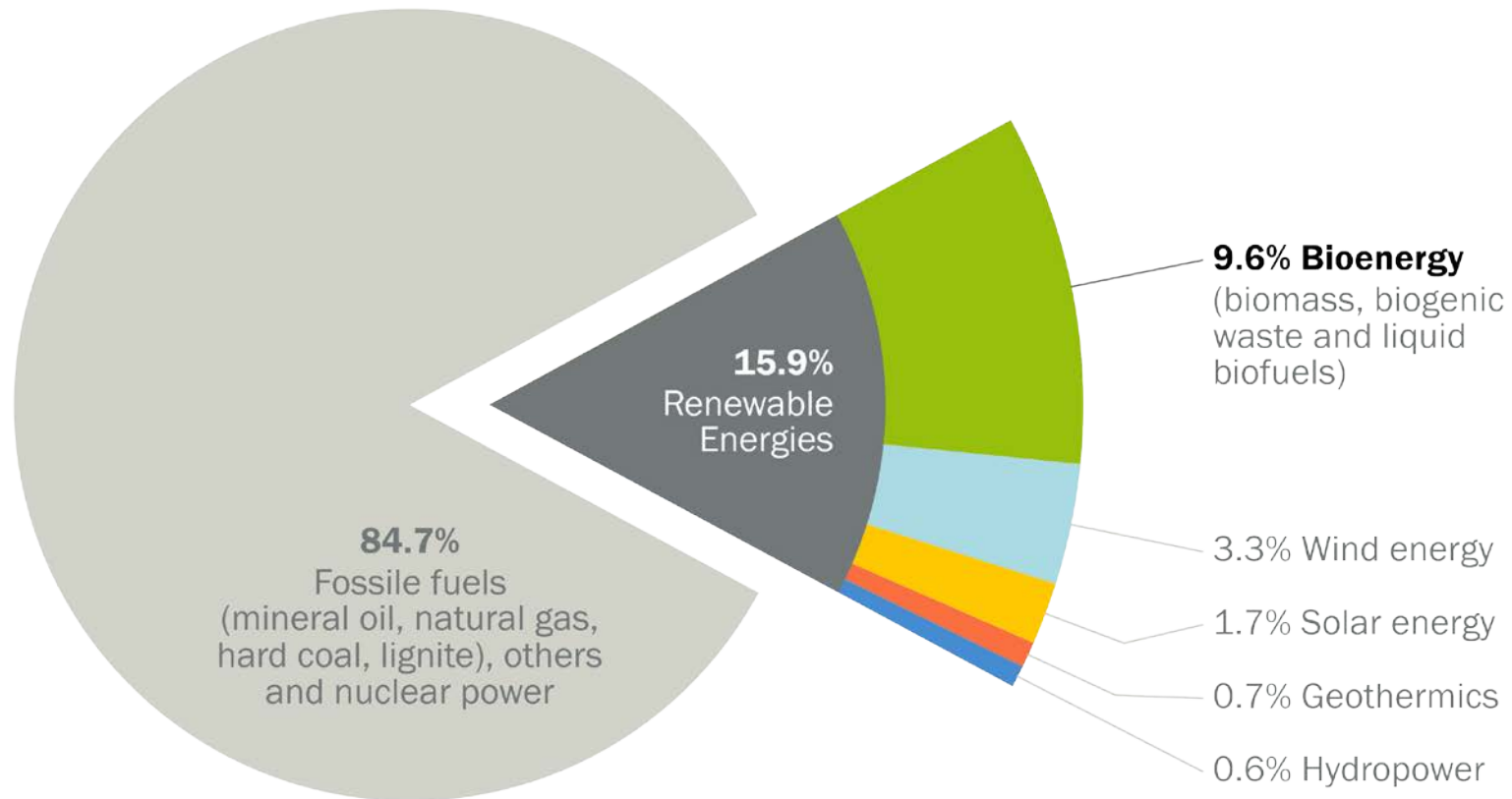


Organic waste





Primary Energy Consumption in Germany 2021



–0.6% Electricity exchange balance not plotted

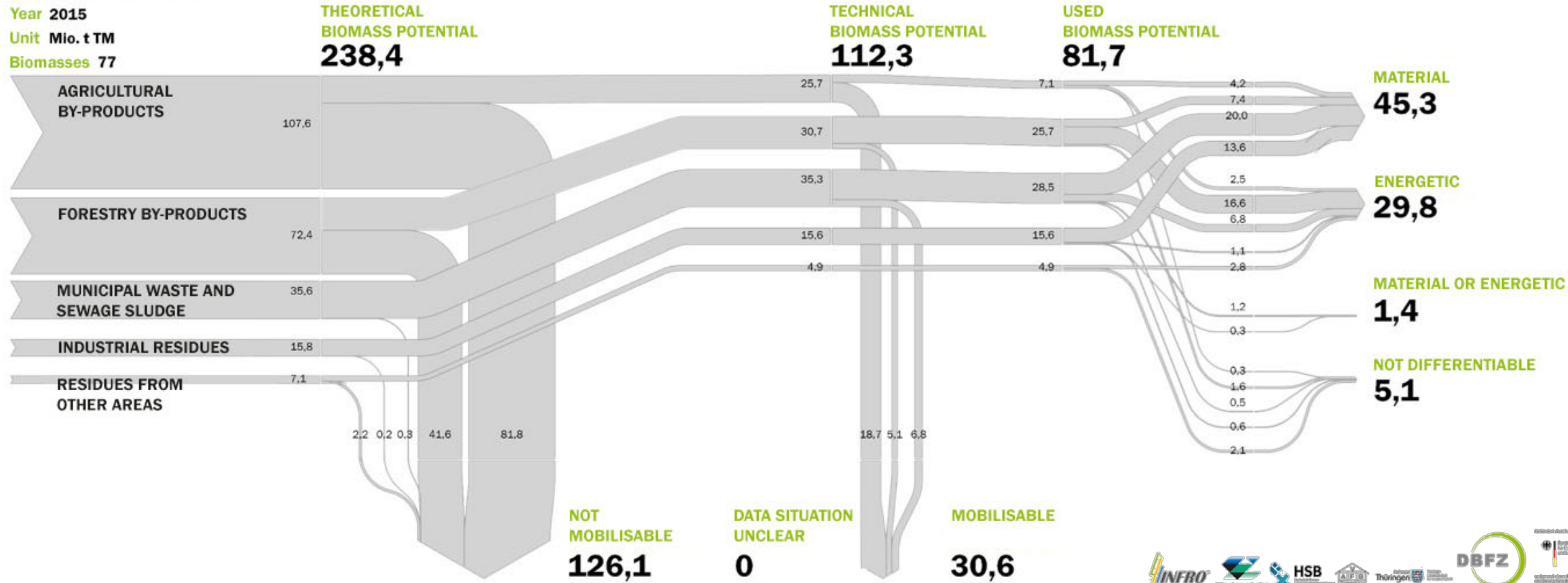
Source: Working Group on Energy Balances (AG Energiebilanzen) "Energieverbrauch in Deutschland im Jahr 2021" Last update 2022-02-14
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- 3. Energy from biogenic waste and residues in Germany**
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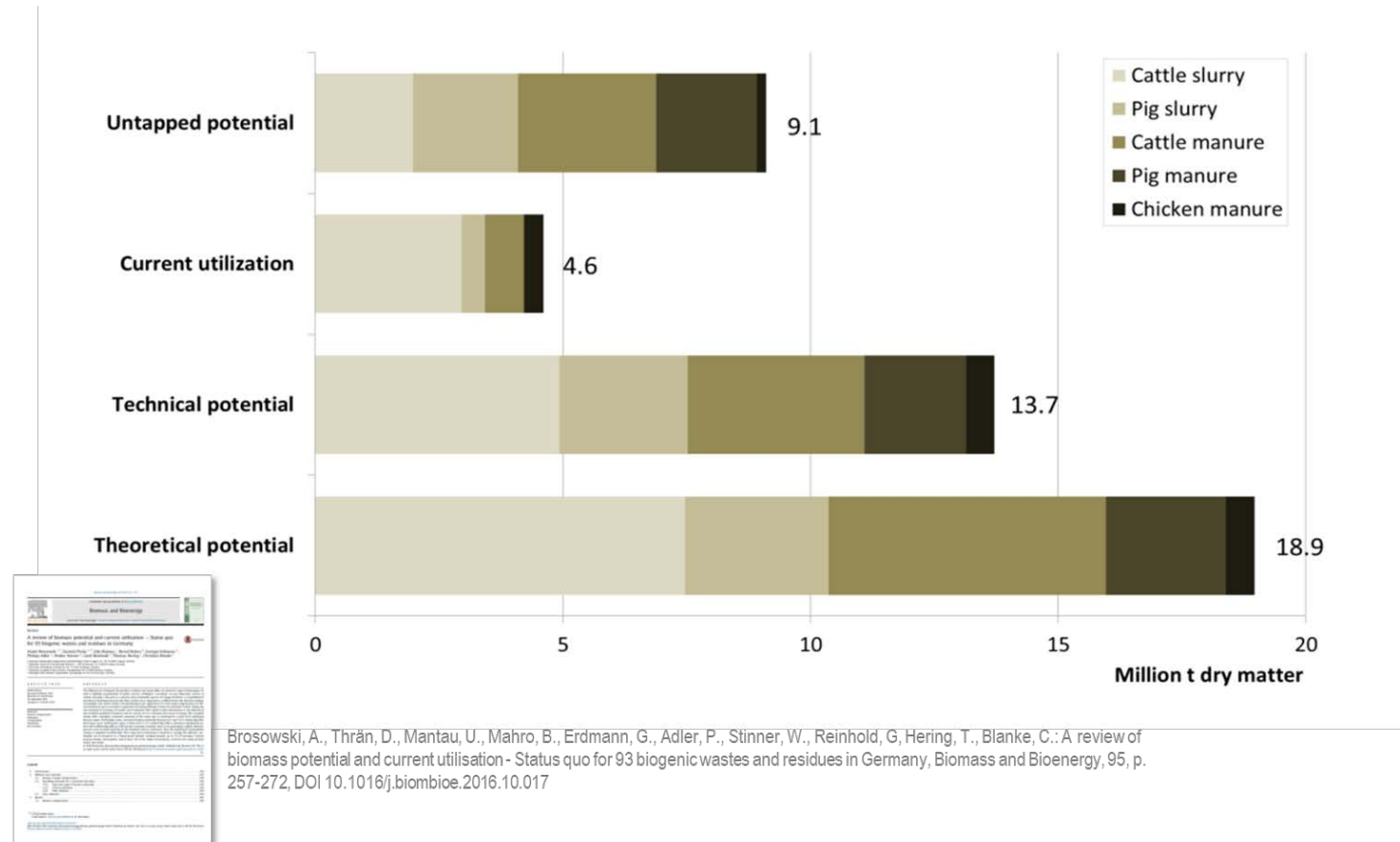
Resource base: Biogenic residues in Germany

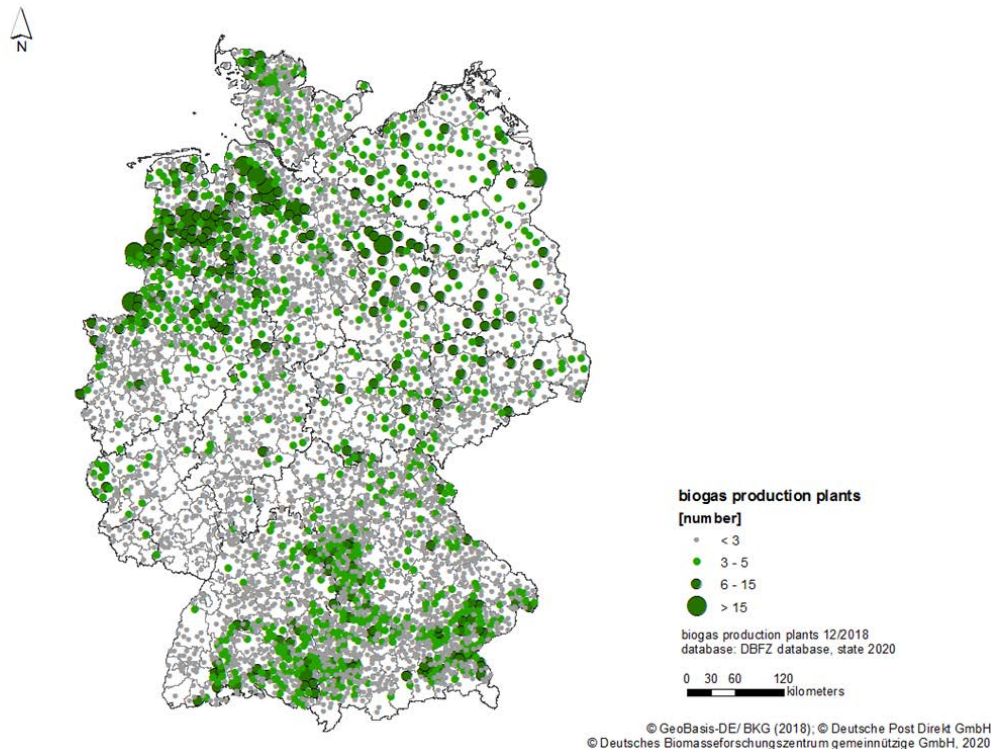
AVERAGE VALUES





Slurry and manure from livestock in Germany - Resource potentials





Biogas plants (2019): ~9,100 plants
~ 8,900 on-site electricity conversion
of biogas

~200 upgrading to biomethane

Installed electrical capacity

→ 5,9 GW_e

Gross electricity production

→ 31,9 TWh_e



Heat supply

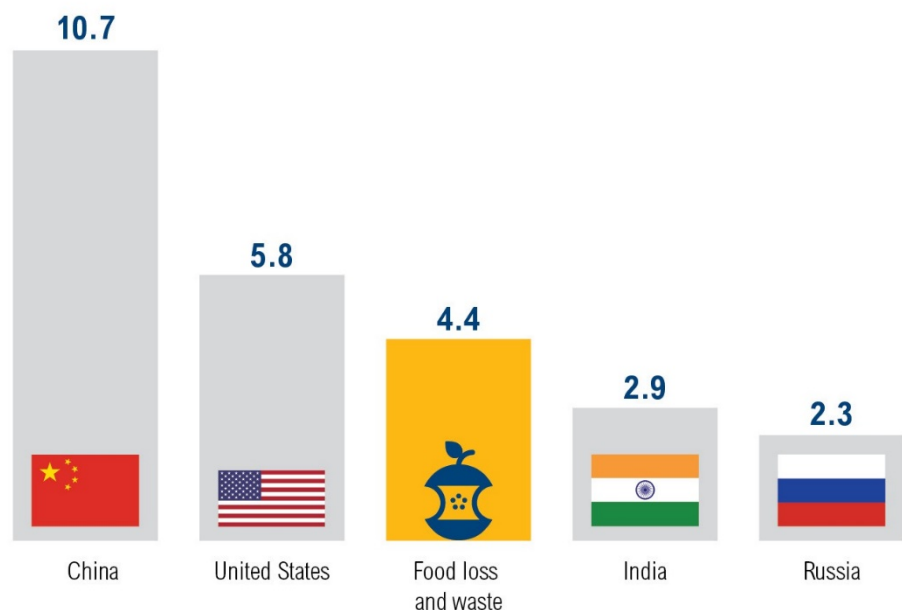
→ 19,3 TWh_{th}



References: DBFZ Database biogas, state 6/2020, DBFZ 2020

Biowaste worldwide in Europe and Germany

If Food Loss and Waste Were its own Country,
it Would Be the Third-Largest Greenhouse Gas Emitter



GT CO₂E (2011/12)*

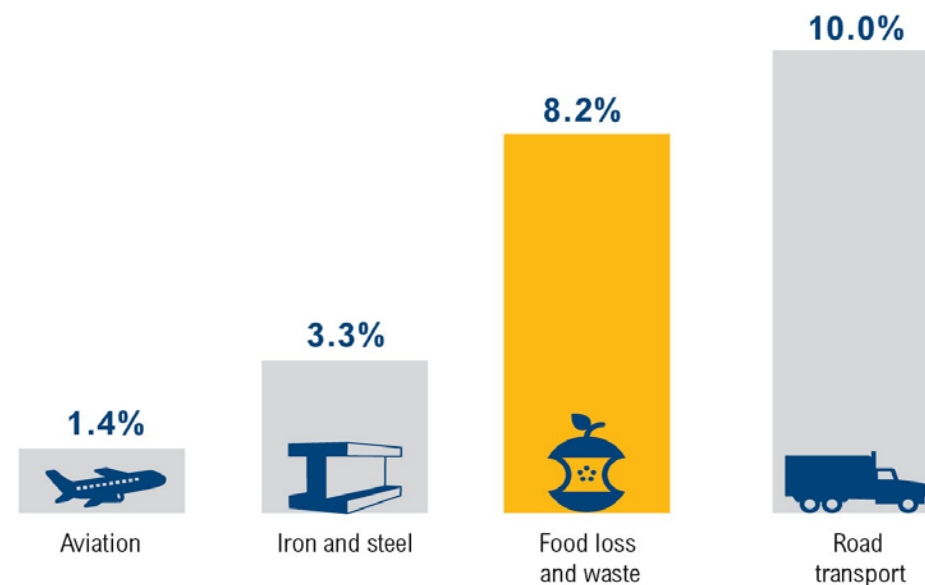
* Figures reflect all six anthropogenic greenhouse gas emissions, including those from land use, land-use change, and forestry (LULUCF). Country data is for 2012 while the food loss and waste data is for 2011 (the most recent data available). To avoid double counting, the food loss and waste emissions figure should not be added to the country figures.

Source: CAIT, 2015; FAO, 2015. *Food wastage footprint & climate change*. Rome: FAO.



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Greenhouse Gas Emissions from Food Loss and Waste
Approach the Levels from Road Transport



SHARE OF GLOBAL GREENHOUSE GAS EMISSIONS (2011/12)*

* Sector data is for 2012 while the food loss and waste data is for 2011 (the most recent available). Since the food loss and waste data combines emissions from various lifecycle stages of the food that is ultimately lost or wasted (e.g., road transport, landfills), the food loss and waste figure should not be added to the sector figures in order to avoid double counting.

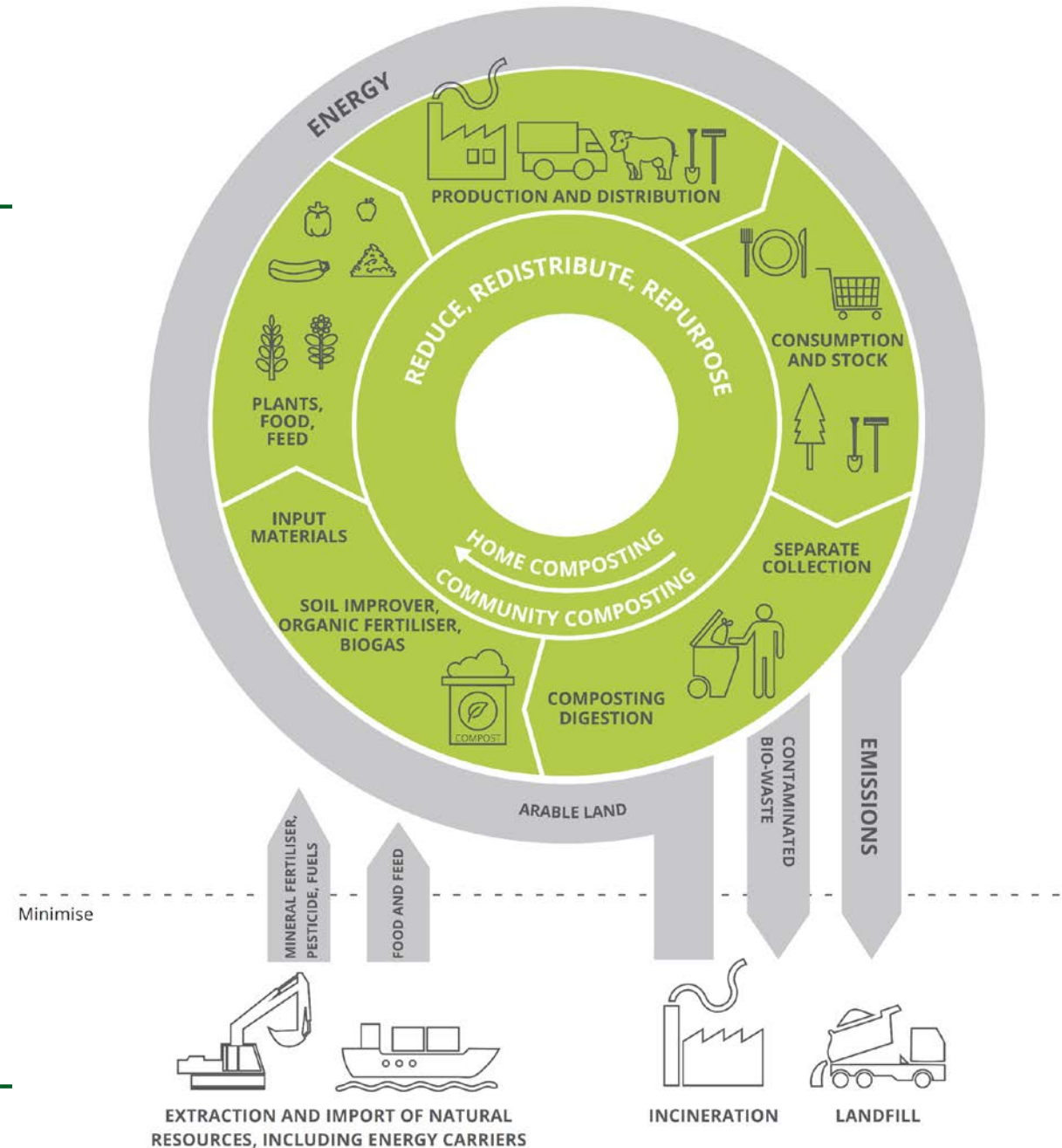
Source: International Energy Agency (IEA). 2014. *CO₂ Emissions from Fuel Combustion* (2014 edition). Paris: OECD/IEA; WRAP, 2014. *Strategies to achieve economic and environmental gains by reducing food waste*.

22 Banbury, UK: WRAP; FAO, 2015. *Food wastage footprint & climate change*. Rome: FAO.



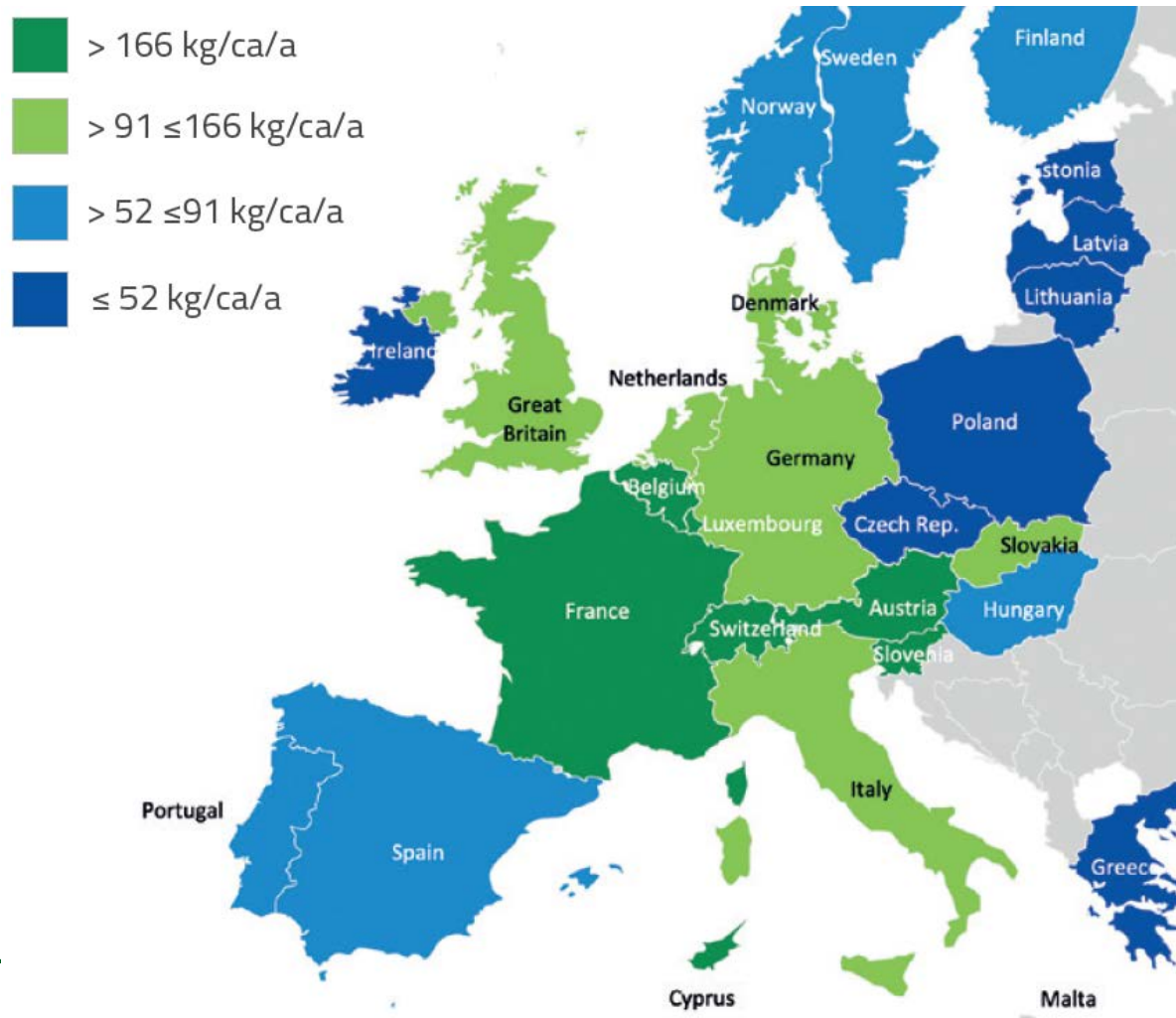
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Bio-waste in a circular economy



EEA Report No 04/2020 - Bio-waste in Europe
- turning challenges into opportunities

Bio-Waste collected in EU+ (2020) [kg per capita]



Challenge for Europe:

The share of the separate collection of biowaste in Europe was around 50% in 2020!

ECN data report 2022

Examples of biowaste in Germany





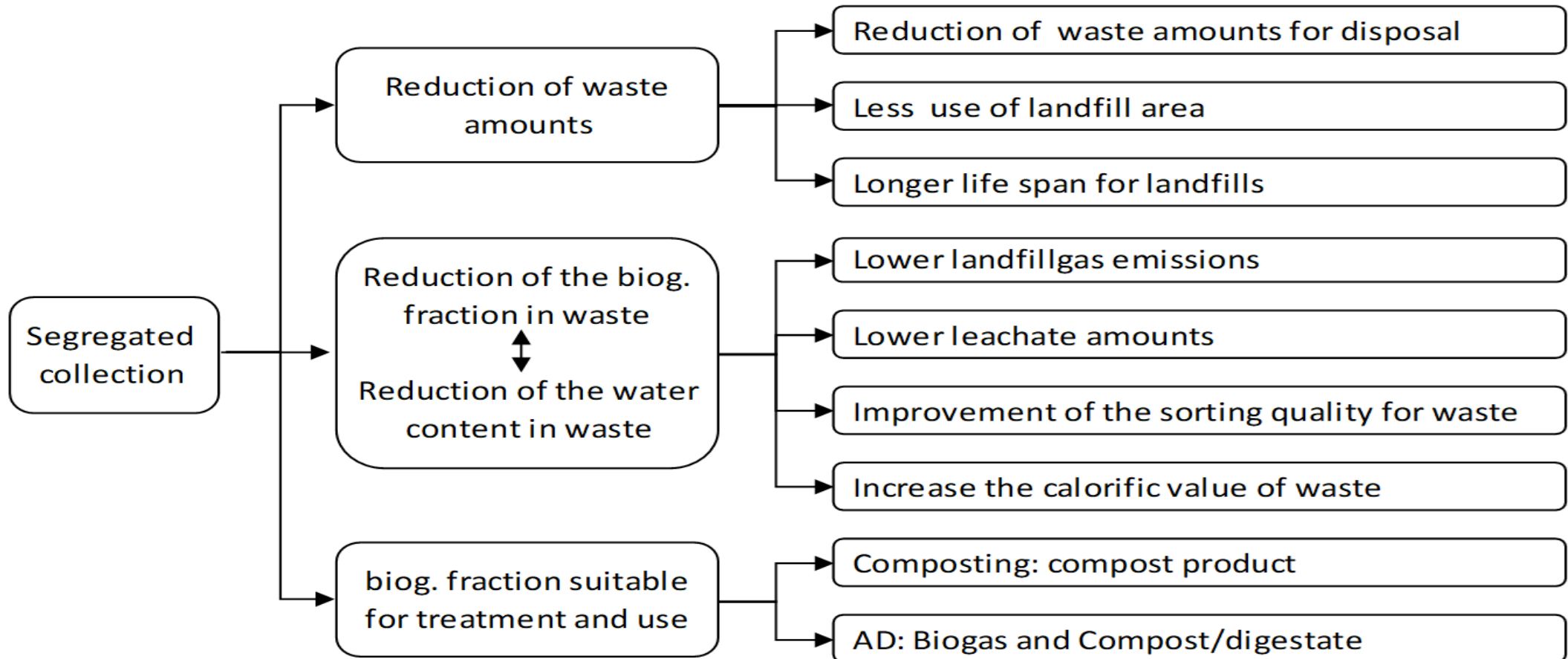
↑
Residual waste

↑
Organic waste
(kitchen & green
waste)

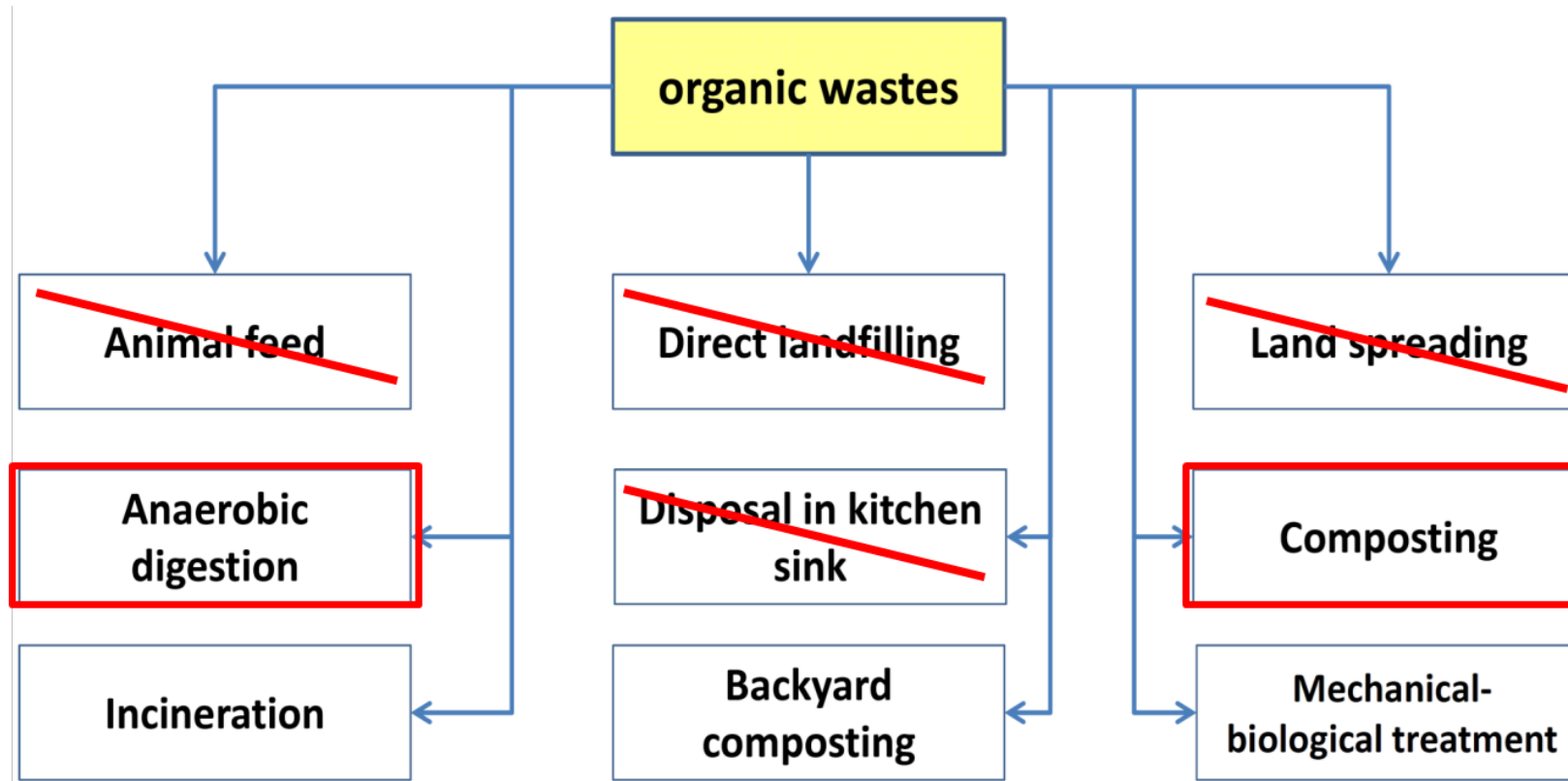
↑ ↑
Paper and
cardboard

↑ ↑
Lightweight packaging
waste made from
plastic, aluminium, tin
and compounds
materials

Source: Nassour

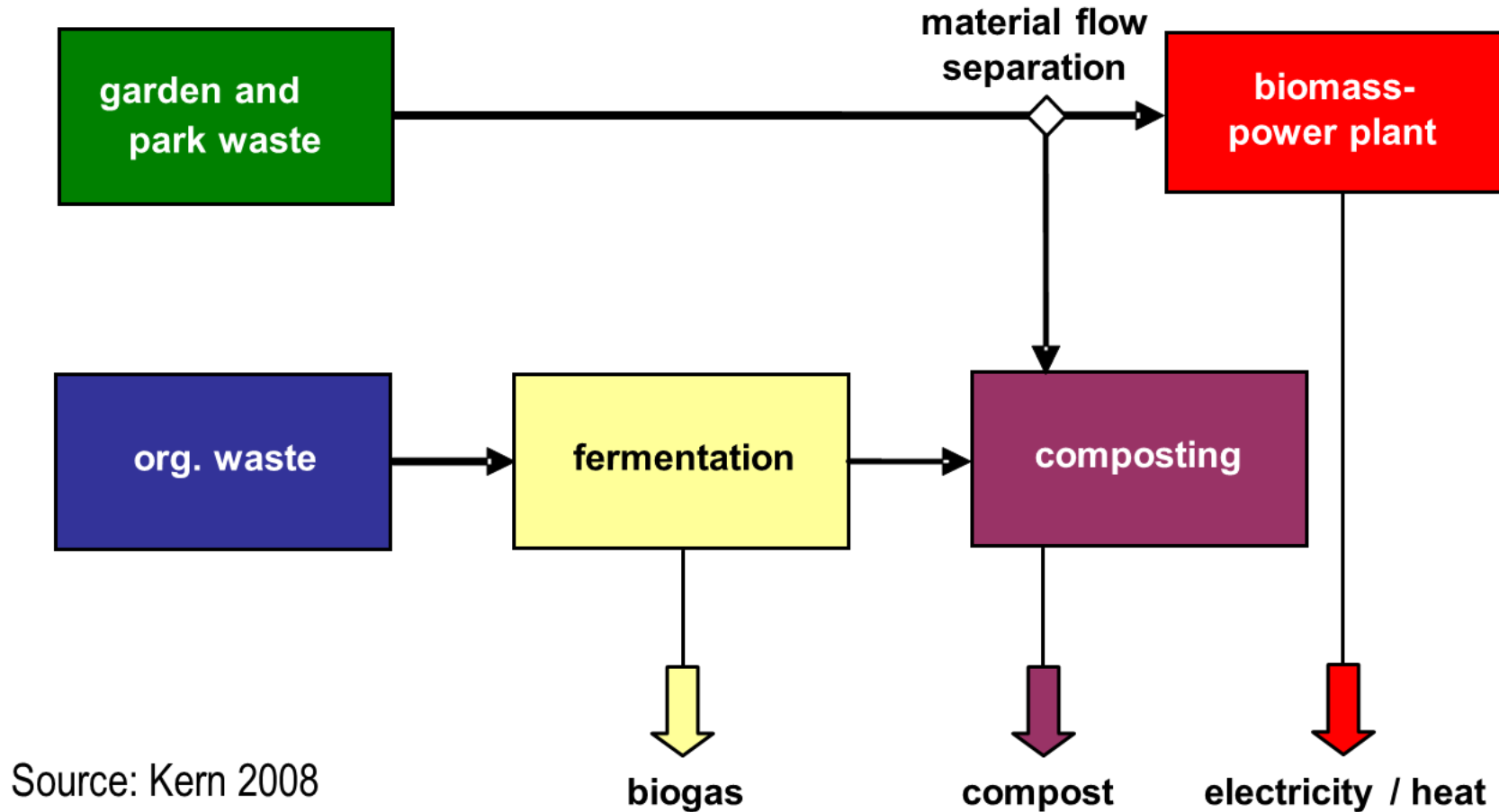


Nassour

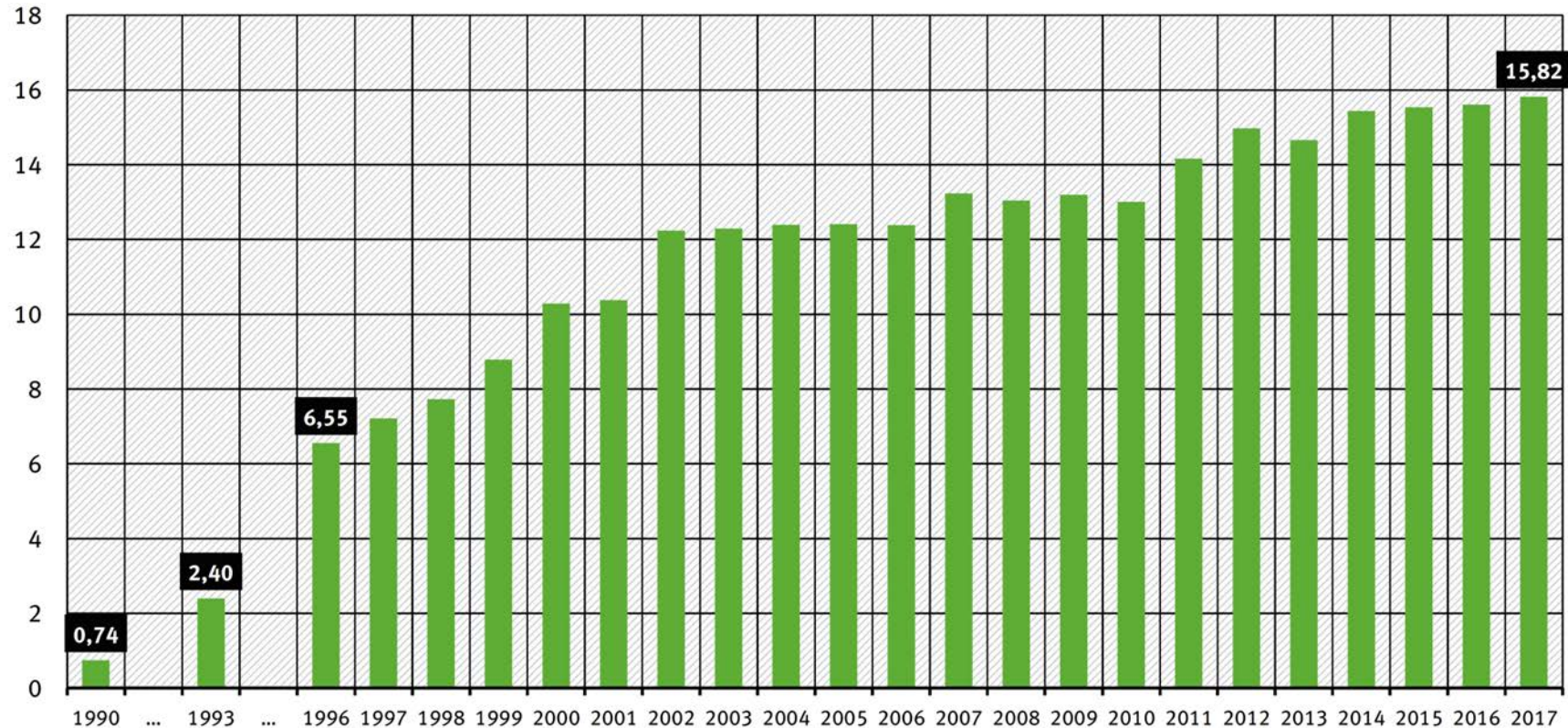


Source: Morscheck

Integration of the anaerobe fermentation process into the waste treatment concept



Composting of biowaste in Germany – Input in 2018 [Mill. Mg]

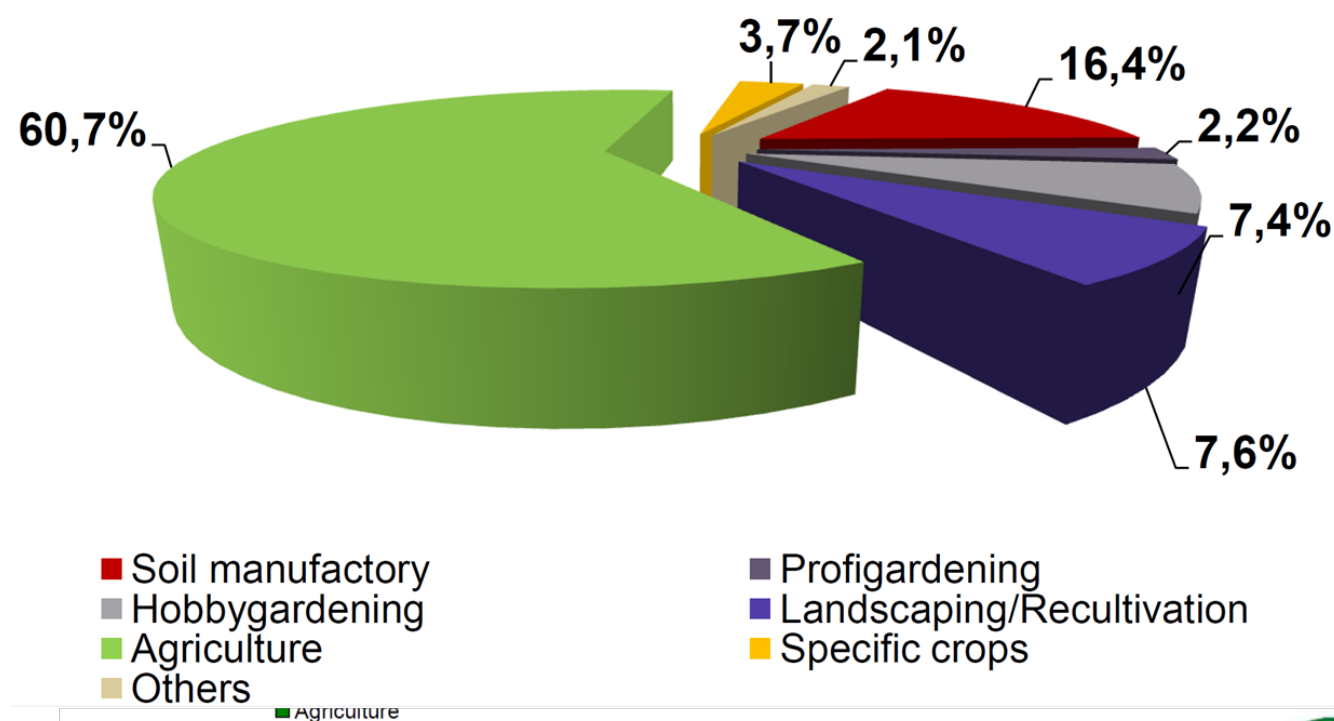


- 47 % of the composting plants treat only green waste
- 53% of plants treat a mix of separately collected biowaste and green waste

destatis, 2020

Compost - Marketing Structure Germany 2017

3.9 mill. tons of compost



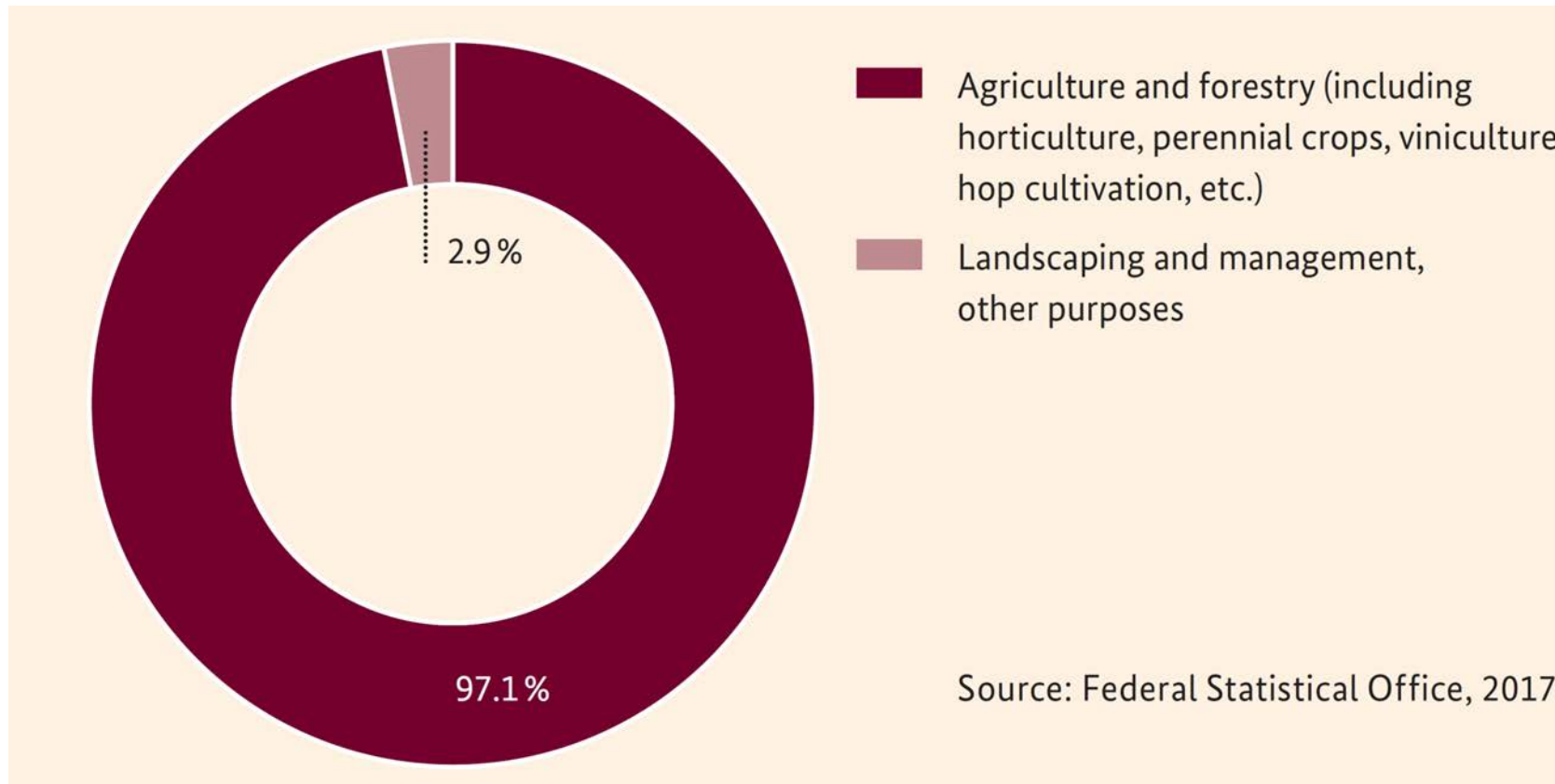
■ Soil manufactory
■ Hobbygardening
■ Agriculture
■ Others

■ Profigardening
■ Landscaping/Recultivation
■ Specific crops

Bundesgütegemeinschaft
Kompost e.V.



Digestate - Marketing Structure Germany 2017 (3.4 mill. tons of digestate)



Threshold values in the biowaste ordinance (BioAbfV) and in the fertilizer ordinance (DüMV)

		Treshold values		Product quality of compost Germany 2013; n = 2,834)
		Compost according DüMV and BioAbfV		
		20 tons DM per ha within 3 years	30 tons DM per ha within 3 years	
Arsen (As)	mg/kg DM	40	40	
Blei (Pb)		150	100	33.97
Cadmium (Cd)		1,5	1.0	0.42
Chrom (Cr-Total)		100	70	23.5
Chrom (VI)		2,0	2,0	
Nickel (Ni)		50	35	14.7
Mercury (Hg)		1,0	0,7	0.11
Thallium (Tl)		1,0	1,0	
Copper (Cu)		100	70	42.3
Zink (Zn)		400	300	173
Perfluorinated surfactants	ng/kg DM (WHO-TEQ)	0,1	0,1	
Dioxins/Furans (PCDD/ PCDF) and dl-PCB		30	30	Bundesgütegemeinschaft Kompost e.V. (BGK)

Impurities
(limit values)

- ▶ Max. 0.5 weight-% in DM selectable, species-inappropriate material > 2 mm diameter
- ▶ Total surface area of impurities < 25 cm²/l FM (if more impurities than 0.1 weight-% DM were found)
- ▶ Stones > 10 mm: max. 5 weight-% in DM



Impurities were sorted out of a 1 liter digestate test sample

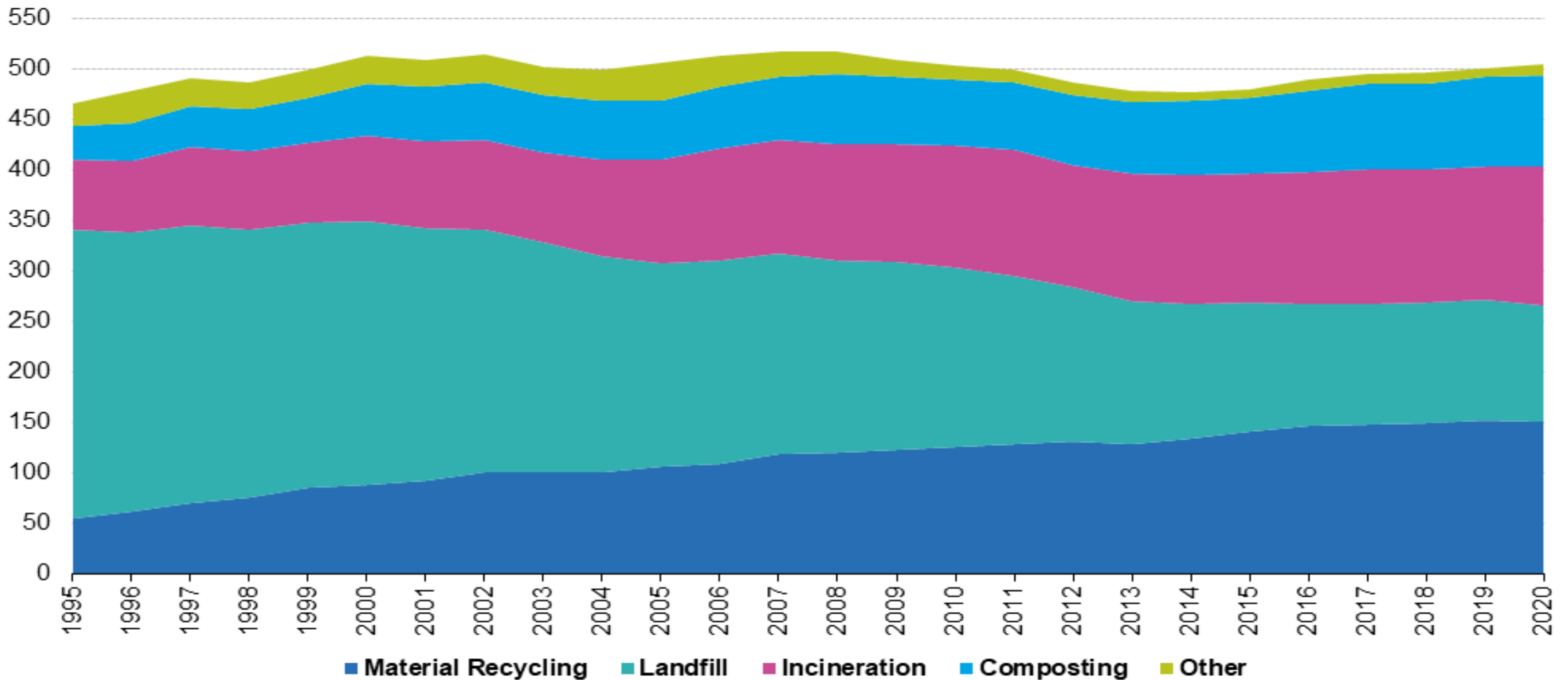
production of good-looking compost and digestate is an essential task of composting and digestion plants

Bundesgütegemeinschaft
Kompost e.V. (BGK)

Residual Waste in Europe and Germany

Municipal waste treatment, EU, 1995-2020

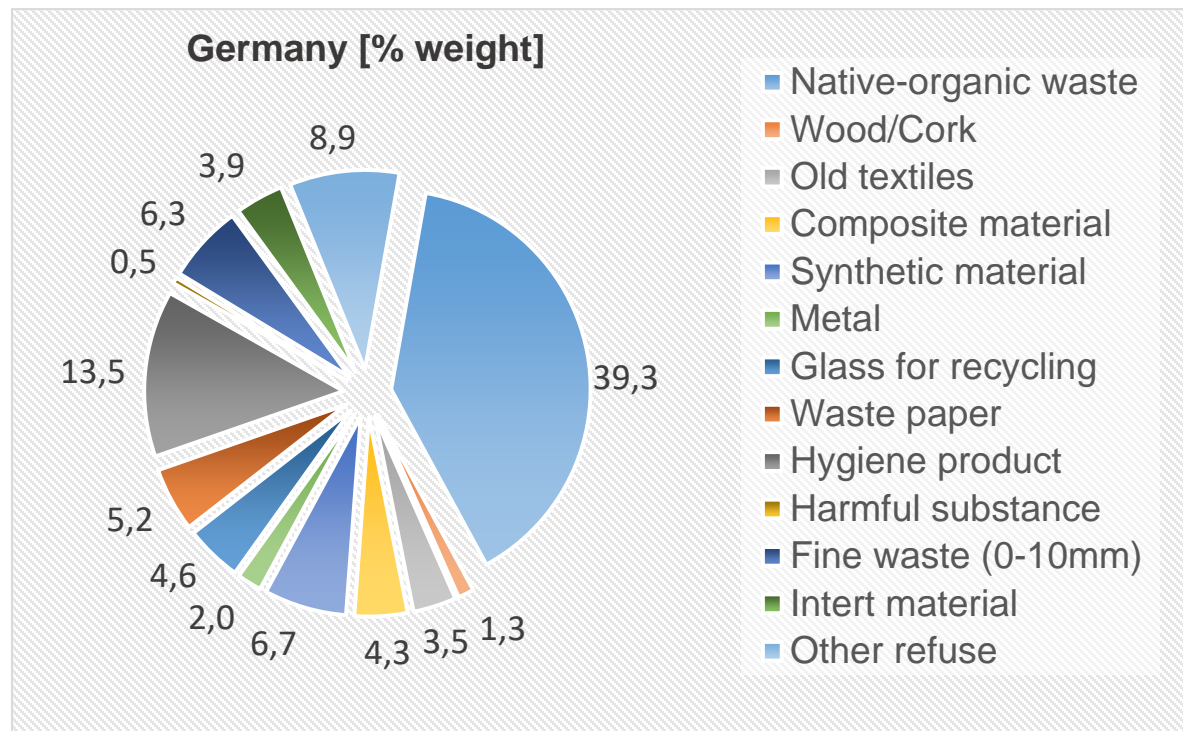
(kg per capita)



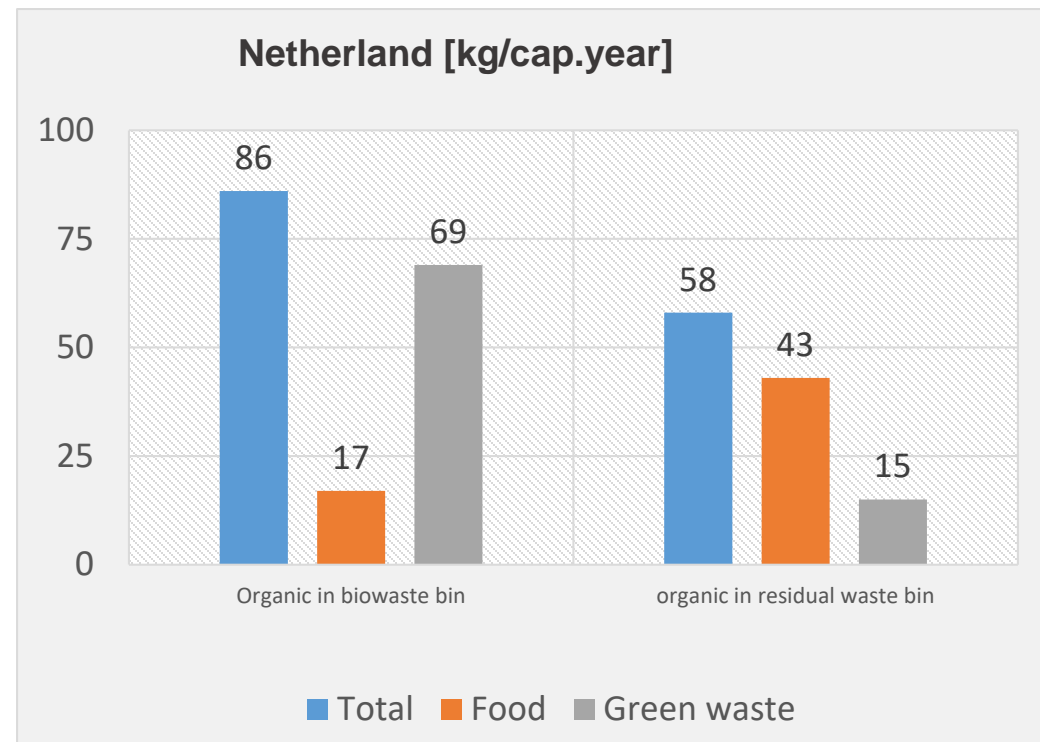
Note: estimated by Eurostat.

Source: Eurostat (online data code: env_wasmun)

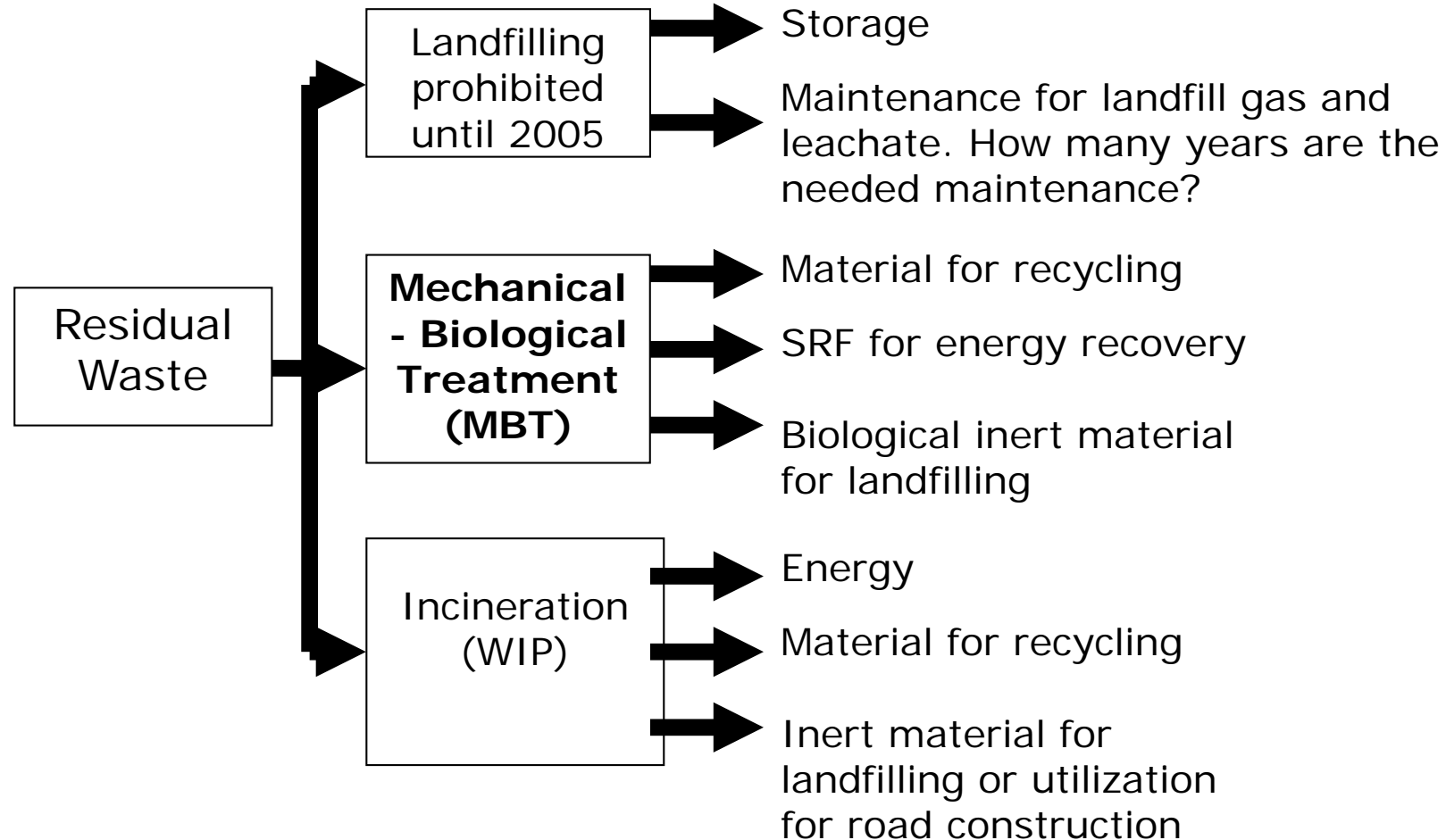
Organic waste in Germany and the Netherlands 2019 and 2020



Composition of residual waste in Germany

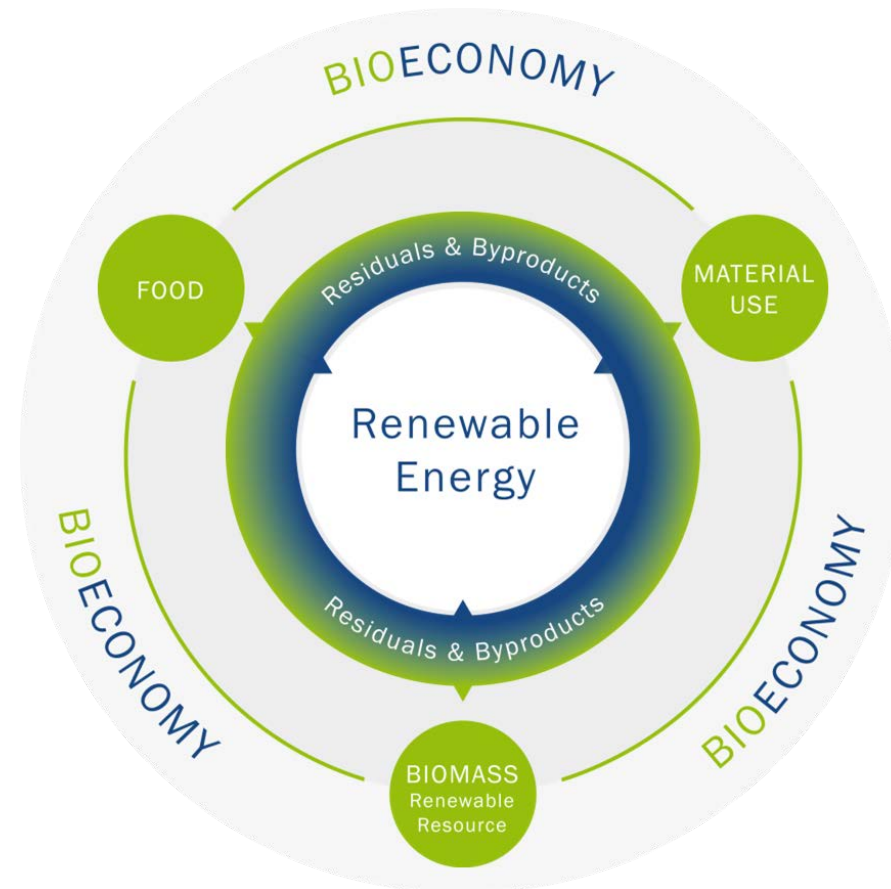


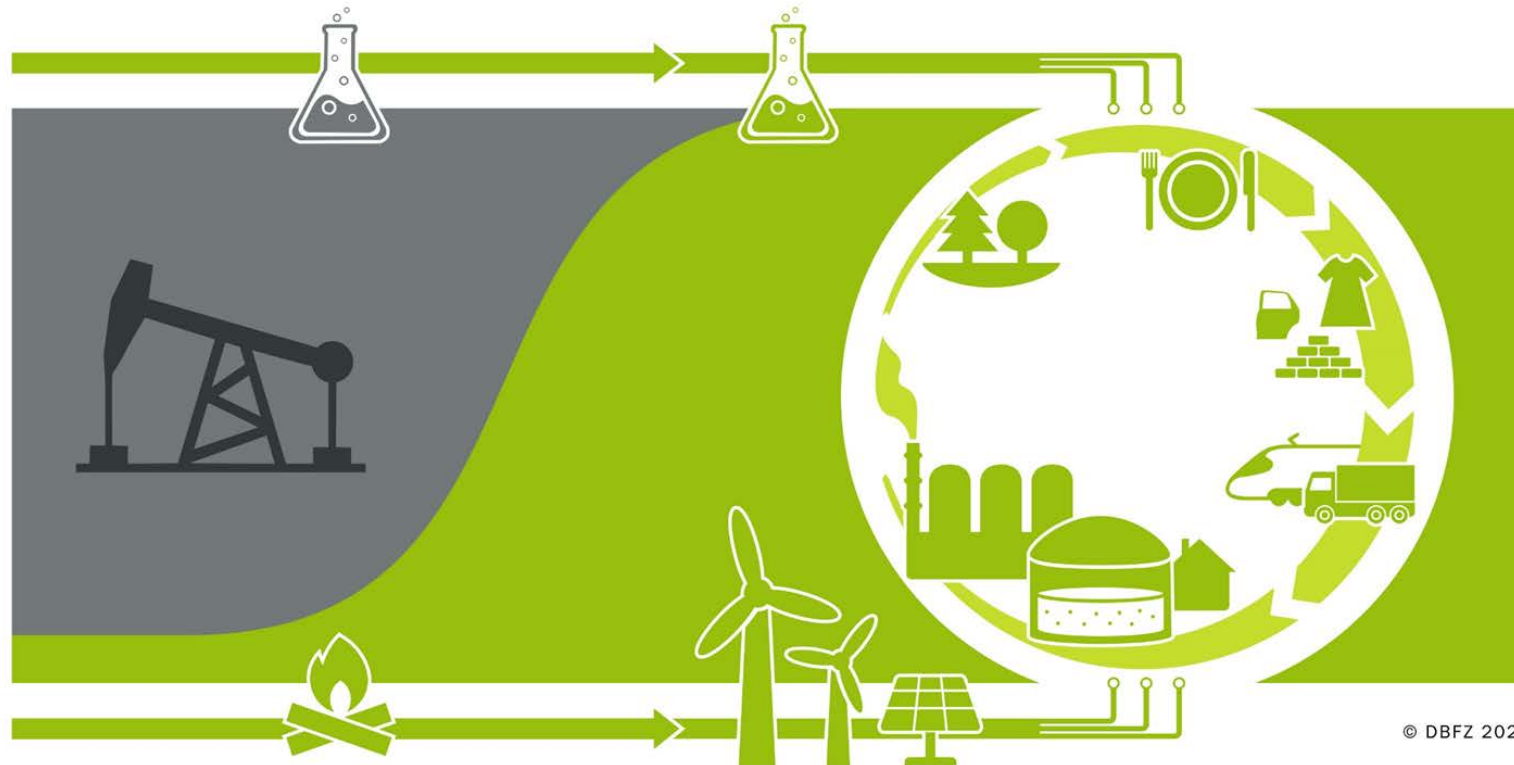
Collection of organic waste in the Netherland





















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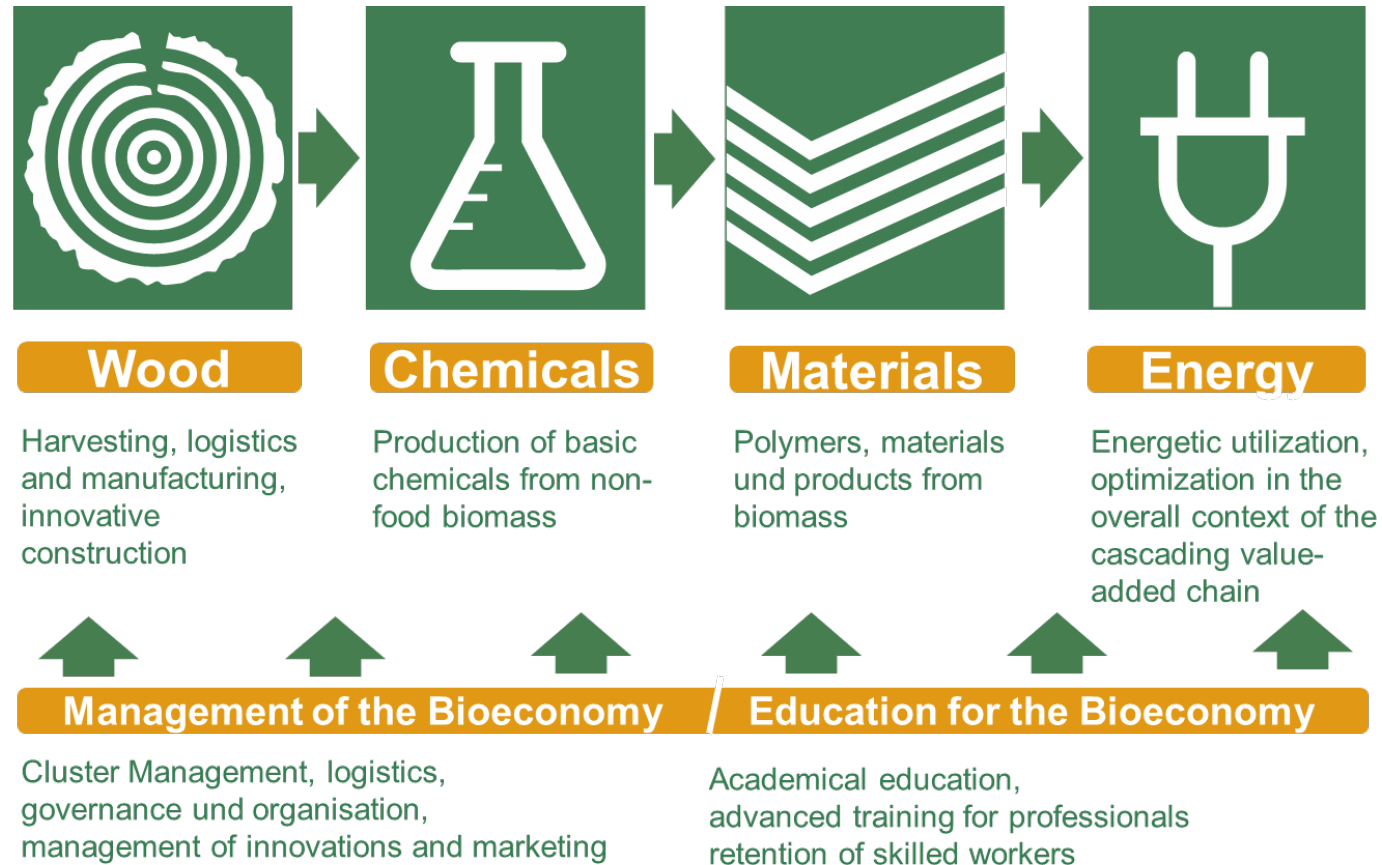
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Biobased products and energy fuels – targets and sectors

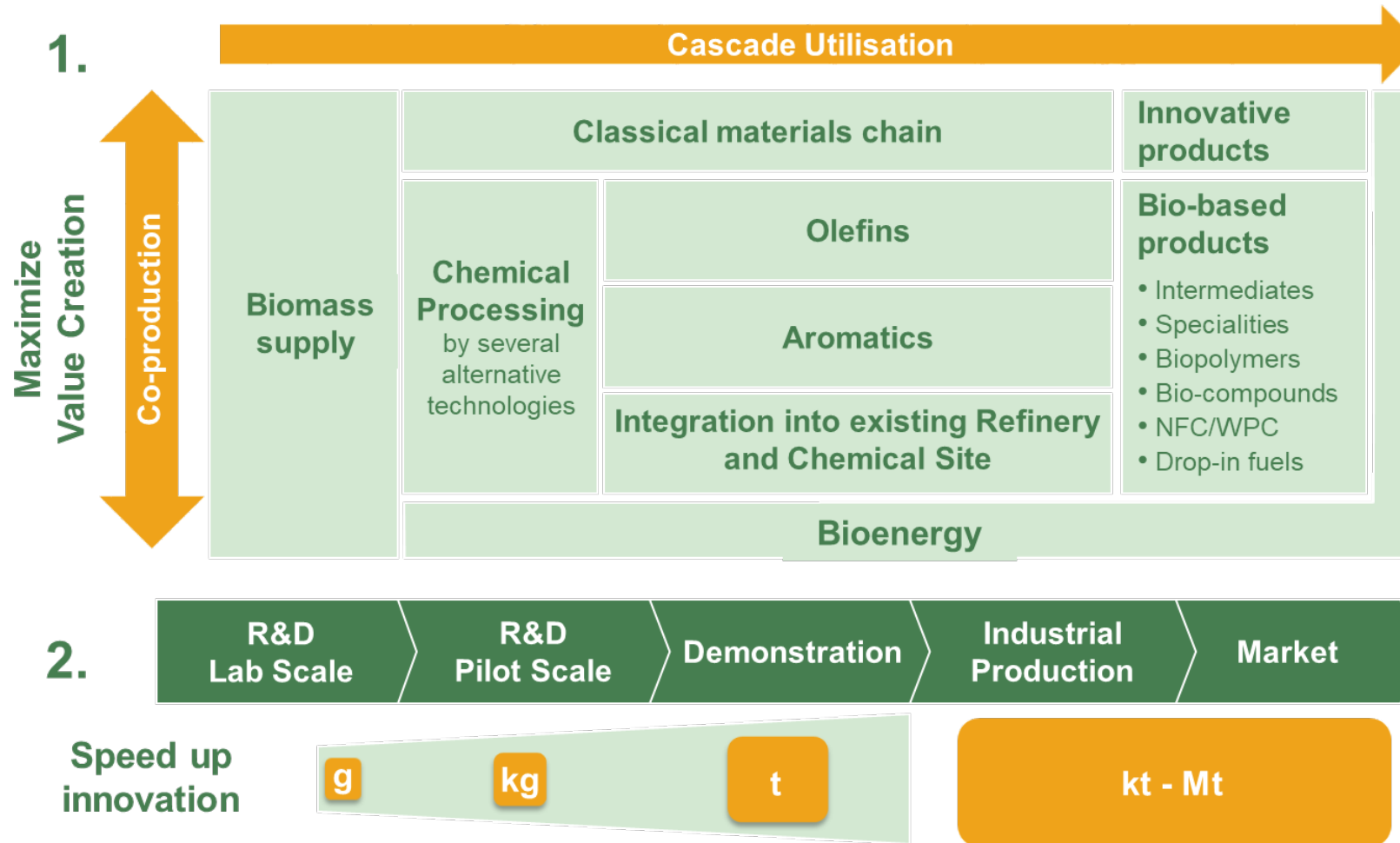
Sectors Target	Agriculture and forestry	Processing industry	Engineering	Chemistry/ pharm. industry	Energy sector	Waste management
Climate protection						
Security of supply	Quelle: Martin Dotzauer/DBFZ	Quelle: Andreas Pilz/DBFZ	Quelle: Paul Trainer/DBFZ	Quelle: Paul Trainer/DBFZ	Quelle: Martin Dotzauer/DBFZ	Quelle: Gabi Schoenemann_pixello.de
Innovation						
Rural development	Quelle: Heike_pixello.de	Quelle: Paul Trainer/DBFZ	Quelle: Paul Trainer/DBFZ	Quelle: lichtkunst.73_pixello.de	Quelle: Erdgas Schwaben	Quelle: plu700_pixello.de
Biobased Knowledge						
Biodiversity	Quelle: Margot Kessler_pixello.de	Quelle: H.D. Voitz_pixello.de		Quelle: Didi01 / pixello.de	Quelle: Petra Dirscherl_pixello.de	Quelle: Hartmut910_pixello.de

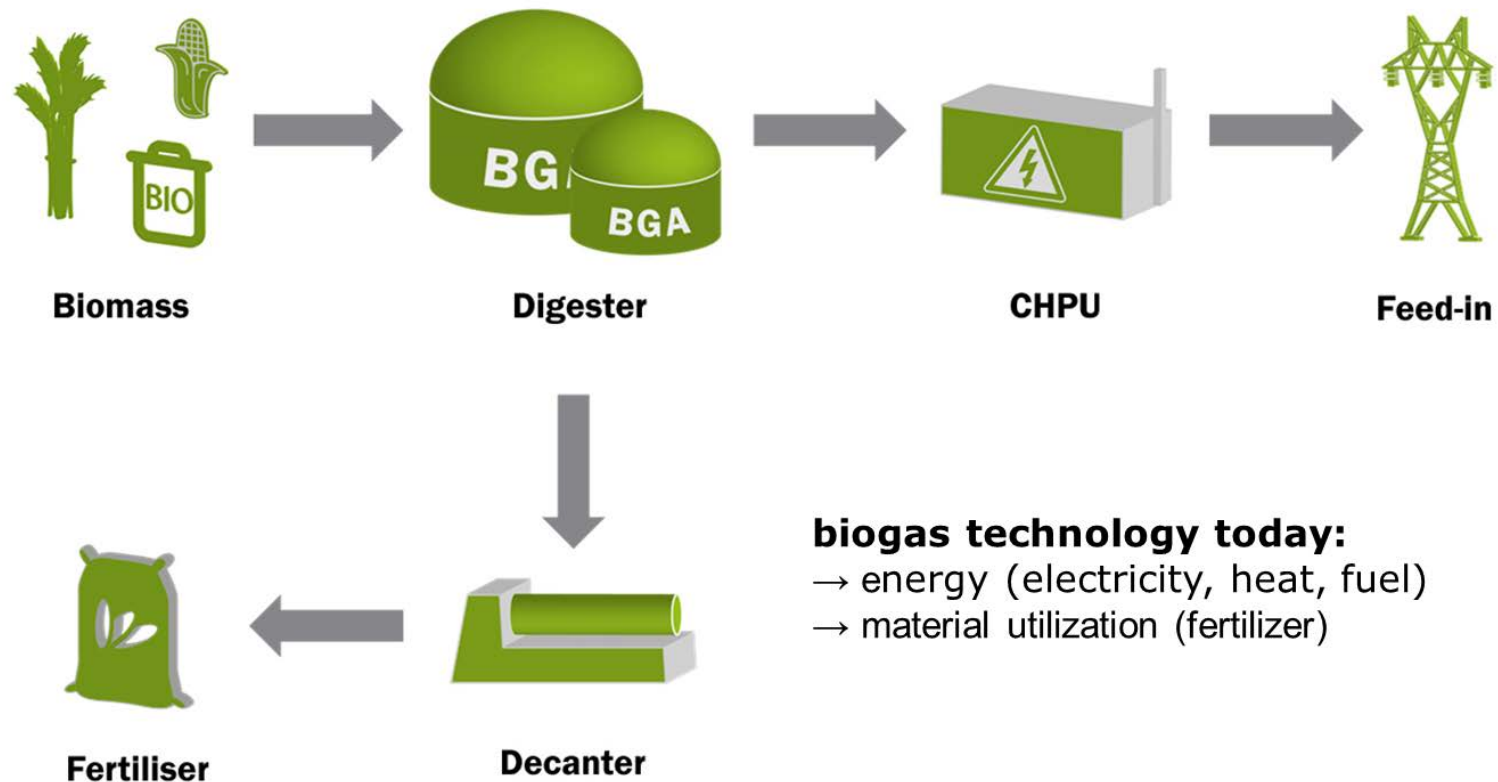


Examples of biobased products

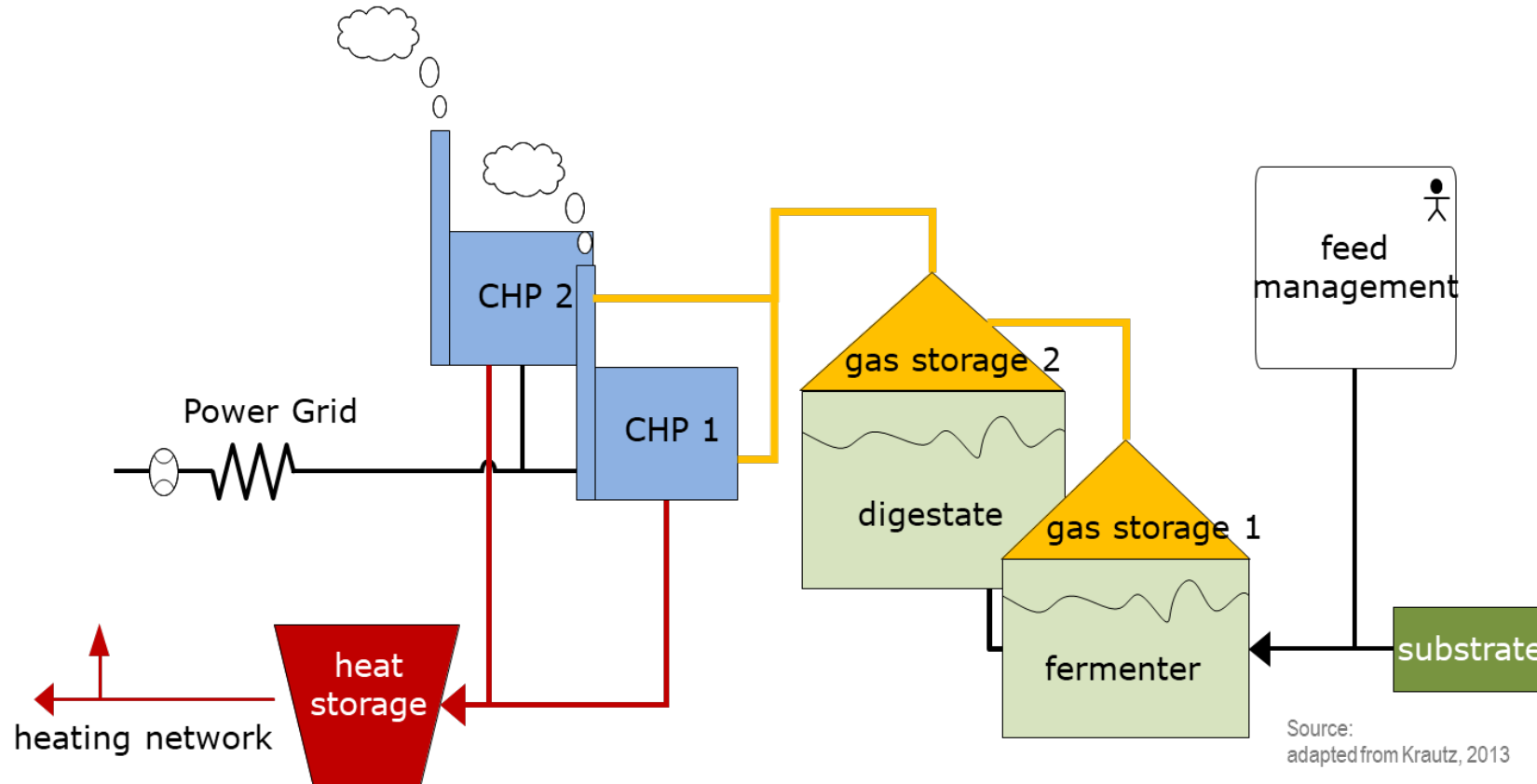


Bilder: DBFZ/Bioeconomy e.V.

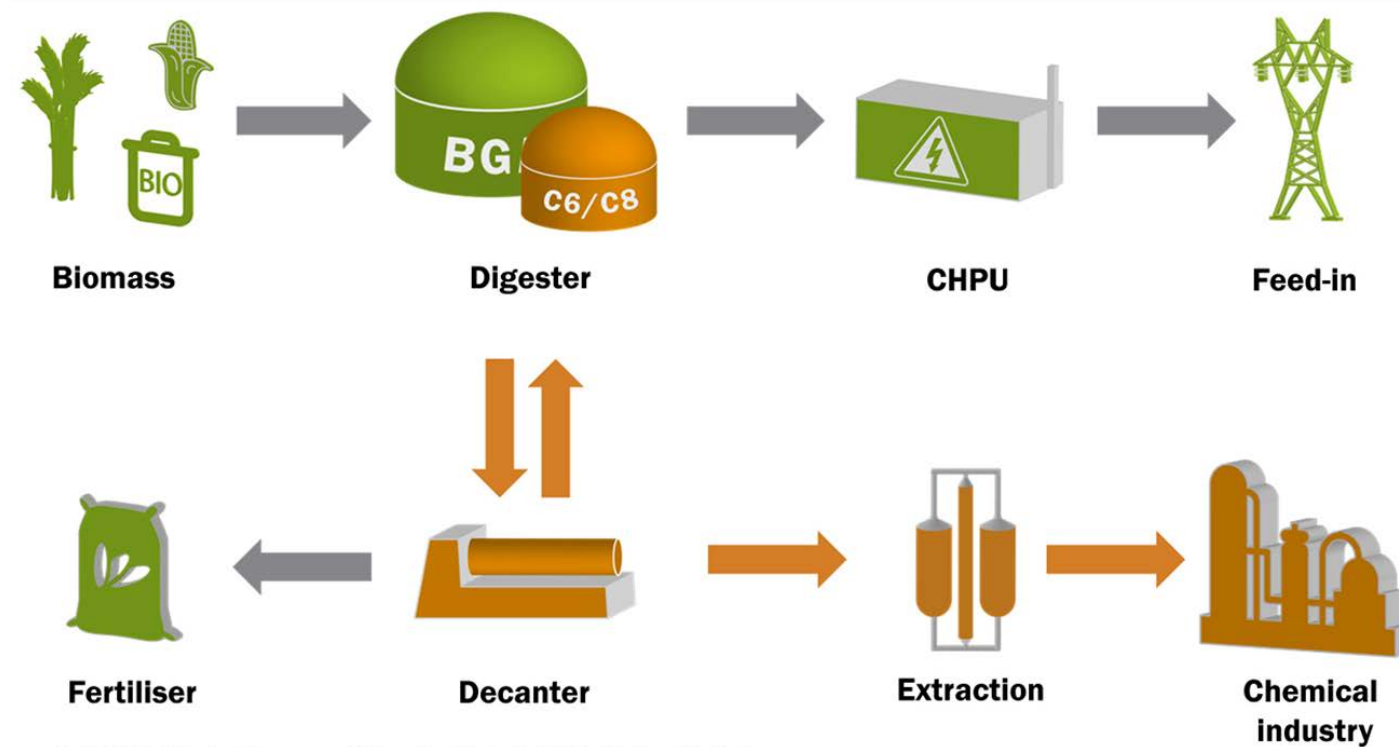




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biogas plants in the future are bio-refineries



© DBFZ: Maria Braune, Björn Schinkel; UFZ: Heike Sträuber

- **Long term vision (2050):** the global Energy System is based on 100 % renewable energy and the bio based economy is well developed in a climate neutral society worldwide!
- **Sustainable utilization of biomass, particularly organic waste and residues** are key elements in the energy system and bio based economy of the future
- The **waste segregation at the source** is a key element to achieve high biowaste recycling rates and a good quality of the compost and/or digestate
- **Germany** is on track to implement in long term a sustainable Circular Economy and Energy System, but there is a long way to go!
- The successful **international cooperation** is one important base to design the future in this field!

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