Universität Rostock Traditio et Innovatio

DBFZ

ECOLOGICALLY AND ECONOMICALLY REASONABLE TECHNICAL CONCEPTS FOR THE UTILISATION OF BIOGENIC WASTE

Michael Nelles[1/2], Haniyeh Jalalipour, Gert Morscheck[1], Satya Narra[1/2], Abdallah Nassour[1], Sven Schaller[2] & Jan Sprafke[1/3]

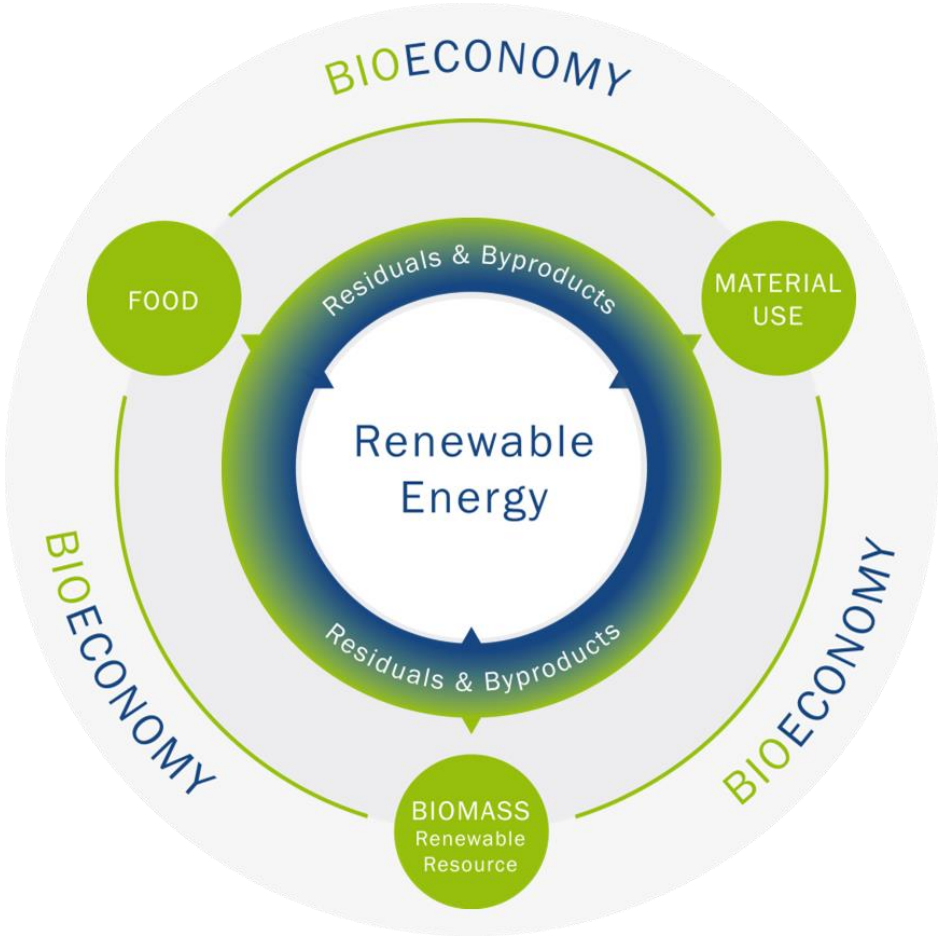
1) University of Rostock, 2) DBFZ, the German Centre for Biomass Research in Leipzig & 3) German RETech Partnership in Berlin

Overview

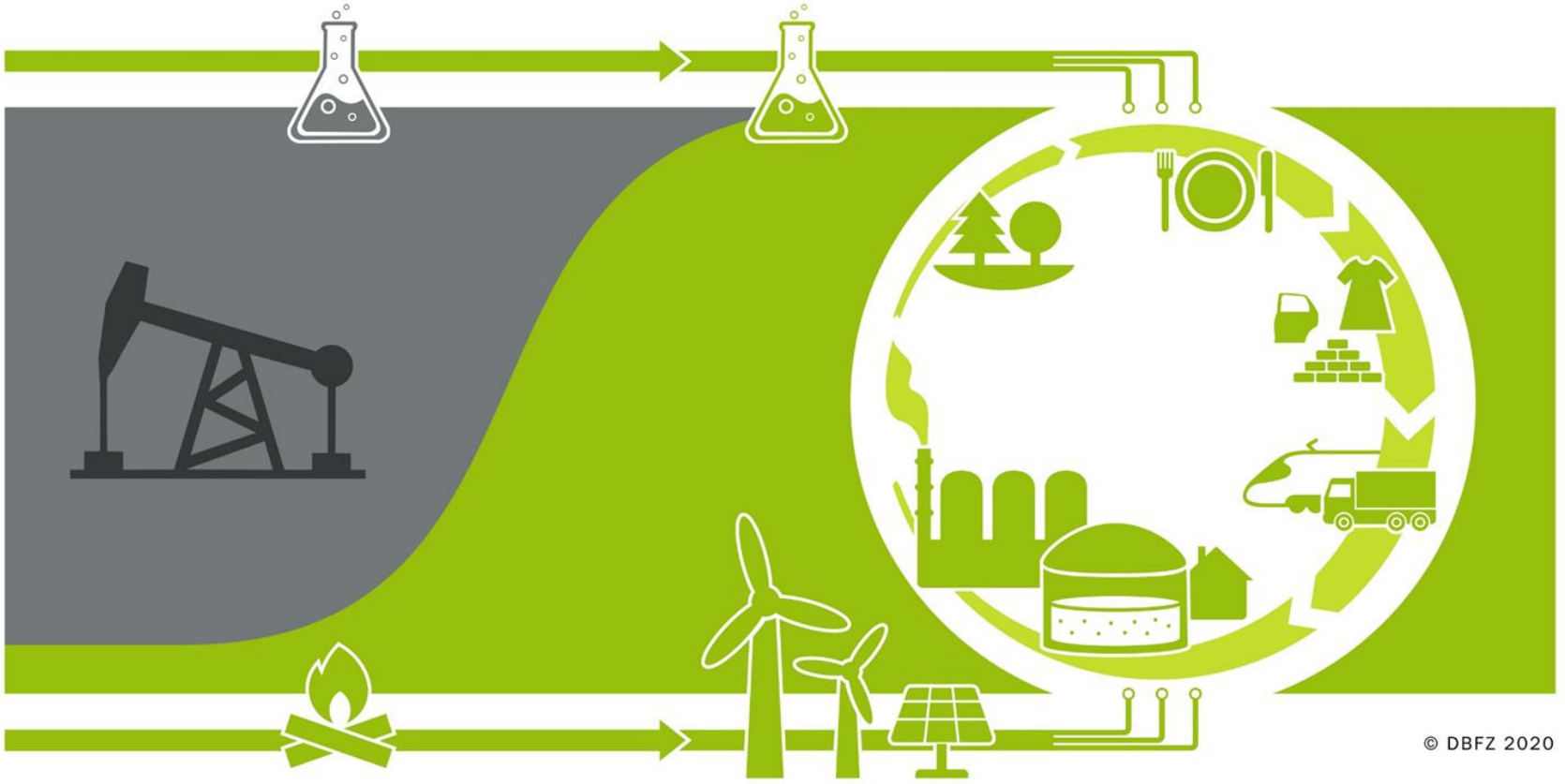
ECOLOGICALLY AND ECONOMICALLY REASONABLE TECHNICAL CONCEPTS FOR THE UTILISATION OF BIOGENIC WASTE

1. **Sustainable Circular Bioeconomy – biobased products and bioenergy**
2. Biogenic waste and residues – ecological challenges
3. Separate collection – a key for sustainable solutions
4. Composting and anaerobic digestion
5. Mechanical-biological treatment of residual waste (mixed solid waste)
6. Conclusion and Outlook

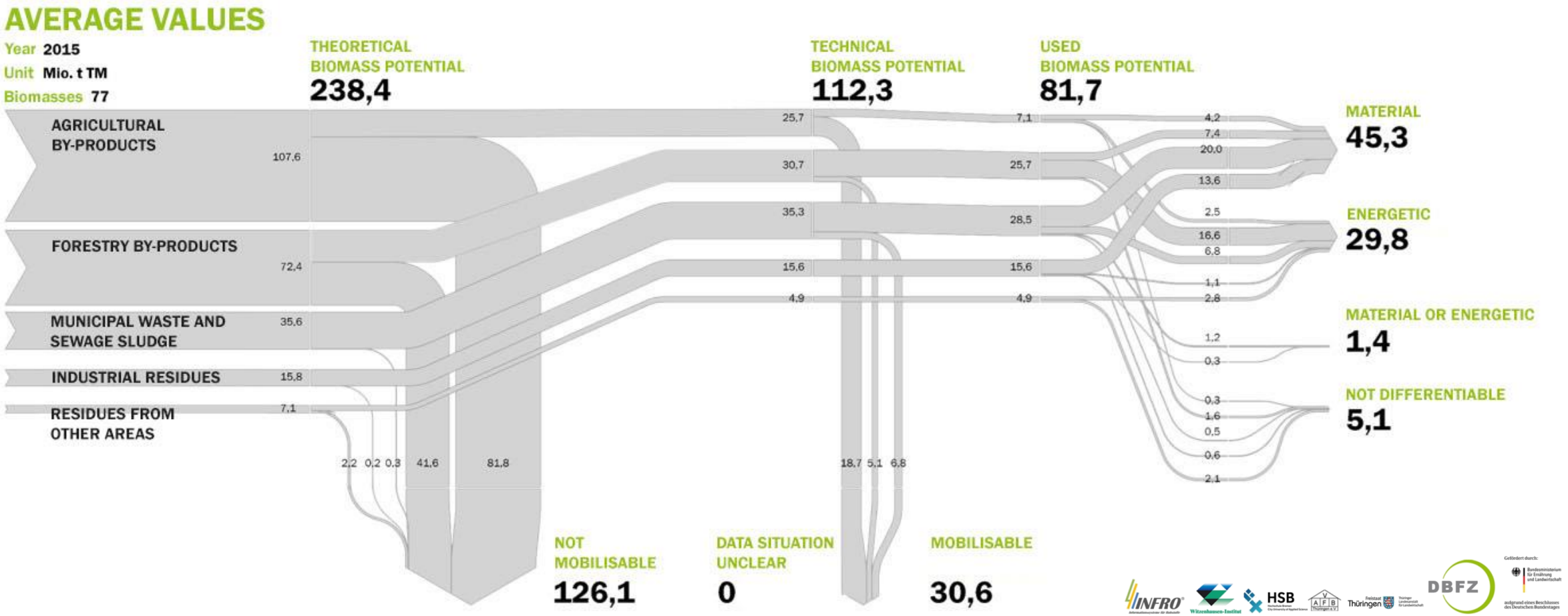
Biomass - a limited resource



DBFZ – „Smart Bioenergy Concept“



Biogenic waste and residues in Germany



Source: Brosowski et al.: How to measure the impact of biogenic residues, wastes and by-products: Development of a national resource monitoring based on the example of Germany, Biomass and Bioenergy, Volume 127, 2019

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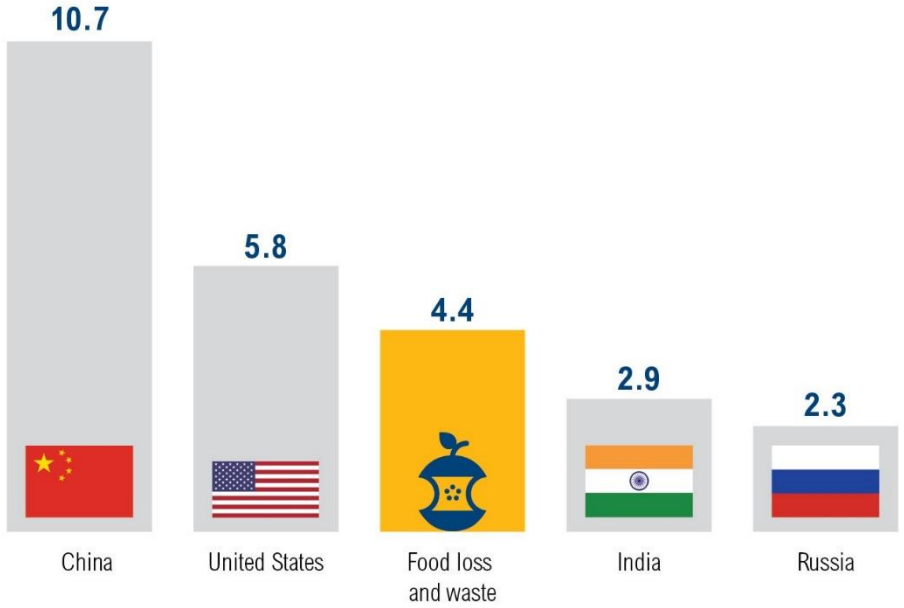
GHG-emissions from food loss and waste worldwide

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



GT CO_2E (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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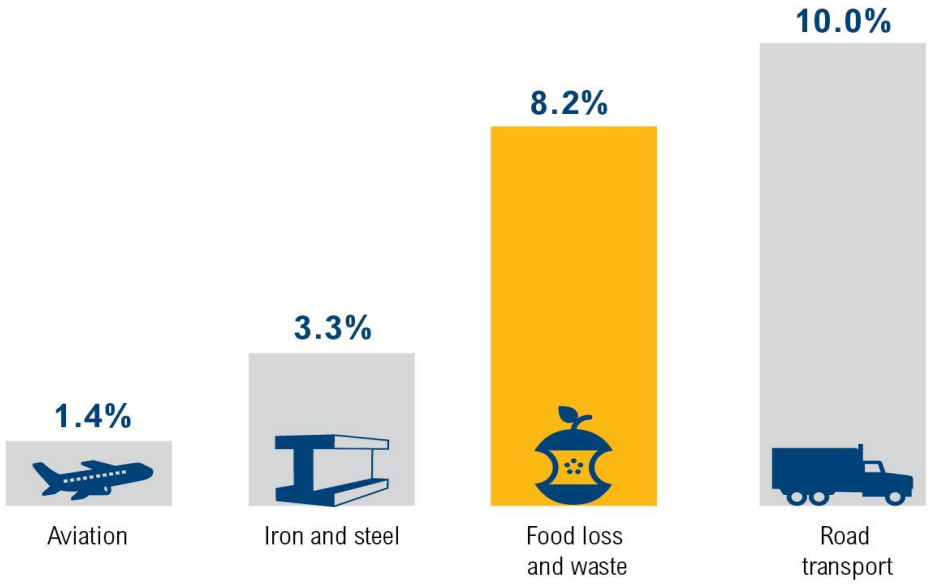
Greenhouse Gas Emissions from Food Loss and Waste Approach the Levels from Road Transport



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. *CO_2 Emissions from Fuel Combustion* (2014 edition). Paris: OECD/IEA; WRAP. 2014. *Strategies to achieve economic and environmental gains by reducing food waste.* Banbury, UK: WRAP; FAO. 2015. *Food wastage footprint & climate change.* Rome: FAO.

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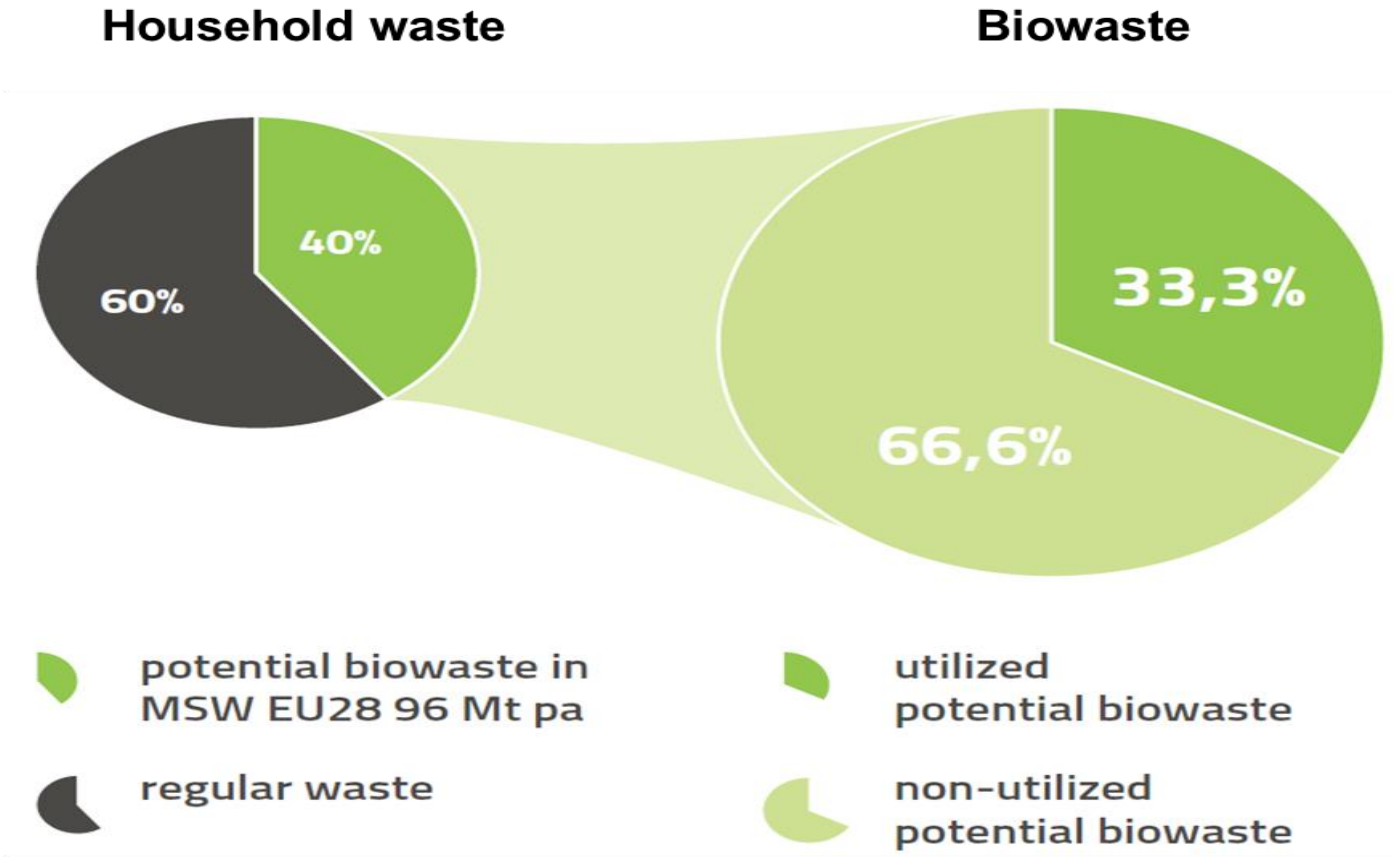
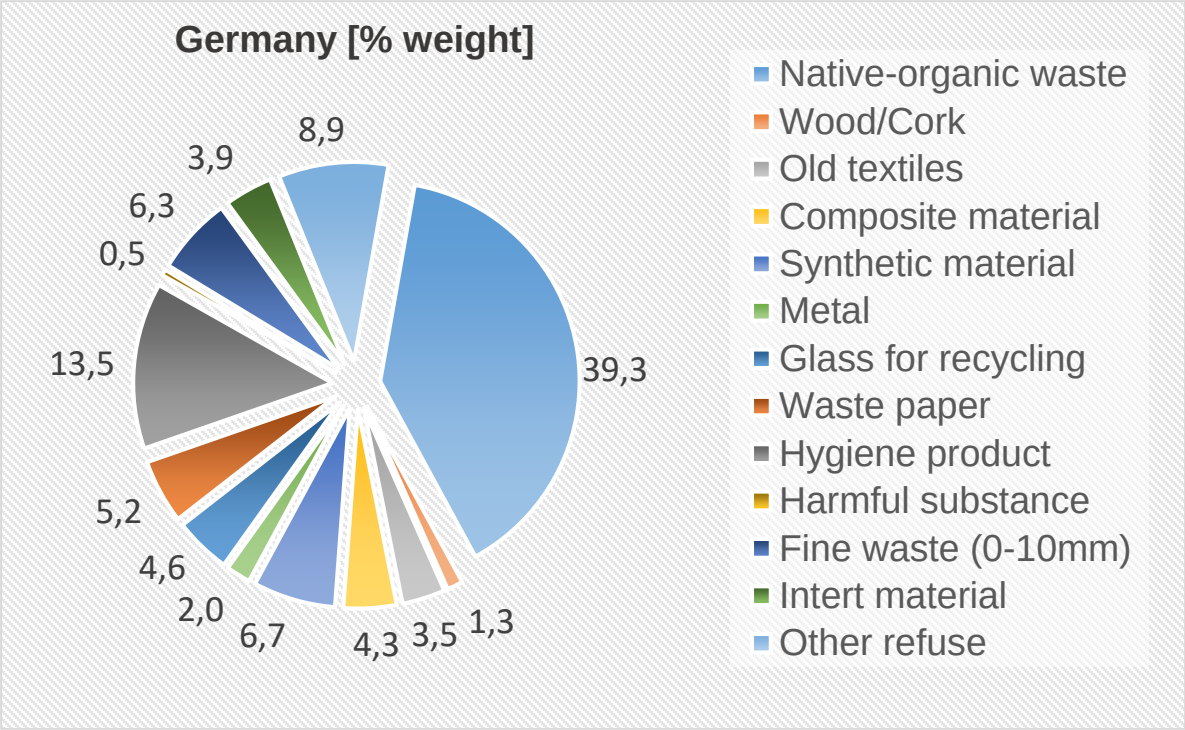
Biowaste potential of households in the European Union



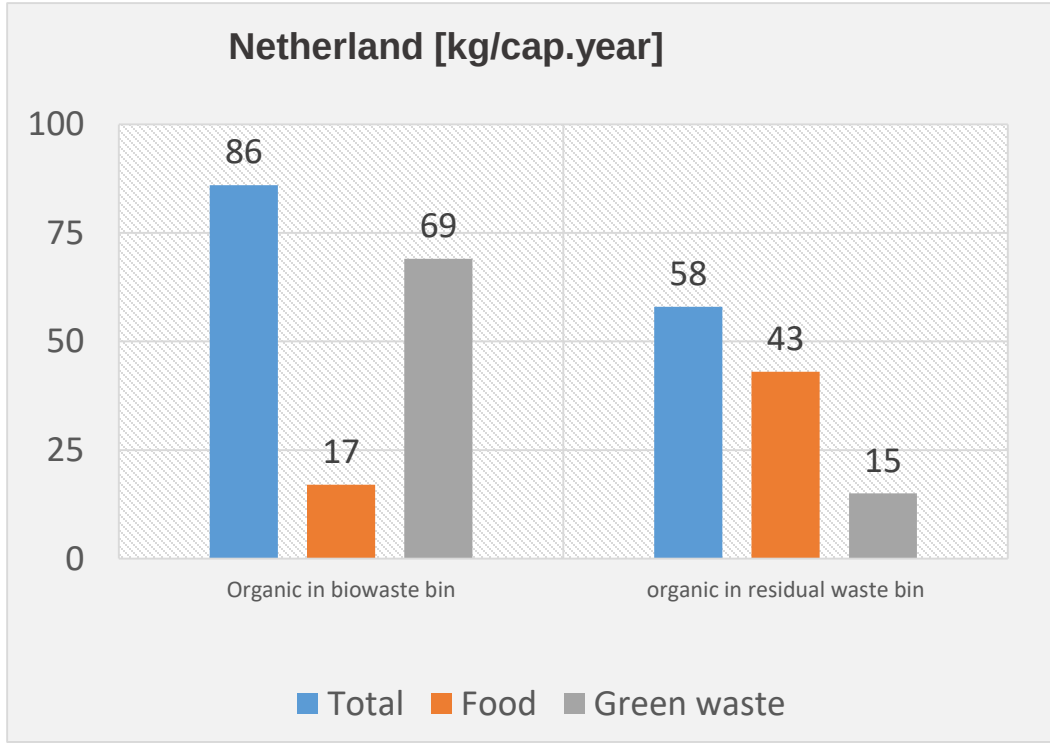
Source: ECN 2016: ECN Factsheet biowaste generates jobs, http://www.compostnetwork.info/

Organic waste in Germany and the Netherlands 2019



Composition of residual waste in Germany

Source: Dornbusch et al. 2020



Collection of organic waste in the Netherland

Source: Langveld, G. et al. 2020

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Collection of Waste in Germany

Residual waste

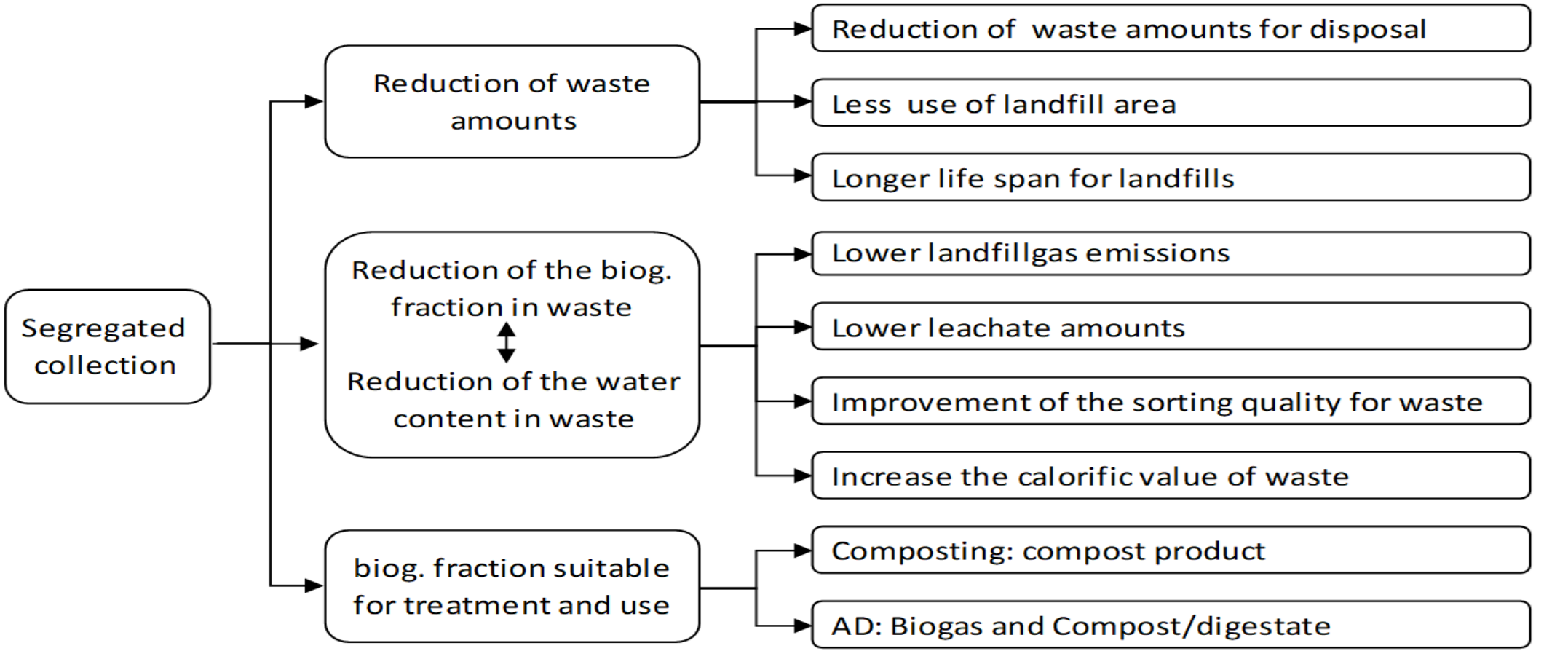
Organic waste (kitchen & green waste)

Paper and cardboard

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

Source: Nassour

Importance of separate collection of biowaste



Nassour

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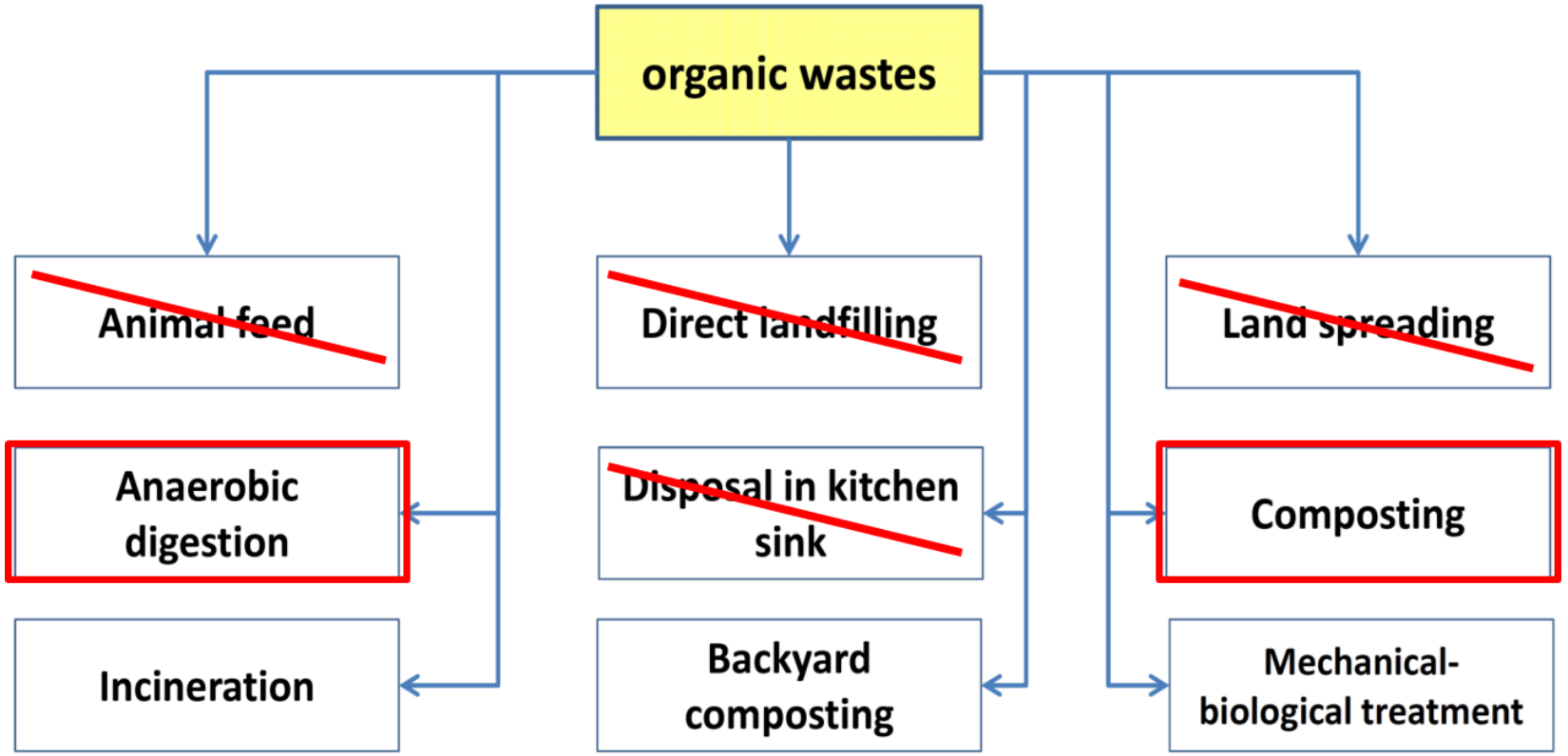
Biowaste – treatment Options in Germany



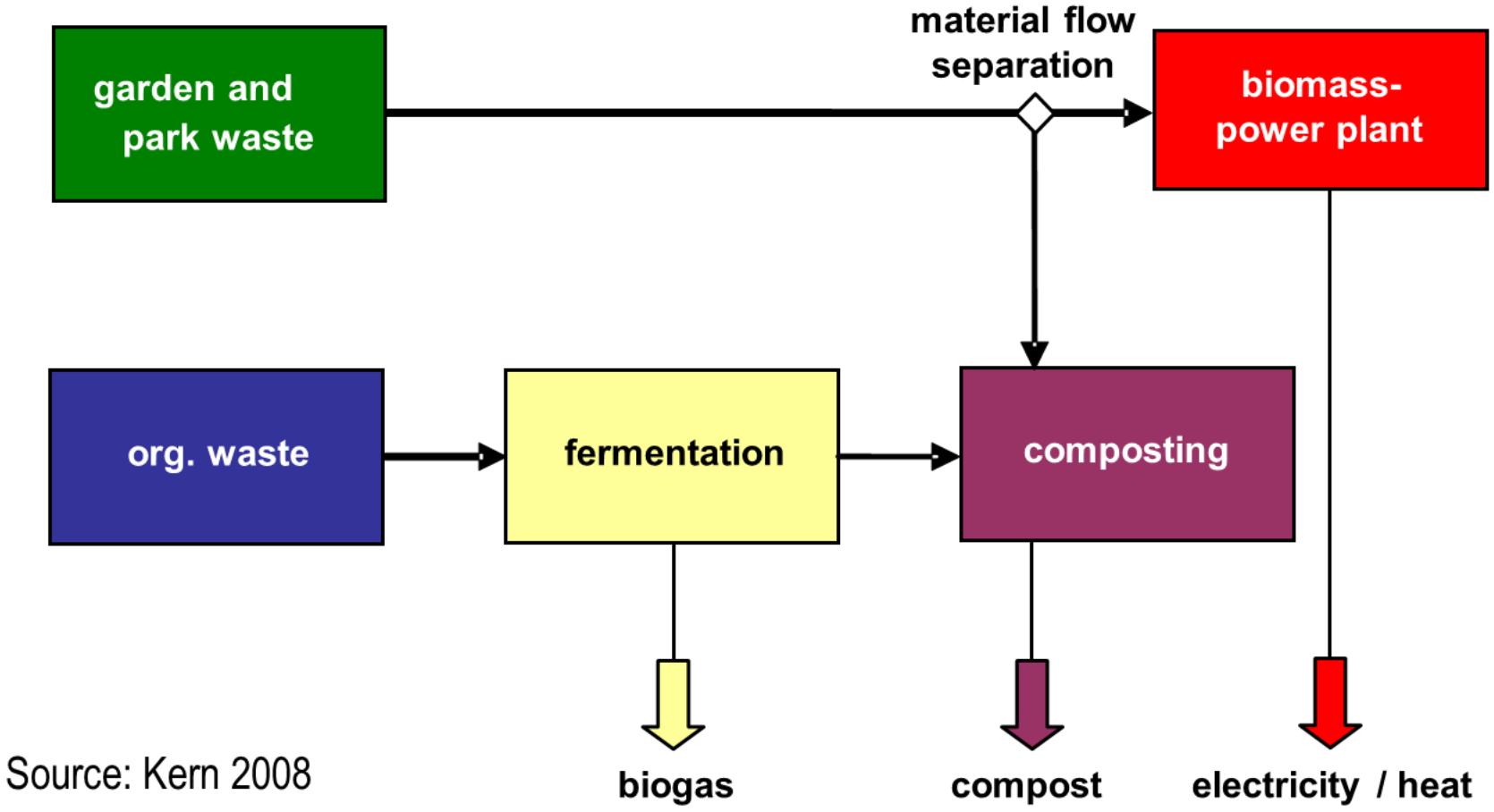
Source: Morscheck

Composting and Fermentation in Germany 2017

- **14.2 million tons of biodegradable waste collected (biodegradable contents, biodegradable garden and park waste, market waste)**
  - 7.6 million tons in composting plants
  - 6.6 million tons in fermentation plants

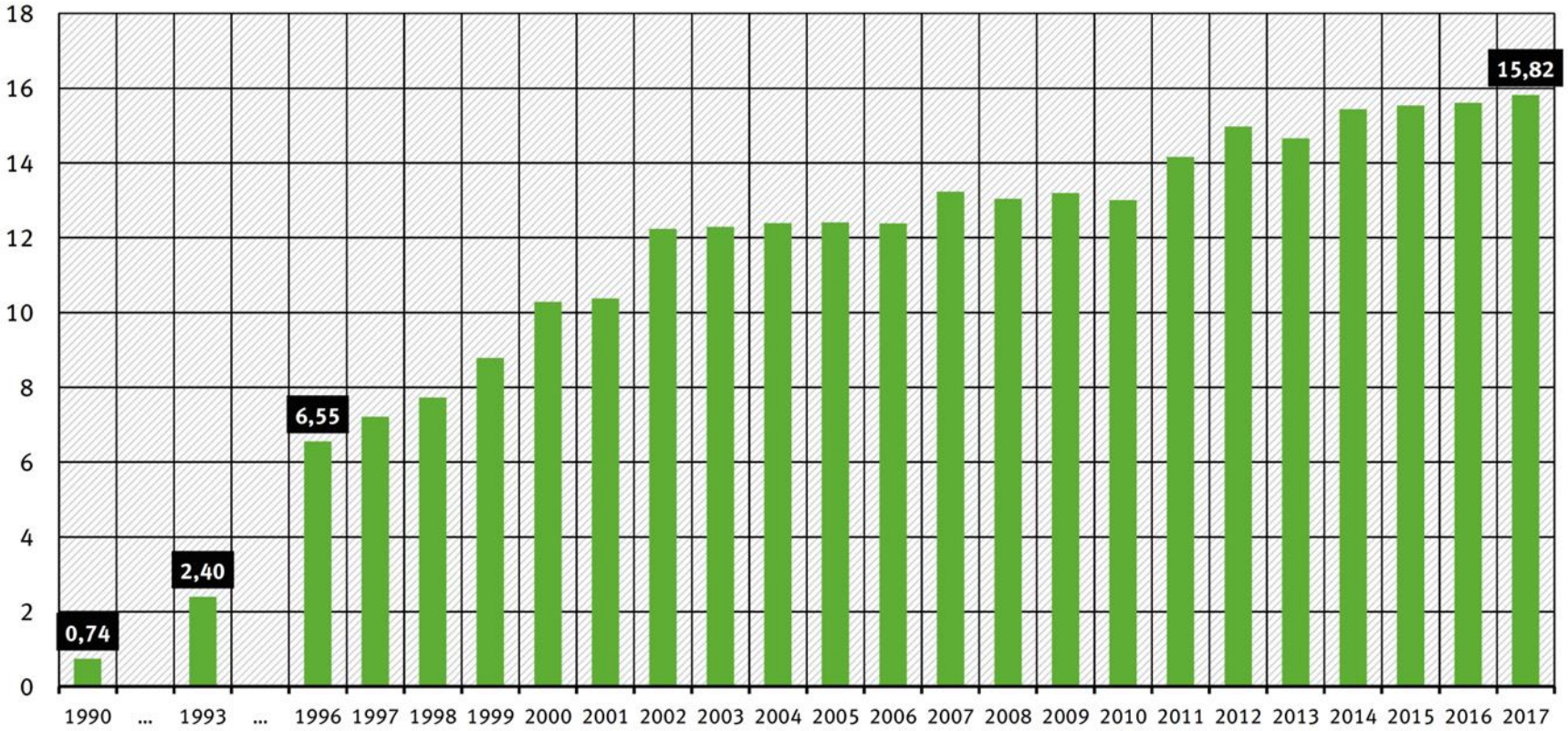
- **of which 10.3 million tons / 125 kilograms per inhabitant**
  - 4.9 million tons collected in **biowaste** bins (59 kilograms per inhabitant)
  - 5.4 million tons of garden and **park waste** (65 kilograms per inhabitant)

Integration of the anaerobe fermentation process into the waste treatment concept



Source: Kern 2008

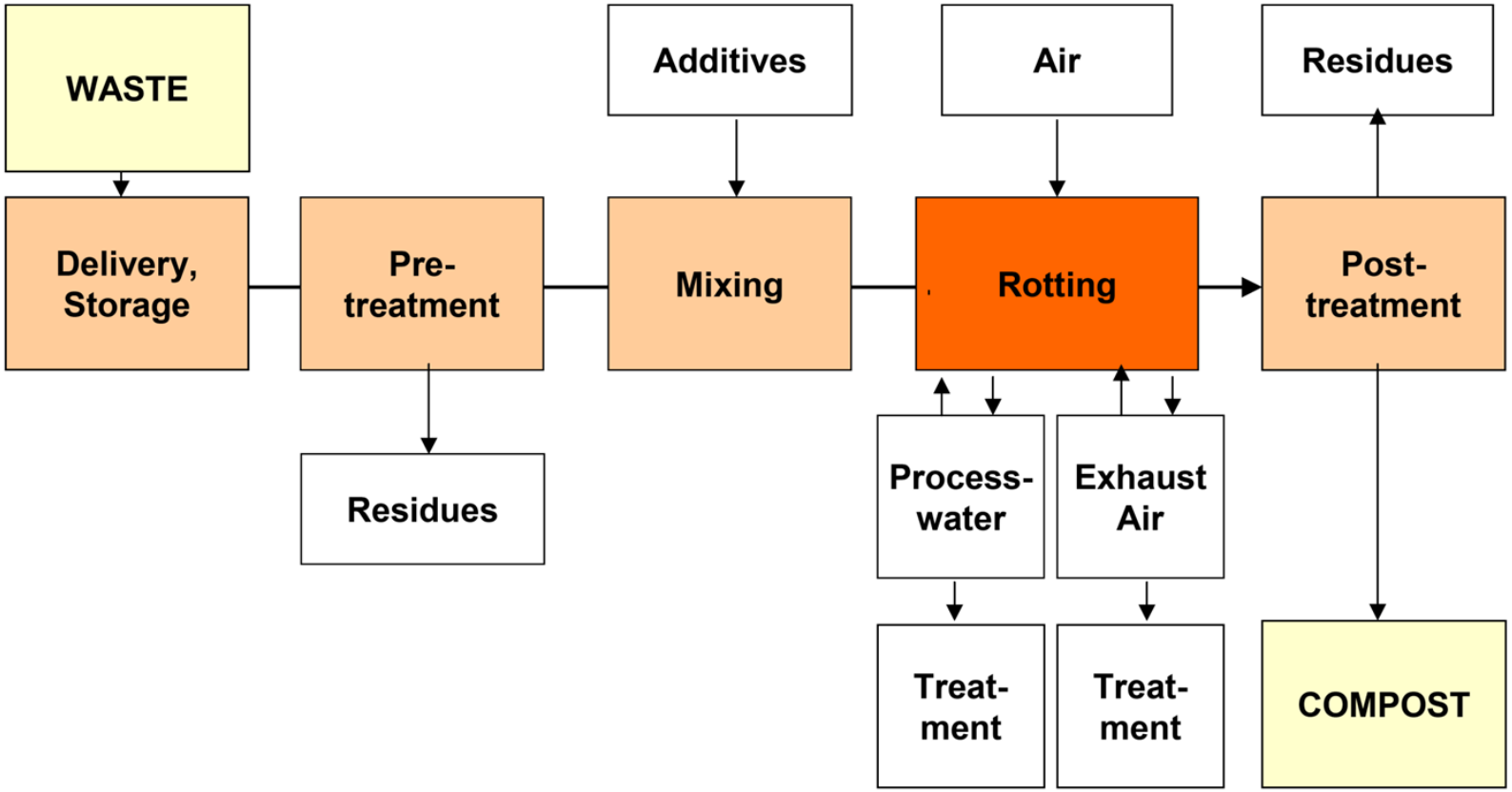
Composting of biowaste in Germany – Input in 2018 [Mill. Mg]



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

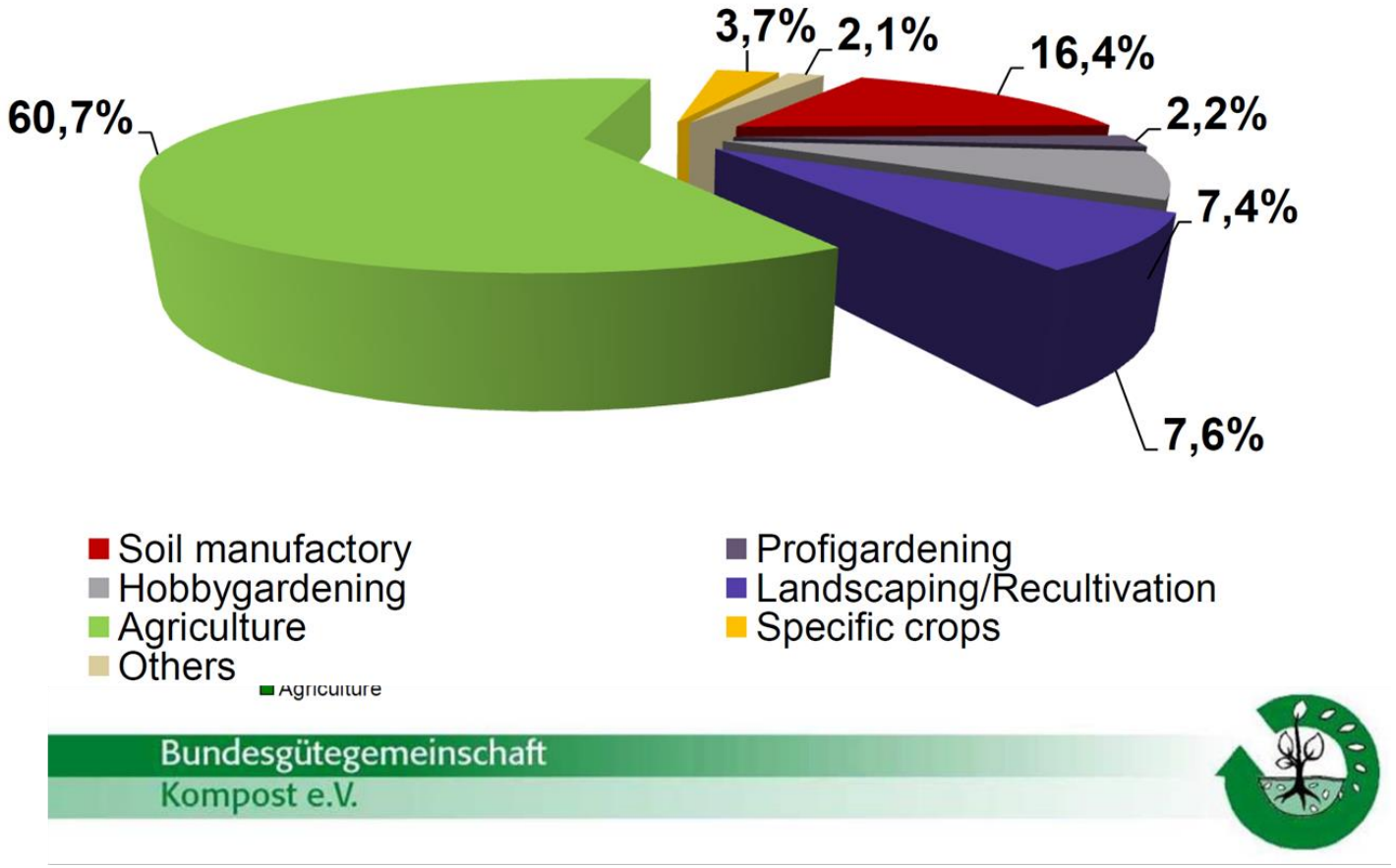
destatis,2020

Basic Layout of a Composting Plant

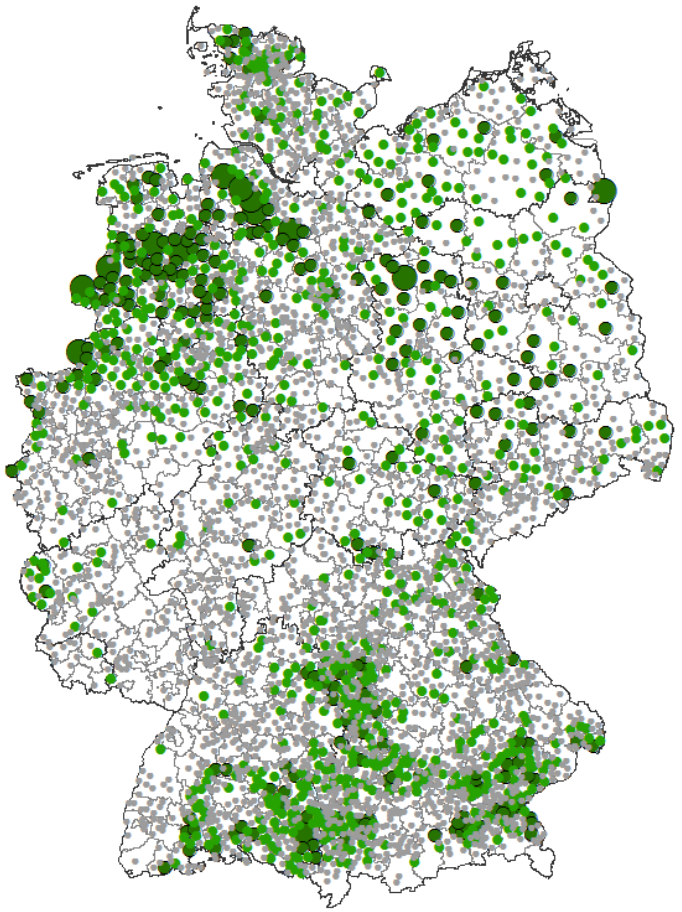


I. Körner, R. Stegmann *TUHH*

Compost - Marketing Structure Germany 2017
3.9 mill. tons of compost



Biogas plants in Germany (2020)



Biogas plants (2020) ~ 9,000 plants (including shutdowns)

- **~ 8,800** on-site electricity conversion of biogas
- **~230** upgrading to biomethane

Installed electrical capacity

→ 6,9 GW_e

Gross electricity production

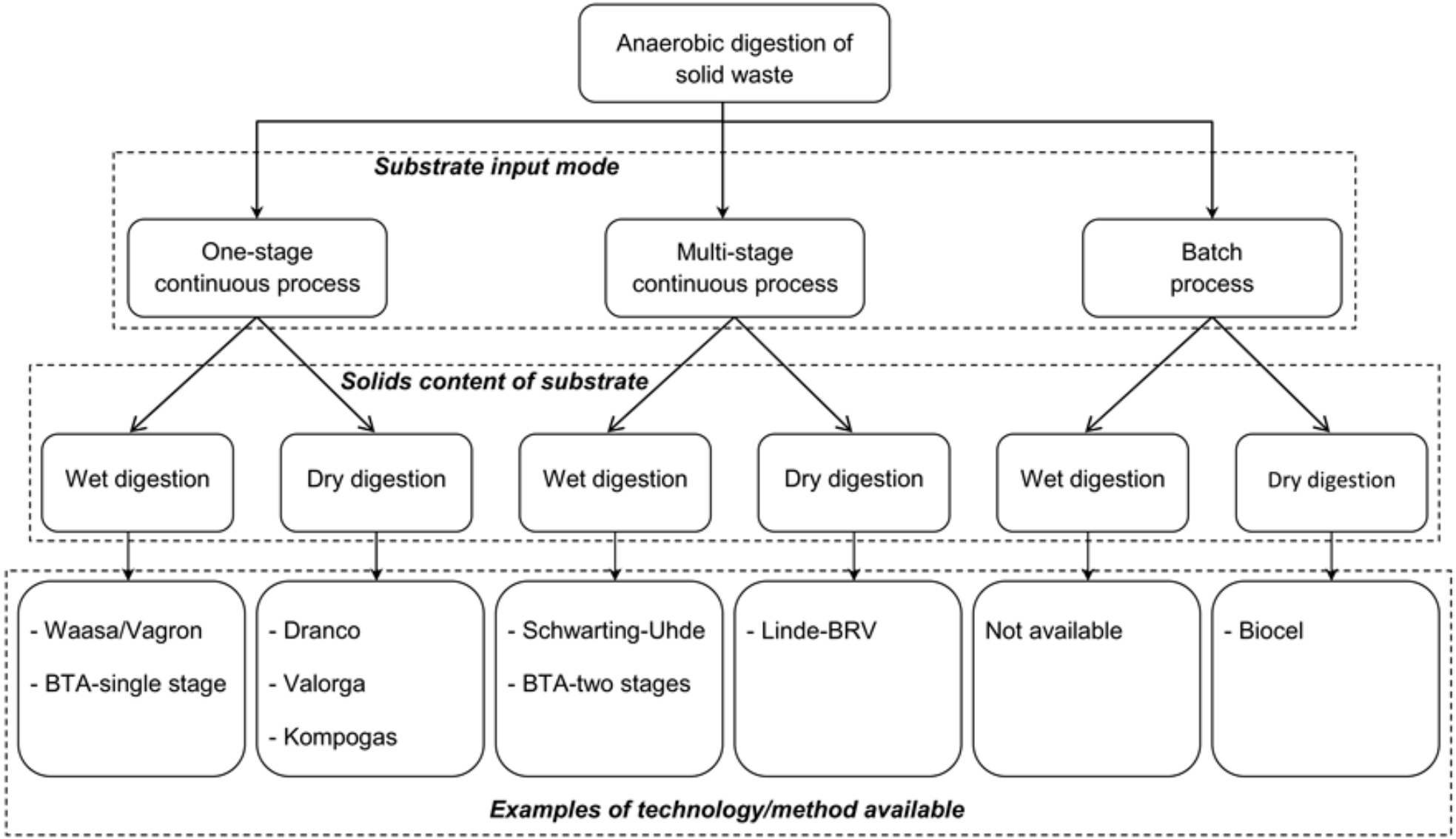
→ 31,3 TWh_e

Heat supply

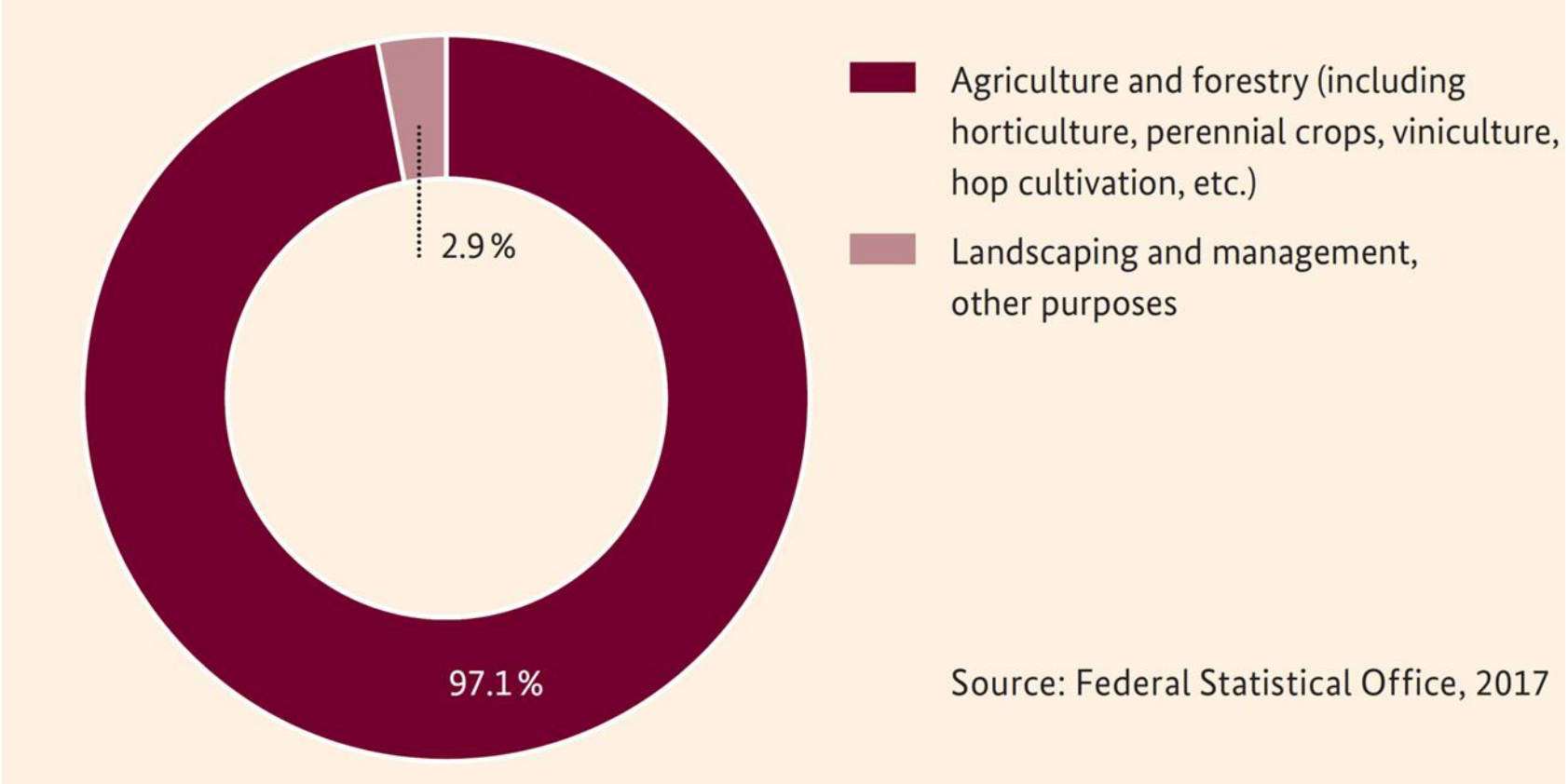
→ 16,7 TWh_{th}

References: Figure - DBFZ Database biogas, state 6/2020, Biogas plants: estimation DBFZ 2021 and dena 2021. Data regarding electricity/heat/installed capacity according to BMWI 2021.

Anaerobic Digestion Methods (examples)



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		
		Compost according DüMV and BioAbfV		Product quality of compost Germany 2013; n = 2,834)
		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		0,1	0,1	
Dioxins/Furans (PCDD/ PCDF) and dl-PCB	ng/kg DM (WHO-TEQ)	30	30	

Bundesgütegemeinschaft Kompost e.V. (BGK)

Quality requirements for compost

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)

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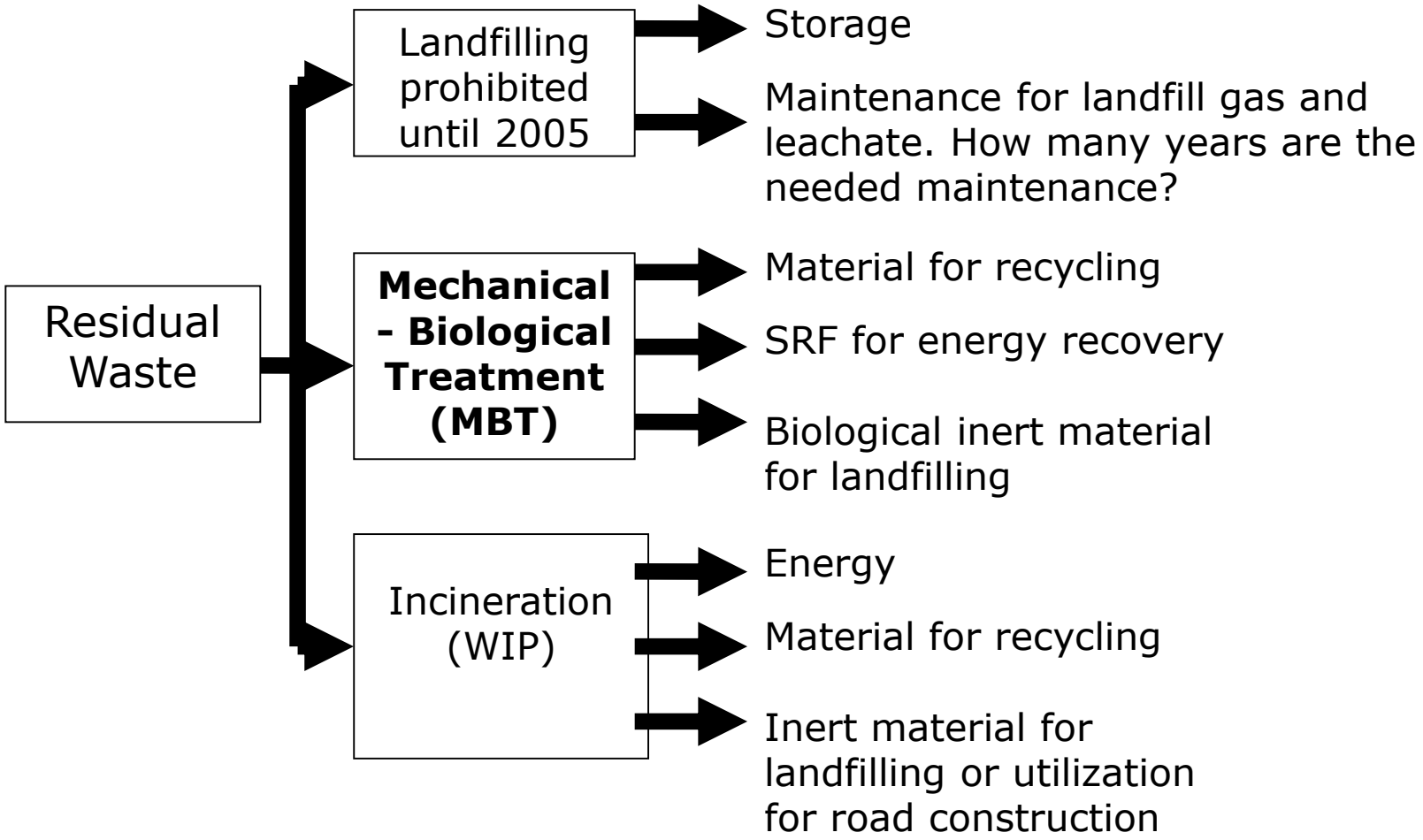
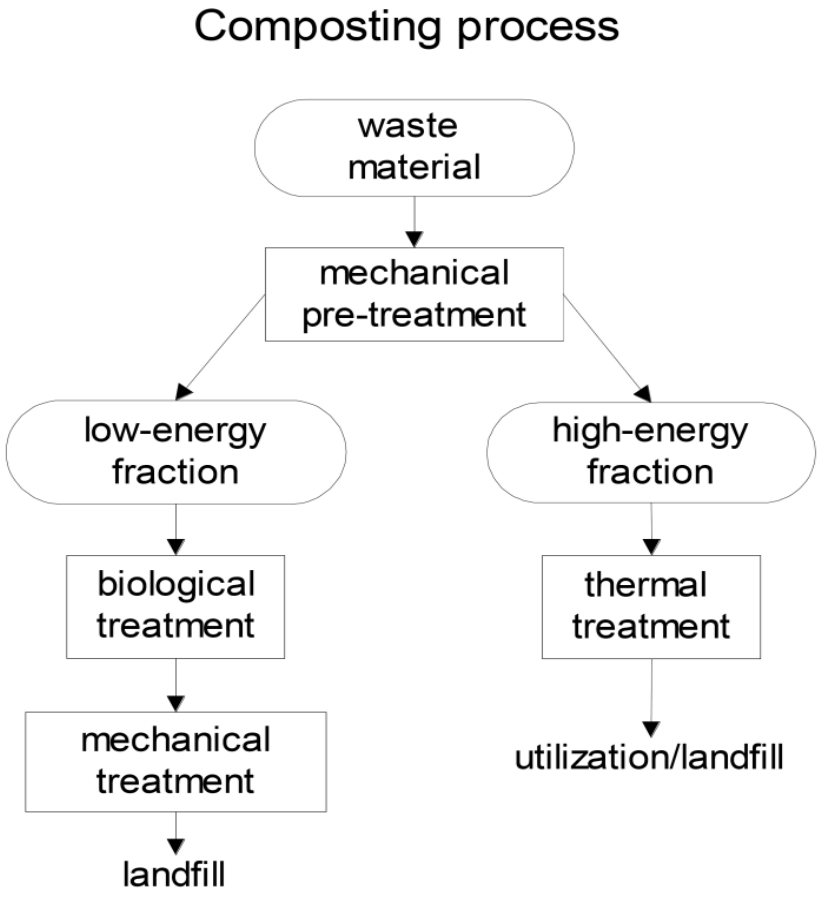
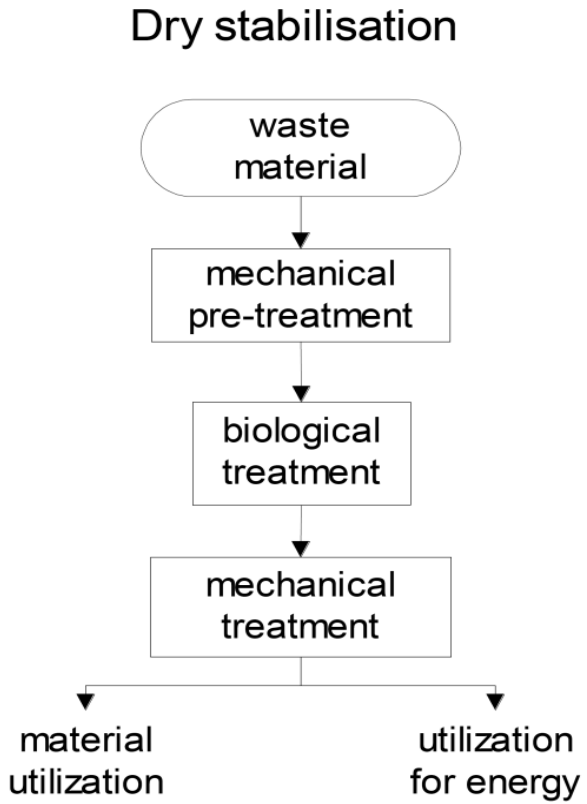
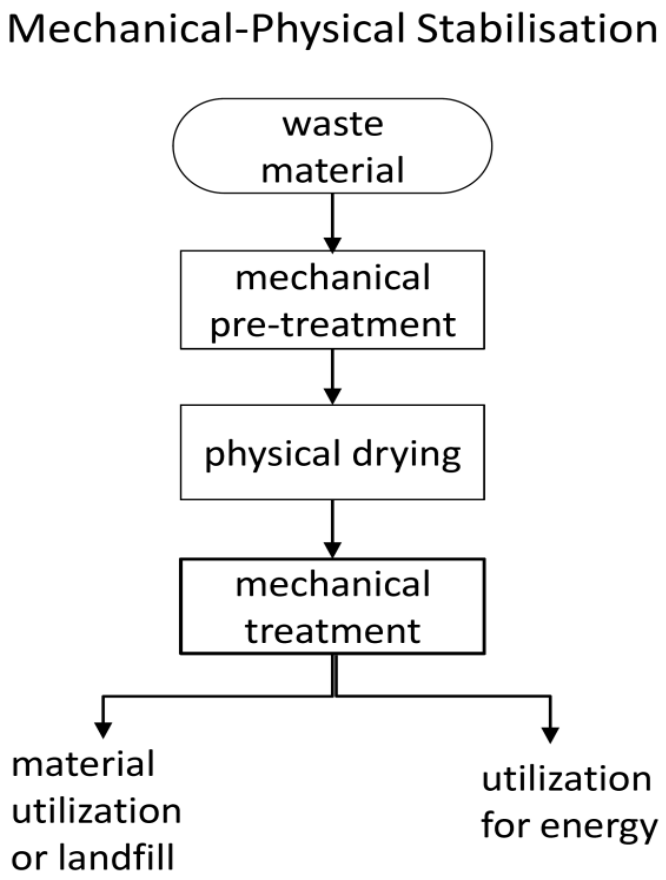
Treatment of residual waste in Germany



Simplified diagram of basic MBT concepts in Germany

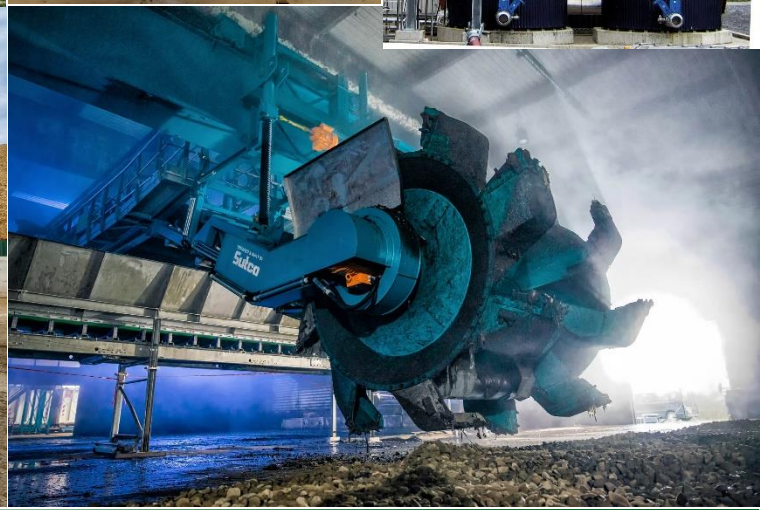






biogenic waste treatment systems (examples)

Sutco treatment systems



Source: Sutco 2021

Remondis composting and AD-plant Erftstadt

Adresse: **RETERRA Service GmbH**

Kompostierungsanlage VZEK

Tonstraße 1 A, 50374 Erftstadt

Eigentümer & Betreiber RETERRA Service GmbH

Inbetriebnahme 1995/2021

Verfahren Tunnelkompostierung/Pfropfenstromverfahren

Kapazität 183.000 t/a Gesamt

Zugelassene Abfälle Grünabfälle/Bioabfälle/Organische Gewerbeabfälle

Produkte
RETERRA Aktivkompost
RETERRA Protect
RETERRA Gartenkompost Classic
RETERRA Humusboden
RETERRA Gartenkompost Fein
RETERRA Rindenmulch Null-40 und Null-20
RETERRA Rasenerde VZEK
RETERRA Hackschnitzel und Holzhäcksel
PYROHACK Premium

Source: Remondis 2021

Tietjen treatment systems

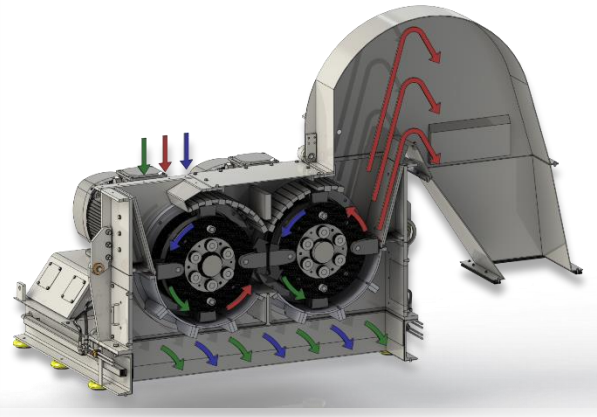
Food Waste **Commercial Waste** **Municipal Waste**











Source: Tietjen 2021

Conclusion and Outlook

- **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 an 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!

Contact information

Prof. Dr. mont. Michael Nelles

michael.nelles@uni-rostock.de

Director

Department Waste & Resource Management and China-Coordinator of the University of Rostock, Germany

Homepage: www.auf.uni-rostock.de/aw

michael.nelles@dbfz.de

Scientific Manager

Deutsches Biomasseforschungszentrum (DBFZ) in Leipzig, the Centre for Biomass Research in Germany

Homepage: www.dbfz.de