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Biogas production and nutrient recycling in the EU: the role of manure and agricultural residues

SCALE UP Training Session, 24/04/2024

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EBA members operate across the whole biogases value chain

+240 companies

51 National Associations

Research Centres

Europe produced 21 bcm of biogases in 2022

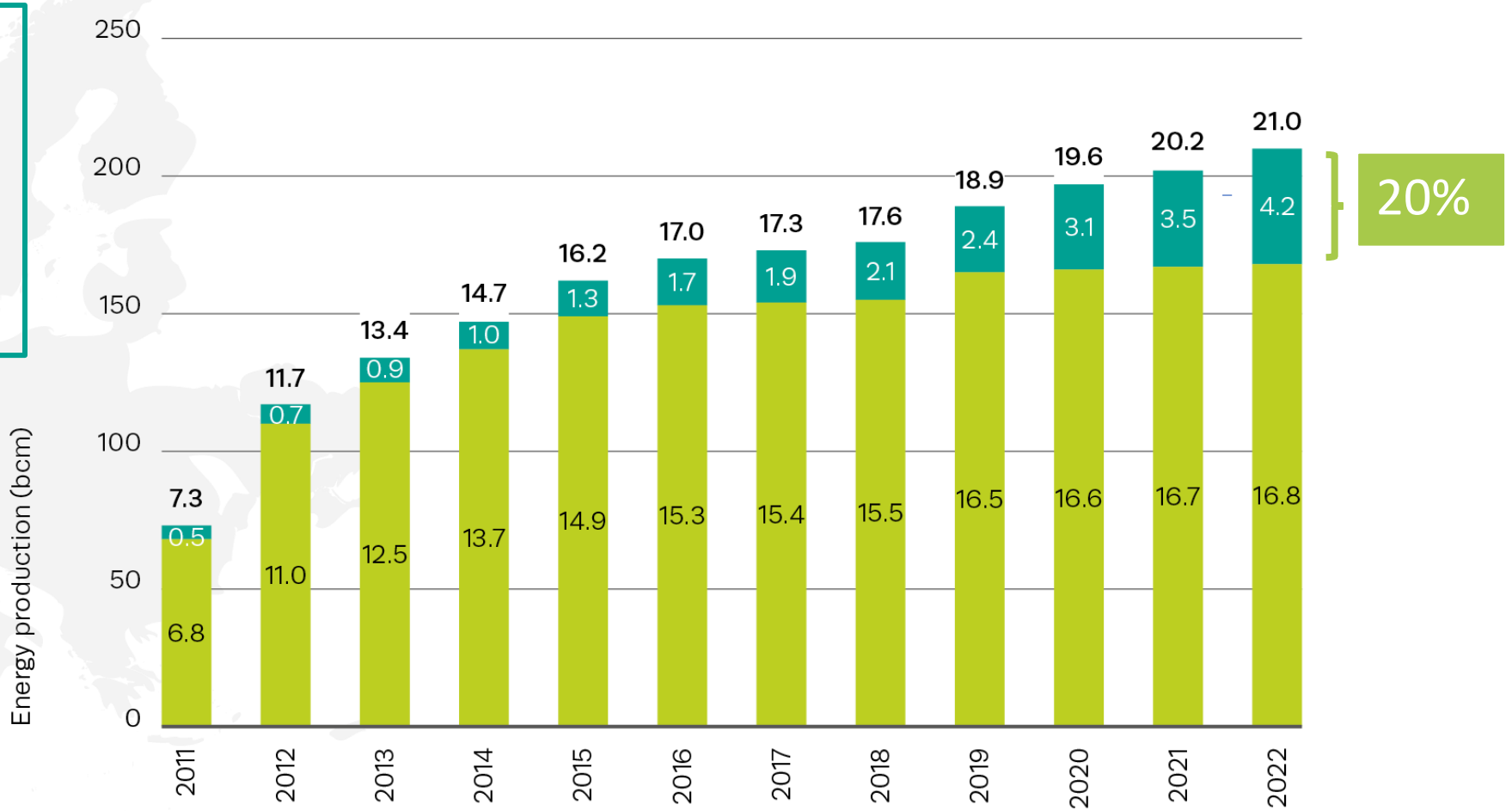
> gas demand of Poland

= 6% EU gas consumption

20% biogases upgraded

18 bcm produced in EU-27

Combined biomethane and biogas production in Europe



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Agricultural plants rank first for the biogas and biomethane production

67% of the biogas and **64%** biomethane is produced from agricultural plants in Europe

Figure 2.8

Percentage of European biogas production per plant type in 2022

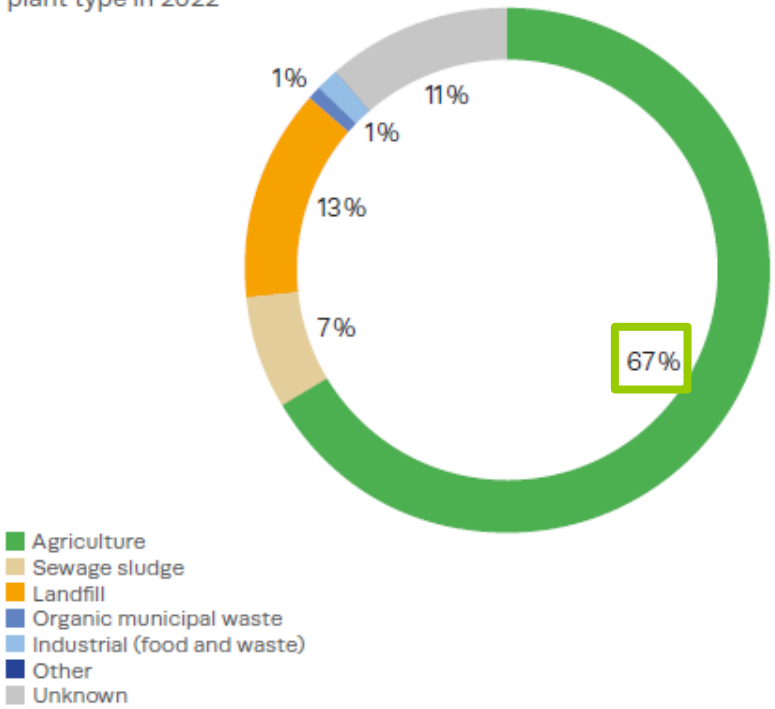
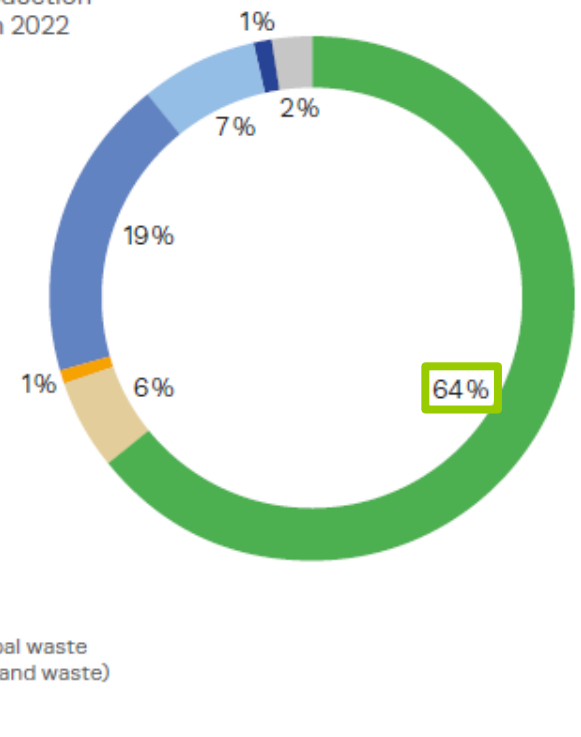


Figure 2.9

Percentage of European biomethane production per plant type in 2022



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Source: EBA Statistical Report 2023

Biomethane in Europe is produced from sustainable feedstocks

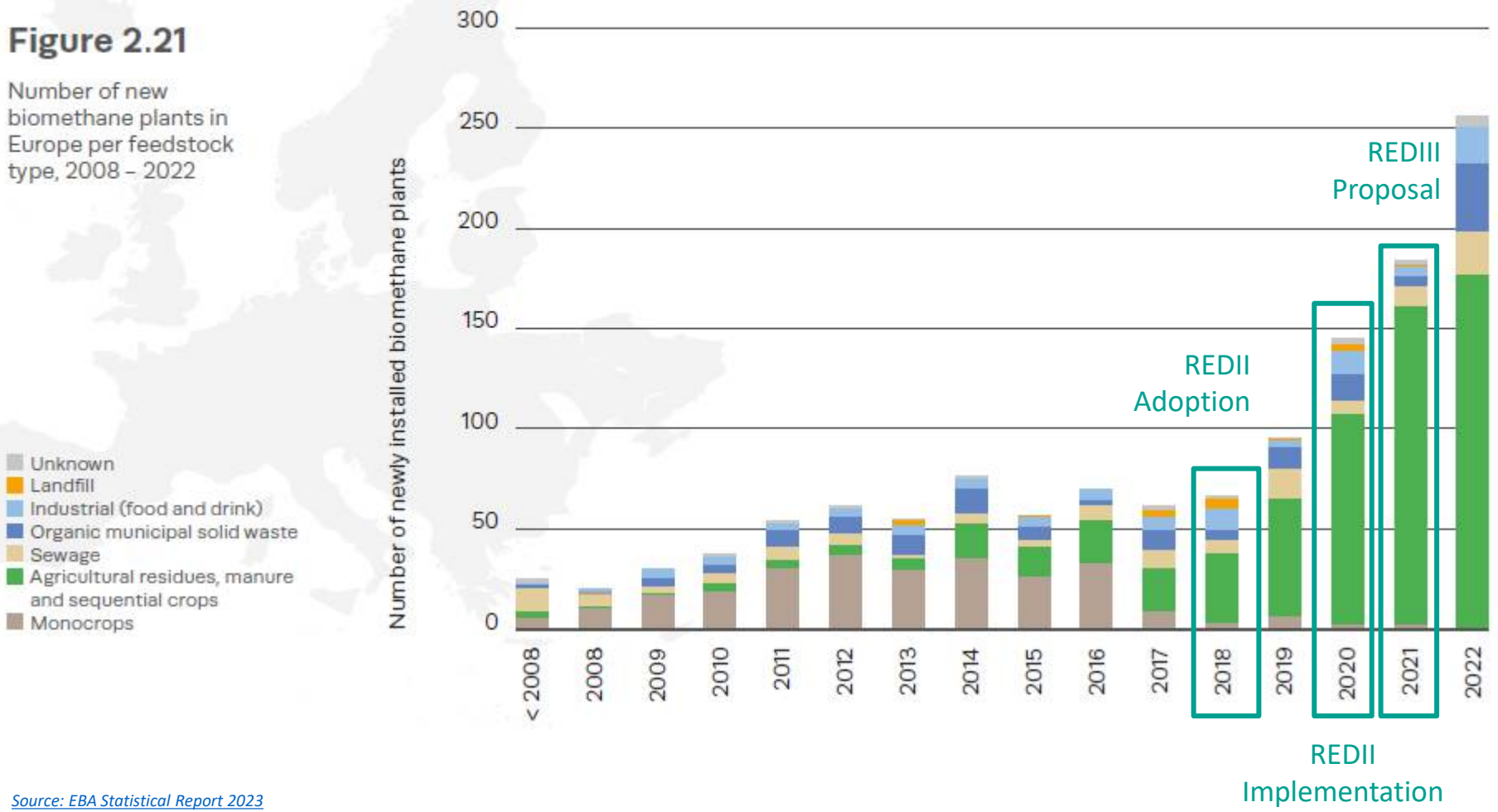
Evolution of feedstock use

Driver #1: GHG emissions savings

Enabler #1: Tech development

Figure 2.21

Number of new biomethane plants in Europe per feedstock type, 2008 – 2022



Source: EBA Statistical Report 2023

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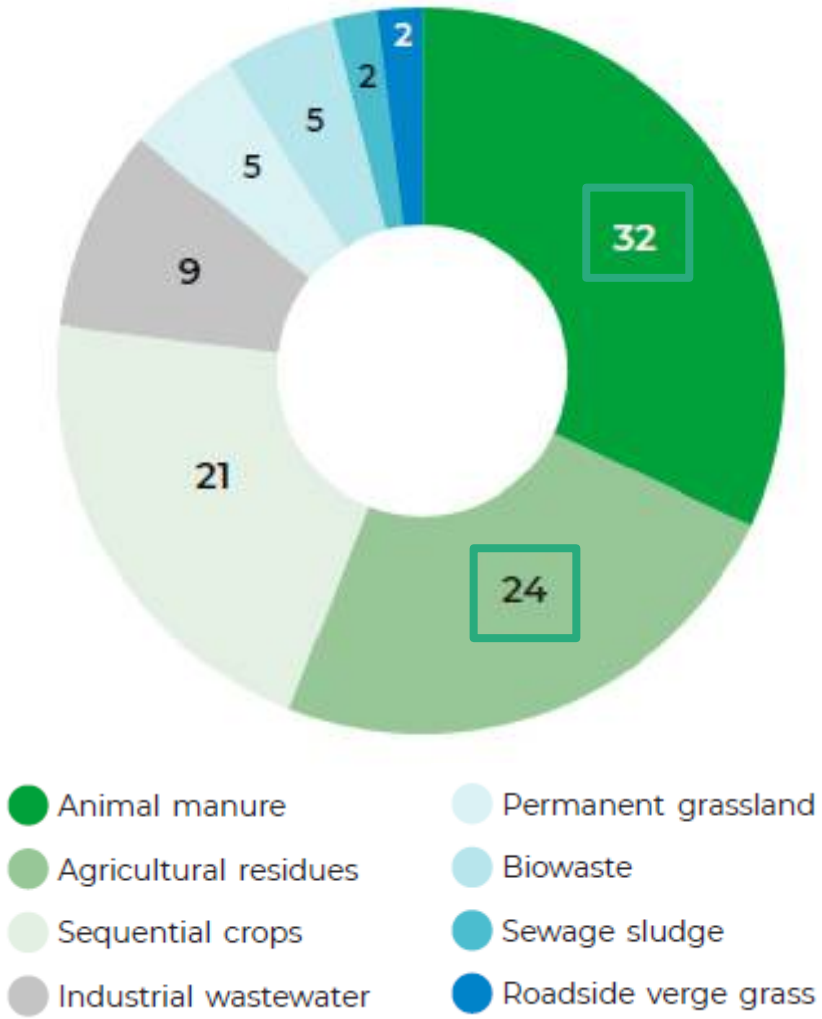
Manure will be the most used feedstock for biomethane in 2030

In 2030, **32%** of EU biomethane will be produced from **manure** and **24%** from **agricultural residues.**

EU anaerobic digestion potential in 2030 per feedstock



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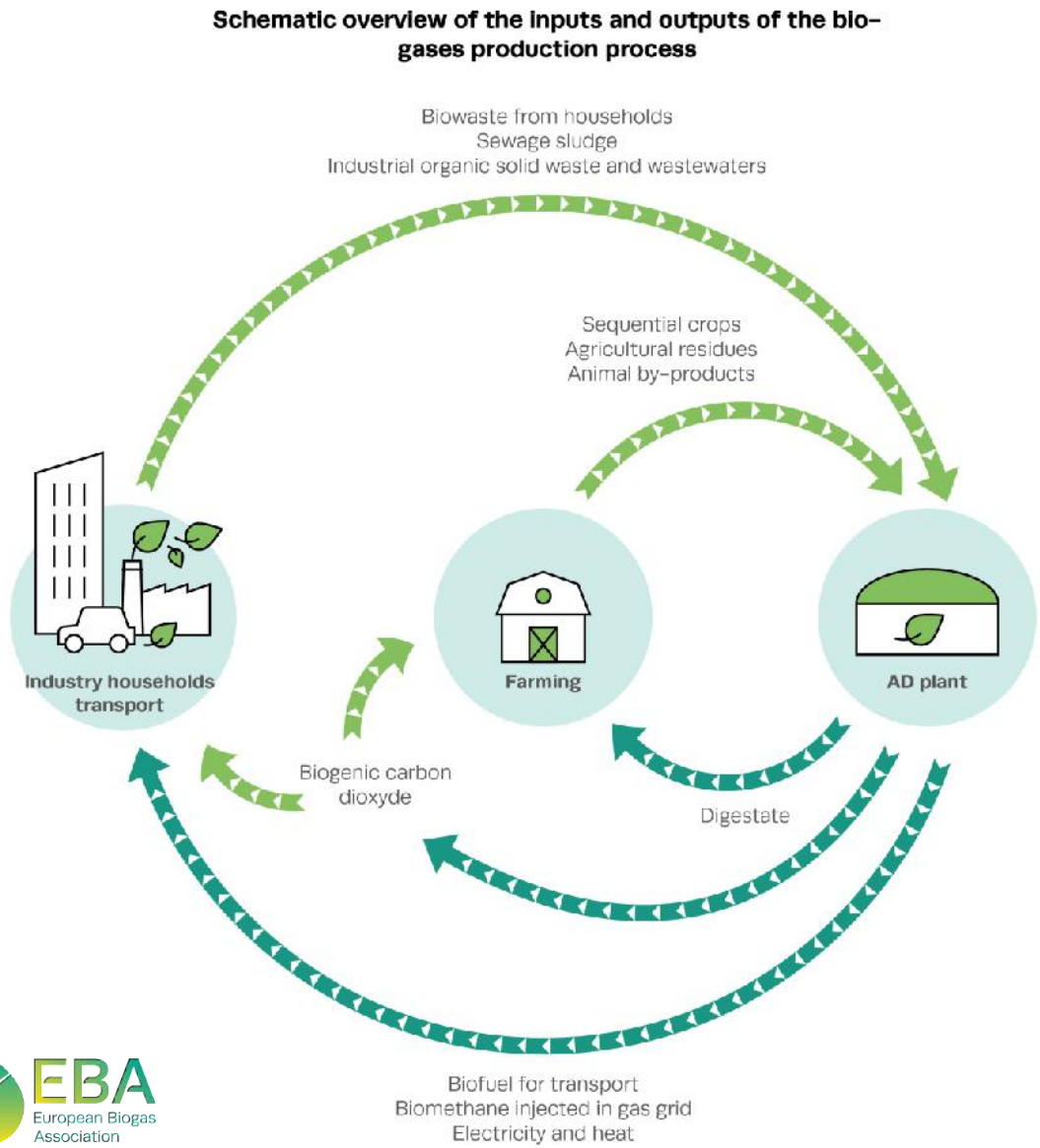
What is digestate?



During anaerobic digestion, **biogas is produced** along with digestate.

Digestate contains a higher proportion of **readily available nutrients** than in the raw feedstock.

The same amount of **stabilised organic matter** is present in the digestate than in the raw feedstock.

➔ **Digestate is a valuable organic fertiliser and soil improver.**

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Digestate offers an alternative to synthetic fertilisers

31 Mt (DM)
digestate produced
Europe, **2022**

Digestate can already displace:

15%
Nitrogen-based fertilisers
(N applied in EU-27: 11.1 Mt/year)

11%
Phosphorus fertilisers
(P applied in EU-27: 2.8 Mt/year)

6%
Potassium fertilisers
(K applied in EU-27: 3.1 Mt/year)

GHG reduction potential when displacing synthetic N-fertilizers with digestate

10 Mt
of CO_2 equivalent
in 2022

Natural gas is the main feedstock and energy source to produce **synthetic fertilisers**

The replacement of 15% of **synthetic nitrogen fertilisers** with digestate could save today around
2 bcm of natural gas

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Digestate is an enabler of carbon sequestration

9,3 Mt of Total Organic Carbon, **2022**

More **stable organic carbon**, particularly **recalcitrant to biodegradation**

- High potential for **carbon sequestration**
- Leads to **humus** and **structure formation** in the soil and increases its **fertility, functionality, microbial activity, aeration, and water storage capacity**

Carbon sequestration potential of digestate

	% of remaining TOC after 92 days
Solid fraction of digestate	86%
Digestate 1	73%
Digestate 2	56%
Cattle manure	58%
Maize straw	43%

Reuland, G.; Sleutel, S.; Li, H.; Dekker, H.; Sigurnjak, I.; Meers, E. Quantifying CO_2 Emissions and Carbon Sequestration from Digestate-Amended Soil Using Natural ^{13}C Abundance as a Tracer. Agronomy 2023, 13, 2501.

➔ The application of (solid fraction) digestate on soil is both a **sustainable soil management** and a **carbon farming practice**

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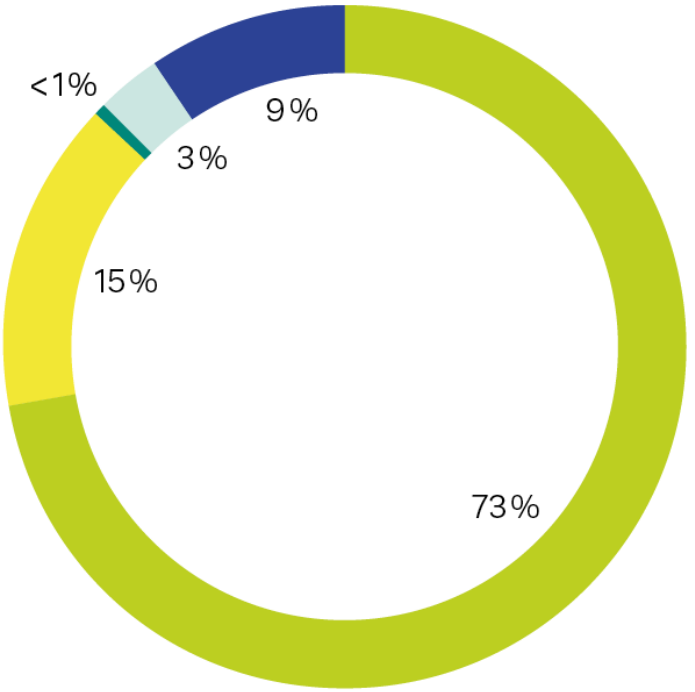
European digestate production

Most common end-use:
directly applied biofertilizer

Mostly non-separated digestate
Austria, Denmark, Germany, Poland, Slovakia, Sweden, and Ukraine

Mostly liquid digestate
Serbia, Croatia, Slovenia, UK, Switzerland and Belgium

Digestate end-uses in Europe



Digestate valorization routes

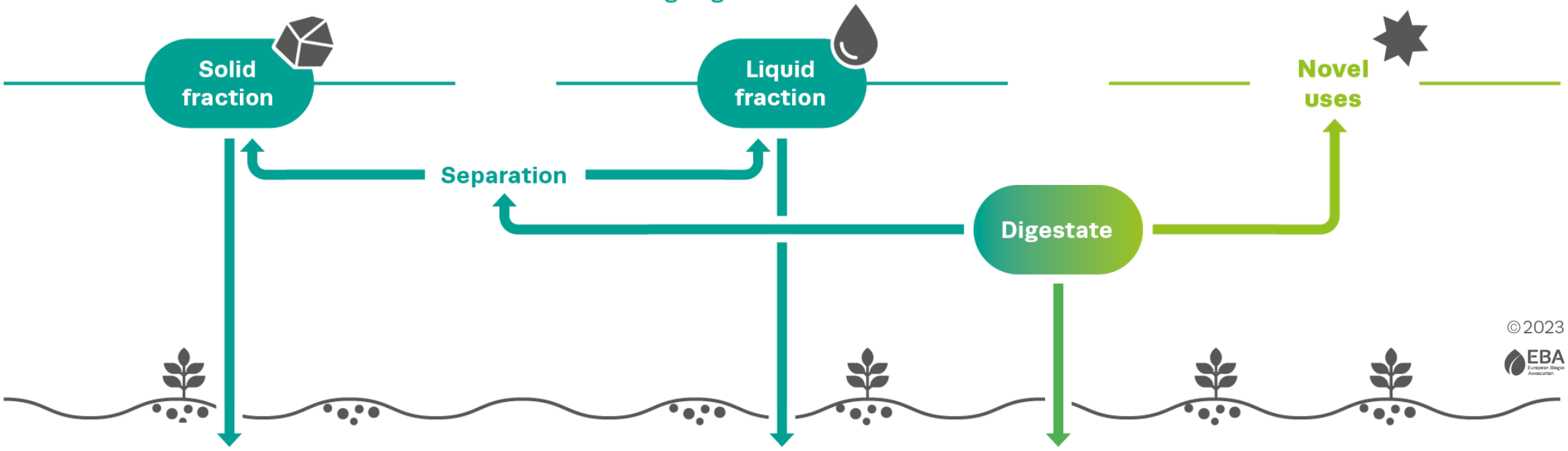
Nutrient recovery
char, hydrochar, biofuels

- Pyrolisis
- Gasification
- Hydrothermal carbonization

- Membrane filtration
- Reverse osmosis
- Evaporation
- Ammonia stripping and scrubbing
- Struvite precipitation
- Microalgae growth

Range of different
value added products

- Insects cultivation
- Pretreatment agent
- Substrate for microbial fuel cells
- Medium for hydroponics
- Production of volatile fatty acids (VFAs)
- Bio stimulants



Regulatory challenges and opportunities for digestate

Challenges

- **Fertilising Products Regulation** (EU 2019/1009): setting heavy requirements for digestate to be CE-marketed as organic fertiliser or soil improver.
- **Animal By-Products Regulation** (EC 1069/2009 & EU 142/2011, EU 2023/1605): setting additional requirements for certain *animal by-products* to be placed on the market.
- **Nitrates Directive** (91/676/EEC): restricting the application of digestate from *manure*.
- **Sewage Sludge Directive** (86/278/EEC): restricting the application of digestate from *sewage sludge* in agriculture.

Opportunities

- **Soil Monitoring Law:** promoting the application of circular fertilisers as a sustainable soil management/regeneration practice.
- **Common Agricultural Policy:** incentivizing the use of organic fertilisers through eco-schemes.
- **Carbon Removal Certification Framework:** setting a voluntary framework for carbon removal activities including carbon farming.
- **Waste Framework Directive:** encouraging the recycling of *bio-waste* through anaerobic digestion with use of digestate.
- **Urban Wastewater Treatment Directive:** stimulating the recovery of nutrients from *sewage sludge*.

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Thank you for your attention!

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