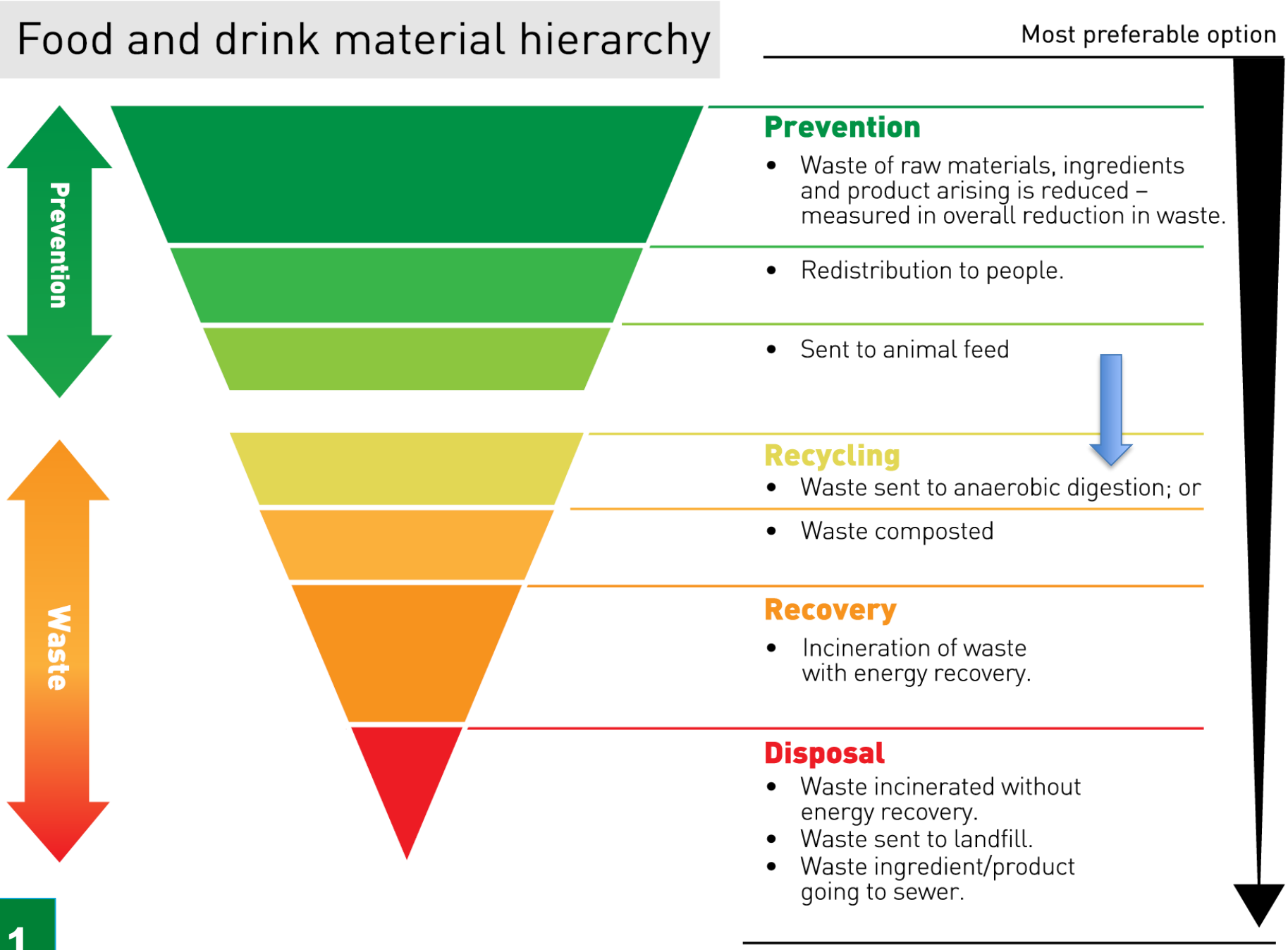
Food Waste to Biogas and Biomethane: Perspectives
iREXFO Final Conference 22Feb2022

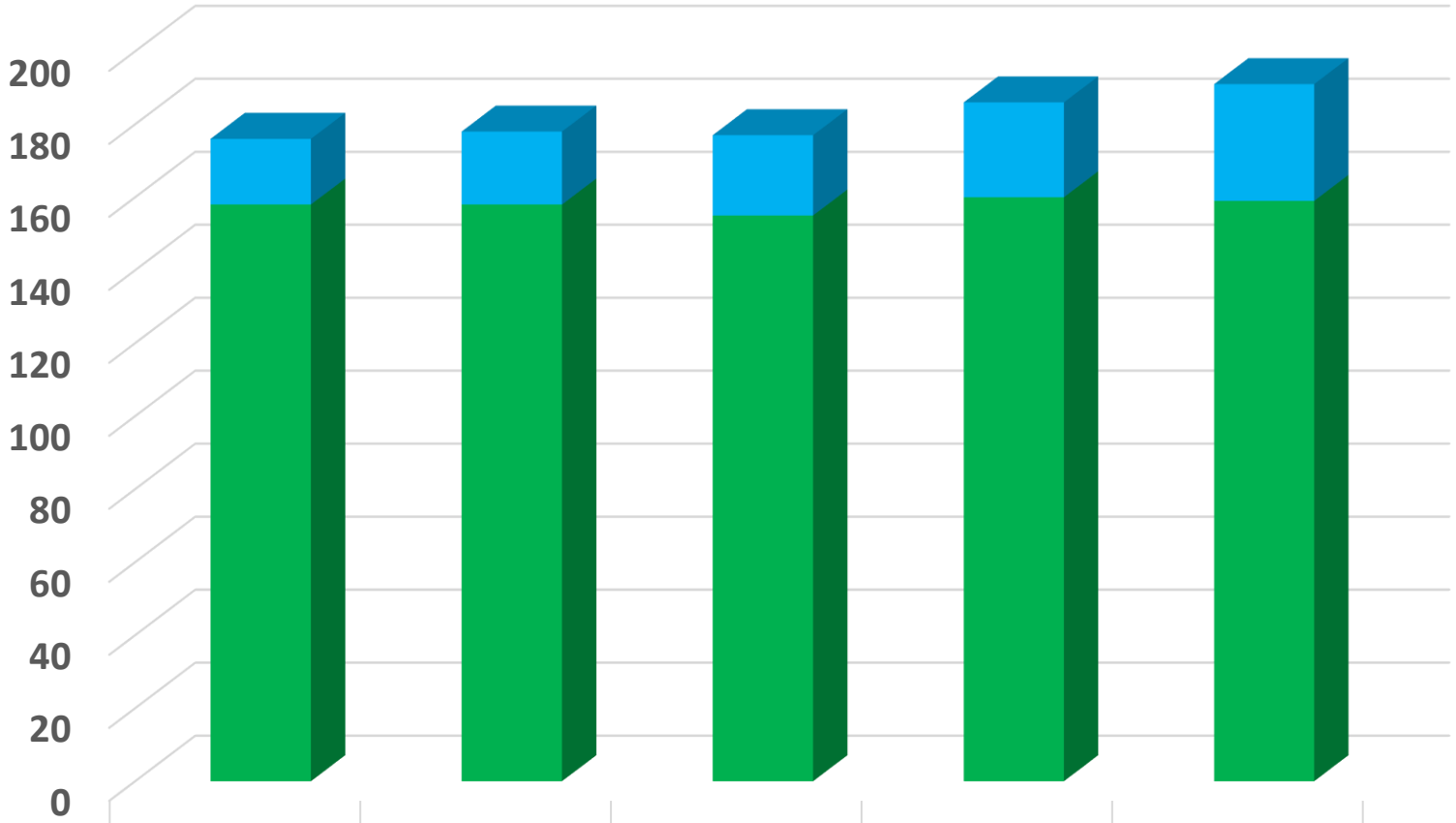
Food and drink material hierarchy



Food Waste Recycling Options

	Biogas	Composting
Operating conditions	anaerob, closed space	aerob, open space
	liquid phase (mostly)	solid phase
Gaseous emissions	negligible	NH_3, H_2S, N_2O, VOC, CH_4 *Source: [4]*
Odour generation	none	yes
Output	renewable gas	
	soil improver	soil improver
Investment costs	higher	lower

The European Biogas&Biomethane Industry in 2020 *Source: [1]*

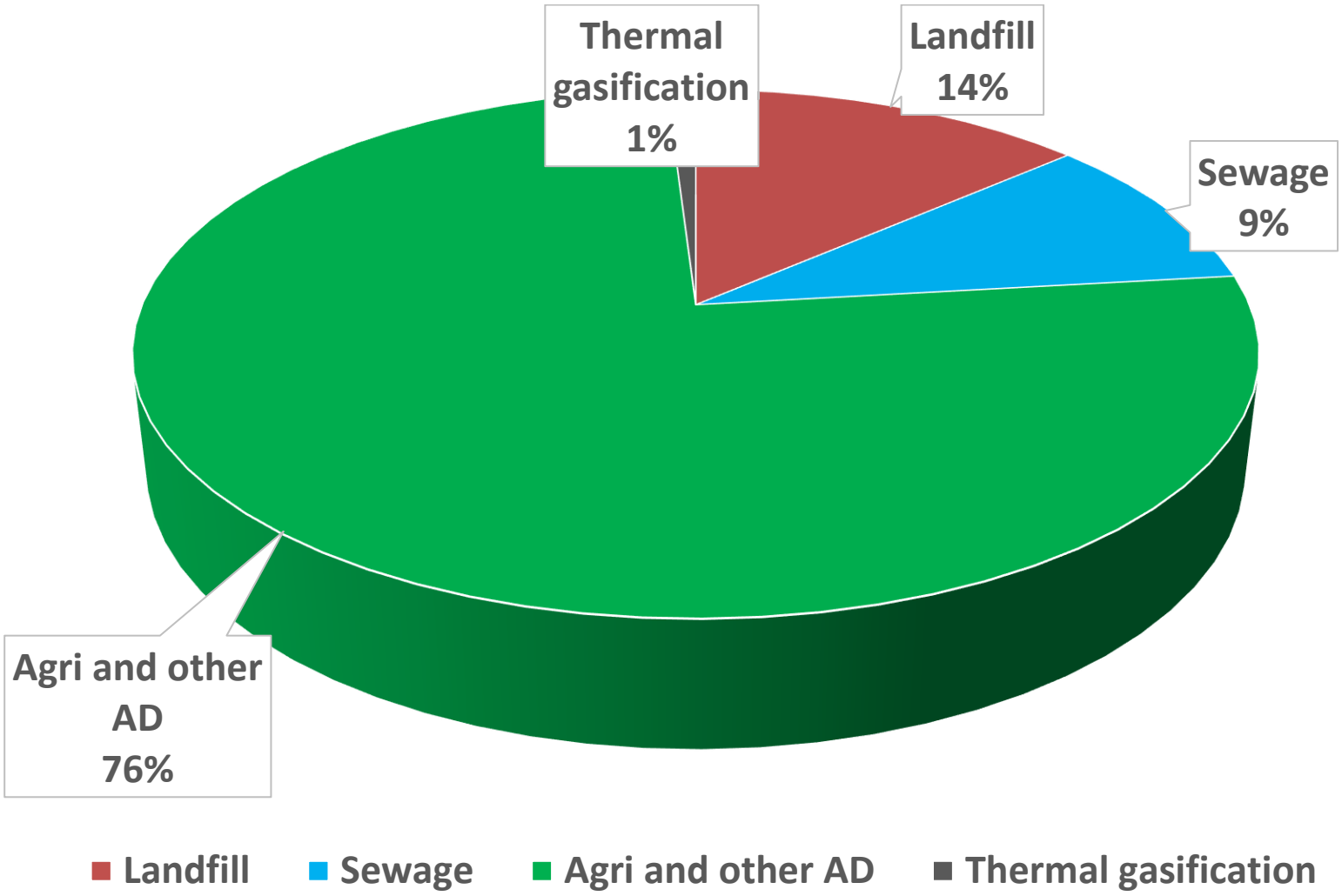


	2016	2017	2018	2019	2020
Biomethane, TWh	18	20	22	26	32
Biogas, TWh	158	158	155	160	159

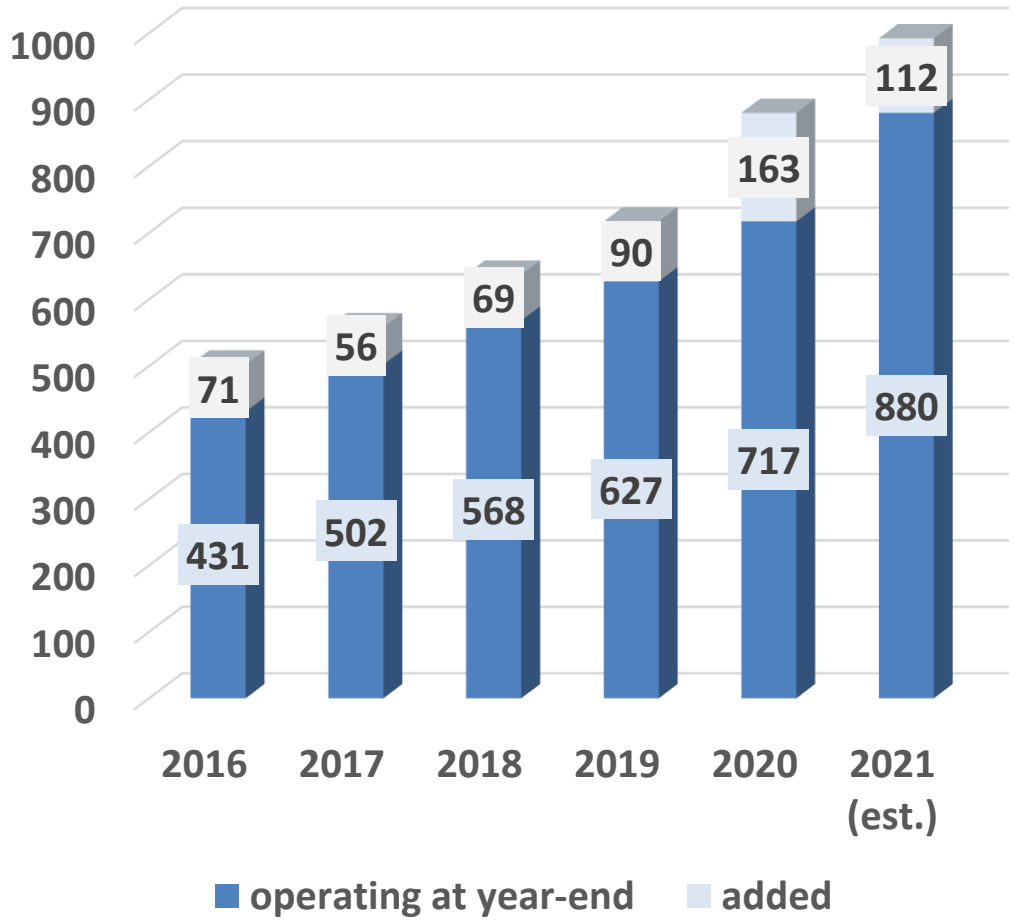
The European Biogas&Biomethane Industry in 2020 *Source: [1]*

Combined number of plants	19.654	units
Combined gas production	18	billion m^3/year
Biomethane share in production	16,8	%
Biomass input (estimated)	240	million to/year
Average biomass input (estimated)	12.200	to/year/unit
Average unit size	230	m^3 biogas/hour
	122	m^3 CH_4/hour

Biogas Sources in Europe
Source: [2]



Number of Biomethane Plants in Europe
Source: [1]



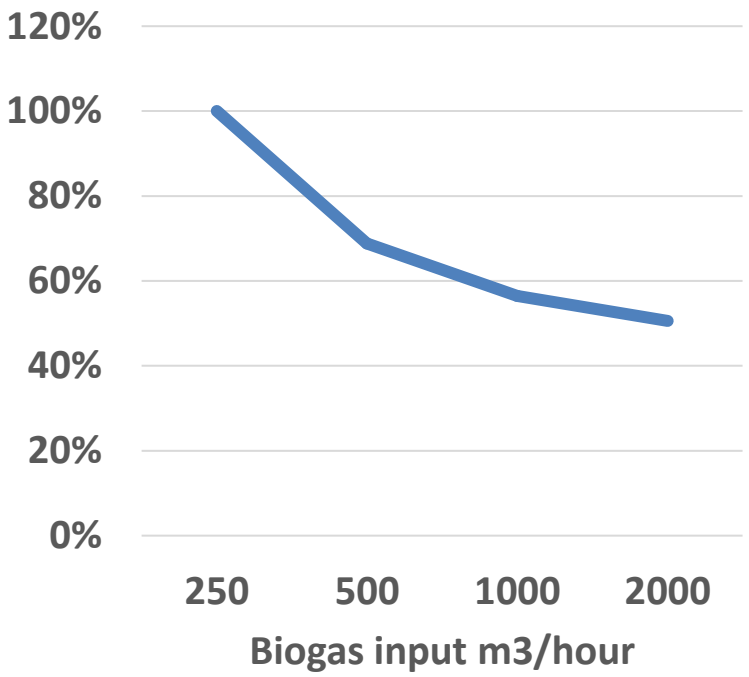
- Multiple application (incl. transport fuel)
- Distribution through the natural gas network
- Average unit size: 3.4 million m^3/year
- Average unit size: 455 m^3/hour

Food Waste Methane Potential
Source: [3]

Methane potential	355 - 533	kg CH_4/to oDM
at 20% oDM correponds to	106 - 159	m^3 CH_4/to FM
calculated for 10.000 tons	1.0 – 1.6	million m^3 CH_4/year
calculated for 10.000 tons	141 - 212	m^3 CH_4/hour
calculated for 8,8 million tons	0.9 – 1.4	billion m^3 CH_4/year

Economies of Scale
Source: [5],[6],[7]

- Minimum feasible size without co-digestion is determined by the CAPEX/OPEX of FW depackaging and pretreatment equipment
- AD unit: modest unit cost reduction with size increase, potentially offset by higher unit transportation costs
- Upgrading unit: up to 50% unit cost reduction at 8fold increase of throughput



Drivers

- Biogas producers are eagerly looking for replacement of food/feed crops in the substrate mix;
- GHG emission reduction is gaining increasing market value, especially in the field of transport fuels (RED II qualifies biomethane from FW as „advanced fuel”);
- Food producers may reduce their carbon footprint through (partially) covering their energy demand by biogas;
- European, national, regional, local regulations and incentives;

Constrains

- The composition and volume of input material fluctuates;
- Food waste contaminated with foreign material (packaging, glass, metal, plastics, etc.) requires costly equipment (depacking, sizing, hygienisation) and operation;
- Remaining content of foreign materials in digestate may hinder recycling the digestate as soil improver;
- The increased investment and operational costs are not recognised in the revenue from producing renewable energy;
- Financing institutions are reluctant to provide credits due to the complex risk profile;

Conclusions

- Reliable source separation and collection is strongly recommended;
- Co-digestion with other substrates provides more stable operations and economy of scale;
- Existing biogas/biomethane plants (adapted to processing FW) may offer the most feasible solution for processing FW;
- Anarobic digestion is the preferred pathway for recycling FW (in case volume for feasible investment/operation can be secured);
- Placing the digestate must be secured in advance;
- (Except for rare situations) the value of produced renewable energy is not sufficient for the feasibility of investment&operation - additional income or financial incentive is required.

Literature

[1] European Biogas Association 2021 Statistical Report (www.europeanbiogas.eu)

[2] EurObServ'er Biogas Barometer 2020 (https://www.eurobserv-er.org/biogas-barometer-2020/)

[3] Kampman, B. et al: The optimal use of biogas from waste streams – An assessment of the potential of biogas from digestion in the EU and beyond 2020 https://ec.europa.eu/energy/sites/ener/files/documents/ce_delft_3g84_biogas_beyond_2020_final_report.pdf (europa.eu)

[4] Cerda A. et al: Composting of food wastes: Status and Challenges, Bioresource Technology 248, 2018, 57-67

[5] Skovsgaard L., Jacobsen H.K. Economics of scale in biogas production… Energy Policy, 101, 2017, 77-89

[6] Mertins A., Waver T. Exploiting potential for economics of scale in biogas purification, University of Applied Sciences, Osnabrück

[7] Bhatt A.H., Tao L. Economic perspectives of biogas production via anaerobic digestion, Bioengineering 2020, *7*(3), 74; https://doi.org/10.3390/bioengineering7030074

Many thanks for your attention!

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