Policy Learning Platform Online Discussion
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Potential analysis, cost structure & business model for a bio-waste to biogas plant

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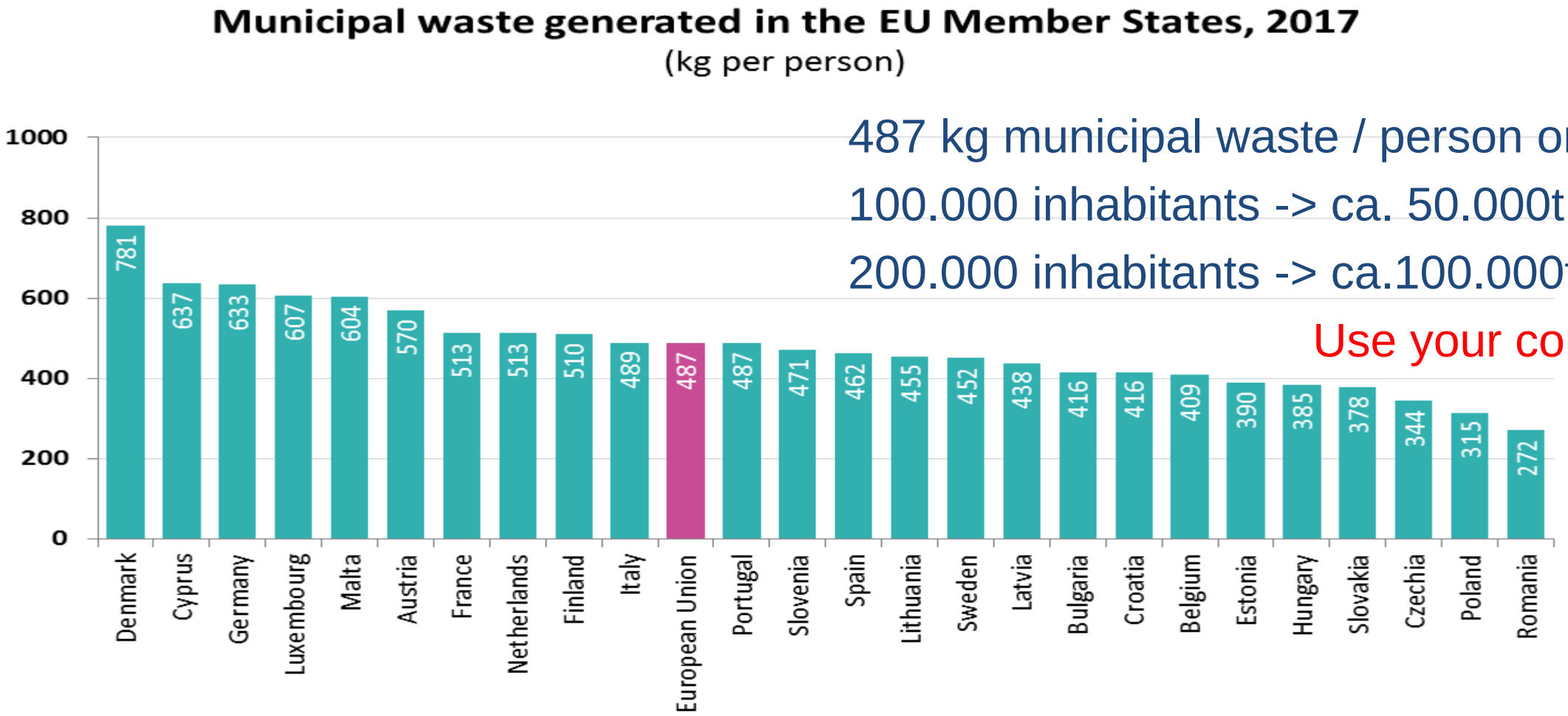
Ratio population / household waste generation



Note: 2017 data are not available for Ireland, Greece and the United Kingdom

487 kg municipal waste / person on average

100.000 inhabitants -> ca. 50.000t MSW / year

200.000 inhabitants -> ca.100.000t MSW / year

Use your country value!

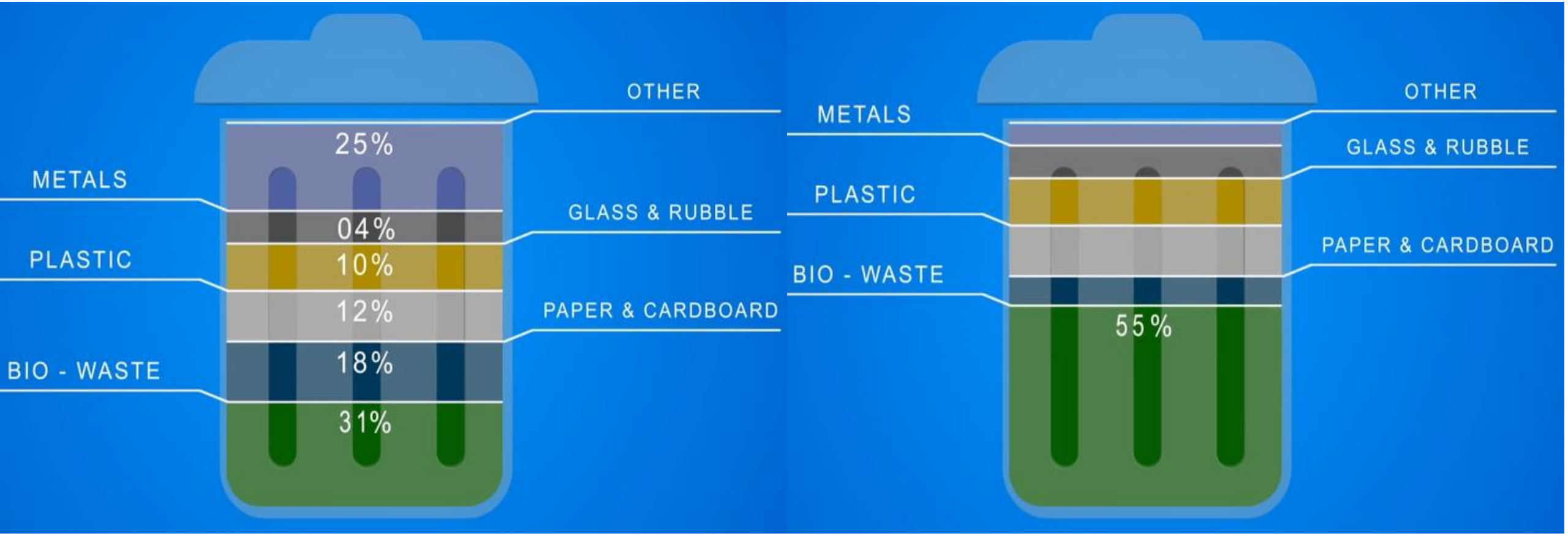
Ratio MSW / bio-waste

Northern Europe: ca. 30%

100.000t MSW -> 30.000t bio-waste

Southern Europe: ca. 55%

100.000t MSW -> 55.000t bio-waste



Theoretical vs empirical values for bio-waste

e.g. Cyprus: 637 kg MSW / capita / year

e.g. Limassol: 150.000 inhabitants -> 95.550t MSW / year

Southern Europe: 55% of MSW is bio-waste.

Check local waste composition analysis for more detailed estimate!

Theoretical amount of all bio-waste in Limassol: 95.500t MSW * 55% = 52.525t /year

Empirical values from countries with decades of experience in separate collection of bio-waste from households, such as Finland show: ca. 30% of bio-waste still end up in mixed household waste, even with good behavior training how to sort waste!

Thus, assume to collect max. 70% of all bio-waste = 36.500t / year separately collected from households

Relation bio-waste / biogas / energy yield

36.500t / year corresponds to 100t / day, every day.

Feedstock	Daily Quantity [t/d]	Annual Quantity [t/y]	Organic dry matter [t/d]	Biogas Yield [m³/d]	Biogas Yield [m³/y]
Seperately collected bio-waste from households	100	36.500	30	14.700	5.365.500

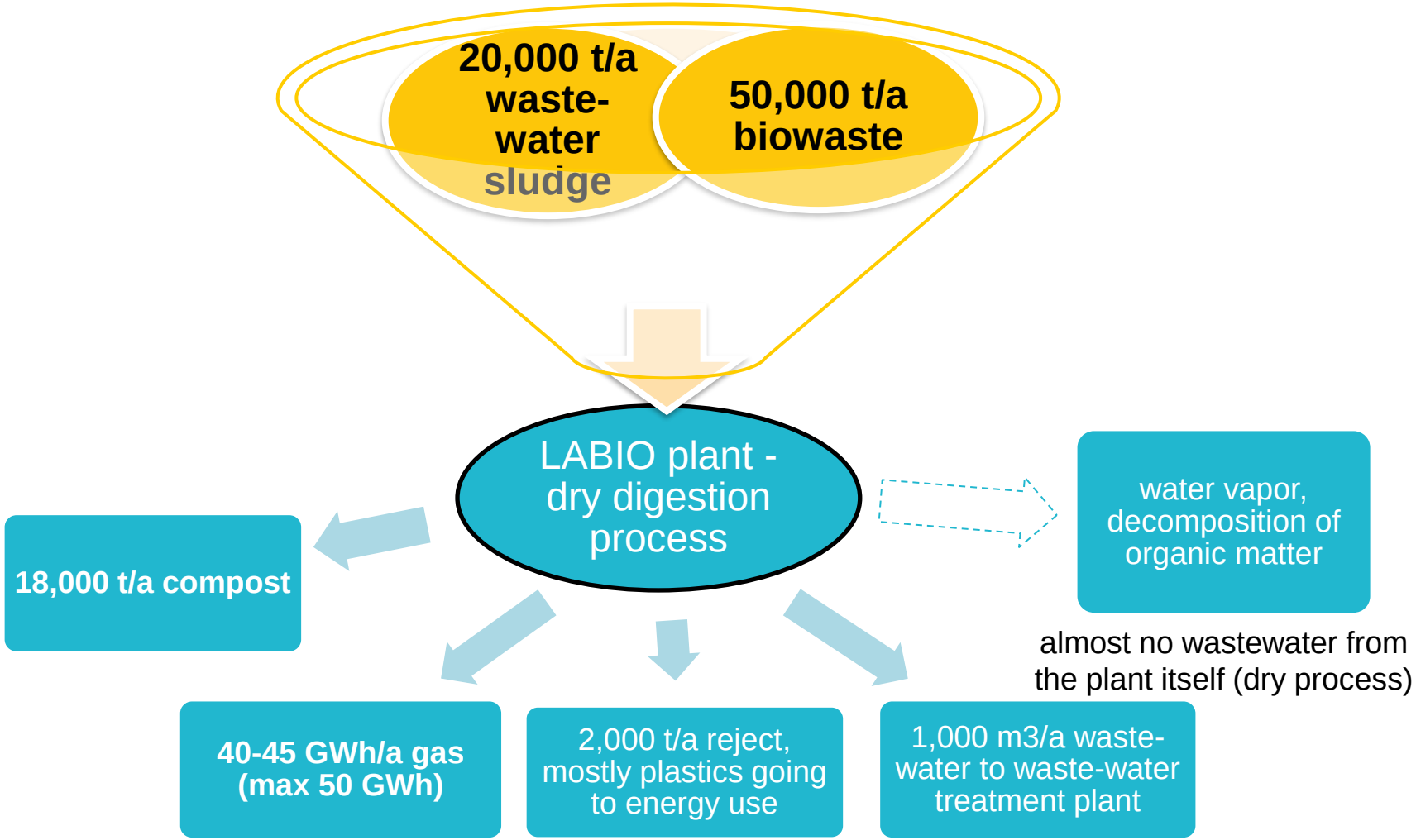
Biogas use options:

- Upgrade to bio-CNG and inject in gas grid as renewable gas: 34 GWh gas / year

OR

- Use in a generator to produce renewable electricity & heat: 13,5 GWh electricity (=1,75 MW capacity) / year and 18,6 GWh heat / year

Example: LABIO Ltd. biogas plant (Lahti)



Rought cost and revenue calculation

Project Financial Sources & Uses	
Project Capital Uses	**Euro**
Construction	1.000.000
Equipment	5.090.080
Vehicles	200.000
Feasability studies	0
Connexion to Grid	
Insurance	0
Working capital	0
Security	0
Bank fees	0
Contingencies	0
Office Equipment	0
Land	0
Total Project Cost	**6.290.080**
Project Capital Sources	**Euros**
Equity	1.887.024
Debt	4.403.056
Total	**6.290.080**

Careful! This example does not capture all project costs!

Pricing & Revenues	**EUR in`000**
Annual Operating Revenue	
Electricity from Biogas	1.357
Compost	0
Gate fee	730
Average Annual Output Sold	
Electricity from Biogas kWh	13.569.993
Compost ton	0
Tons of waste treated	36.500
Pricing Real	**EUR**
Electricity from Biogas sales price/kWh	0,10
Compost sales price/ton	-
Waste gate fee/ton	20,00

Economic viability

- Equity IRR (%) 10 years 16,7%
- Equity Payback (Years) 5
- Project IRR (%) 10 years 14,8%

Careful! As our example does not capture all project costs, the revenues for a real plant must be higher!

With 20 EUR / ton gate fee and 0,10 EUR / kWh for renewable electricity, our example 100t / day bio-waste to biogas plant is reaching the minimum economic viability values (minimum of 15% equity IRR).

But this minimum value is only acceptable, if the project risk is low!

Risk

Risk is defined in financial terms as the chance that an investment's actual gains will differ from an expected outcome.

Risk includes the possibility of losing some or all of an original investment.

Risk perception and profitability requirements are proportional to each other.

e.g. Government bonds = low risk = ok to have only a low interest rate

What is risky about a bio-waste biogas plant?

External risks (=>can be managed by public authorities)

- To receive less input waste for treatment, resulting in double income loss (gate fee and revenue from energy production)
- To be paid late, both during construction and operation
- To face changes in the revenue / ton of waste treated
- To face changes in the revenue / unit of energy produced

Internal risks (can only be managed by the plant operator)

- To have down-time in the process due to technical, quality or logistical issues
- To produce less energy than calculated
- …..

How public authorities can reduce risk

- Long-term feedstock contracts to ensure the input supply (15 years)
- Long-term gate-fee contracts to ensure a predictable revenue for waste treatment (15 years)
- Long-term Power Purchasing Agreements (PPA) for the renewable energy produced (el, heat, gas)
  - ➢ Consider making a direct PPA to supply all public buildings with renewable energy if the national tariff for renewable electricity is too low
- If possible: offer uptake contracts not only for electricity, but also for heat
  - ➢ If there is a district heating network, the plant can supply heat

At regional level: potential analysis & planning

Regions can do a potential analysis to assess the theoretical amount of bio-waste and other feedstocks for biogas.

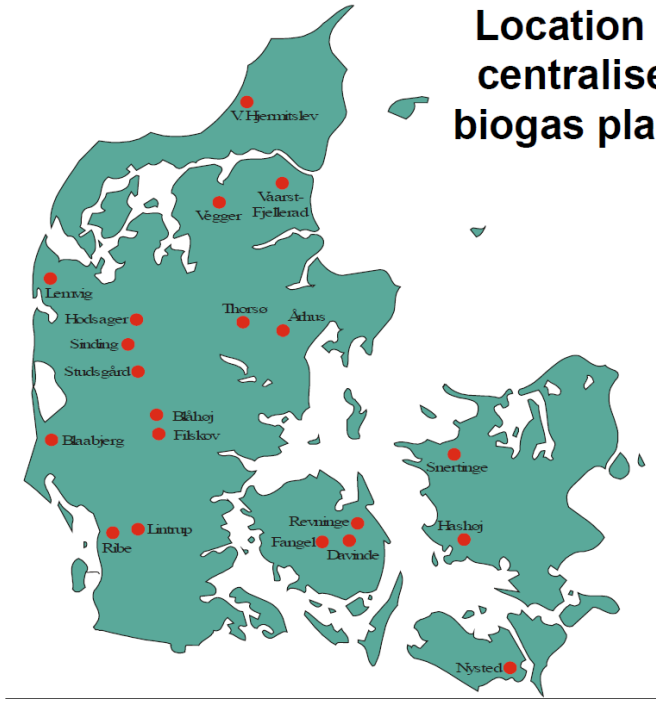
Plan future biogas plants at territorial level, avoiding future competition for feedstock by supporting too many biogas plants in an uncoordinated manner.

Good practice: DK: central planning of future plants for the whole territory

Bad practice: UK, FI (supported too many plants at the same time that are now fighting for feedstock to sustain their business)

Denmark has fully integrated bio-waste management in its renewable energy strategy.

Location of centralised biogas plants



Animal Manure
Cattle
Pig
Poultry

Organic waste
Industries
Organic household waste (MSW)
Sewage treatment plant

Centralized Biogas Plant

Homogenization
Digestion
Reduction of odour nuisance
Sanitation
Nutritionally defined product

Fertilizer on the fields
Improved utilzation of plant nutrients

Reduction of the consumption of mineral fertilizer

Reduction of water pollution

Biogas for heat & power generation
Renewable energy source
CO_2 -neutral
Reduction of air pollution
Effective energy utilization