# Co-digestion of animal manure and organic household waste - the Danish experience

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# Co-digestions of manure and organic waste

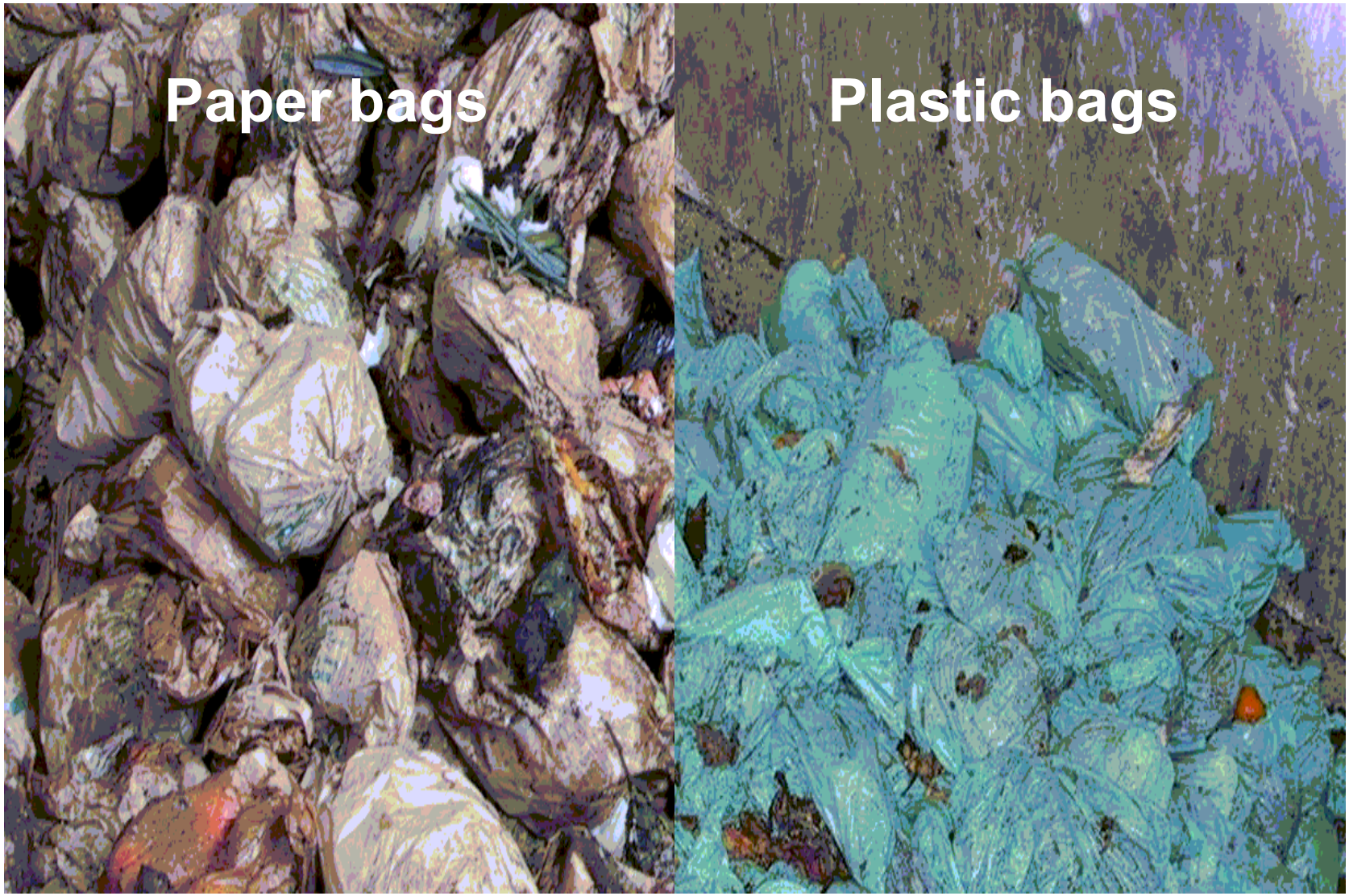
- Introduction
- Waste handling
- Energy aspects of waste handling strategies
- Co-digestion of animal manure and organic waste
- Regulatory framework
- Summary and conclusions

# Waste handling routes for organic household waste

- Recycling
  - Anaerobic treatment
  - Composting
- Incineration
- Landfill

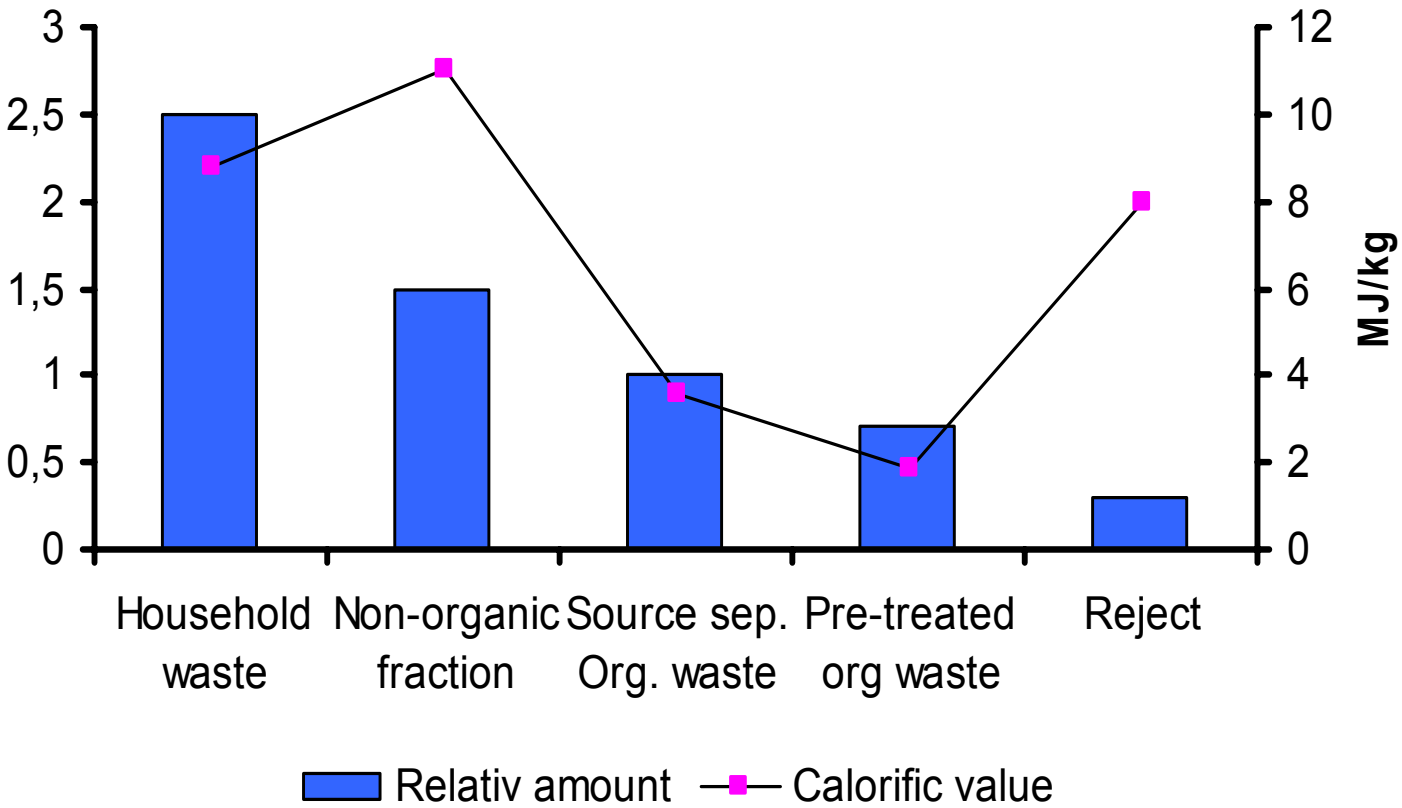
# Organic household waste - composition

| | Danish average data | |
|---|---|---|
| Dry Matter, DM, % | 25 | (17-31) |
| Ash, % of DM | 12 | (9-17) |
| Heating value, MJ/kg DM | 20 | (19-21) |
| K, potassium, % of DM | 1.1 | |
| P, phosphorous, % of DM | 0.5 | |
| N, nitrogen, % of DM | 2,8 | |
| Pre-treated org. Waste % ww | 67 | (52-76) |

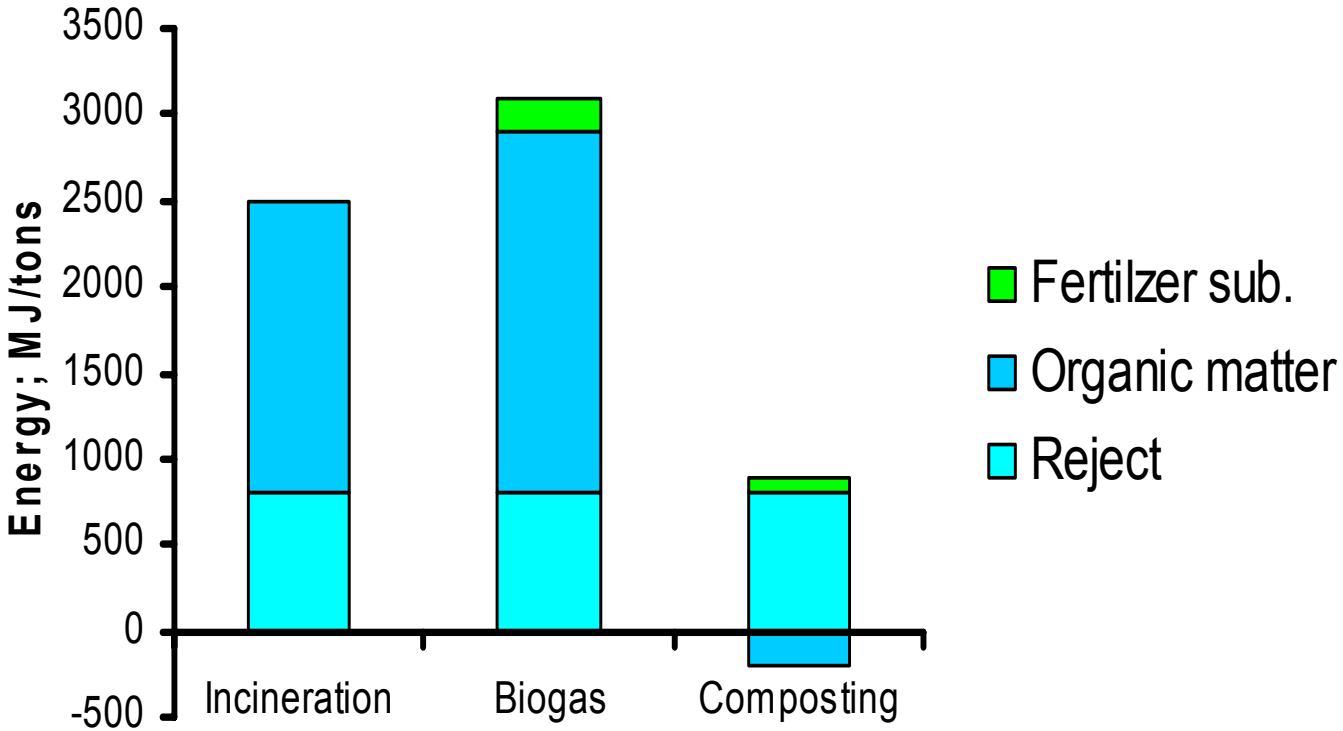

Paper bags
Plastic bags

# Pretreated organic household waste

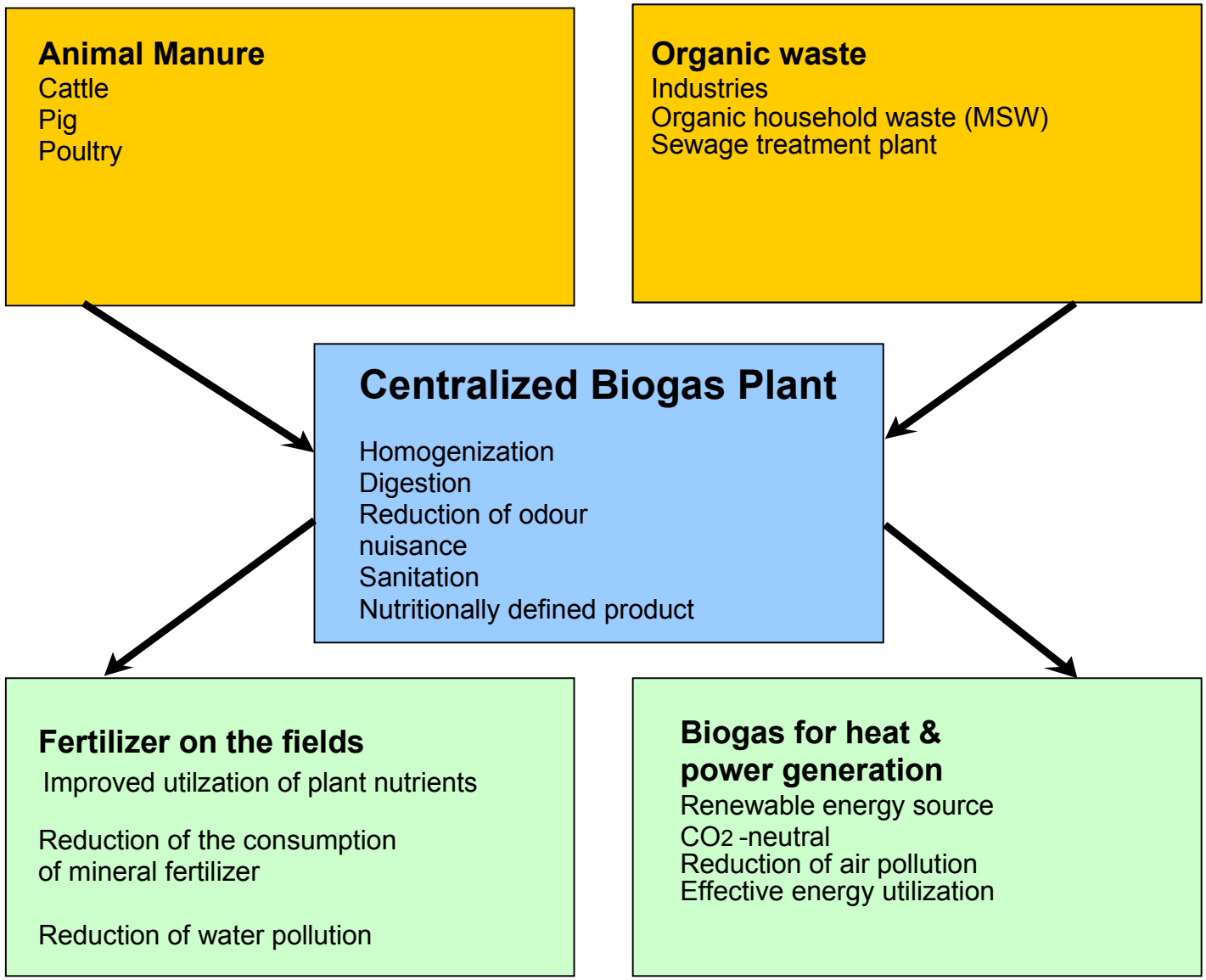
# Co-digestions of manure and organic waste



# Co-digestions of manure and organic waste



# Centralised Biogas Plant


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
CO2 -neutral
Reduction of air pollution
Effective energy utilization

# Location of centralised biogas plants

# Organic waste for improvement of gas yield

- Gas yield from manure: 15-20 m3/tonne
- Addition of organic waste to improve gas yield
- Average 60% of gas production originates from addition of waste
- Industrial waste, organic household waste and sludge can be used to improve production

# Organic waste for improvement of gas yield

- **Concentrated fat, fish silage etc.**
  **200 - 1,000 m3/tonne**

- **Fish waste, fat and flotation sludge, slaughterhouse waste, dairy waste, organic household waste etc.**
  **50 - 200 m3/tonne**

- **Fruit and vegetable waste, industrial wastewater, sewage sludge**
  **10 - 50 m3/tonne**

# Biogas potential in Denmark

| | Estimated Potential PJ | Production in 1999 PJ | Production in 2000 PJ | Danish energy plan 2030 PJ |
|---|---|---|---|---|
| Animal manure | 24.0 | 0.50 | 0.56 | 14.0 |
| Sewage sludge | 4.0 | 0.79 | 0.86 | 1.5 |
| Industrial waste, Danish | 2.5 | 0.51 | 0.56 | 1.5 |
| Industrial waste, imported | | 0.30 | 0.35 | 0.0 |
| Organic household waste | 2.5 | 0.01 | 0.01 | 2.0 |
| Garden waste | 1.0 | 0.00 | 0.00 | 0.8 |
| Landfill gas | 1.0 | 0.55 | 0.58 | 0.2 |
| | 35.0 | 2.67 | 2.91 | 20.0 |

# Will organic household waste to biogas plants increase?

- **High quality necessary**
  - **low heavy metal content**
  - **low content of organic micropollutant**
  - **sanitation at the biogas plant**
- **Pre-treatment necessary**
- **Reliable disposal route**

# Regulatory framework

- **Statutory order on utilisation of waste products in agriculture**
  - **all waste, including industrial waste, organic household waste and sludge**
  - **quality demands for heavy metals, organic micropollutants**
  - **hygienic treatment requirements**
  - **rates of application (kg N, kg P pr. ha. and year)**
  - **supervision by local author**

# Summary and conclusions

- **Higher energy production through biogas production than incineration**
- **Nutrients are utilized in agriculture**
- **Co-digestion with animal manure results in a stable process**
- **Reliable disposal route if the organic waste has high quality**
- **Research on energy aspects and cost-benefit analysis are ongoing**