

CIRCULAR ECONOMY IN DENMARK

The quiet revolution of biogas in Denmark

ICAW Webinar: Food Waste and the Circular
Economy – Experience from Denmark, May 6th

BD Manager, Claus Mortensen
Agro Business Park, Denmark
cm@agropark.dk // +45 4030 4820



KINGDOM OF DENMARK: BEER, BUTTER, BACON & BIOGAS

43.000 km² –5,6 MILLION DANES: THE AG AND FOOD SECTOR MATTERS

- 25% of all export is ag and food related / 6.5% of the workforce. Cooperative traditions
- Home to global companies like Danish Crown, Arla, Carlsberg, Novozymes, Chr. Hansen, Danfoss, Grundfos, Vestas, LEGO, Siemens Wind Power, Maersk Shipping et.al

SIGNIFICANT LIVESTOCK PRODUCTION CALLS FOR AGRIENVIRONMENTAL SOLUTIONS

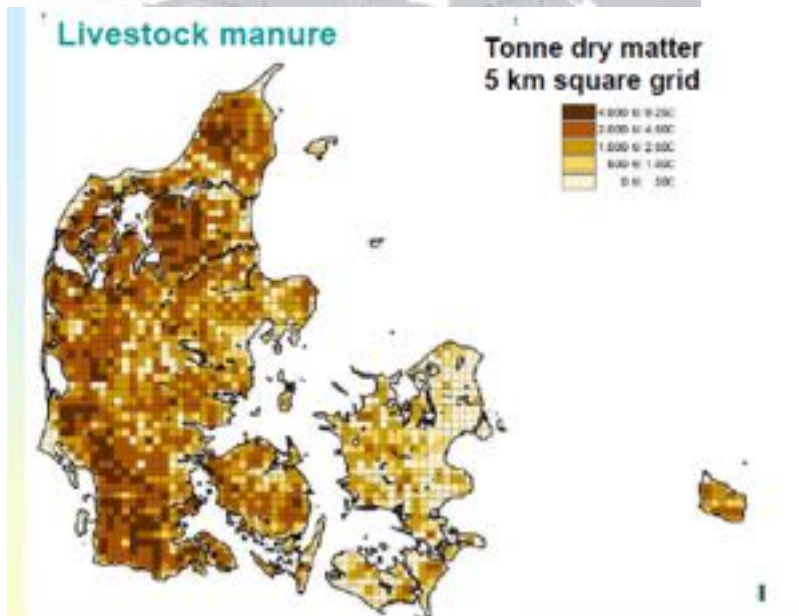
- 35+ million piglets/year and 1.5 million cattle incl. 575.000 Dairy cows located on a areas half the size as Tasmania (around 33.000km²).

CIRCULAR ECONOMY – ORGANIC WASTE AS A RESSOURCE

- 2022 target: Min. 50% recycling from households.
- 2023 target: Around 300.000 tons organic waste from households must be collected separately. Used for biogas production and later fertilizer.

RENEWABLE ENERGY

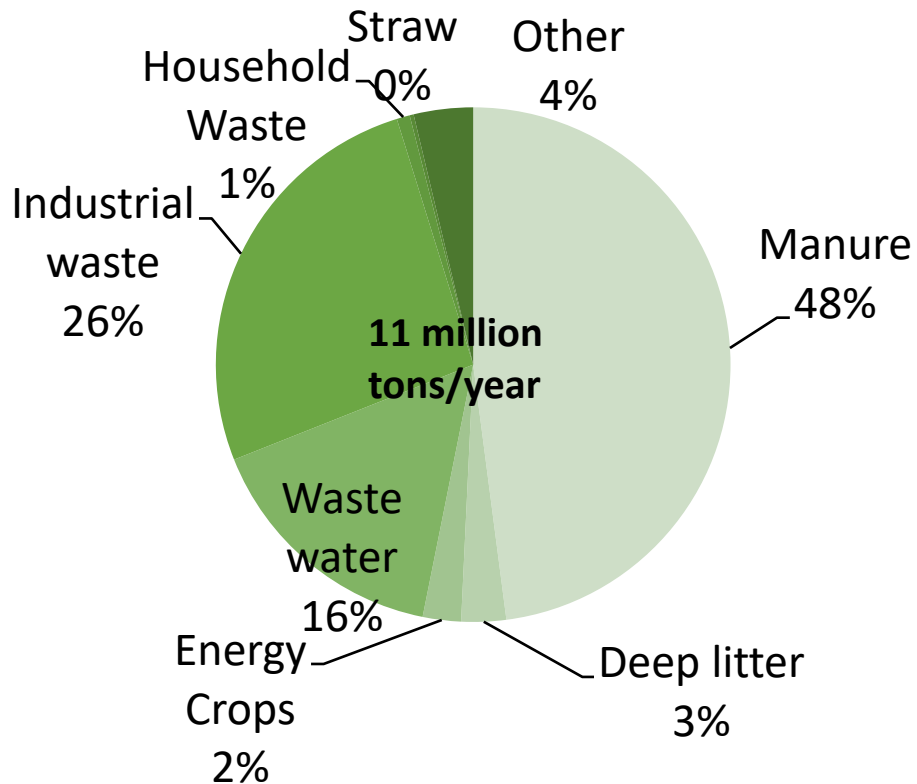
- Although considered a wind-power country, 2/3 of all renewable energy in Denmark is bioenergy. 34% of all energy production is RE.
- Goal: Climate neutral by 2050
- Framework: Overall strong political consensus across the 10 parties in the Parliament.



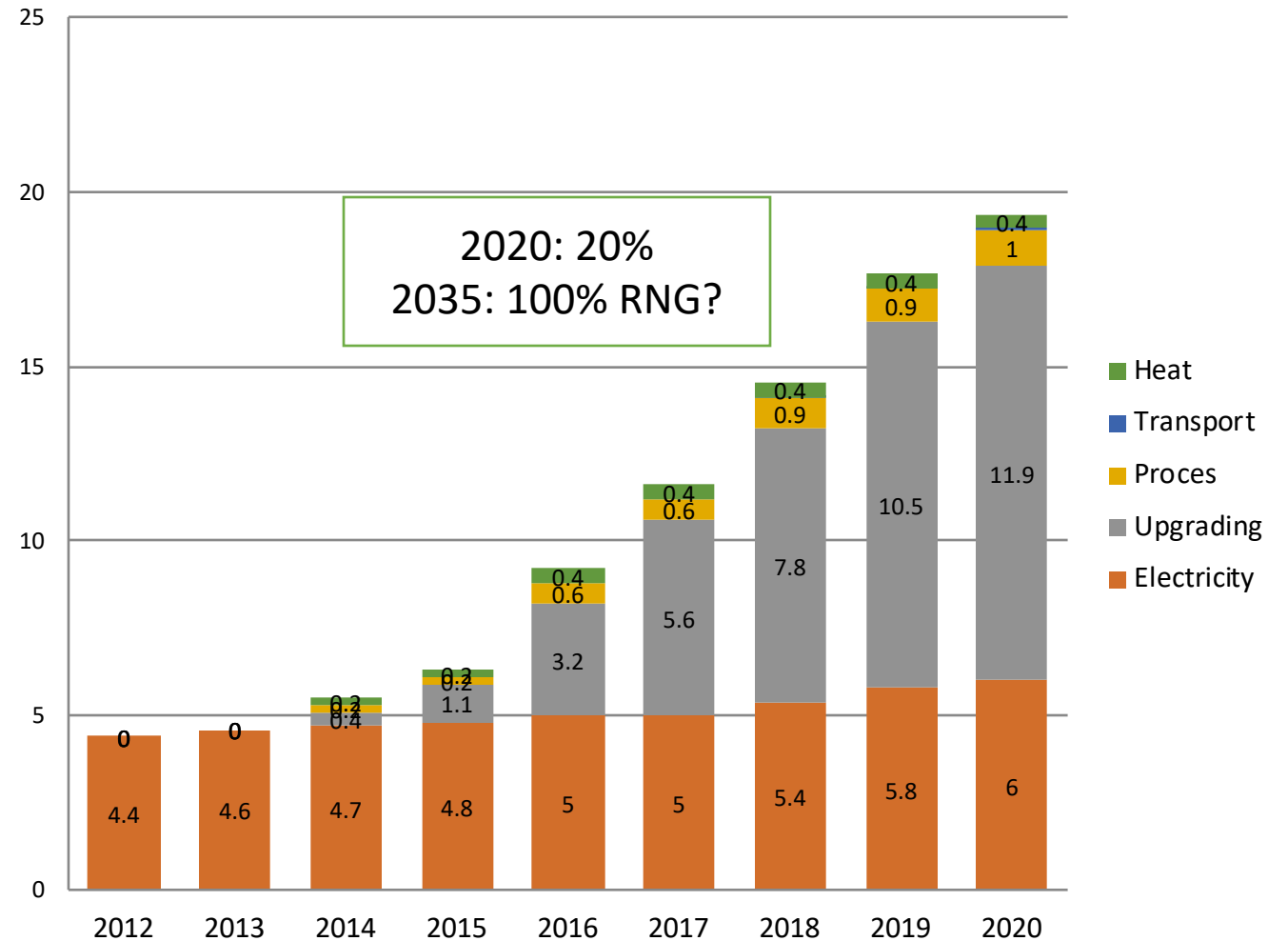
FROM FARM BASED TO INDUSTRIAL BIOGAS PLANTS IN A FEW DECADES

Currently 166 biogas plants in Denmark

- 56 waste water plants
- 6 industrial plants (food waste)
- 28 landfills (no more landfills are build)
- 27 agriculture co-op plants (increasing)
- 49 farm based plants



Biogas production and use in Denmark 2012-2020 (PJ). Source: DEA



WHY BIOGAS?

Agri-environment

- Less smell and leaching
- Less methane and laughing gas slip
- Higher availability of nutrients

Energy

- Renewable and storable gas that replace fossil fuels
- Opportunities to integrate wind power

Economy

- Jobs through local value chains
- New products: food grade CO₂
- 1PJ biogas = reduction of around 1.084.000 tons/CO₂/year (Danish DEA)
- Socioeconomic value of biogas in Denmark: \$26 pr. GJ

THE DANISH APPROACH

Circular economy

- Co-digestion: Agri-, food-, industrial waste
- Fertilizer of high value for organic farming
- AD is much more than just energy

Technology & Process

- Economy of scale but no size fits all
- Mainly thermophilic processes in CSTR
- Flexible plants putting gas to the grid

Ownership & Management

- Biomass suppliers co-invest
- Long contracts and partnerships
- Operation is key and not a part time job!

MÅNSSON PLANT: LARGEST ORGANIC BIOGAS PLANT IN THE WORLD



Biomass supplier/investor

Investor/operation

Design/commissioning

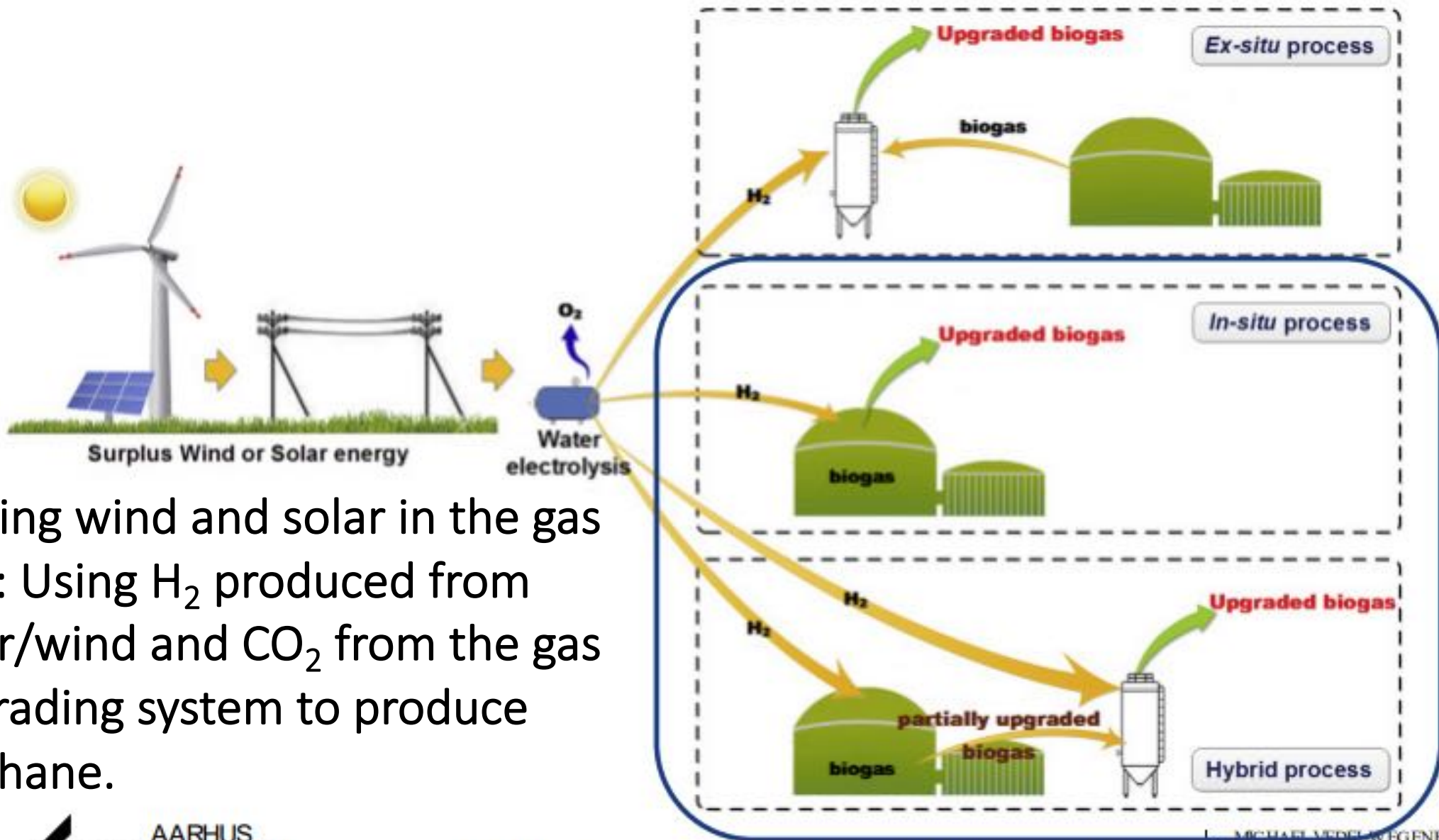
Biogas upgrading

H₂S removal

Foodwaste tech/sup



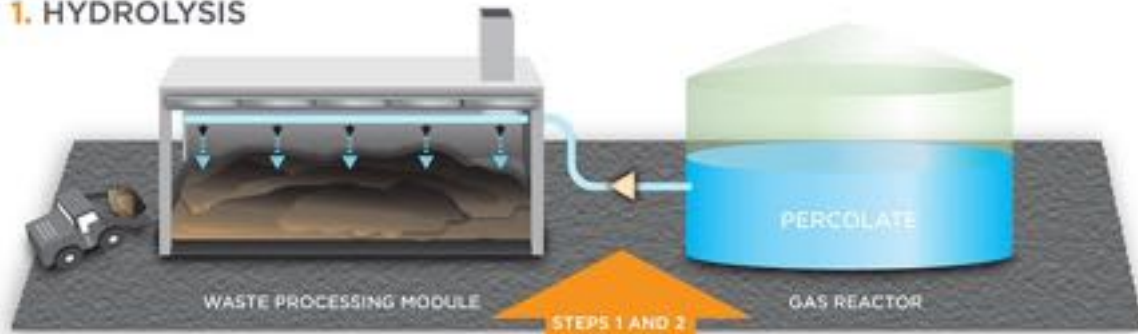
POWER2GAS: THE FUTURE OF BIOGAS IN AN INTEGRATED ENERGY SYSTEM



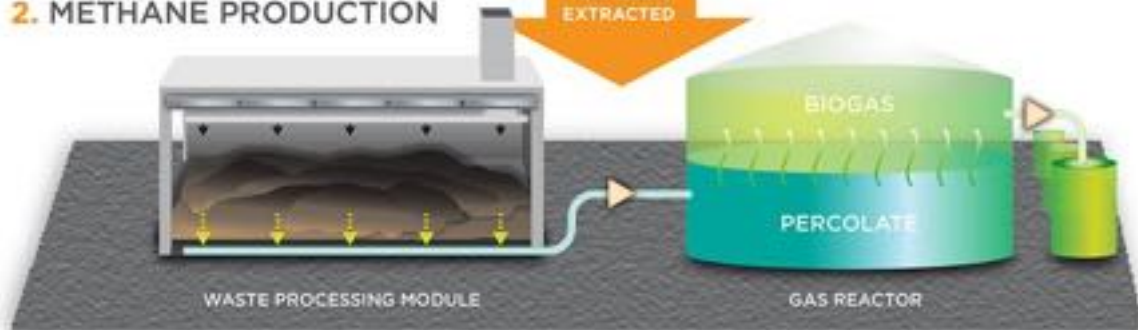
Storing wind and solar in the gas grid: Using H_2 produced from solar/wind and CO_2 from the gas upgrading system to produce methane.

BIOGAS PRODUCTION & COMPOSTING IN ONE

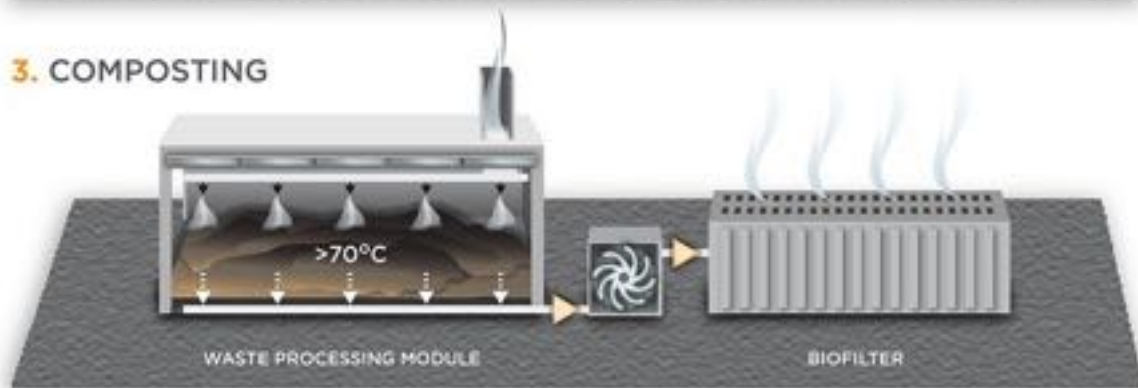
1. HYDROLYSIS



2. METHANE PRODUCTION



3. COMPOSTING



Hydrolysis: Inside the process module fresh waste is sprayed with degasified percolate drawn from the biogas reactor. This induces bacterial hydrolysis, leaching out fatty acids. Percolate is drained from the bottom of the process module, effectively separating the waste into dry and wet fractions.

Methane production: The wet fraction (the percolate), with its content of fatty acids, is pumped back to the biogas reactor where methane production takes place, physically separated from the solid waste fraction. Steps 1 and 2 are continued as long as the percolate has potential for methane production.

Composting: When the potential for methane production has decreased, the process module switches to forced ventilation (negative aeration) of the remaining solid waste. Aeration rapidly initiates a highly effective composting process. Heat from the composting ensures complete sanitization and evaporation of excess humidity.



Morten E. Gyllenborg, Development Director
Mail: mog@solum.com // Phone: +45 2876 9706



ICELAND
IS GOING
EVEN GREENER

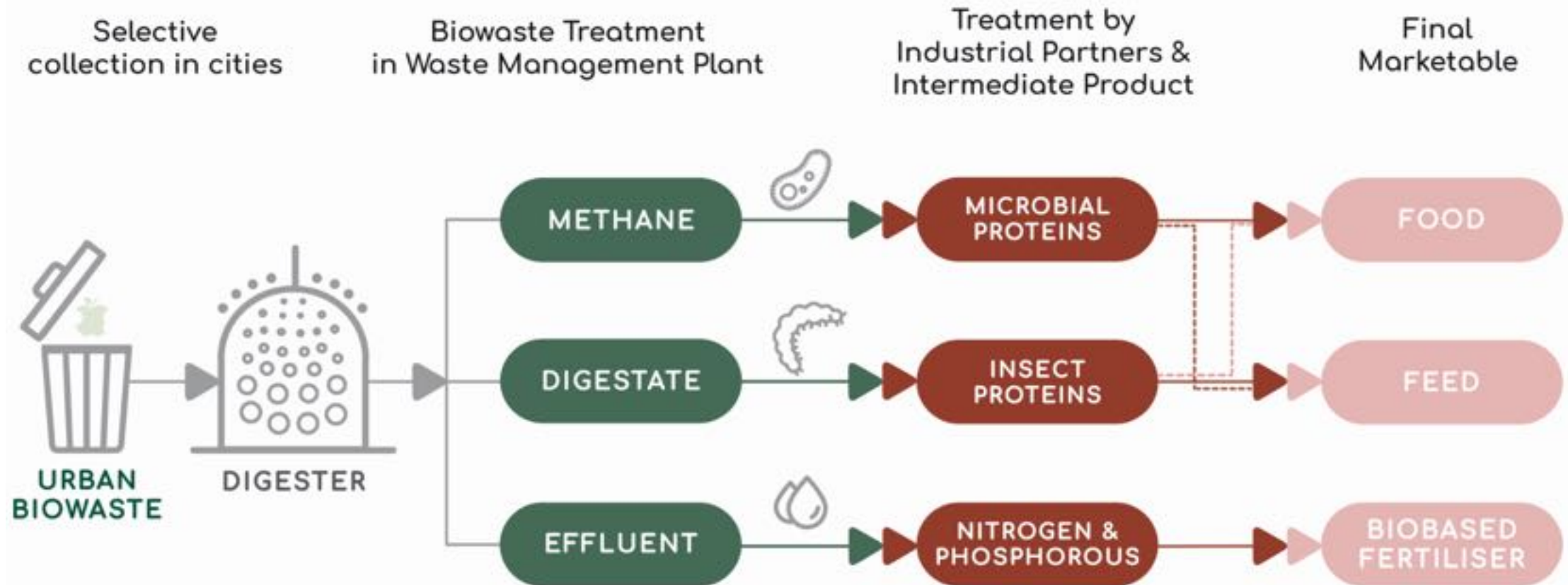
SUSTAINABLE DEVELOPMENT GOALS



FUTURE: BIOGAS TECHNOLOGY IS MUCH MORE THAN ENERGY



THREE VALORISING LINES OF URBAN BIOWASTE



LET'S CONNECT!



We facilitate collaboration between Danish and US stakeholders on **biogas policy, R&D and commercial agreements**. Free of charge.



Claus Mortensen
Int. Business Development Manager
Copenhagen, Denmark
cm@agropark.dk
+45 4030 4820
www.biogasgoglobal.dk

Chris Voell
Commercial Advisor
The Trade Council in
Washington DC
chrvoe@um.dk
+1 240-877-4745

