



Waste biorefinery technologies for accelerating sustainable energy processes

# Anaerobic Digestion of second crops and agro industrial by-products: a focus on the Italian Biogasdoneright® model

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WG2: Biorefinery Technologies



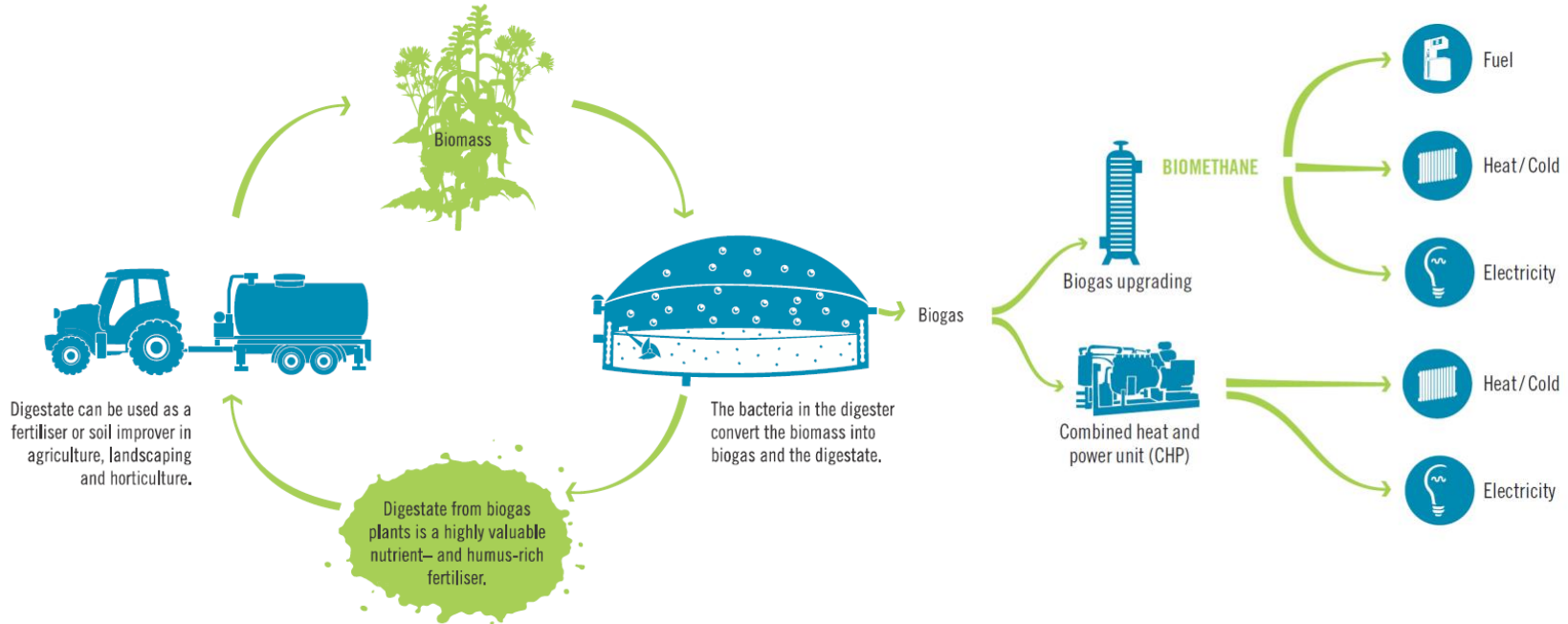
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the European Union



- Anaerobic digestion and biogas: general overview
- Feedstock for anaerobic digestion
- First and second generation biorefineries: benefits and drawbacks
- The Italian *biogasdoneright*® model: sustainability of agricultural systems
- The *biogasdoneright*® feedstock
- CRPA – Research Centre on Animal Production and its activities



# Anaerobic Digestion (AD)



Adapted from Biowaste to biogas, Fachverband Biogas e. V. (2016)

# AD - biomass

W I R E

**LIVESTOCK  
MANURE**



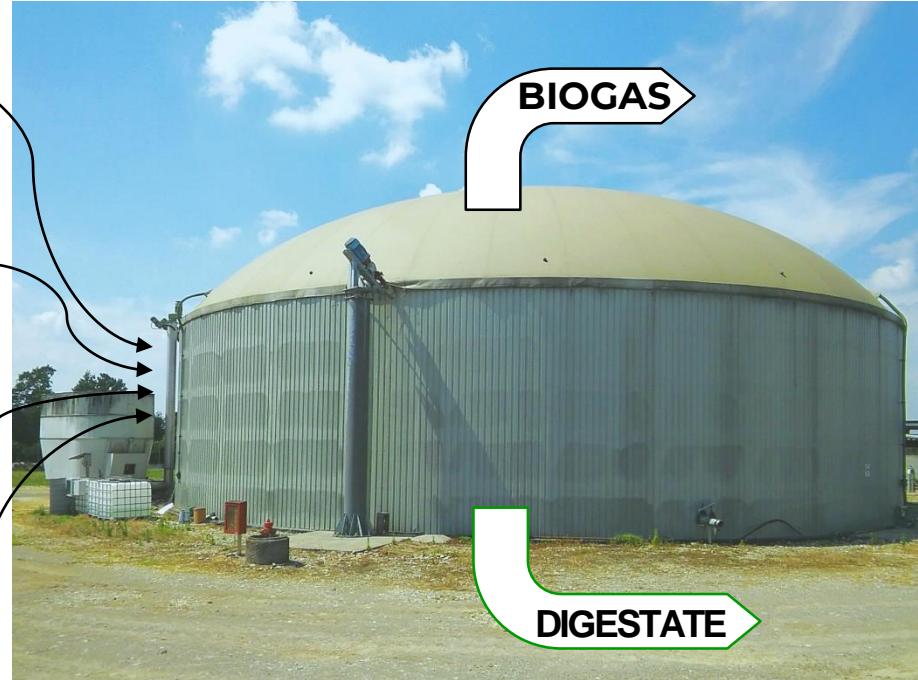
**BYPRODUCTS**



**SECOND CROPS**



**AGRICULTURAL  
RESIDUES**



# Digestate - fertilizer



- Rich in *nitrogen (N)*, *phosphorous (P)* and *potassium (K)*
- **Stabilized material**: fertilizer or soil improver
- Reduces  $\text{CH}_4$  and  $\text{NH}_3$  emissions and odours
- **Recycles organic carbon**, increasing its content in the soil



# 1° & 2° generation biofuels

## BIOFUEL

Generated from *plants, animal waste, sludge*, in either solid, liquid or gaseous form and capable of being converted to another variety of biofuel

- Renewable and carbon- and CO<sub>2</sub>/GHG-neutral during the progression of the life cycle
- Biodegradable, sustainable and environmentally friendly
- Produced from locally available and accessible resources
- Safe production methods
- Enhance home-grown agricultural development and investment



# 1° & 2° generation biofuels



## 1<sup>st</sup> generation feedstock

*i.e. rapeseed oil,  
soybean oil, corn,  
sugarcane*



## 2<sup>nd</sup> generation feedstock

*i.e. lignocellulosic  
biomass, agricultural  
and forestry residues,  
wood/wood  
processing waste*

### PROS

- Low production cost
- Good cost/yield ratio
- Large number of carbohydrates in starch or saccharose form

- Cellulose, hemicellulose
- No competition with food
- Large amount of biomass available
- Environmentally friendly

### CONS

- Need large arable lands
  - Deforestation
  - Exploitation and drastic changes of natural ecosystems
  - Food vs. Energy debate
  - Larger carbon footprint compared to other generation biofuels
- 
- Need pre-treatments: net energy balance?
  - Technical challenges/technology under development

Is it possible to **combine food and renewable energy production** in a **sustainable way**, as well as carbon sequestration?



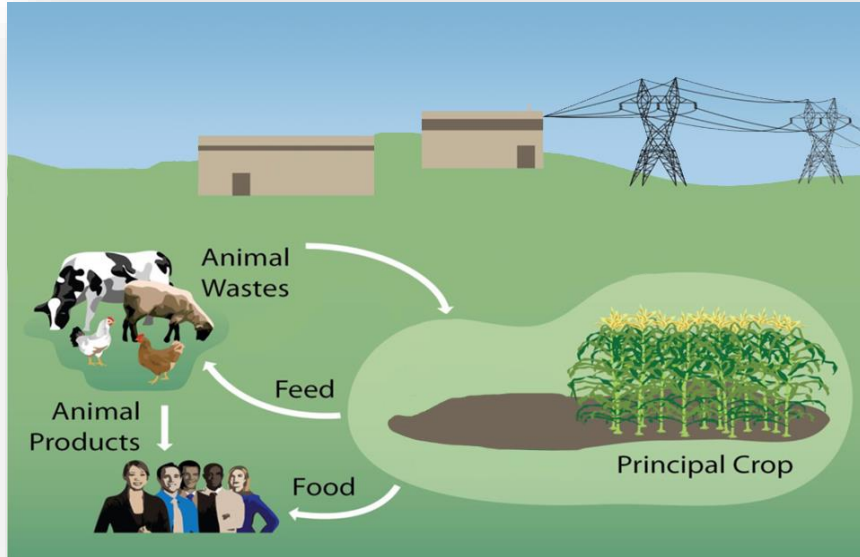
**BIOGASDONERIGHT®**

ANAEROBIC DIGESTION AND SOIL CARBON SEQUESTRATION  
A SUSTAINABLE, LOW COST, RELIABLE AND WIN WIN BECCS SOLUTION



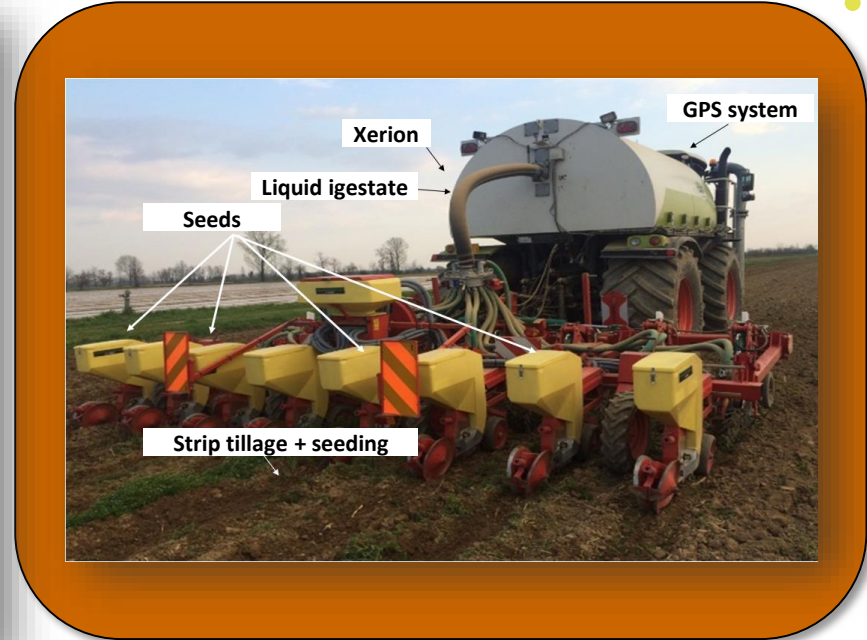
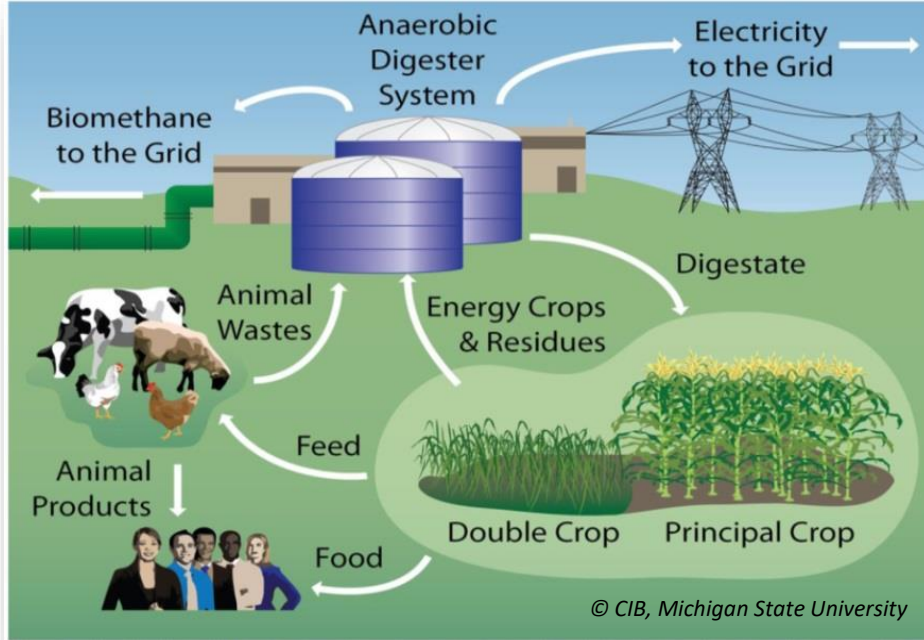
# Traditional agriculture

W I R E

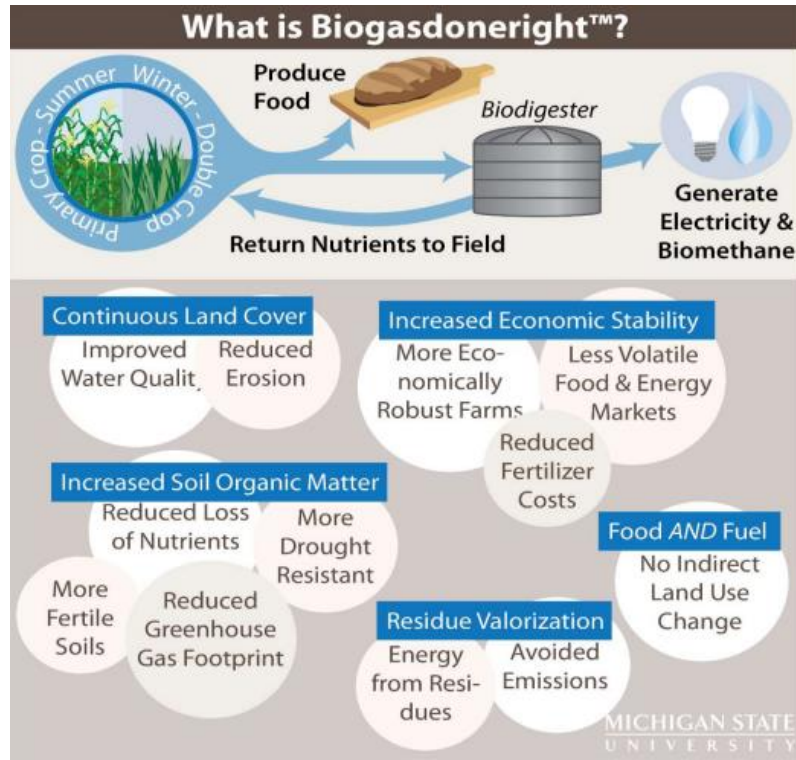


# Innovative agriculture

WIRE



# biogasdoneright® model



- Mitigation of emissions from livestock effluents
- Keeping the soil covered the whole year applying new and improved crop rotations
- Organic fertilizers, soil nutrient balance and new machinery avoiding nutrients losses and soil compaction
- Shift from deep plowing to precision farming and minimum tillage agriculture
- Increased share of renewable energy in agriculture (power, heat, fuel)
- Market diversification, better cash flow, more jobs, more investment attractiveness

Dale et al., The potential of expanding sustainable biogas production in selected countries and some possible impacts in specific countries (2020)

## WHICH BIOMASSES CAN BE USED?

- Livestock effluents
- Organic- by-products
- Double, catch or cover crop before/after a main crop
- Lignocellulosic biomass (i.e. perennial grasses)

## Classification of feedstock beyond the concept of 1° and 2° generation



SUSTAINABILITY!

- No matter if the biomass is «food» or «no food»
- The relevance is in the use of the soil that is made (soil covered the whole year)
- Also, contribution that some crop rotation and farming practices offer to the mitigation of agricultural GHGs emissions and soil fertility improvement

# Our company



Centro Ricerche Produzioni Animali



Animal Production  
and welfare

Agriculture and farm  
management,  
mechanization and  
economics



Environment & Energy

Results dissemination

- Support to biogas and biomethane plants
- Expert consulting and knowledge transfer
- Experimental support by CRPA Lab: deep characterization of organic matrices



W I R E





# Thank you!

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Mirco Garuti

Mariangela Soldano

Sergio Piccinini

WG2: Biorefinery Technologies

WIRE Working Groups Workshop (Naples 6-7<sup>th</sup> October)

