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Appropriate German high tech biogas technology adapted to the low tech, low-cost version for the emerging markets - State of the Art and Case Studies for Solid Substrates

- Kirchberg, 2.February 2021
- Michael Köttner
- International Biogas and Bioenergy Centre of competence, IBBK

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Facilitator:
eclareon

International Biogas and Bioenergy Centre of Competence IBBK

- Know-How transfer (international workshops, conferences, study tours, training)
- Technical support especially with dry digestion, lagoon technology, small scale installations
- Contacts to experts in planning, design and construction
- Contacts to specialized companies
- Networking with members in different regions nationally and internationally
- Origin in Organic Biogas

Content

1. Feasible technology options for dry and wet residues
2. Innovations in biogas and biomethane
3. Economic success factors
4. Case studies of wet and dry digestion in India and Germany

2. Feasible Technology Options for Biomethane Production from feedstock over 20% DM

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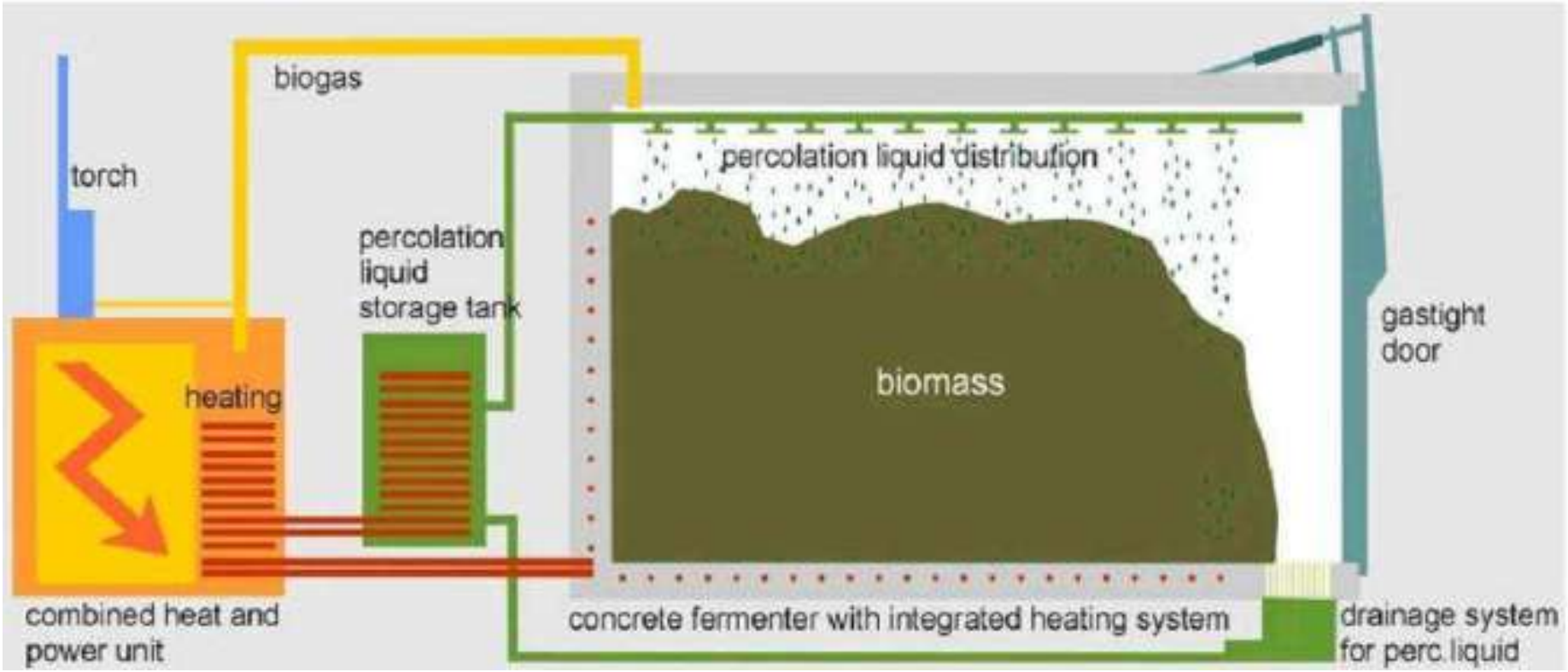
Dry fermentation in a batch garage type digester



CSTR System Steel Tank with Hydrolysis

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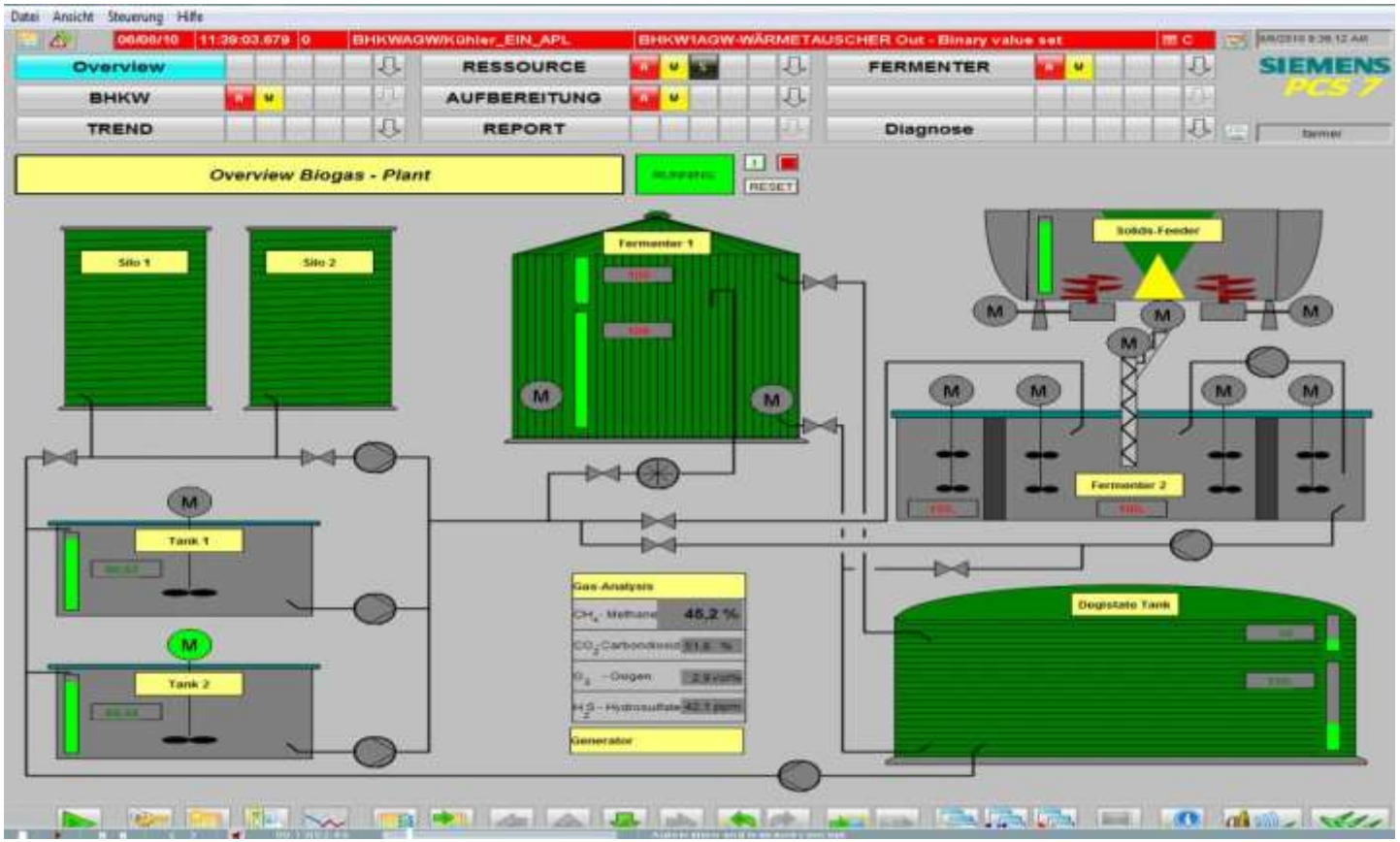
CSTR Control system with Hydrolysis



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Sauter Irrigation System for Solids Fermentation

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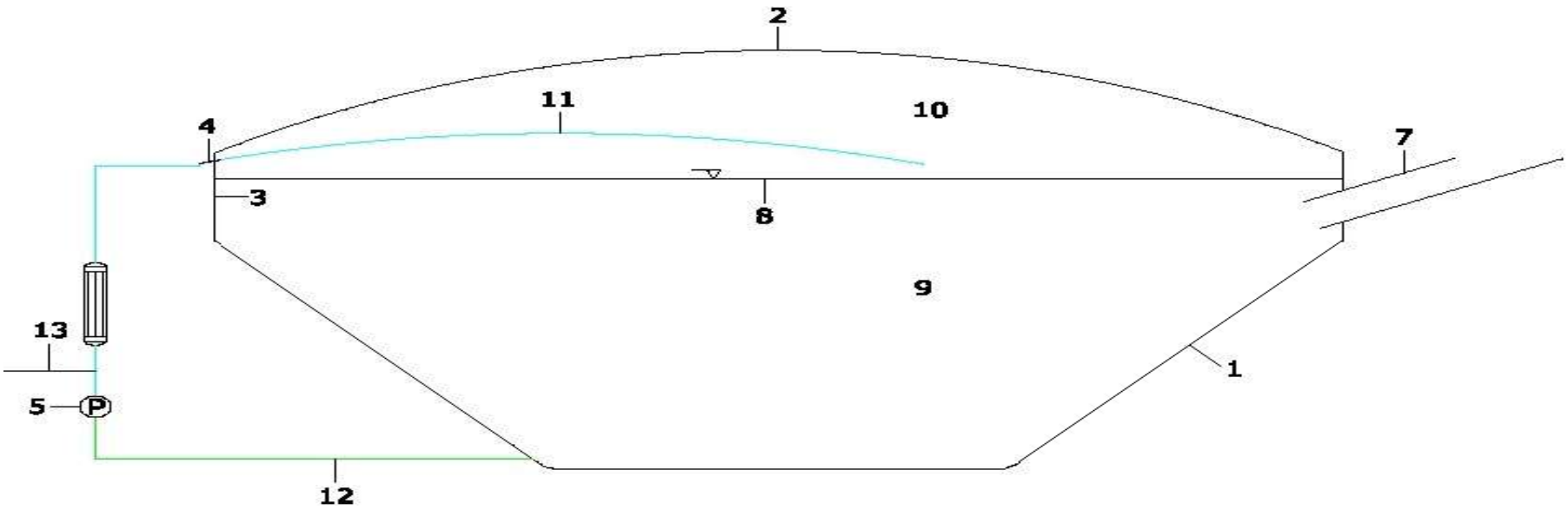

D&K DIY System for building owner construction

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Feeding systems – Simple Chute

- Rather simple feeding system used in combination with lagoon digesters
- Very simple system
- No moving parts, little wear and tear compared
  with other systems
- Must reach under liquid level → CH4 emissions

Feeding systems – Hopper feed pumps

- Used for mixing solids with liquid
  → alternative to traditional mixing pit
- Suitable for any type of wet digester
- Solids are not compressed
  → fine dosing & quick degradation
- Sensitive towards stones and contaminants
- Requires buffer for solids
- Challenge is the level control of solids

2. Innovations in biogas and biomethane

Process optimization – Hydrogen Injection in Digester

- A specially developed biogas injector injects the H2 gas at a certain depth.
- The biological process forms 10 -15% more biogas
- Bio-H2-Plus-biogas is created by bacteria joining H2 with CO2.

Durchführer

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oav GERMAN ASIA-PACIFIC BUSINESS ASSOCIATION

AHK Deutsch-Koreanische Industrie- und Handelskammer 한독상공회의소

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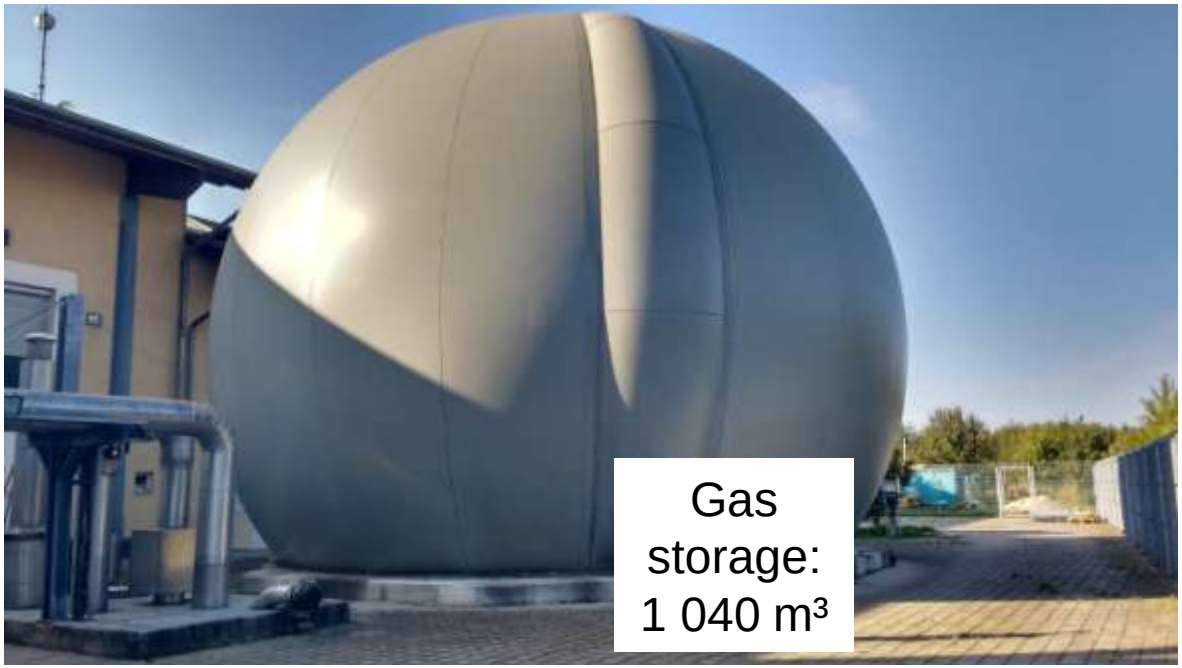
Flexible production of electricity

- ✓ Production of electricity when its price it's at its highest
- ✓ Possibility that other renewable energies don't have
- × Biogas storages are necessary → Need of big investments
- × So far additional income is minimal due to the low energy prices



Digestate Upgrading to Tradable Fertilizer

Separation solid liquid	Liquid enters a vacuum evaporation unit	Nutrients in a concentration	Water evaporation	Ammonium sulphate solution	Crystallization of the solution	Mineral organic fertiliser

Farm Scale Biomethane Filling Station

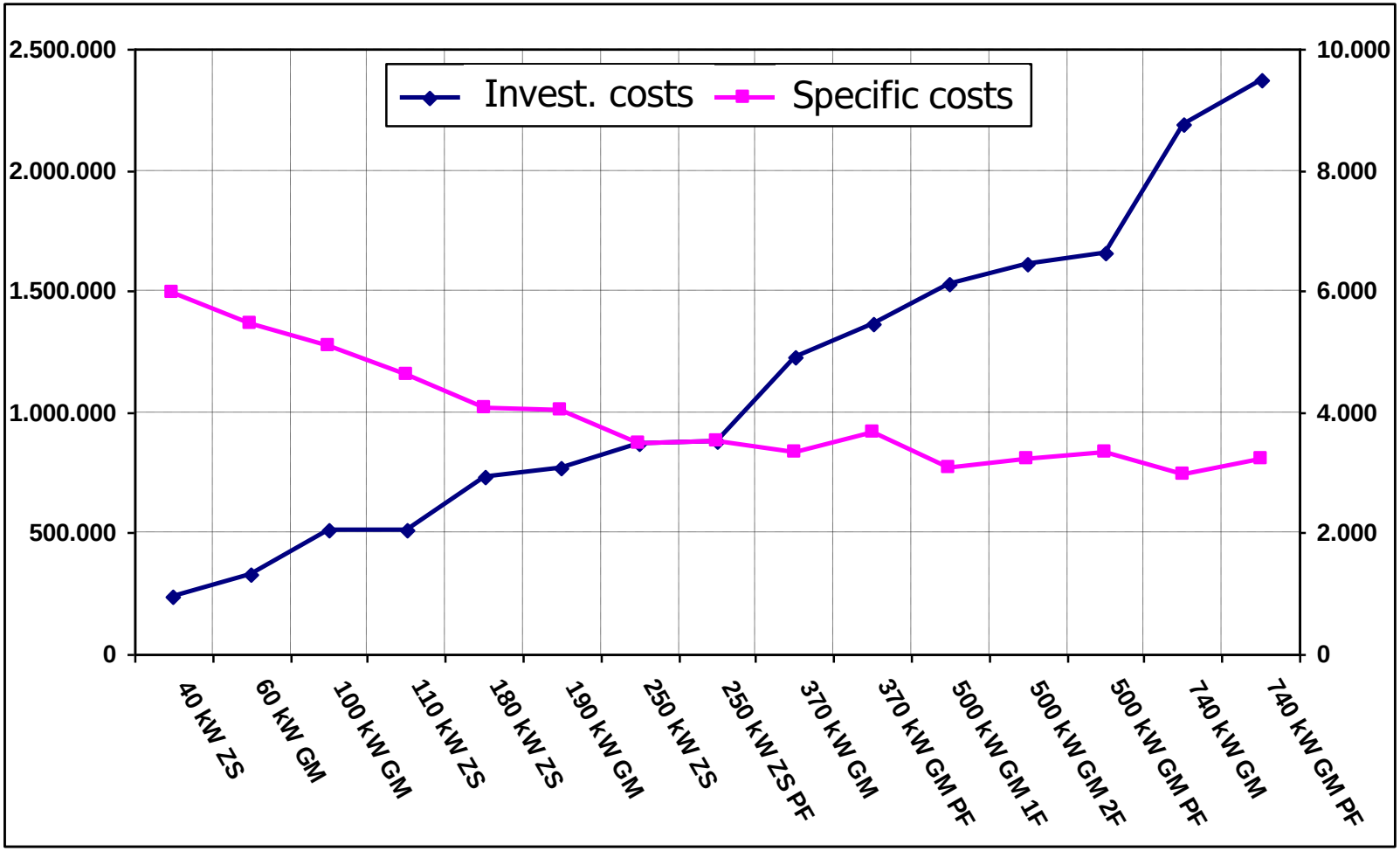
PRODUCT LINE	AgriGNV® 200K	AgriGNV® 350K	AgriGNV® 750K
km travelled	200 000 km/year	350 000 km/year	750 000 km/year
Biogas flowrate	3 Nm³/h 26 280 Nm³/year	5,5 Nm³/h 48 180 Nm³/year	10 Nm³/h 87 600 Nm³/year
BioCNG flowrate	1,40 Nm³/h 12 264 Nm³/year	2,50 Nm³/h 21 900 Nm³/year	5 Nm³/h 43 800 Nm³/year
Installed power	1 kW	2 kW	2,5 kW
Filling time for light vehicle*	11 h without storage < 5 min with stockage	6 h without storage < 5 min with storage	3 h without storage < 5 min with storage
Number of vehicules that could be filled in simultaneously	1	2	2
Number of full-tank refueling per day	2	4	8
Dimensions (w x l x h)	1 200 x 1 200 x 2 200 mm		

*empty tank

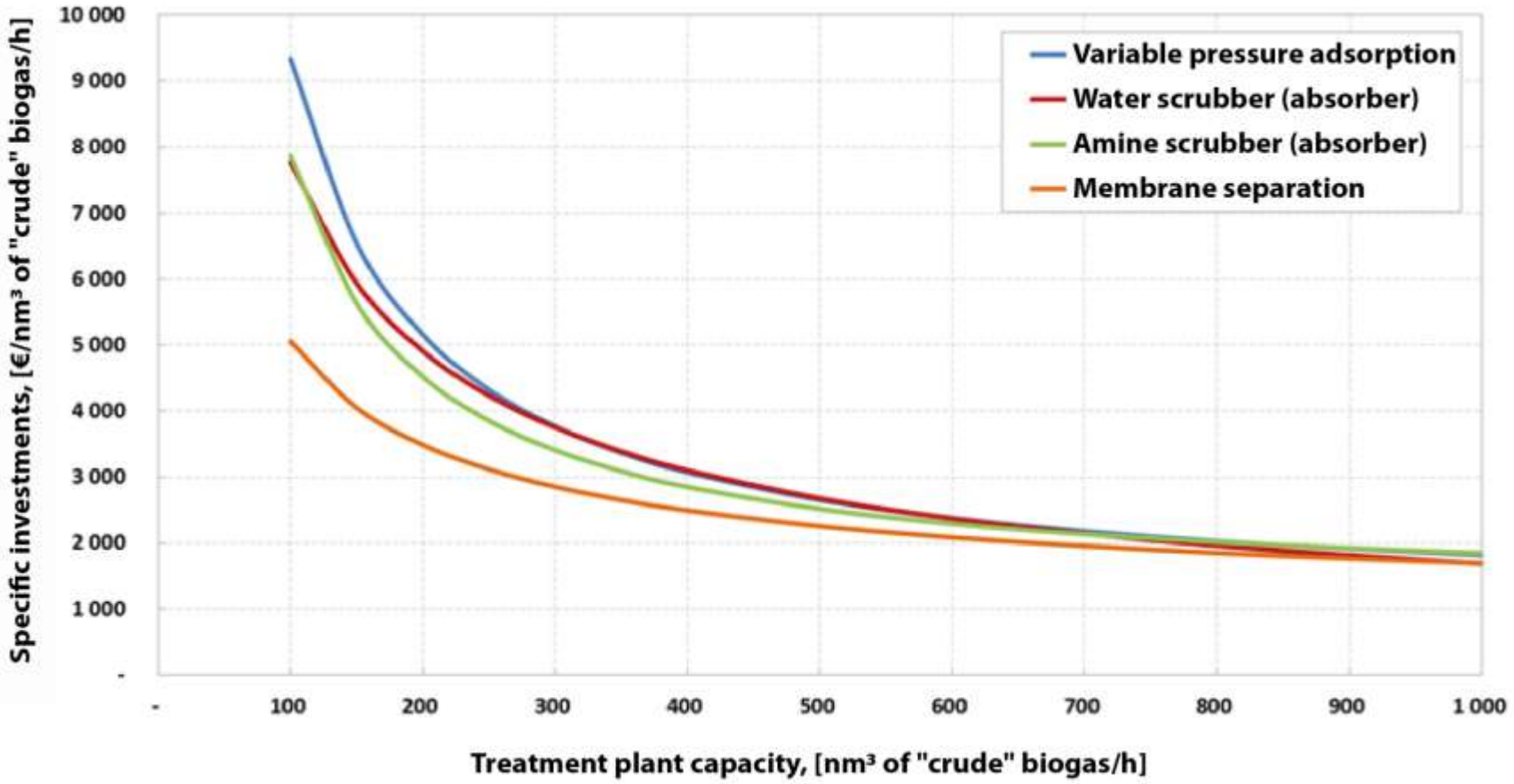
Source: https://www.prodeval.eu/fr/

3. Economic success factors for Biogas Projects

Investment costs for Biogas Plants without gas upgrading



Investment costs for Biomethane Upgrading Plants



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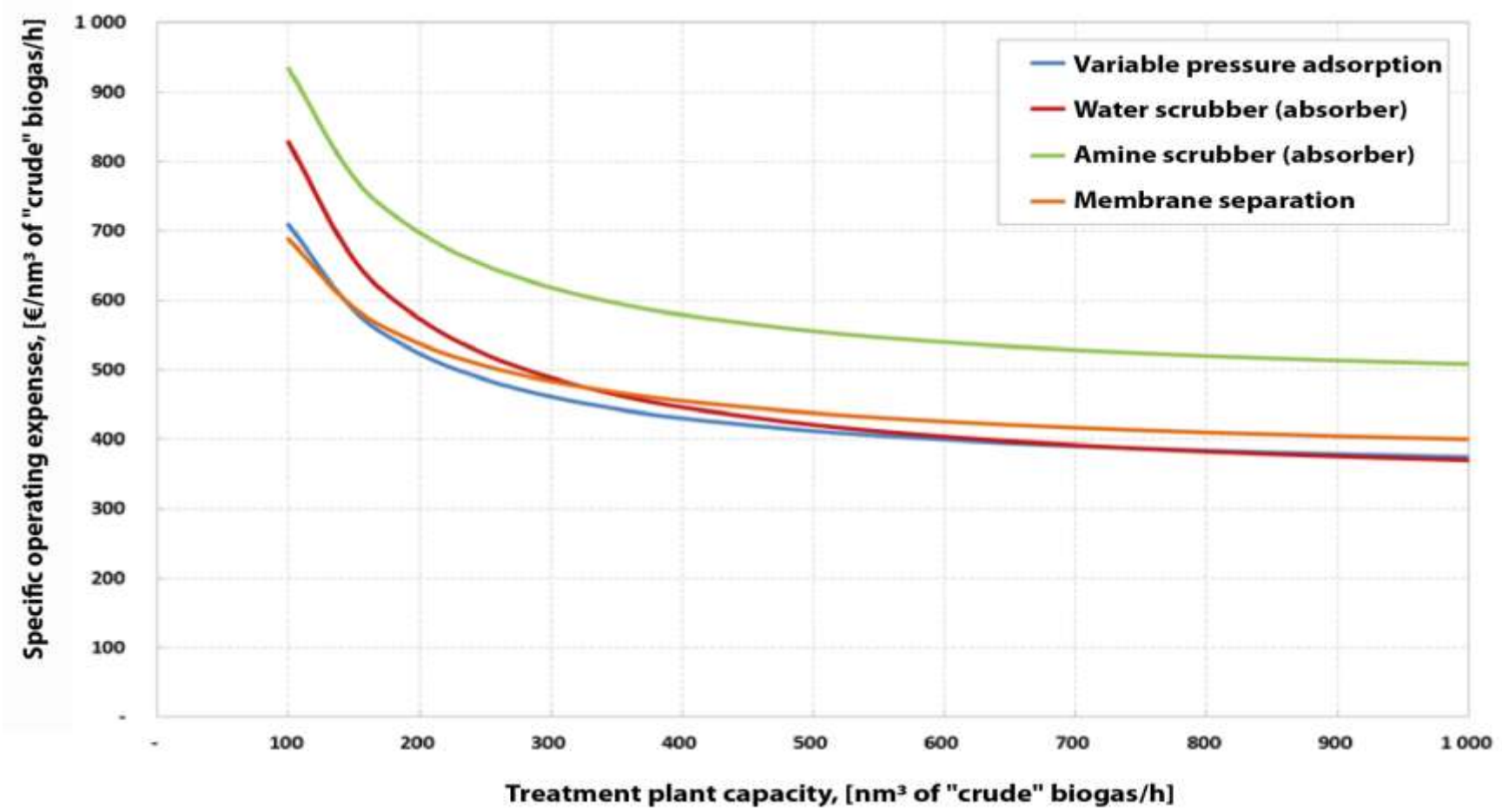
Operating Costs for Biomethane Plants



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Operating Costs

- Depreciation costs
- Interest charge (related to 1/2 of investment costs)
- Maintenance & repair of biogas plant
- Maintenance Biomethane Upgrading lant
- Insurance
- Labour costs
- Costs for input substrates
- Costs for land spreading digestate

4. Case studies of wet and dry digestion in India and Germany

1. Biogas Project, Goa, India

- 1500 m3 Dry Digester volume for 350 m3/h biogas production

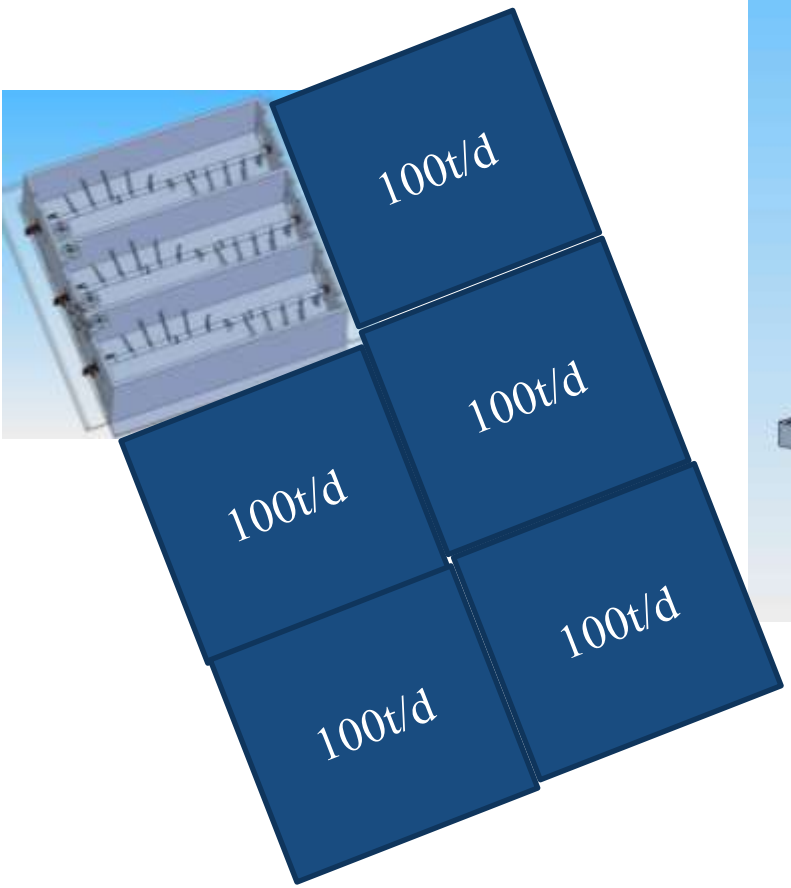
- Thermophillic operation at 55°C

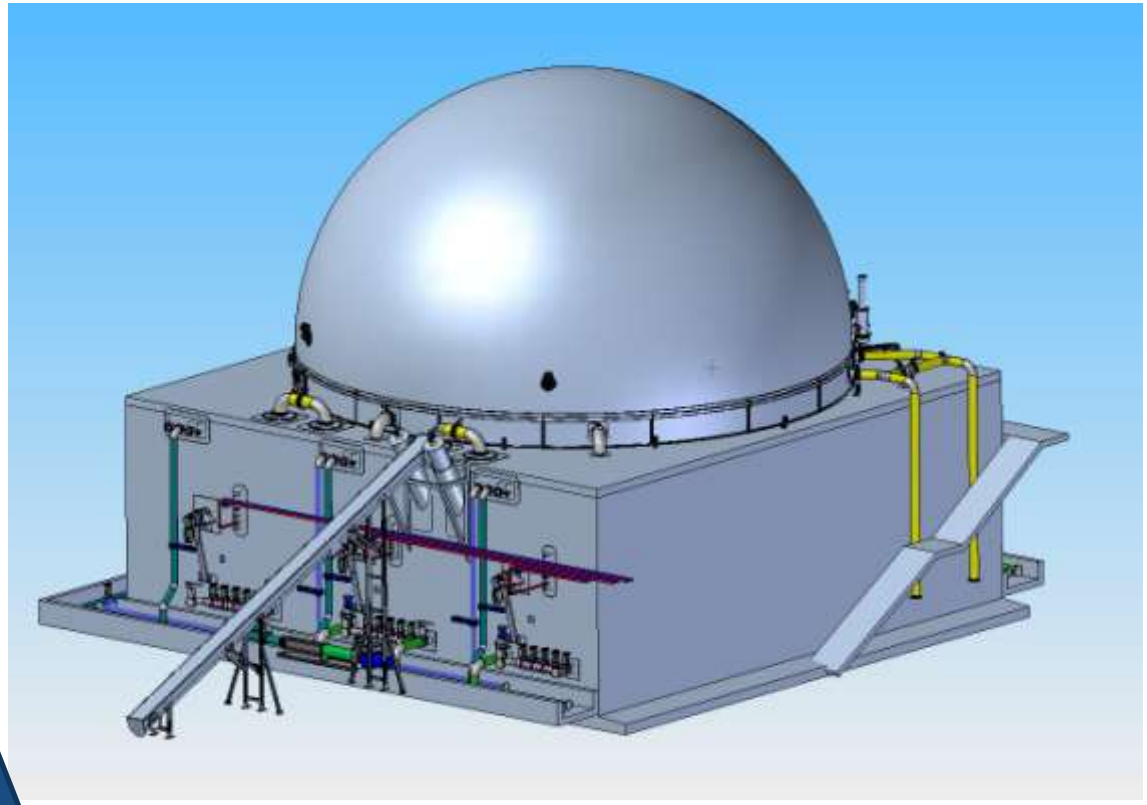
- Slow turning paddle mixer at 2 rpm

- Digester is easily accessible to be able for maintenance

- Continious sand drain for safe operation

Dry digester in modular construction





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Dry Digester Inside

- Digester within waste treatment facility

- Composting and waste water treatment plant

- Prettreatment and reception hall

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2. Biogas Project, Jalgaon, India

Fruit Processing Plant at JISL, Jalgaon

Onion Dehydration Plant at JISL, Jalgaon

- Fruit plant processes over 1,000 MT of fruit /day.
- Onion plant processes over 350 MT of Onions /day

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Solid waste problems

Mango waste

Onion waste

- Over 30 – 40 % from processed quantity comes out as organic waste
- Solid waste posed problems of eco-friendly disposal and space constraints

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Salient Points

- Although there are tons of waste but availability is seasonal.

  Biogas process runs 24x7 without break.
- Looking for an alternative feedstock to run the plant 24x7x365.
- Identified Press Mud Cake (PMC) from Sugar Industry as a viable alternate feed stock.
- Disposal of PMC is a problem for Sugar Industry.

Biogas Digester

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Biogas Cleaning

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Biogas storage balloons & Blower

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Automation & control panel

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Biogas Engine

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Waste Heat Recovery (VAM)

"Jain Bio-Samrudhi" – soil conditioner – a byproduct of Biogas power project

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Salient Points

•Biogas power plant operates at more thane 80 % PLF (Plant Load Factor) and obtains average 33 MWh/day at 1.7 MW installed synchronized with the grid

•Efficient utilization of Biogas for generation of electricity, recovery of heat and 400 MT of refrigeration.

•Officially recognized as “First of its kind” Biogas power plant in India by MNRE, Government of India. Because of its unique nature of-

- •Two stage bio-methantion process
- •Acceptance to broad area of feedstock.
- •Utilization of biogas to generation of Combined Heat and Power (CHP)
- •Zero discharge system
- •Standard protocol for waste treatment established

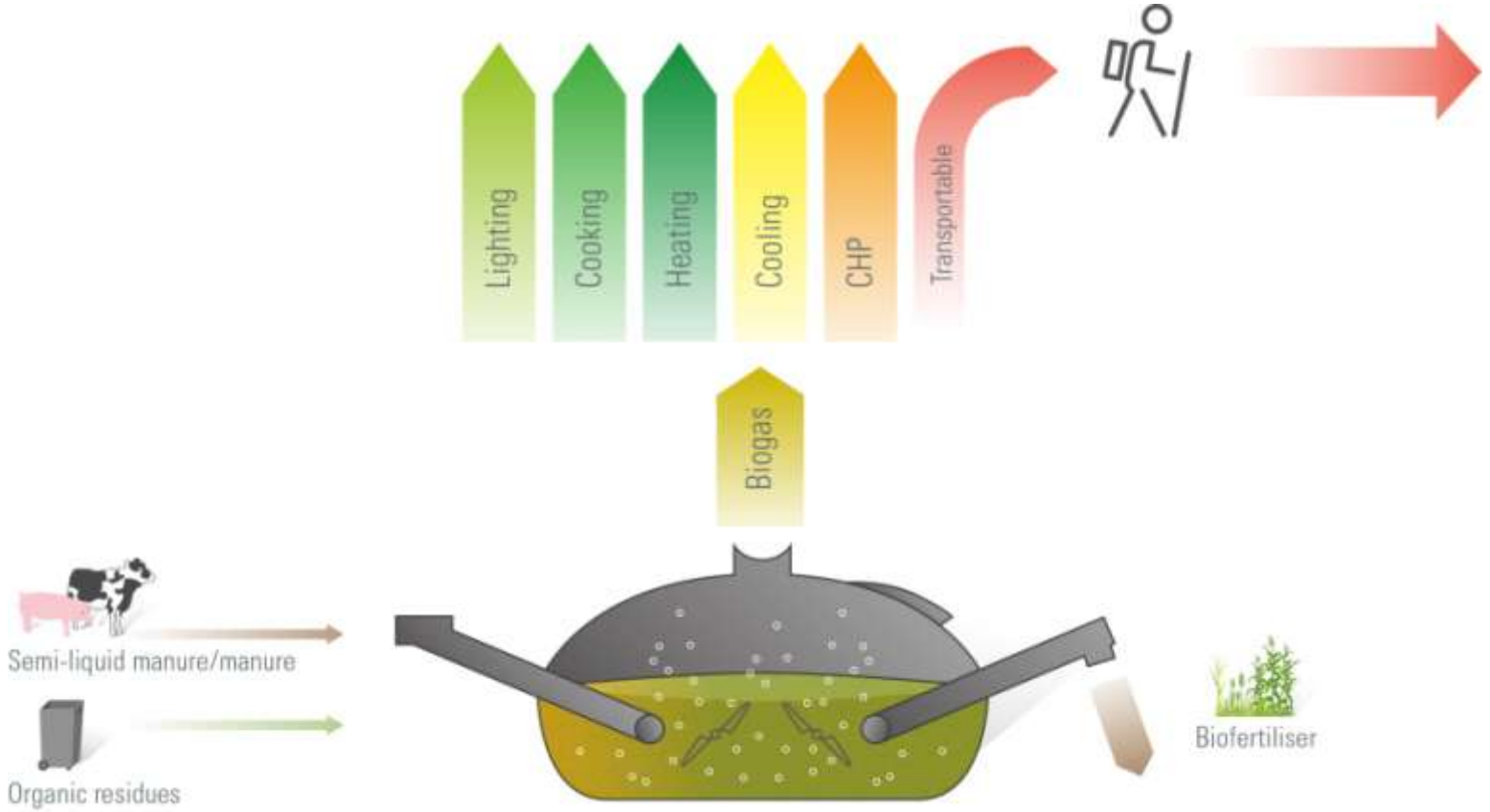
•Fully automated power plant with Industrial and Environmental safety standards.

•Power Plant run by competent and highly trained technical team

3. Small Scale Manure and straw for cooking, Columbia

HoMethan Technology

5m³ biogas per day



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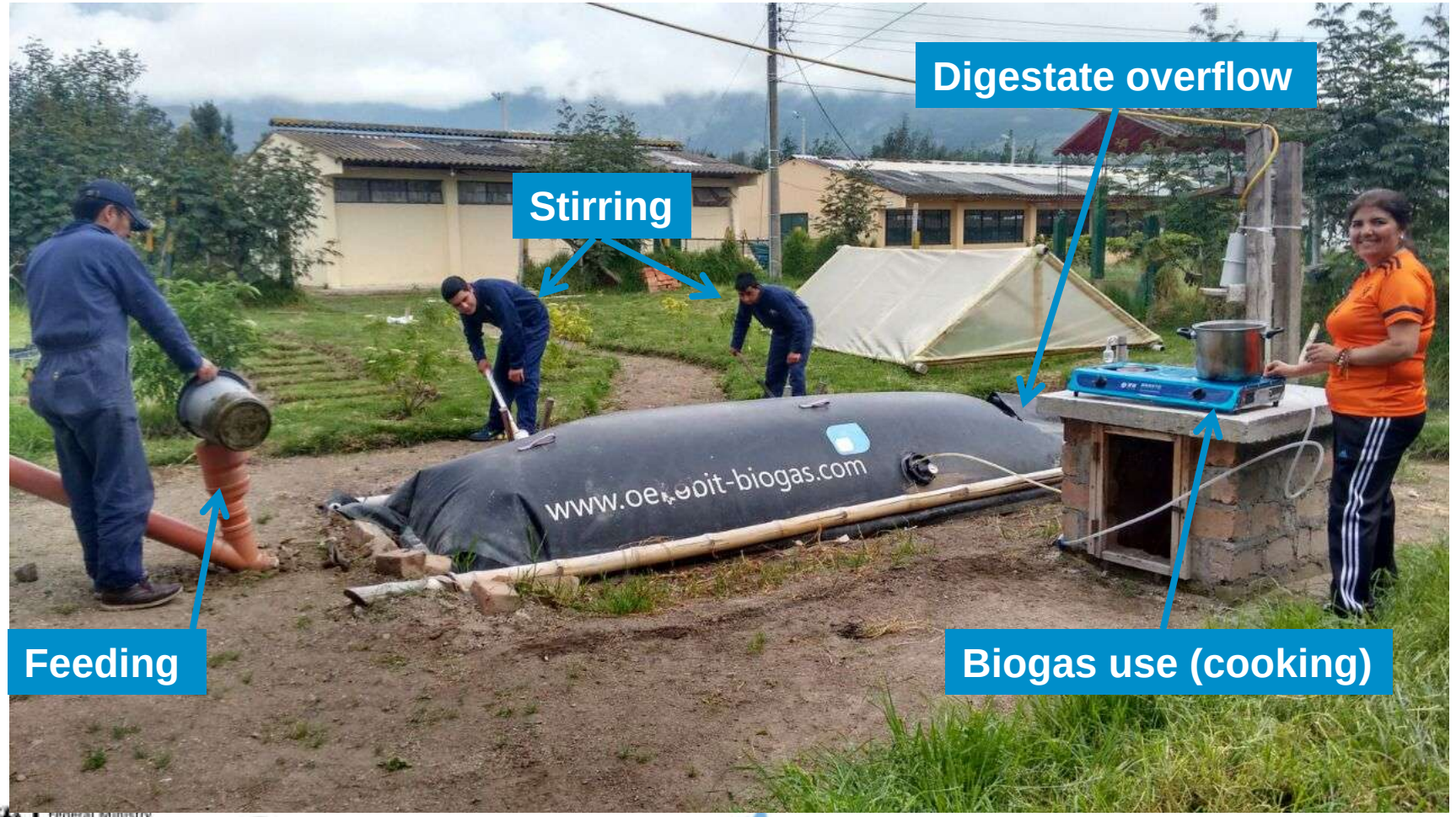
HoMethan Technology

5m^3 biogas per day



4. Manure and straw to CNG, Germany

- **Future option BioCNG instead of (only) green electricity**
- **Readiness for new technology**

Winfried Vees Energiehof Weitenau

eclareon

Biomethane tractor

Full day of farm-work autonomy

Source: https://www.bwagrar.de/Am-liebsten-mit-eigenem-Kraftstoff,QUlEPTU1MzIzNzEmTUlEPTE2MjkyNQ.html

Manure and straw to CNG

Biogas Plant Hof Weitenau; VEES

Advantages:

- Independence from the grid
- Lower quality biomethane possible
- Local customer base

Problems encountered:

- Little offered technology for On farm plants
- Lack of political support (generally only political "electrical vehicle euphoria")
- Offers are mostly for larger plants
- Service problem (Chicken - egg)

Outlook

- IBBK can help with Technology adaptation and knowledge Transfer.
- The technology adaption is combining low investment cost with high rate degradation performance
- Long experience with solids („dry“) digestion in batch and continious mode

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Thank you for your attention!

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