



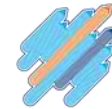
# **W2GAS**

## **Waste-To-Compost and Green Energy**

**CES - Technical background / Potential analysis for Austrian companies**

**Daniel Fleischmann, Project Manager - CES**

Vienna, September 2020



# Agenda / Table of Content

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- Introduction company CES
- Technical background information
- Potential analysis for Austrian companies
- Summary



# INTRODUCTION CES-CLEAN ENERGY SOLUTIONS

Company Profile & Business Units



# Company Profile

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- Vienna/Austria based consulting and engineering company
- Focus in general on renewable energy and energy efficiency
- Studies, design, tendering, supervision
- consultancy to the public and private sector
- Founded in 2008 by Mr. Johannes Posch and iC group
- Since 2014 independent
- ISO 9001 - quality management certified



# Business Units (1/2)

## Renewable energy

- Hydropower
- Wind power
- Biomass plants
- Geothermal energy
- Photovoltaics
- Solar thermal energy
- Biogas



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## Energy efficiency and management

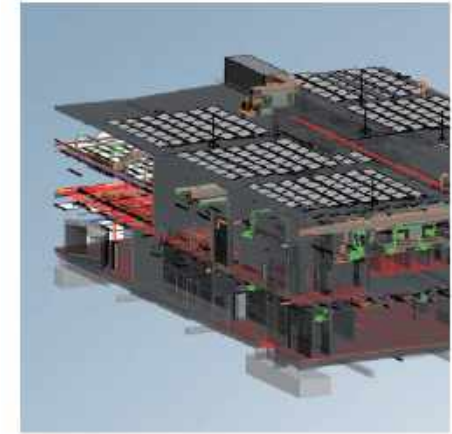
- Industrial facilities  
(glass, paper, cement, food etc.)
- Electrical systems
- Residential and office buildings
- Public buildings
- Shopping centres
- Educational institutions and hospitals
- Urban infrastructure
- Airports



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## Innovative building technology

- Passive house
- Plus-energy buildings
- Autarkic energy systems
- Building management systems
- Building Information Modeling (BIM)
- Transient system simulation  
(TRNSYS, Energy Plus etc.)
- Indoor comfort - analysis and optimisation





# Business Units (2/2)

## Plant engineering

- Industrial facilities
- Biofuels
- District heating and cooling
- Cogeneration / trigeneration
- Solar cooling systems
- Thermal waste treatment
- Utilities supply and discharge
- Sewage treatment plants (industrial wastewater)



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## Sustainability

- Urban and regional development
- Resource efficiency
- Infrastructure
- Life cycle analysis
- Environmental pollutants
- Building certification systems (LEED, BREEAM, ESTIDAMA, ÖGNB, DGNB / ÖGNI, Green Building, GSAS)



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## Research and development

- FP7, H2020, EUREKA, FFG
- Smart City
- Bio economy
- Storage technologies (electrical / thermal / mechanical / chemical)
- Innovative Enterprise Resource Planning (ERP) systems



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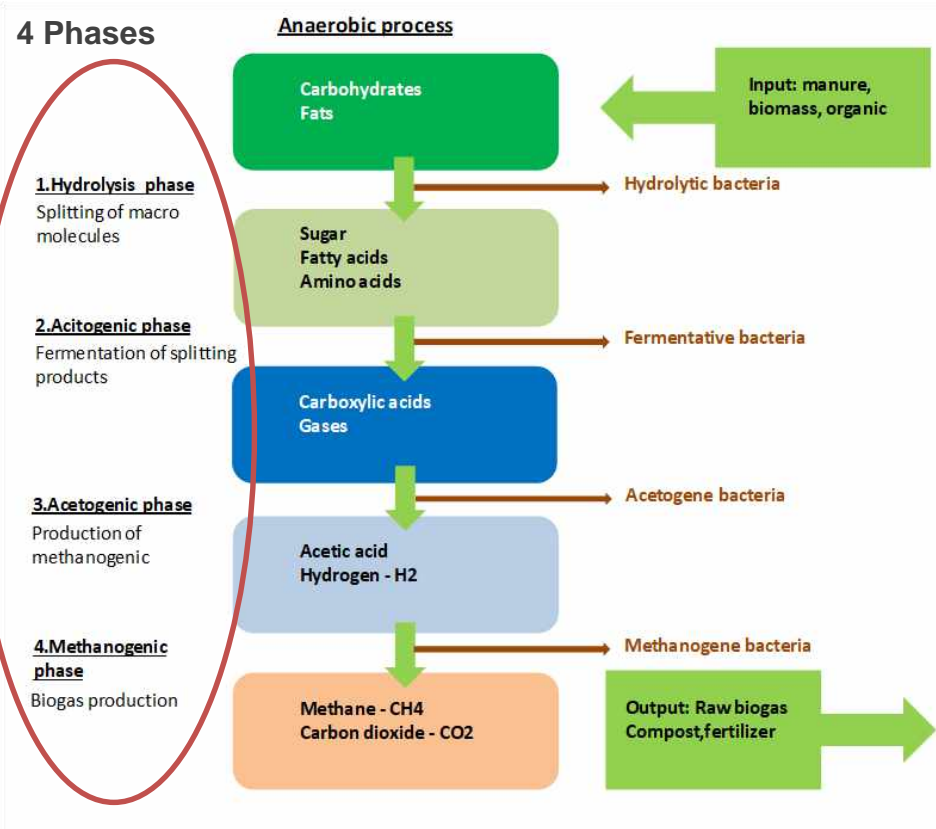


# TECHNICAL BACKGROUND INFORMATION



# Biogas production (anaerobic)

- Anaerobic degradation process, without contribution of air
- Conversion of organic drymass of substrates into CO<sub>2</sub> (1/3), CH<sub>4</sub> (2/3 ~ 65%) and < 2% trace gases, lower heating value ~ 6,5kWh/m<sup>3</sup>, density ~ 0,7 – 1,2kg/m<sup>3</sup>



<b>DM</b>		<b>H2O</b>
<b>org.DM</b>	<b>Ashes</b>	

## Biogas composition

Parameter	Item	Range	Unit
CH <sub>4</sub>	Methane	50-75	Vol. %
CO <sub>2</sub>	Carbon dioxide	25-50	Vol. %
H <sub>2</sub> S	Hydrogen sulphide	0-0,7	Vol. %
N <sub>2</sub>	Nitrogen (molecular)	0-0,2	Vol. %
H <sub>2</sub>	Hydrogen (molecular)	0-0,5	Vol. %
O <sub>2</sub>	Oxygen (molecular)	traces	Vol. %

## Input substrates – Biogas yield

Input Substrate	Spec. Biogasproduction rate (m <sup>3</sup> /t ODM)	DM (%)	ODM (%)	CH <sub>4</sub> (%)
Cows - Manure	250	8,5	82	65
Pigs - Manure	400	5	82	60
Corn silage	700	30	94	53
Green plants silage	550	30	98	55



# Biogas plants

- Agricultural biogas plants (ABG)
  - Main general target: energy production (electrical power/heat) & improvement of properties of digested substrates, use of harmless substrates (not contaminated) > fertilizer
  - Different plant sizes economically available from large to small scale, Co-fermentation (manure/renewable resources)
  - For municipalities with enough agricultural surrounding areas (no long distances, direct use of digested output on fields)
- Mechanical biological treatment plants (MBP)
  - Main general target: Reduce organic masses in waste collection/preparation > biogas, waste treatment (sorting & screening for further usage)
  - High investment costs, complex technology and processes (waste collection, waste pre- and post-treatment, waste water- & exhaust air treatment), feasible for bigger municipalities (integration in an overall waste management system)
  - Used input substrates for anaerobic digestion (experiences) i.e. Bio wastes, green cut wastes, residual wastes



# Biogas plants (overview)

Main plant type	Sub plant type	Input substrates	Process (state of the art)	Input substrate treatment	Output substrate treatment	Item
Agricultural BG plants (ABG plants)	Co fermentation plants	Co fermentation of <u>manure</u> & agricultural wastes, energy plants, renewable resources, bio wastes	Mainly continuous wet fermentation (dry solids < 12% to 15%) "Flow storage process"	No special input treatment required (i.e. only cutting and mixing). In case of add. using wastes of restaurants (leftovers) hygienic pre treatment is required	No special output treatment required. Fermented substrates can be used as fertilizer directly on agricultural areas/fields. Also aerobic compost production or production of dry fertilizer is possible with additional effort.	In case of agricultural BG plants no special treatment of input and output is required. The output of the BG plants can be used as fertilizer for agriculture. Dry discontinuous fermentation is also used for biowastes of municipalities.
	Fermentation plants	Fermentation of agricultural wastes, energy plants, renewable resources, bio wastes	Mainly continuous wet fermentation (dry solids < 12% to 15%) "Flow storage process"  Dry discontinuous fermentation (dry solids typical > 30% ) "Percolation process"			
BG plants for bio- & green wastes & rest wastes (Mechanical biological plants - MB plants)	BG plants for bio- & green wastes of municipalities/cities	Fermentation of bio- & green wastes of municipalities/cities	Mainly dry discontinuous (dry solids typical > 30% ), also dry continuous fermentation (dry solids typical > 25% )	Special mechanical input treatment is required (cutting, mixing, metall sort out etc. ). Hygienic pre treatment is required	Fermented substrates can be used as fertilizer (separation of liquid & solid). Also aerobic compost production is possible.	Special input treatment is required. The output of the plant can be prepared to liquid & solid fertilizer or aerobic treated to compost
	BG plants bio- & green wastes & <u>rest wastes of municipalities/cities</u>	Fermentation of bio- & green wastes & <u>rest wastes</u> of municipalities/cities		Very high effort of special mechanical input treatment is required (separation of rest wastes - organic/non organic). Hygienic pre treatment is required	Fermented substrates are not allowed to be used as fertilizer. Special treatment of output required. Output can be prepared & used as fuel or it has to be deposited	High effort of input and output treatment of substrates and waste water etc. Output cannot be used as fertilizer/compost



# Agricultural biogas plants (ABG)

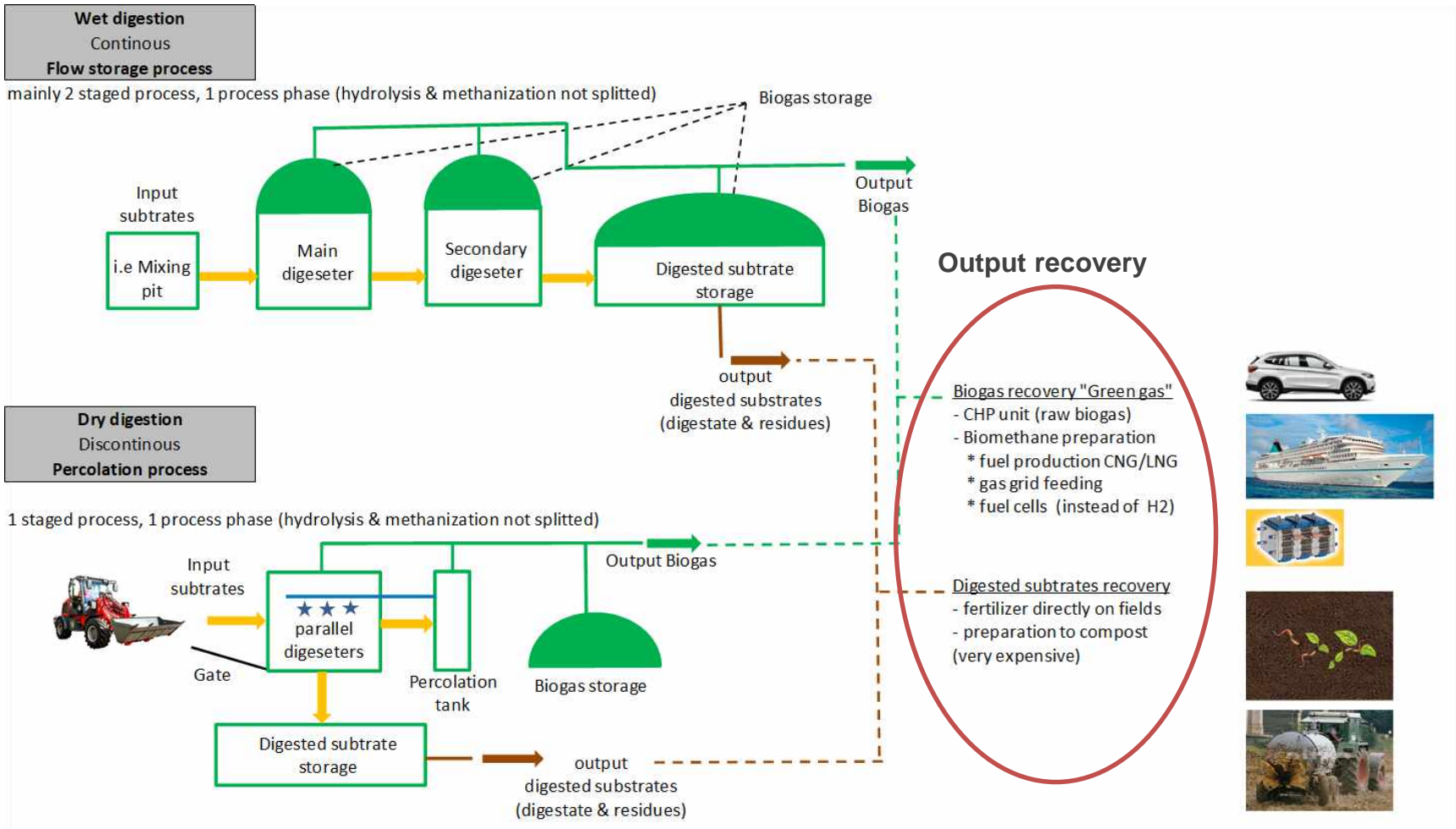
- Mainly continuous wet fermentation (dry solids ~ < 12%), Flow storage process, 2 staged
  - Continuous biogas production, use of standard pumping & mixing equipment
- Also dry discontinuous fermentation (dry solids typical ~ > 30% ) mainly "Percolation process" is available, parallel time shifted operation of digesters
- Mainly mesophilic temperature range 30 – 38°C (lower heat energy demand, lower biogas production )

Main plant type	Digestion process	State of the art technology (mainly used)	typical dwell time (d)	typical space load (kgODS/m <sup>3</sup> /d)
Agricultural BG plants (ABG plants)	Continous wet digestion	Flow storage process: 2 staged process (primary digester, secondary digester, substrate storage), every digester and the storage tank is equipped with a biogas storage system, dry solids < 12% so that standard technical equipment can be used.	37 to 210 (100 to 150 substrate renewable plants)	0,5 to 3,2
	dry discontinous digestion	Percolation process: 1 staged process, parallel time shifted operation of different dry digesters for continous biogas production, dry solids > 12%, no mechanical mixing equipment in the digesters required.	20 to 45	up to 10

characteristics



# Agricultural biogas plants – typical concepts





# Mechanical biological treatment plants (MBP)

- Mechanical biological treatment plants (MBP)
  - Mainly dry discontinuous fermentation (dry solids ~ > 30%), i.e. Percolation process, 1 staged process (i.e. Kompoferm, Bekon)
  - Also dry continuous fermentation (dry solids typical ~ > 25% ), mainly 1 staged process (i.e. Axpo Kompogas, Laran “Strabag”, Dranco, Valorga)
  - BG plants (anaerobic) for bio & green wastes of municipalities/cities
    - Special input treatment is required. The output of the plant can be prepared to liquid & solid fertilizer or aerobic treated to compost
  - BG plants for bio- & green wastes & rest-/residual wastes of municipalities/cities
    - High effort of input and output treatment of substrates and waste water, exhaust air etc. Output cannot in general be used as fertilizer/compost without very high effort on treatment
  - Mainly thermophilic temperature range 50 – 60°C (higher biogas production & hygienic substrate treatment )

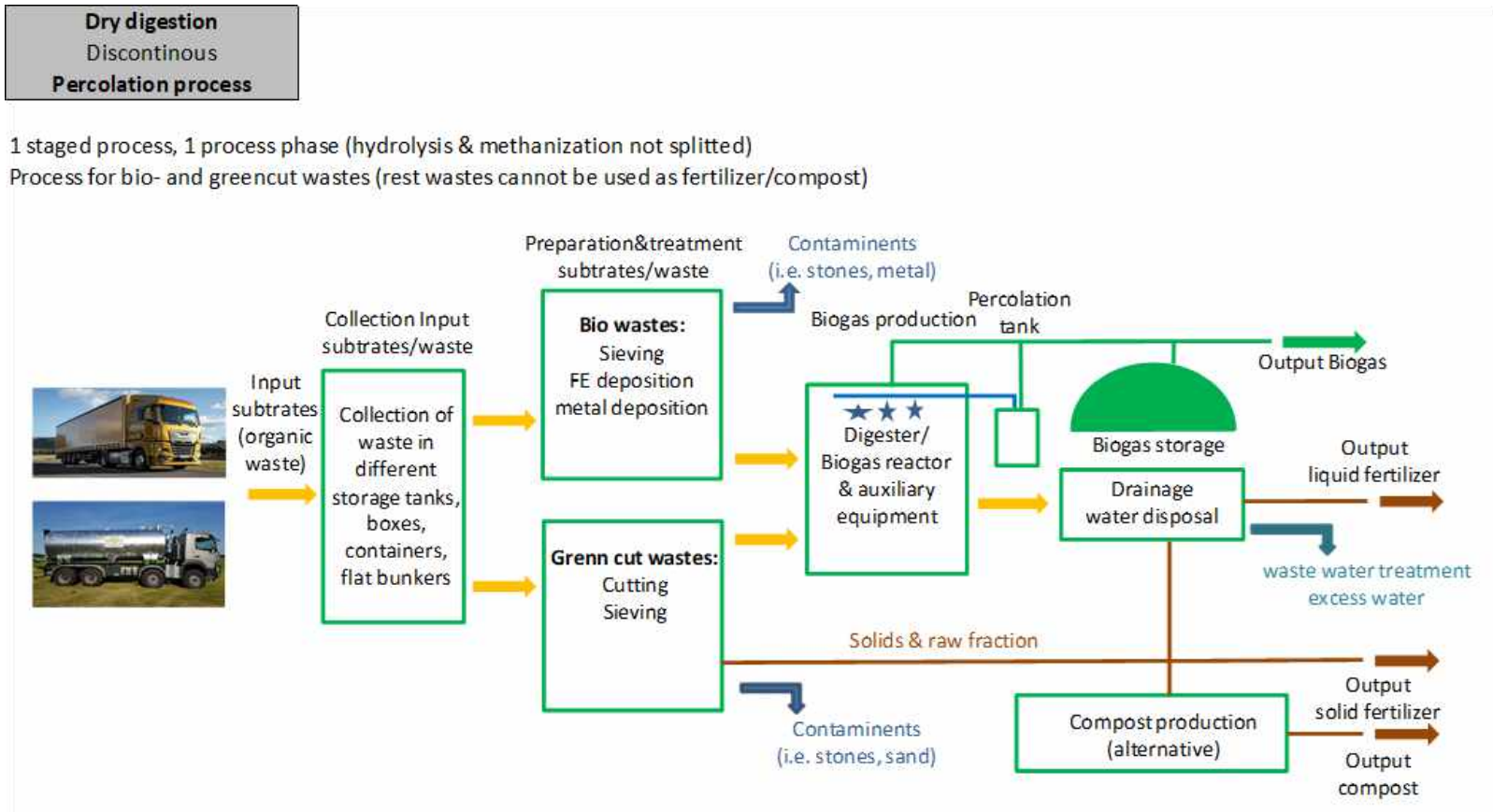
Main plant type	Digestion process	State of the art technology (mainly used)	typical dwell time (d)	typical space load (kgODS/m <sup>3</sup> /d)
BG plants for bio- & green wastes & rest wastes (Mechanical biological plants - MB plants)	Continous dry digestion	mainly 1 staged process i.e: Kompogas process (Axpo Kompogas AG) , Laran process (STRABAG Umwelttechnik GmbH), Dranco process (OWS nv), Valorga process (Valorga International SAS)	20 to 45	up to 10
	Discontinuous dry digestion	1 staged process i.e: Kompoferm process (Eggersmann GmbH) - Percolation with aerobic startphase, Bekon process (Bekon GmbH) similar to Kompoferm	20 to 45	up to 10

characteristics

# Mechanical biological treatment plants (MBP) – typical concepts



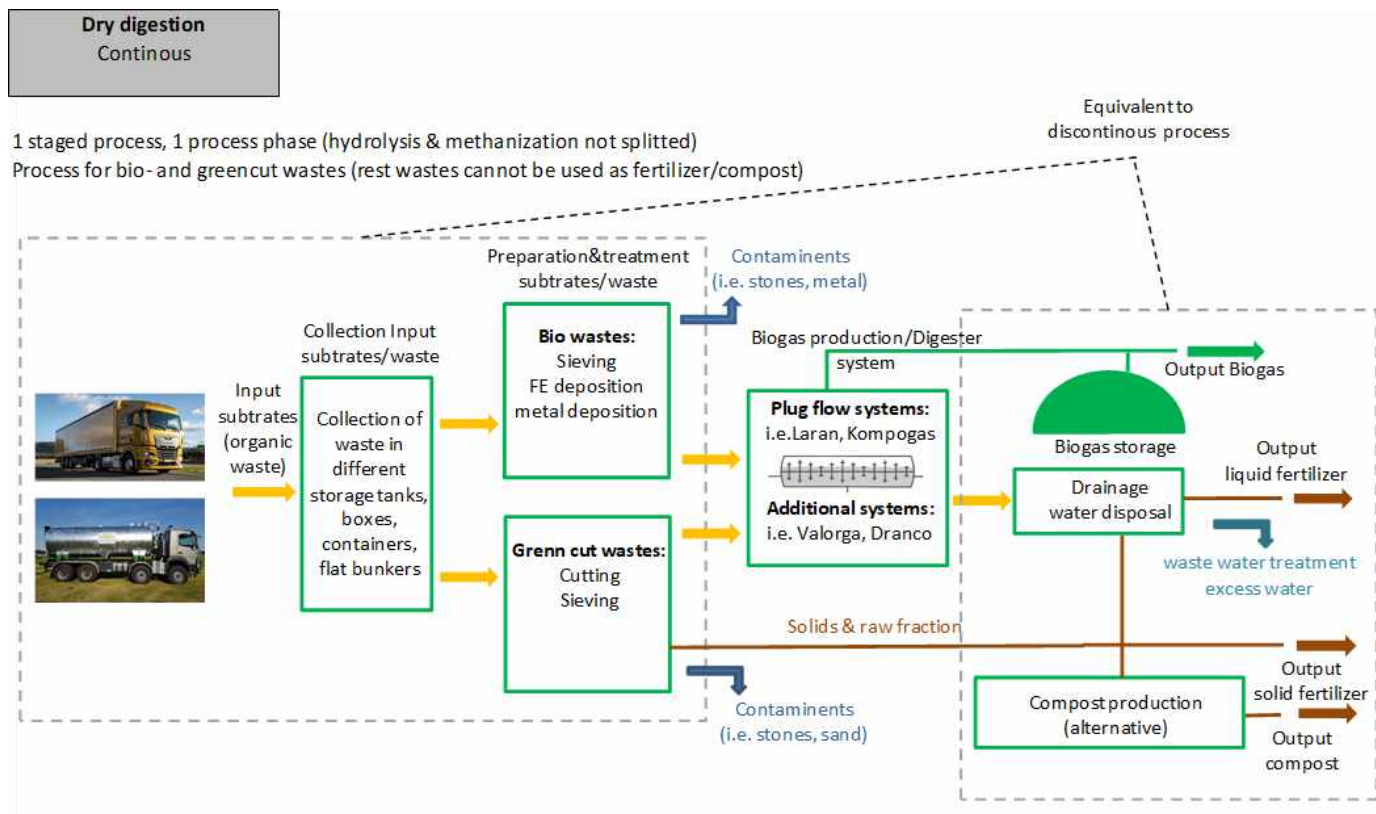
- Dry discontinuous fermentation i.e. Percolation process



# Mechanical biological treatment plants (MBP) – typical concepts



- Dry continuous fermentation (i.e. Axpo Kompogas, Laran “Strabag”, Dranco, Valorga)





# Biogas treatment “Desulfurization”

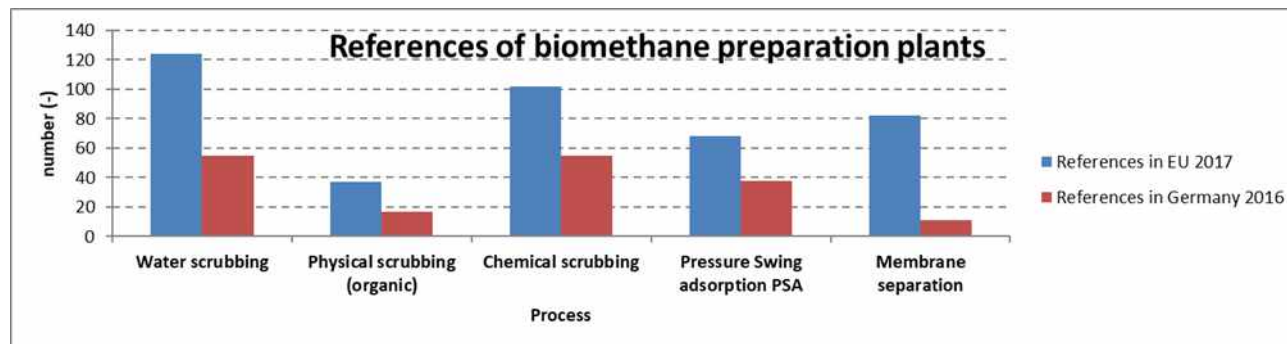
- Biogas pre cleaning “Desulfurization”
  - General steps homogenization, dedusting/particle separation, dehumidification/drying, desulfurization (“high corrosive effects of H<sub>2</sub>S”), selective separation of Biogascomponents i.e. CO<sub>2</sub>

Process desulfurization "pre cleaning - biomethane production"			
Nr.	Process	Item	Desulfurization grade
1	Biological simple process	Injection of 3-4 vol. % air into the digester (gas storage). H <sub>2</sub> S conversion "oxidation" to elementar sulfur. This simple process is mainly used in agricultural BG plants.	80 to 95%
2	Sorption on activated carbon or ironhydroxide	Packed columns filled with activated carbon or ironhydroxide cleaning mass	up to 99% < 1ppm
3	add iron sludge, iron (II) and (III) chloride	Add iron sludge or iron (II) or (III) chloride to the substrate inflow of the digester "oxidation"	up to 95%
4	Biological process "trickling column"	Biological desulfurization by specific bacterias used in a trickling column. This biological process is mainly used in <u>industrial/communal plants</u> .	up to 99%
5	Membrane separation	Separation of H <sub>2</sub> S and CH <sub>4</sub> /CO <sub>2</sub>	up to 99%



# “Raw biogas” to Biomethane

- Biogas treatment “Raw biogas” to Biomethane
  - Raw biogas ~ 65% methane, Biomethane > 96% methane
  - Biomethane quality to be used for:
    - Gas grid feeding, fuel substitution (CNG/LNG), fuel cells instead of hydrogen
  - Technologies:
    - Water scrubbing
    - Physical scrubbing
    - Chemical scrubbing
    - Pressure swing adsorption (PSA)
    - Membrane separation
  - References biomethane preparation plants





# Biogas treatment technologies - overview

Item	Biomethan production process					Unit
	Water scrubbing	Physical scrubbing (organic)	Chemical scrubbing	Pressure Swing adsorption PSA	Membrane separation	
Process principle	physical absorption	adsorption	absorption	adsorption	adsorption	-
Typical plant capacity - Biomethane	200-1200	300-1500	400-2000	300-800	50-500	m <sup>3</sup> /h
Typical range of methane content in biomethane	95-99	95-99	> 99	95-99	95-99	vol. %
Typical methane losses - production process "methane slip"	1-2	2-4	< 0,1	0,6-3	< 5	vol. %
Operation pressure	4-7	4-7	no pressure	4-7	8-10	bar
Pre cleaning required "desulfurization" ?	no	yes	yes	yes	yes	-
Specific electricity demand	< 0,25	0,25-0,33	<0,15	0,25	0,35	kWh/m <sup>3</sup> biomethane
Heat requirement "process temperature" ?	no	55-80	110-160	no	no	°C
Chemicals requirement	no	yes	yes	no	no	-
Controllability "part load range"	50-100	50-100	50-100	85-115	50-105	%
<b>Typical specific CAPEX of Biomethane preparation plants</b>						
plant 100 m <sup>3</sup> /h biomethane	10 100	9 500	9 500	10 400	7 300 - 7 600	€/m <sup>3</sup> /h biomethane
plant 250 m <sup>3</sup> /h biomethane	5 500	5 000	5 000	5 400	4 700 - 4 900	
plant 500 m <sup>3</sup> /h biomethane	3 500	3 500	3 500	3 700	3 500 - 3 700	
<b>Typical OPEX of Biomethane preparation plants</b>						
plant 100 m <sup>3</sup> /h biomethane	14	13,8	14,4	12,8	10,8-15,8	cent/m <sup>3</sup> biomethane
plant 250 m <sup>3</sup> /h biomethane	10,3	10,2	12	10,1	7,7-11,6	
plant 500 m <sup>3</sup> /h biomethane	9,1	9	11,2	9,2	6,5-10,1	
<b>References</b>						
Number of references (general)	high	low	high	mean	mean	-
References in Germany 2016	55	17	55	38	11	-
References in EU 2017	124	37	102	68	82	-



# CNG/LNG (Basis)

- Regulations and Standards (references i.e.) – grid feeding, fuel
- Different national standards, overall basis is EN ISO and also laws for quality requirements
- CNG - compressed natural gas as fuel: methane content in general > 96% (> 87% for H gas), expansion relation 1:200, up to 200bar, 12kWh/m<sup>3</sup>@1bar, ~ 1909kWh/m<sup>3</sup>@200bar
- LNG - liquified natural gas as fuel: methane content in general ~ 98%, expansion relation 1:600, cool down to ~ -162°C, 12kWh/m<sup>3</sup>@1bar (“gaseous”), ~ 5714kWh/m<sup>3</sup>@1bar (“liquified”), liquefaction process “Reverse Brayton cycle”

Austrian Standards/laws	Germany Standards	EN ISO Standards	Item
GWG 2011	DVGW-G260	EN ISO 16723-1	Gas quality for grid injection
ÖVGW-G31			
ÖVGW-G B220	DVGW-G262		
ÖNORM EN 16723-1	DIN EN 16723-1	EN ISO 16723-2	Gas quality for fuel purposes
BGBI. II Nr. 209/2004	DIN EN 16723-2		
BGBI II Nr. 418/1999	DIN 51624		
ÖNORM EN 16723-2			

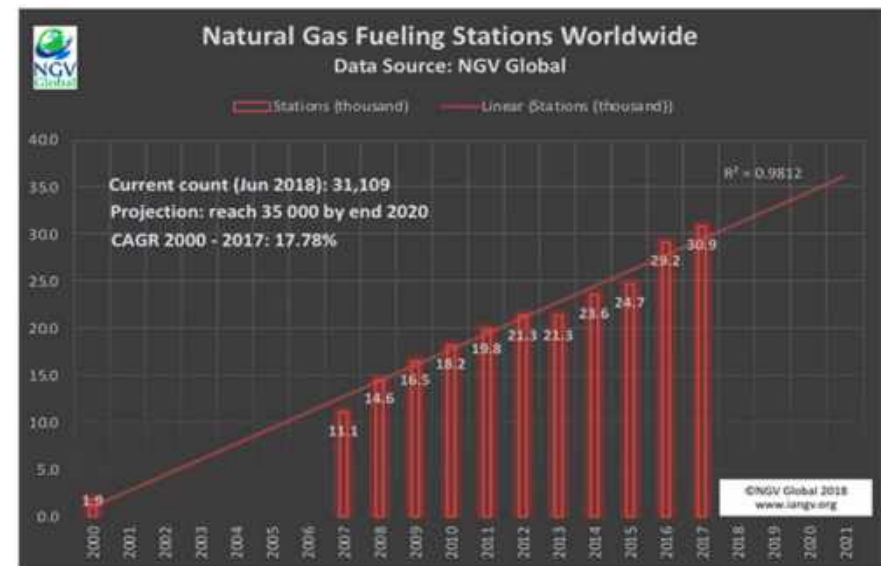
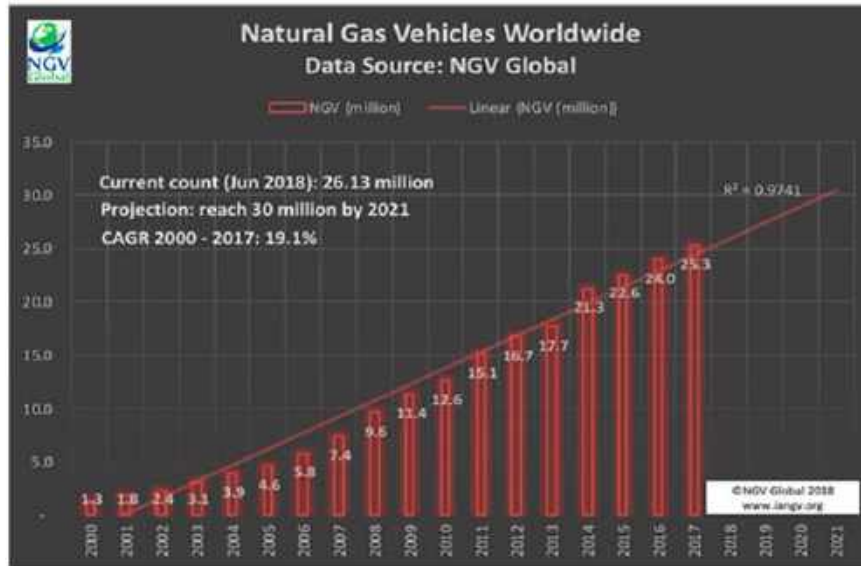
Fuel energyequivalent (gas to standard fuel)
1kg H gas $\triangleq$ 1,5l petrol or 1,3l diesel
1kg L gas $\triangleq$ 1,2l petrol or 1,1l diesel
<b>1kg biomethane <math>\triangleq</math> 1,5l petrol or 1,3l diesel</b>

Type of transport	CNG	LNG
Vehicles	X	
Buses	X	X
Trucks	X	X
Ships		X



# CNG as fuel for transport

- CNG worldwide market development
  - Growth in gas vehicles and fueling stations



## Manufacturers

### CNG vehicles manufacturers

Audi, Fiat, Seat, Skoda, VW, Mercedes, Citroen, Honda, Volvo

### CNG buses & trucks manufacturers

Iveco, MAN, Mercedes, Neoplan, Renault, Scania, Volvo, Fiat, VW, Solaris



# LNG as fuel for transport

- LNG market development
  - Growth in LNG trade and liquefaction capacity



## Manufacturers

### LNG trucks manufacturers

Iveco, Scania, Volvo

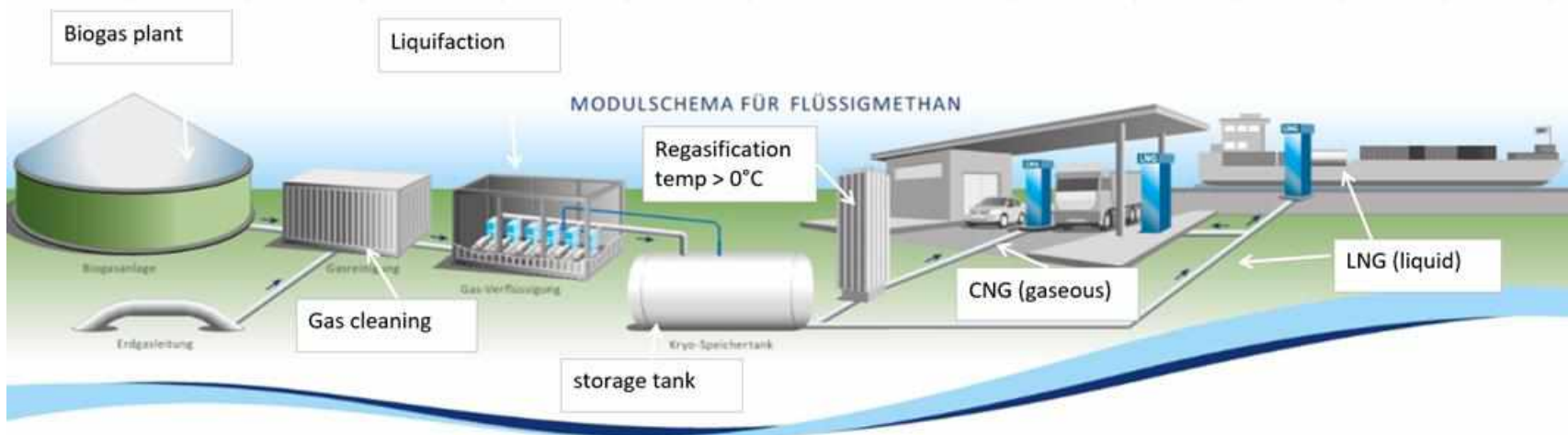
### LNG ship engines manufacturers

Caterpillar, WinGD, MAN, Anglo Belgian, Daihatsu, Hyundai, Kawasaki, Mitsubishi, Rolls-Royce



# CNG/LNG – concept

- Biogas Plant, natural gas > Gas cleaning/treatment
- LNG, gas liquefaction > cryogenetic storage
- Regasification optional > liquid to gaseous (i.e CNG for gas vehicles)
- LNG ship terminal





# POTENTIAL ANALYSIS FOR AUSTRIAN COMPANIES



# Elaboration list of technology / service providers

- 79 Austrian companies / associations identified and classified
- Elaboration of a short list with 11 companies offering special / innovative processes etc. > today presentation of Austrian companies
- Detailed results > outlined in the study

Contact data, scope of services etc.

Nr	Company	street	Location	Telephone number	Fax number	Email	Homepage/web	Scope of services
1	AAT Abwasser- und Abfalltechnik GmbH	Konrad Doppelmayr Straße 17	A-6960 Wollufurt	+43 (6574) 65190-0 +43 (6574) 65190-18	+43 (6574) 65185-6	<a href="mailto:office@aat-biogas.at">office@aat-biogas.at</a>	<a href="http://www.aat-biogas.at">http://www.aat-biogas.at</a>	Complete biogas plants service, digester systems incl. sanitation & gas preparation Project studies Project accompaniment R&D
2	Axiom Angewandte Prozesstechnik Ges.m.b.H	Wienerstrasse 114, Halle H-1	A-2483 Ebreichsdorf	+43 (2254) 76282	+43 (2254) 74875	<a href="mailto:office@axiom.at">office@axiom.at</a>	<a href="http://www.axiom.at">http://www.axiom.at</a>	Biogas treatment (membrane separation) Assembly Service
4	Flowserve SHH (Hauptstadt)	Gewerbestrasse 14	A-2351 Wiener Neudorf	+43 (2236) 31530	no nr. available	<a href="mailto:sales_austria@flowserve.com">sales_austria@flowserve.com</a> <a href="mailto:service_austria@flowserve.com">service_austria@flowserve.com</a>	<a href="http://www.sterilgasbi.at">http://www.sterilgasbi.at</a>	Biogas treatment (membrane separation) Liquid pumps Vacuum pumps Plant technic Service Condition monitoring
19	Bio Trend Entsorgung und Handels GmbH	Hochmeide 33	A-4202 Helfmünzstätt	+43 (7215) 3194	+43 (7215) 3194-31	<a href="mailto:biotrend@bcn.at">biotrend@bcn.at</a>	<a href="http://www.biotrend-entsorgung.at">www.biotrend-entsorgung.at</a>	Organic waste treatment Development of a special biogas reactor
23	Envicare Engineering GmbH Ingenieurbüro für Verfahrenstechnik	Eisteichgasse 20/36	A-8042 Graz	+43 (316) 3810380	+43 (316) 381038-9	<a href="mailto:office@envicare.users.abolton.at">office@envicare.users.abolton.at</a>	<a href="http://www.envicare.at">http://www.envicare.at</a>	Planning and Consulting for biogasplants incl. gas treatment "biomethane" and waste disposal plants Process Engineering R&D membrane preparation
24	Bauertech GmbH Ingenieurbüro - Projektunterstützung	Oberegging 24	A-3254 Bergland	+43 (7412) 52295-0	+43 (7412) 52295-12	<a href="mailto:office@bauertech.com">office@bauertech.com</a>	<a href="http://www.bauertech.com">http://www.bauertech.com</a>	Planning and Consulting for biogasplants and waste disposal plants Process Engineering Patent for a special developed tube digester
37	BIOGEST Energie- und Wassertechnik GmbH	Inkustraße 1-74/2	A-3400 Klosterneuburg	+43 (2243) 20840 00	+43 2243 20840 40	<a href="mailto:office@biogest-biogas.com">office@biogest-biogas.com</a>	<a href="http://www.biogest.at">http://www.biogest.at</a>	Planning of biogas plants, special biogasplant concepts (power ring, power compact)
72	PÖTTINGER Entsorgungstechnik GmbH	Moos 31	A-4710 Grieskirchen	+43 (7248) 9001-8040	+43 (7248) 9001-2429	<a href="mailto:fermenter@poettinger.at">fermenter@poettinger.at</a>	<a href="http://fermenter.poettinger.com/world.at">http://fermenter.poettinger.com/world.at</a>	Biogas dry fermenter systems "Percolation process" modular system in containers
73	AR ENERGY INTERNATIONAL GMBH	Andreas-Hofer-Straße 43	6020 Innsbruck	+43 (120) 51085574		<a href="mailto:arenergyinternational@gruppoab.it">arenergyinternational@gruppoab.it</a>	<a href="https://www.arenergy.com">https://www.arenergy.com</a>	Biogas preparation & treatment to biomethane (membrane technology)
78	STRABAG Umwelttechnik GmbH	Schatzdorferstraße 9	4021 Linz	+43 (732) 3731 821	+43 (732) 3731 829	<a href="mailto:sut@strabag.com">sut@strabag.com</a>	<a href="http://www.strabag-umwelttechnik.com">http://www.strabag-umwelttechnik.com</a>	Special biogas process (Lupari) for continuous dry fermentation of bio wastes & bulky wastes mechanical biological plants full service
79	Thöni Industriebetriebe GmbH	Obermarkstraße 48	6410 Telfs	+43 (5262) 6903-0	+43 (5262) 6903-210	<a href="mailto:peter.scherl@thoeni.com">peter.scherl@thoeni.com</a> <a href="mailto:thoeni@thoeni.com">thoeni@thoeni.com</a>	<a href="https://www.thoeni.com">https://www.thoeni.com</a>	Special developed plug flow reactor/digester for continuous dry fermentation. Also solutions for wet and semi fermentation, biogas full service



# Elaboration list of technology / service providers

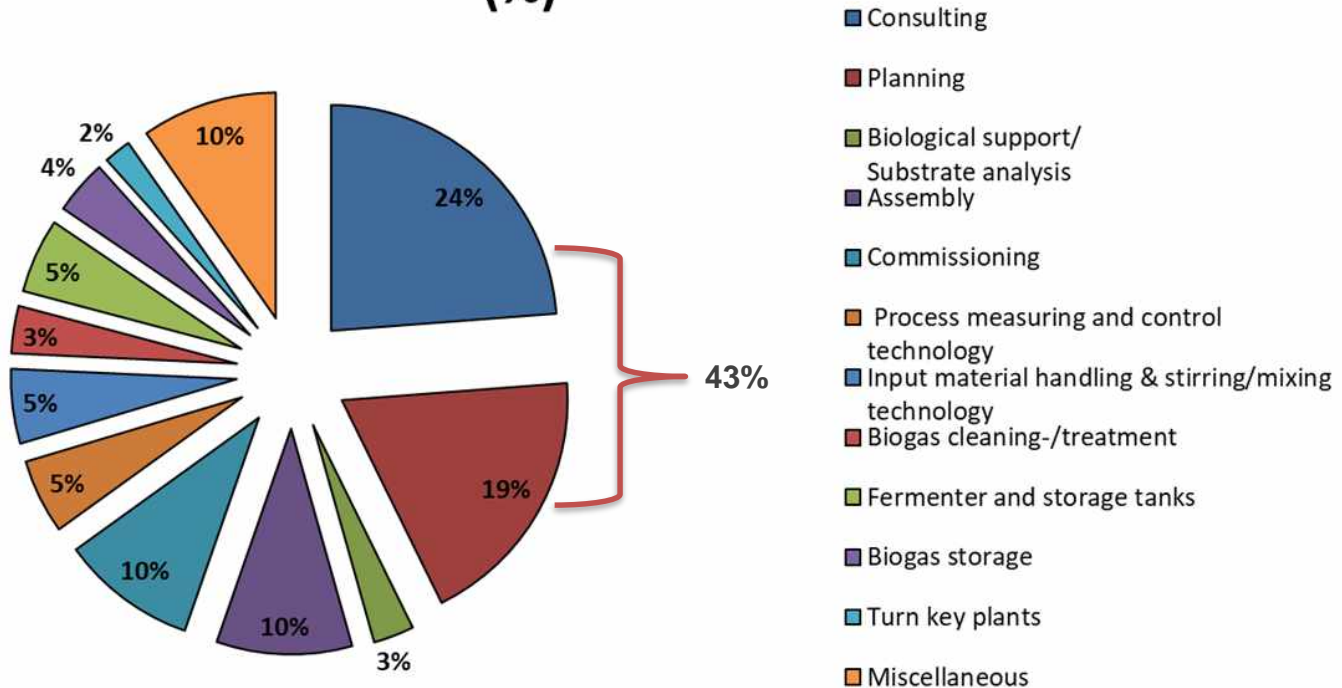
- Classification of Austrian technology providers services for assessment

Nr.	Item	Note
1	Consulting	Individual consulting not related to a special technology and equipment/product manufacturer
2	Planning	Individual planning not related to a special technology and equipment/product manufacturer
3	Biological support/ Substrate analysis	In terms of R&D Know How
4	Assembly	Assembly of biogas components (main & auxiliary equipment)
5	Commissioning	Commissioning of biogas components (main & auxiliary equipment) and complete biogas plants
6	Process measuring and control technology	Delivery of process measuring, control and steering equipment
7	Input material handling & stirring/mixing technology	In terms of pumping, mixing, separation etc.
8	Biogas cleaning-/treatment	In terms of converting raw biogas into biomethane
9	Fermenter and storage tanks	Delivery of tanks made of steel or concrete etc.
10	Biogas storage	Delivery of biogas storage systems (membranes, tanks)
11	Turn key plants	Delivery of biogas components (main & auxiliary equipment) and complete biogas plants ready for commissioning
12	Miscellaneous	Side services like compost preparation, waste economy etc.

# Quantified Results of Austrian providers - classification



## Provider analysis - companies in the field of biogas (%)





# General conclusion of technology analysis

- Austrian companies are very experienced in the field of biogas and use in general state of the art of technology & proven biogas systems and processes
- biogas treatment > membrane separation technology is mainly available from Austrian providers
- Some providers have already entered the Romanian market
- many Austrian providers act in the field of planning & consulting >, advantage in case of supporting Romanian municipalities or public organisations in the following services:
  - Project development (Pre-feasibility studies) & project pre-engineering
  - Project permission (permission engineering)
  - Tender and award (detail engineering, creation of tender documents, request for quotation, offer review, award proposal etc.)
  - Construction supervision



# Biogas potential – Romania

- CNG & LNG in Romania
  - 2 CNG fueling stations, 900 natural registered gas vehicles (Austria: 152 CNG fueling stations, ~ 2 LNG fueling stations, 11.500 natural registered gas vehicles > growing market)
- 16 MBPs are already in the planning phase > improvement of waste management
- Biogas potential (Galati Region as reference)
  - Cultivated areas – used i.e. for food production (vegetables, cereals)
  - Residues (wastes) of animal keeping (manure/slurry)
  - Non-agricultural residues/wastes i.e. from municipalities
  - Additional “free” areas from cultivated areas – not already used for food production
  - Results (extrapolated) for total Romania (excl. cultivated areas for food production)
    - ~ 2.000 plants with a capacity of 700m<sup>3</sup>/h biomethane – medium scale plants
    - ~ 5.500 plants with a capacity of 250m<sup>3</sup>/h biomethane – small scale plants

Biogas/Biomethane potential in Romania			Mean energy content (KWh/m <sup>3</sup> )	Energy (MWh/a)
Biogas Total	22 833 798 478	m <sup>3</sup> /a	6,25	142 711 240
Biomethane total	12 101 007 930	m <sup>3</sup> /a	10	121 010 079

~ 142 TWh/a

22billion m<sup>3</sup>/a biogas, 12billion m<sup>3</sup>/a biomethane





# Project opportunity “Galati city” (2/2)

- Plant design “rough” based on possible amount of digested output > directly used as fertilizer on surrounding areas
- Base data: 40.000t/a Co-fermentation plant (40% manure/60% renewable resources)
- Annual biogas yield ~ 4,5 million m<sup>3</sup>/a (> 2,5million m<sup>3</sup>/a biomethane)
- Required area ~ 240x150m (3,6ha), Capex ~ 4,2million € excl. vat



Item	Value	Unit
<b>Basic Data</b>		
Mass Input	40 000	t/a
Biogas output	4 579 800	m <sup>3</sup> /a
Biomethane output	2 442 174	m <sup>3</sup> /a
Output after digestion	36 101	t/a
<b>Plant Data (wet continous, mesophilic, digestion - flow storage)</b>		
Main Digester (1pc, diameter ~ 30m, height ~ 5m) volume	3 750	m <sup>3</sup>
Secondary Digester (1pc, diameter ~ 30m, height ~ 5m) volume	3 750	m <sup>3</sup>
Digested substrate (2pc, diameter ~ 30m, height ~ 5m) volume storage	2 x 3750	m <sup>3</sup>
Dwell time	~70	d
Space load	3	kgOD/Mm <sup>3</sup> /d
Biogas power (lower heat value 5,44kWh/m <sup>3</sup> )	2 845	kW
Own demand - electricity energy	450 000	kWh/a
Own demand - heat energy (process)	3 900 000	kWh/a
Biogas volume flow	523	m <sup>3</sup> /h
Biomethane volume flow	284	m <sup>3</sup> /h
CAPEX Biogasplant incl. Biomethanepreparation	4 200 000	€ excl. Vat



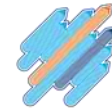
## Market chances

- Romania offers in general good opportunities for generating biogas/biomethane projects > ongoing global rising gas market for traffic/transport
- Romania is at the beginning of providing gas infrastructure for transport purposes (vehicles/ships) > 2 CNG fueling stations, 900 registered gas vehicles
- 16 MBPs are already in the planning phase > chance for suppliers (tendering/award), growing sector of waste management (32 Romanian counties)
- Well-proven culture of cooperation between the Countries Austria and Romania
- Required tendering & award process for public contractors, this could be a potential market for Austrian consulting & engineering companies



# Market entry strategy (possible measures)

- Target: Awareness of Romanian clients (i.e. municipalities, public- & private sector) that experienced Austrian companies are available for support in the field of biogas (project development etc.). This could be done by:
  - Info campaigns for public contractors (i.e. for pre-feasibility studies, project development, tender & award, manufacturing supervision)
    - Mainly for supporting consulting & planning companies
  - Biogas technology trade fair
    - Supporting manufacturers and consulting & planning companies
  - Biogas Congress
    - Supporting manufacturers and consulting & planning companies
  - Biogas plant tour
    - Supporting manufacturers and consulting & planning companies
    - Disadvantage: Only some selected companies would benefit from this measure
  - Realization of a Biogas reference/pilot project
    - Supporting manufacturers and consulting & planning companies
    - Disadvantage: Only some selected companies would benefit from this measure



# Summary

- Austrian companies use in general state of the art of technology & standard proven biogas systems and processes, partly slightly modified, some special technologies (study)
- Many Austrian providers act in the field of planning & consulting ~ 43% > advantage in case of supporting Romanian municipalities or public organisations (Project development, Tender and award etc.)
- Romania offers in general good opportunities for generating biogas/biomethane projects > ongoing global rising gas market for traffic/transport
- Romania is at the beginning of providing gas infrastructure for transport purposes (vehicles/ships) > 2 CNG fueling stations, 900 registered gas vehicles
- 16 MBPs are already in the planning phase > chance for suppliers (tendering/award), growing sector of waste management (32 Romanian counties)
- Benefits > i.e. experienced companies,
- Well-proven culture of cooperation between the Countries Austria and Romania (fast delivery and on-site support, support tendering & award process)



**Thank you!**

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