



Technology Description (TD) for Biogas Upgrading Technologies

Contact Information:

TECHNOLOGY/ EQUIPMENT SUPPLIER	<i>Name of institution:</i> Apex AG	
	<i>Name of contact Person:</i> Ueli Oester	
	<i>Street:</i> Industriestrasse 31	
	<i>Town:</i> Däniken	<i>Zip code:</i> CH-4658
	<i>Country:</i> Switzerland	
	<i>Phone:</i> +41 62 291 26 69	
	<i>e-mail:</i> uoester@apex.eu.com	
	<i>www:</i> apex.eu.com	
<i>Date (of filling the TD):</i> 21/09/2017		

Technology Description:

NAME OF TECHNOLOGY	Type BlueBONSAI / BlueFEED
ASSIGNMENT OF TECHNOLOGY	Membrane technology
TECHNICAL READINESS LEVEL	
<p>TRL 1 - basic principles observed</p> <p>TRL 2 - technology concept formulated</p> <p>TRL 3 - experimental proof of concept</p> <p>TRL 4 - technology validated in lab</p> <p>TRL 5 - technology validated in relevant environment (industrially relevant environment in case of key enabling technologies)</p> <p>TRL 6 - technology demonstrated in relevant environment (industrially relevant environment in case of key enabling technologies)</p> <p>TRL 7 - system prototype demonstration in an operational environment</p> <p>TRL 8 - system completed and qualified</p> <p>TRL 9 - actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)</p>	<p>1 2 3 4 5 6 7 8 9</p>
What is the core innovation? (Please explain here what is innovative on this technology and which problem does the	System has new product gas sensors with little need for calibration. New refuelling panel with badge authorising system for low-cost CNG-refuelling instead of



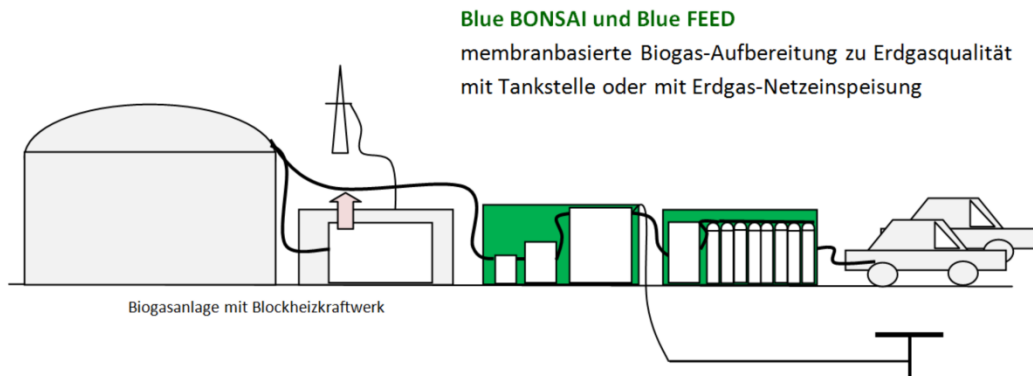
technology solve.)		using a gas dispenser and card-reading unit. Standardised design for series production, thus reducing manufacturing costs.
Vision of the innovation (Please describe here what impact you see for the future)		Small biogas quantities can be upgraded economically and used for gas grid injection or as vehicle fuel.
What are the R&D needs for your technology? (Are there any barriers or challenges which still need to be overcome?)		Certification for the system which uses novel technology presently not foreseen in present standards (need to adapt standard to include new solutions)
TECHNOLOGY/EQUIPMENT AVAILABILITY		
PATENT RIGHTS		NO
METHOD OF MAKING THE TECHNOLOGY AVAILABLE	<i>Licence selling</i>	YES
	<i>Licence granting</i>	YES
POSSIBLE END USERS OF TECHNOLOGY	<i>Please name end users/ contacts that should be invited to project workshops</i>	Sewage treatment plants, agricultural biogas producers

Description of the technology/equipment:

Description of the technology/equipment:

The project „Blue BONSAI“ aims at an economical method for upgrading biogas to natural gas quality for small, decentralized biogas production plants.

The illustration below depicts the schematic of a biogas production plant with CHP, and in parallel or in an alternating mode with a biogas upgrading unit for vehicle refuelling (Blue BONSAI) or biogas injection into the gas grid (Blue FEED).



The upgrading plant can be installed at any location with a biogas fermenter (farm, sewage treatment plant or an industrial biogas production plant).

Biogas upgrading is realized by means of gas-compression and a hollow fibre membrane system (Evonik Fibres):

- Blue BONSAI type BBxy: biogas upgrading and refuelling of fleet vehicles
- Blue FEED type BFxy: biogas upgrading and gas grid injection



Technical Data:

Parameter		Value (please fill or tick) If value not available, please give estimate (and indicate with *).	Comments (e.g. which condition does the entered value correspond to?)
<i>Current technology</i>	Upgrading capacity of technology at current TRL-level (Nm ³ raw gas/h)	20-50Nm ³ raw gas/h (for CNG) 40-100Nm ³ raw gas/h (for grid injection)	Type BlueBONSAI Type BlueFEED
	<i>Data basis for following data list</i>	<p>1.: market ready stage of technology (based on test runs of current techn.)</p> <p>Please only use 2. or 3. if 1. not at all possible.</p> <p>2.: market ready stage of technology (based on estimate)</p> <p>3.: current level (TRL) of technology</p>	<p>1 <input type="checkbox"/> (preferably)</p> <p>2 <input checked="" type="checkbox"/></p> <p>3 <input checked="" type="checkbox"/></p> <p>For Switzerland</p> <p>TRL 7 for Germany and Austria</p>
<i>Technical efficiency</i>	Methane content in raw gas (%)	55-65%	
	Methane content in product gas (%)	>96%	
<i>Capacity</i>	Flow rate (range) /upgrading capacity (Nm ³ raw gas/ h)	20...100 Nm ³ /h	
	Flow rate biomethane (Nm ³ /h)	12...50 Nm ³ /h	
	Possible range for upscaling	Yes, but not in focus	
<i>Data for assessment of economical added value,</i>	Electricity demand (kWhel/Nm ³ raw gas)	Approx. 0.3 for grid injection Approx. 0.5 for CNG (300bar)	
	Heat demand (kWhth/Nm ³ raw gas)	none	



<i>possible contribution to GHG-reduction and availability</i>	Chemical/additives demand (kg/h or kg/Nm ³ raw gas)	none	
	Demand of other substances (kg/h or kg/Nm ³ raw gas)	Active coal depending on raw gas quality	
	Biomethane slip (range in % of biomethane production)	Approx. 1 %	
	Delivery pressure at exit of upgrading plant (bar _{abs})	Approx. 5...10bara	
	Full load hours (h/a)	8'000 h	
	Exhaust gas treatment	Not necessary	
	Usable heat (external) through heat extraction (kWh _{th} /Nm ³ raw gas)	Possible but not in focus	
	Space requirement (m ²)	Approx. 20 m2	
	Staff requirement (excluding maintenance) (h/a)	Approx. 50 h/a	
	Specific capital costs (excluding project development, planning, permission and additional building costs) (€/Nm ³ raw gas)	<p>Please give exact specific cost if possible, if not please specify range.</p> <p><input type="checkbox"/> < 4.000 €/Nm³</p> <p><input type="checkbox"/> 4.000 - 6.000 €/Nm³</p> <p><input checked="" type="checkbox"/> 6.000 € - 8.000 €/Nm³</p> <p><input type="checkbox"/> > 8.000 €/Nm³</p>	
	Maintenance costs (including spare parts such as new membranes, staff) (€/a or €/operating hour)		
	Production costs (€/Nm ³ biomethane)		
Expected lifetime of unit (years)	>10 years		
<i>Flexibility</i>	Start-stop-flexibility	yes	



	Part-load possibility	<input checked="" type="checkbox"/> Yes, 70% of full capacity <input type="checkbox"/> No	Start/Stop-operation ok
	Is self-maintenance of technology possible?	<input checked="" type="checkbox"/> Yes, 50% of total maintenance hours per year that can be done by operator himself <input type="checkbox"/> No	
	Does the upgrading technology remove also H ₂ S or is this necessary in a separate unit?	<input type="checkbox"/> Yes, ...% of total H ₂ S-content of raw gas <input checked="" type="checkbox"/> No	Active coal filter necessary which is an integral part of the total unit
	Necessity for adaptations of other parts of the plant		
	Advantages/disadvantages of technology	Small, "plug-and-play"	
	Special application area of technology	Upgrading and CNG refuelling in one unit	