



BioCat Plant Transfer Proposal v2





Content

- Overview of Store&Go project and achievements
- BioCat plant package
- Commercial proposal (updated)
- Open questions

Store&Go project overview

Industrial scale pilot plant and achievements

Industrial Scale Pilot Plant

Store&Go (Solothurn, Switzerland)

Project objective

Comparison of multiple methanation technologies, performance, load following, energy efficiency, gas quality, with oversight by regional gas grid operators (SVGW, DVGW)

Design features

Basic automation, including remote operation via iPad app, pressure range to 10 barg

Reactor capacity

Bioreactor is designed for 50 Nm³/h CO₂ at up to 10 bar(g); plant design for 35 Nm³/h CO₂

Biogas source(s), scale

Wastewater treatment plant with membrane upgrading system providing CO₂ via 1.5km pipeline

Power source(s)

Renewable power (from local grid/electrolyzer)

Hydrogen source(s), scale

350 KWe electrolyzer (PEM), plus (~70Nm³/h H₂)

350 KWe on-site hydrogen storage (@~70Nm³/h H₂)

Biocatalyst delivery

- Start-up culture of biocatalyst (600l) culture was provided in IBC container. – never replaced

Renewable methane production

- Gas grid injection within 96 hours of start of catalyst commissioning
- Operations under Store&Go project until Feb 2020; >1200 hours, >13,800 Nm³ RNG injected into CH gas grid

Duty cycles

- Load-following protocols demonstrated high flexibility of operation (as part of the STORE&GO project, a H2020 program)



Site owner

Regio Energie Solothurn

Plant operator

Electrochaea, Regio Energie Solothurn (RES), Hochschule Rapperswil (HSR)

Operations dates

May 2019 – February 2020

Project funding source

EC Horizon 2020 STORE&GO Project: RES, HSR, SVGW SSIGE, Empa, EPFL

Store&Go Plant

Solothurn, Switzerland



- Gas grid injection within 96 hours of start up
- 17 216 Nm³ of renewable methane injected
- Full remote plant operation and improved energy efficiency
- Comprehensive training materials (plant operation, commissioning & biocatalyst handling)
- Gas quality without post purification: > 97% CH₄, 0.2-1% CO₂, 1-2% H₂
- Load factor tests: 0%-100% capacity testing achieved (at > 97% CH₄ in product gas)
- Process flexibility: on/off cycles with immediate recovery after various shut-down periods



BioCat Plant

Package and Technology Transfer

BioCat Plant Package Proposal

Contents of the Proposal

Phase 1. Store&GO Project Transfer

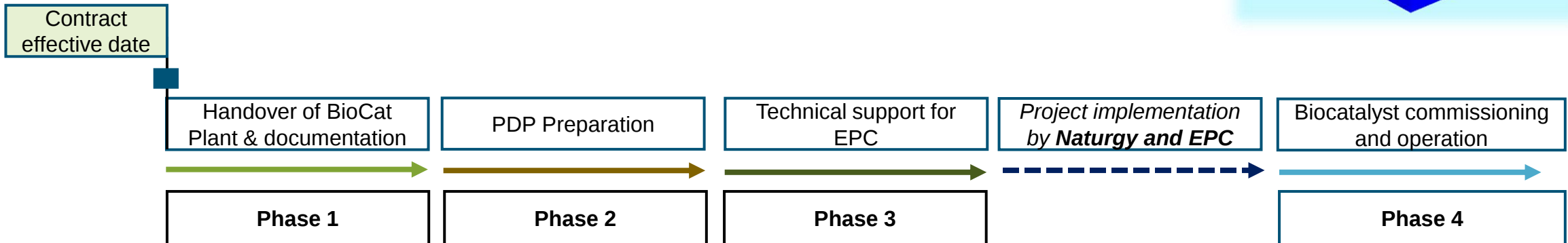
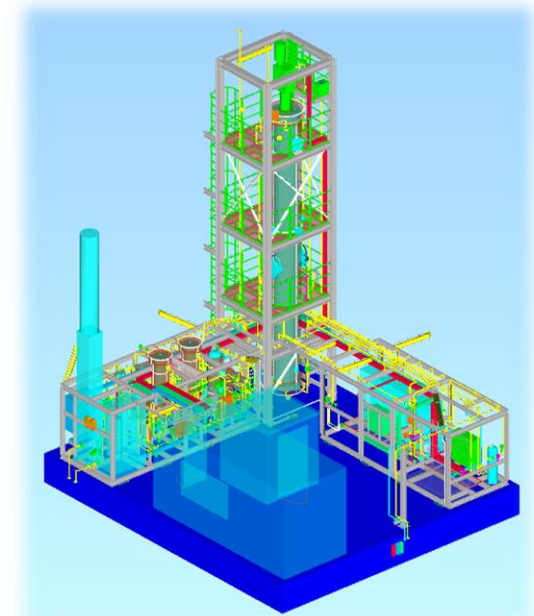
- Decommissioned BioCat Plant delivery
- Existing project documentation

Phase 2. Technology Transfer – Process Design Package (PDP)

- Concept and Costing Package delivery
- Generation and delivery of Licensor package for EPC Design

Phase 3. Support reviewing technical package with EPC

Phase 4. Biocatalyst transfer and support during hot commissioning



Technology Transfer

Process Design Package - Deliverables		
Concept and Costing Package		Licensor package to EPC for design
• Detailed PFD • Mass and Energy Balance • Battery Limit List • Line List • Equipment List • Utility Consumption Schedule • Effluent from BioCat Plants - Biocatalyst Liquid • Process Description and Control Philosophy • Block Flow Diagram • Materials Safety Datasheet - Biocatalyst • Materials Safety Datasheet - Nutrients/Chemicals • Flare Load Summary	• Process Datasheets: – Biomethanation Reactor – Agitator – Membrane Gas Separator Unit – Chemical dosing – Feed Compressor – Foam Trap – Biocatalyst Circulation Pump – Startup Circulation Pump – Reactor Cooler – Gas Dehydration Unit – Gas Analyzer Process Datasheet – Startup Electric Heater – Control valves	• Commissioning protocol and documentation • Process Startup Narrative • Plant Operating Mode and Transitions • Controls narrative • Functional requirements: – Reactor and agitator – Reactor Temperature Control – Chemical Dosing • Wastewater treatment design guideline

BioCat Plant Overview

Plant Characteristics

Year of construction	2018
Nominal capacity	35 Nm ³ /h of CH ₄
Modules	- Skid 1 - Reactor - Skid 2 - Gas Unit - Skid 3 - Process Liquid - Gas Analyser - Electrical Cabinets

Documentation

Condition assessment performed by ECM Kraftanlagen Munich in 2023

As built documents

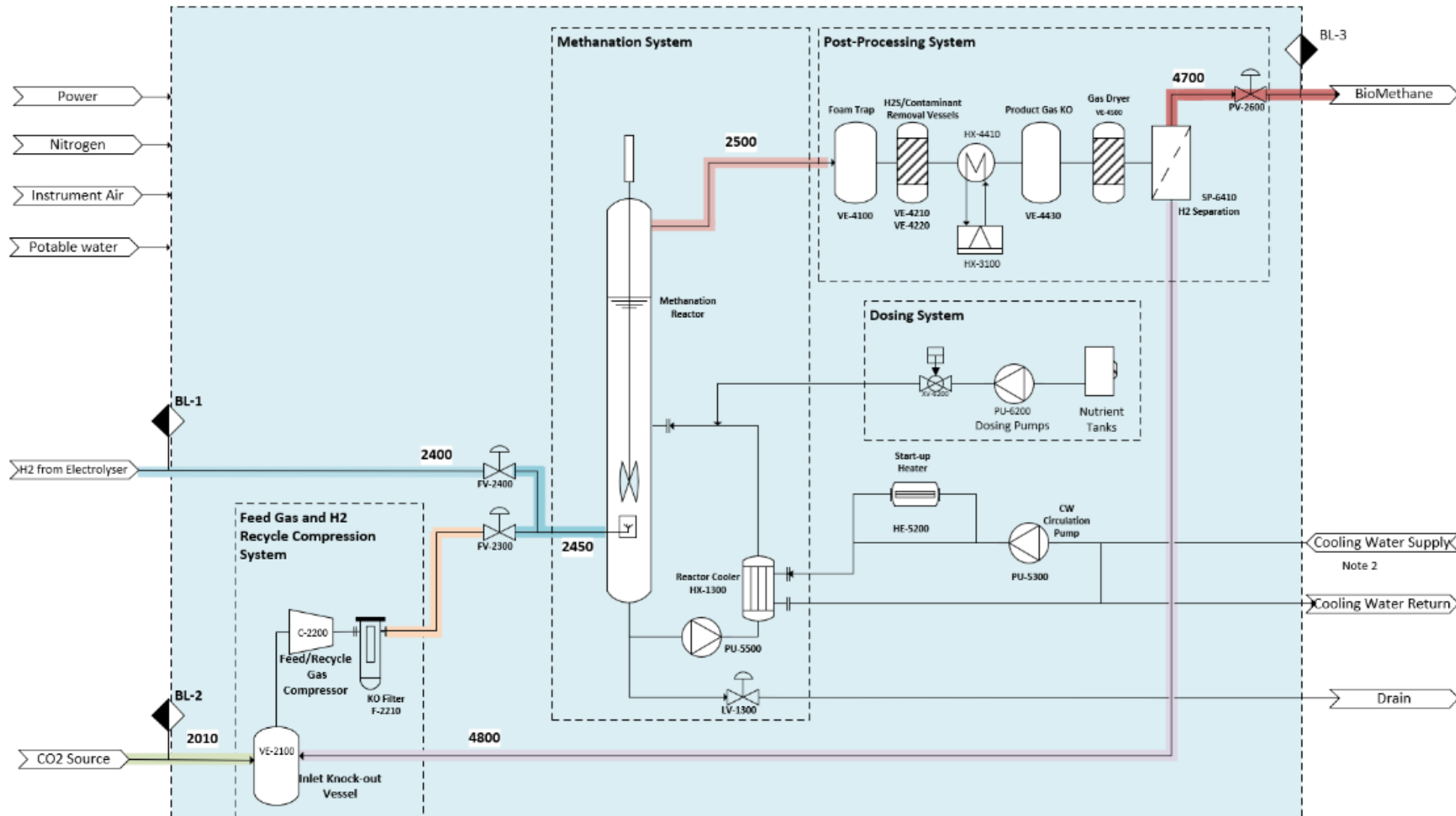
List of equipment in working condition

Module	Unit	Tag	Unit description	Existing	In Working Condition?
Container		700-AN-01	Gas analyser	✓	✓
Skid Gas Unit		500-BE-01	Combustion Chamber	✓	✓
Skid Gas Unit	FL	2301	Carbon feed coalescing filter	✓	✓
Skid Gas Unit	FL	2401	Hydrogen coalescing filter	✓	✓
Skid Gas Unit	FL	4400	PPU Particulate Filter	✓	✓
Skid Gas Unit	HX	4302	Post process recuperator	✓	✓
Skid Gas Unit	HX	4303	Rawgas cooler	✓	✓
Skid Gas Unit	VE	4301	Product gas KO vessel	✓	✓
Skid Process Liquid	HX	3101	Post process chiller	✓	✓
Skid Process Liquid	HX	5110	Air Cooler	✓	✓
Skid Process Liquid	PU	6210	Media Pump	✓	✓
Skid Process Liquid	PU	6230	Antifoam Pump	✓	✓
Skid Process Liquid	PU	6240	Na2S Pump	✓	✓
Skid Process Liquid	PU	6250	NH4OH Pump	✓	✓
Skid Process Liquid	PU	6260	SeW Pump	✓	✓
Skid Process Liquid	PU	6401	Analytical Pump	✓	✓
Skid Process Liquid	TK	6210	Media Feed Vessel	✓	✓
Skid Process Liquid	TK	6230	Antifoam Feed Vessel	✓	✓
Skid Process Liquid	TK	6240	Na2S Feed Vessel	✓	✓
Skid Process Liquid	TK	6250	NH4OH Feed Vessel	✓	✓
Skid Process Liquid	TK	6260	SeW Feed Vessel	✓	✓
Skid Reactor		100-HX-02	Reactor heat management exchanger	✓	✓
Skid Reactor	AG	1000	Agitator	✓	✓
Skid Reactor	R	1000	Bio Reactor	✓	✓
Skid Reactor	V	1200	Agitator Seal Vessel	✓	✓
Skid Reactor	V	3700	Vent separator	✓	✓

Additional information on required equipment provided separately

Strictly Confidential

Current Standard Design



Current standard design includes external cooling and H2 recycling loop. These features are not included in Store&Go plant.

Strictly Confidential

Commercial offer

Equipment transfer and License agreement

Commercial offering

Payment schedule

- **Upfront payment: €850.000** *at signature*
 - delivery of equipment
 - as built documentation
 - PDP transfer
 - Biocatalyst delivery
 - Support for transfer of technical information to EPC
- **2nd Payment: €150.000** after completion of hot commissioning
 - fully paid-up license **(excluding royalty fees)**
 - Includes hot commissioning and operator training
 - **Includes full data access for Electrochaea**
- **Yearly payments: €56.000 per year of operation (fixed royalty fee)**

Contracts and timelines

- Sales agreement for equipment
- License agreement to Electrochaea technology:
 - License to use Electrochaea's technology in combination with the 1MWe plant
 - Services agreement for PDP transfer and EPC support activities
 - Material Transfer agreement for transfer of biocatalyst and materials
- Estimated timeline:
 - Signed license agreement end of June 2025,
 - transfer of equipment and documents July 2025
 - Commissioning of plant 2026

Cost comparisons

- **Original price for Store&Go plant (2018):**
 - €1.6mio EPC (without gas dryer, without compressor)
 - €1.7mio cost for engineering support (Electrochaea)
 - total: €3.3mio (without gas dryer, without compressor)
- **Offer for used Store&Go equipment for Naturgy:**
 - €500.000 for equipment
 - Electrochaea's offer for tech transfer, license fees, biocatalys, commissioning, training €500.000
- **Cost estimate for new 1MW plant (2025):**
 - ~€ 2.4mio EPC similar scope as above
 - Electrochaea tech transfer, license fees, biocatalyst, commissioning, training €600.000
- **Cost estimate for 5MW plant:**
 - Current cost estimate is €5.5mio for a complete plant, including Electrochaea license

Upsides

- Allows rapid implementation of test plant and deep testing of technology at industrial scale
- Tech transfer with pre-qualified EPC (e.g. Sener, Enerco)
- Technology access allows qualification of Electrochaea technology before commercial implementation
- Reduced tech transfer cost/time for commercial implementation of 5MWe standard plants
- Provides basis for techno-economic analysis for commercial operation

Open questions

- At which capacity does Naturgy want to operate the plant? This will have an impact on the needs for re-design of some equipment (e.g. bioreactor is designed for 1MWe capacity, plant design is for 0.7MWe capacity)
- Site specific equipment is not considered
- Depending on eMethane product gas quality expectations, further gas polishing may be required
- Electrolyzer is not included
- Main design differences from current commercial BioCat design:
 - no H₂ recycling included,
 - internal cooling loop instead of external cooling