BIO-METHANE REGIONS

Biomethane Calculator & Cooperative Biogas to Biomethane Developments

Workshop *„Business Agreements for Urban Biogas Projects“* - 14.05.2013

INTELLIGENT ENERGY EUROPE

Sascha Flesch

LEV Steiermark
LandesEnergieVerein

Agenda

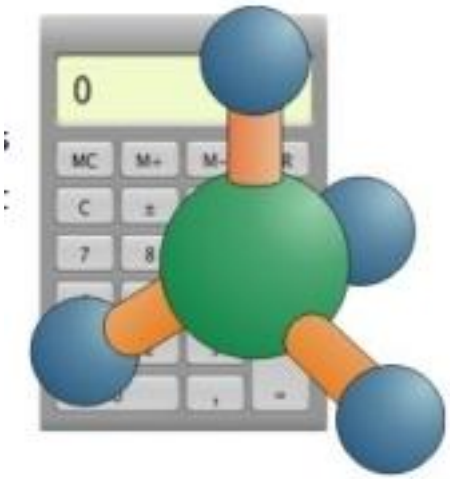
- Biomethane Calculator
- Cooperative Models for Biogas Upgrading

content courtesy of :

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark



http://bio.methan.at/en/download_biomethane-calculator

BIOMETHANE CALCULATOR

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

Biomethane Calculator

- Calculation of investment, operating and overall annual costs for biogas upgrading technologies
- Most key technologies covered
- Includes pre-treatment technologies and feed-in issues
- Feasibility calculations, techno-economic assessment
- Cost parameters will be updated and refined frequently

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

Biomethane Calculator: Inputs

- Plant size
- Raw biogas composition
  - Methane, carbon dioxide, oxygen, nitrogen, water, hydrogen sulfide, ammonia, other contaminants
- Product gas quality requirements
  - Local/regional gas grid quality
  - Heating value, maximum contaminant concentration
- Offgas quality requirements
  - Offgas treatment needs
  - Emission limits

Biomethane Calculator:

- Gas pretreatment technology / desulphurisation
- Gas upgrading technology
- Delivery gas pressure requirement, high-pressure compression
- Biomethane heating value requirements, propane dosing
- Biomethane odorisation
- Biomethane pipeline, feed-in and gas transfer station

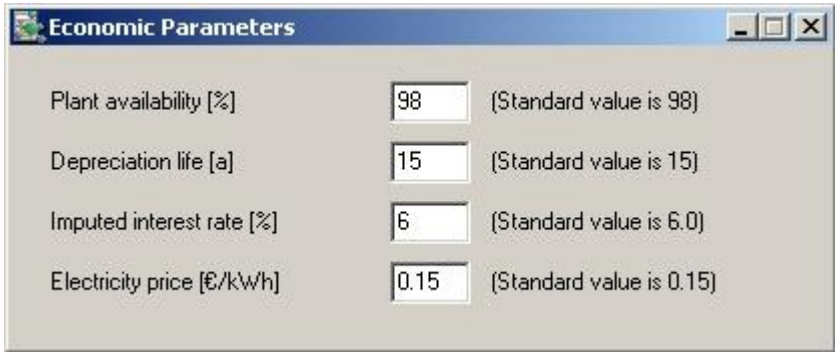
BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LEV Steiermark
LandesEnergieVerein

Biomethane Calculator: Financial Parameters

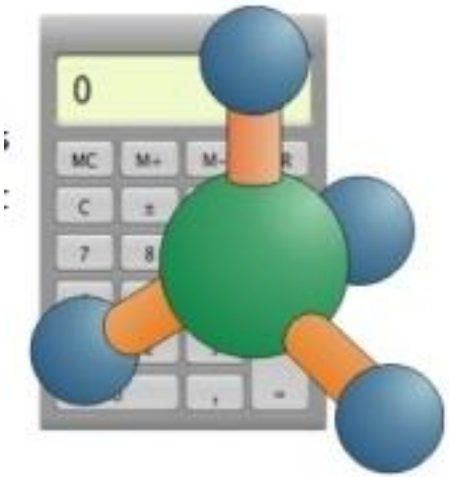
- Capital costs:
  - Interest rate on capital costs
  - Expected plant life-time / long-term contracts
  - Funding of investment costs
- Operating costs:
  - Personnel
  - Electricity
  - Materials / chemicals / analytics & calibration gases
- Maintenance costs
  - Life-time of equipment components / replacement



BIO-METHANE REGIONS

LandesEnergieVerein Steiermark

Biomethane Calculator



- http://bio.methan.at/en/download_biomethane-calculator

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

BiomethaneCalculator: Further Developments

- Integration of different offgas treatment systems
- Integration of additional language: POLISH
- Optionally integration of additional gas upgrading technology (depending on data provided by manufacturers)
- Integration of various biomethane utilisation scenarios (gas grid injection, locally used vehicle fuel)

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

COOPERATIVE BG UPGRADING MODELS

Upgrading Plant Economics

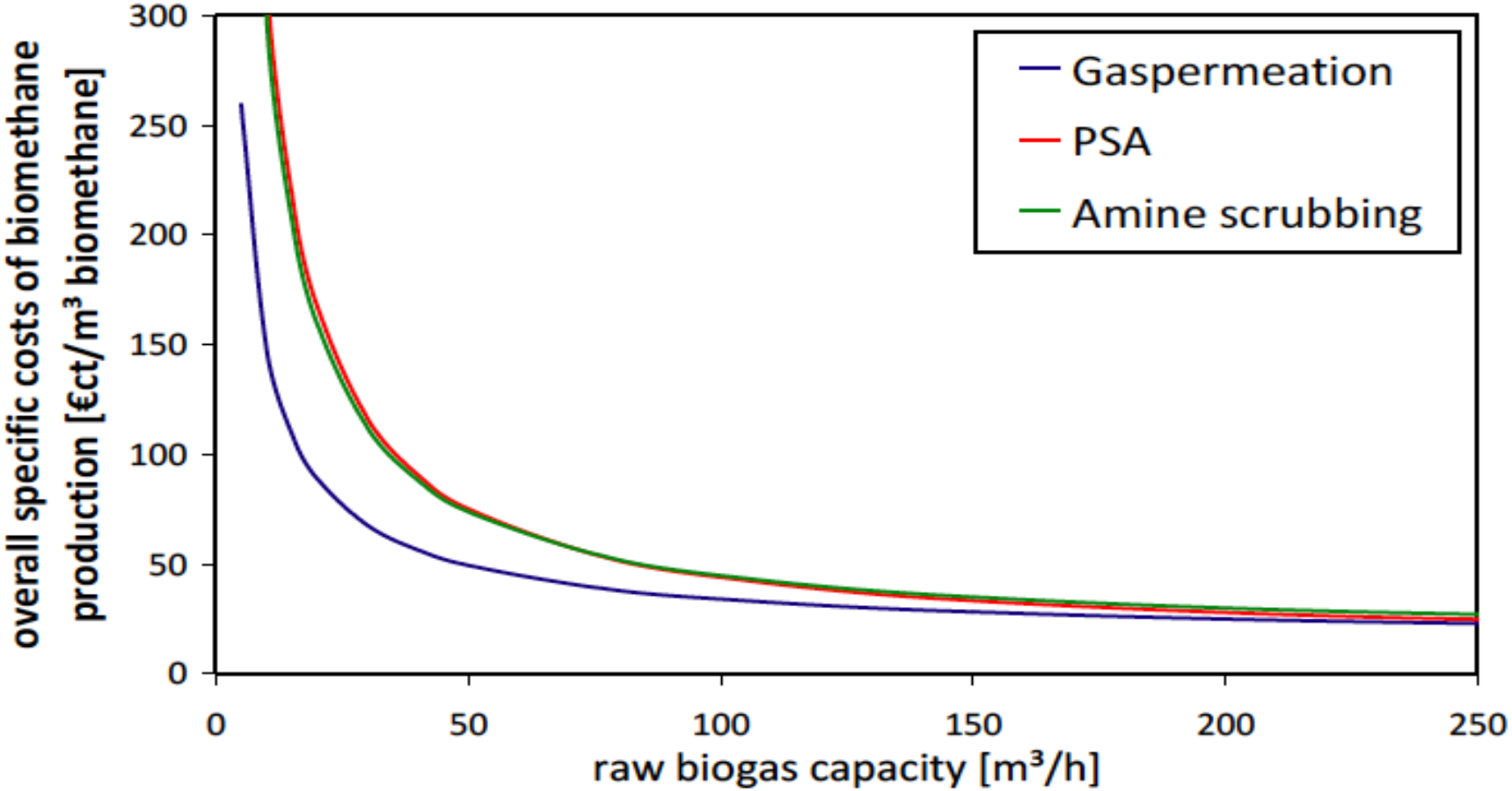


Figure 1: Economy of scale: degression of overall specific costs of biomethane production depending on raw biogas capacity for different biogas upgrading technologies

BIO-METHANE REGIONS

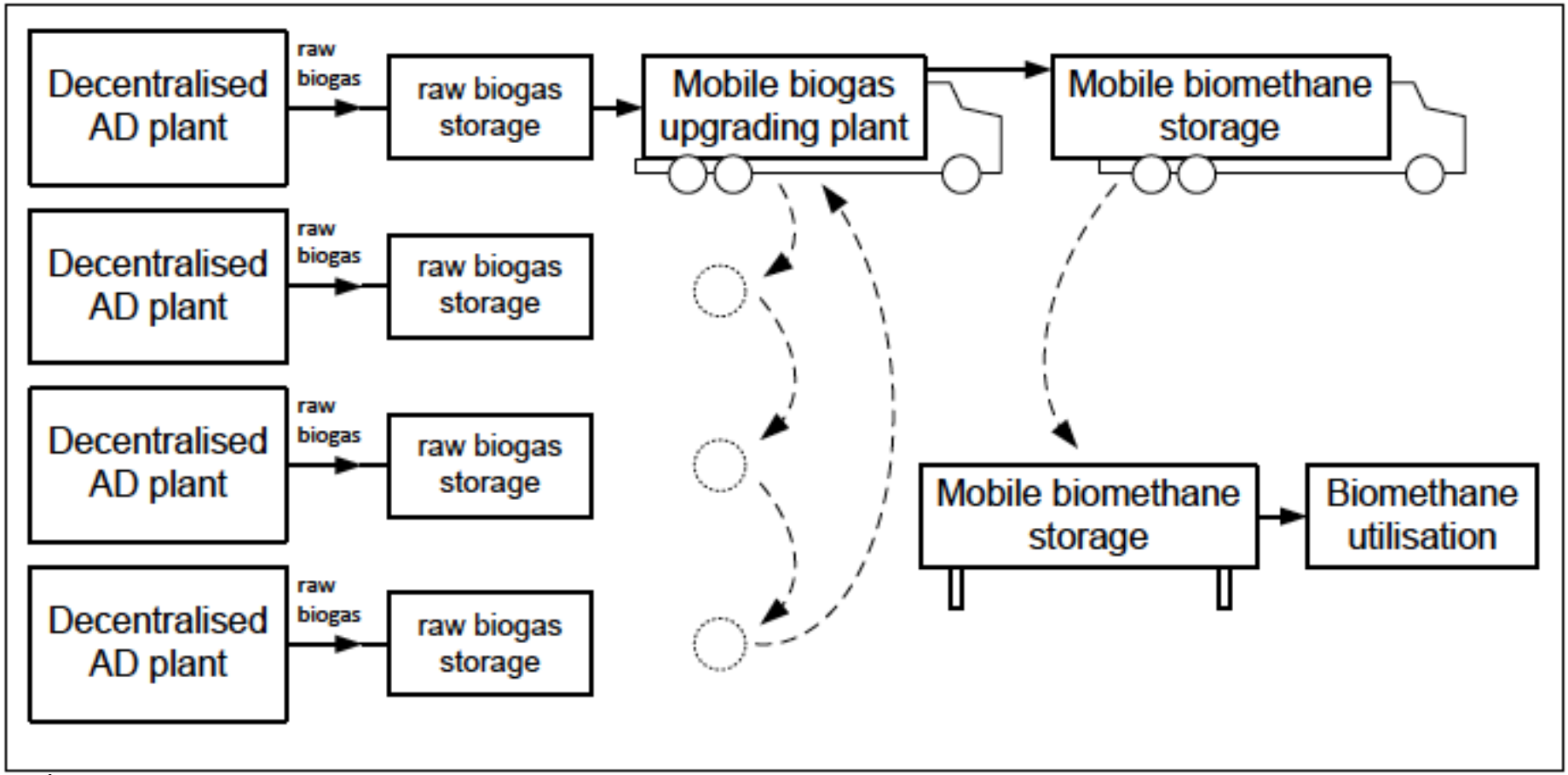
INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

2 options where analyzed

- mobile biogas upgrading solutions
- raw biogas pipeline – centralized biogas upgrading

Mobile Biogas-Upgrading



BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

Prerequisites & Conditions

- Raw biogas buffer storage at BG plant
- Mobile BG upgrading unit
- Mobile BM storage
- Refined logistics

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LEV Steiermark
LandesEnergieVerein

On-Site Buffer Storage Solutions

Figure 4: Low pressure gas storage systems: balloon type gas storage (upper row left); cushion type gas storage (upper row right); membrane roof gas storage on fermenter top (lower row left); external double membrane storage system (lower row right); Sources: Sattler AG and Panaqua AG

On-Site Buffer Storage Solution

Figure 5: Raw biogas storage systems for elevated pressure: gas storage tank (left); compression and expansion unit (right); Source: Panaqua AG

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

Mobile Upgrading Container

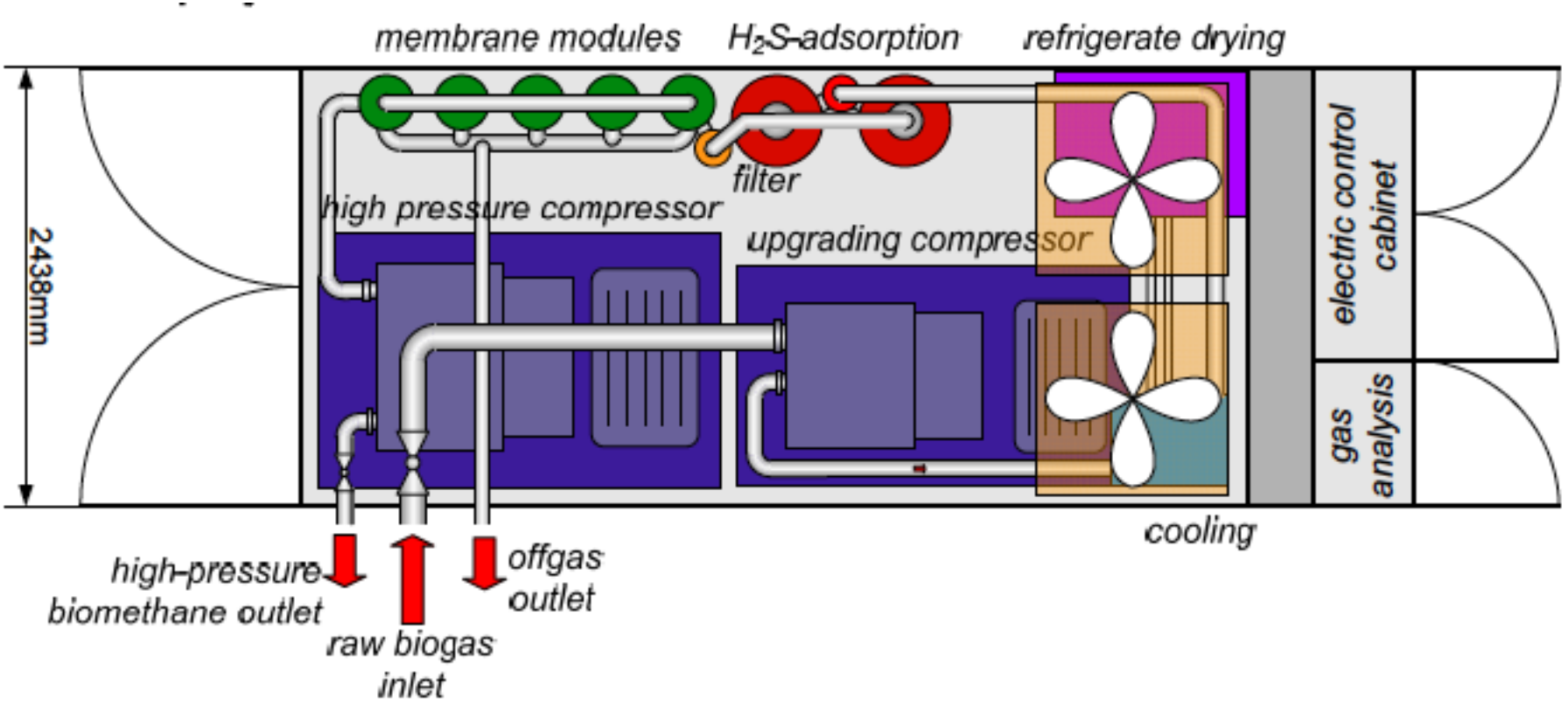


Figure 3: Scheme of a mobile biogas upgrading unit with a capacity of 300m³/h raw biogas using gaspermeation mounted in a 20-foot standard container; Source: Vienna University of Technology

Mobile Storage of BM

Figure 6: Pressurised gas tank transportation systems applying WAB system: design study of gas transportation truck with 150 cylinders of 80 litres volume for 220 bar (left); swap trailer system (mid); light lorry with swap trailer body (right); Source: Güssing Energy Technologies GmbH, Schoon Fahrzeugsysteme

Mobile Storage of BM

Figure 7: Pressurised gas transportation system – the Galileo system "virtual pipeline"; Source: Galileo SA

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

Economics of Concept: Assumptions

- Grid injection
- Transport required to injection point
- Transport pressure 220bar
- No BG production costs included
- €50/m^3 biogas storage

Economics of Concept: Scenario

- total capacity of plants : 210m^3/h
- gas permeation upgrading plant (300m^3/h)
- max. 50km between plants
- €2.7/km
- average transportation time = 1h

	Cooperative biogas upgrading initiative			
	Plant A	Plant B	Plant C	Plant D
Raw biogas capacity [m³/h]	50	80	30	50
Raw biogas storage duration [h]	41	38	43	41
Raw biogas storage volume [m³]	2050	3040	1290	2050

Economics of Concept: Schedule

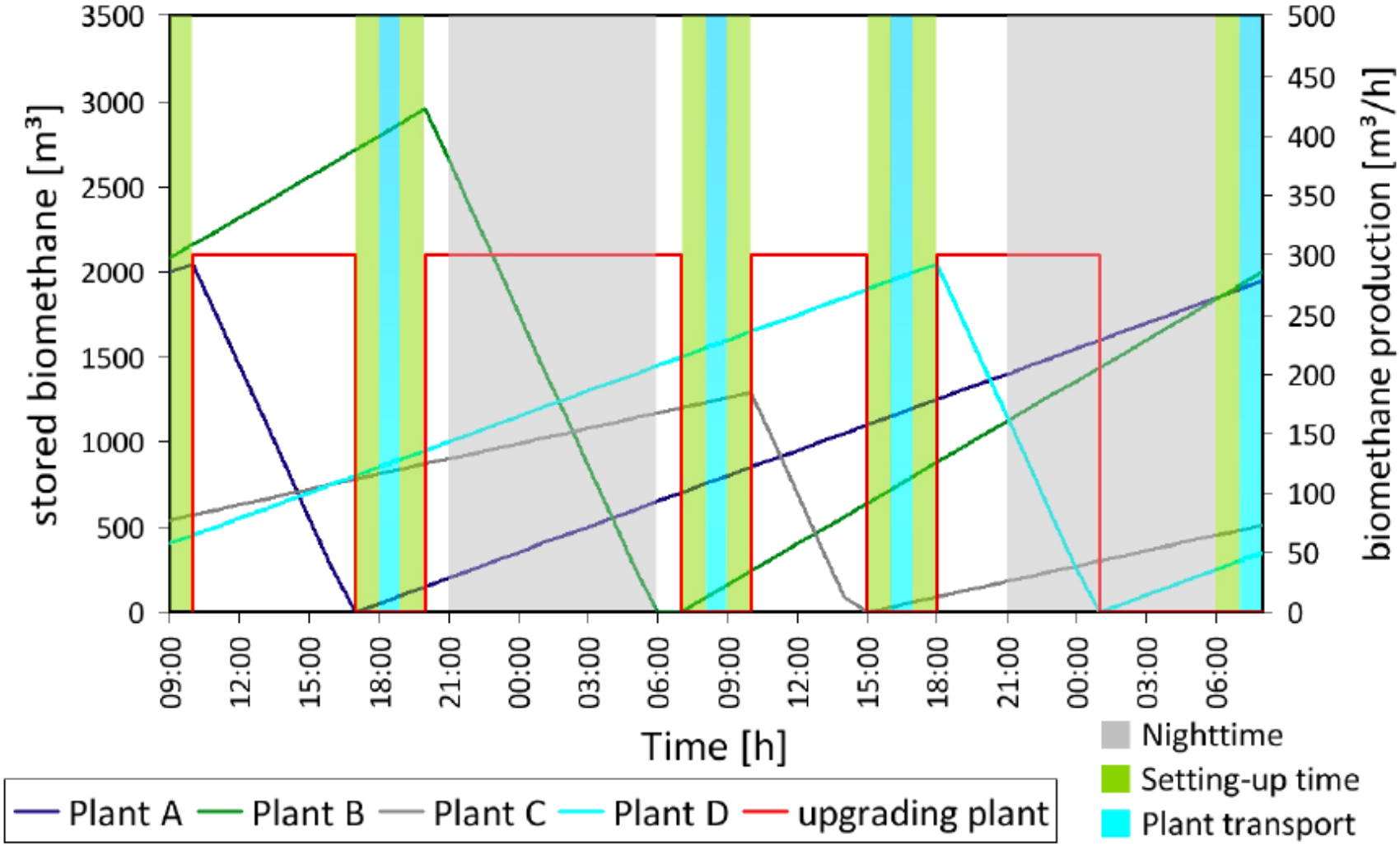
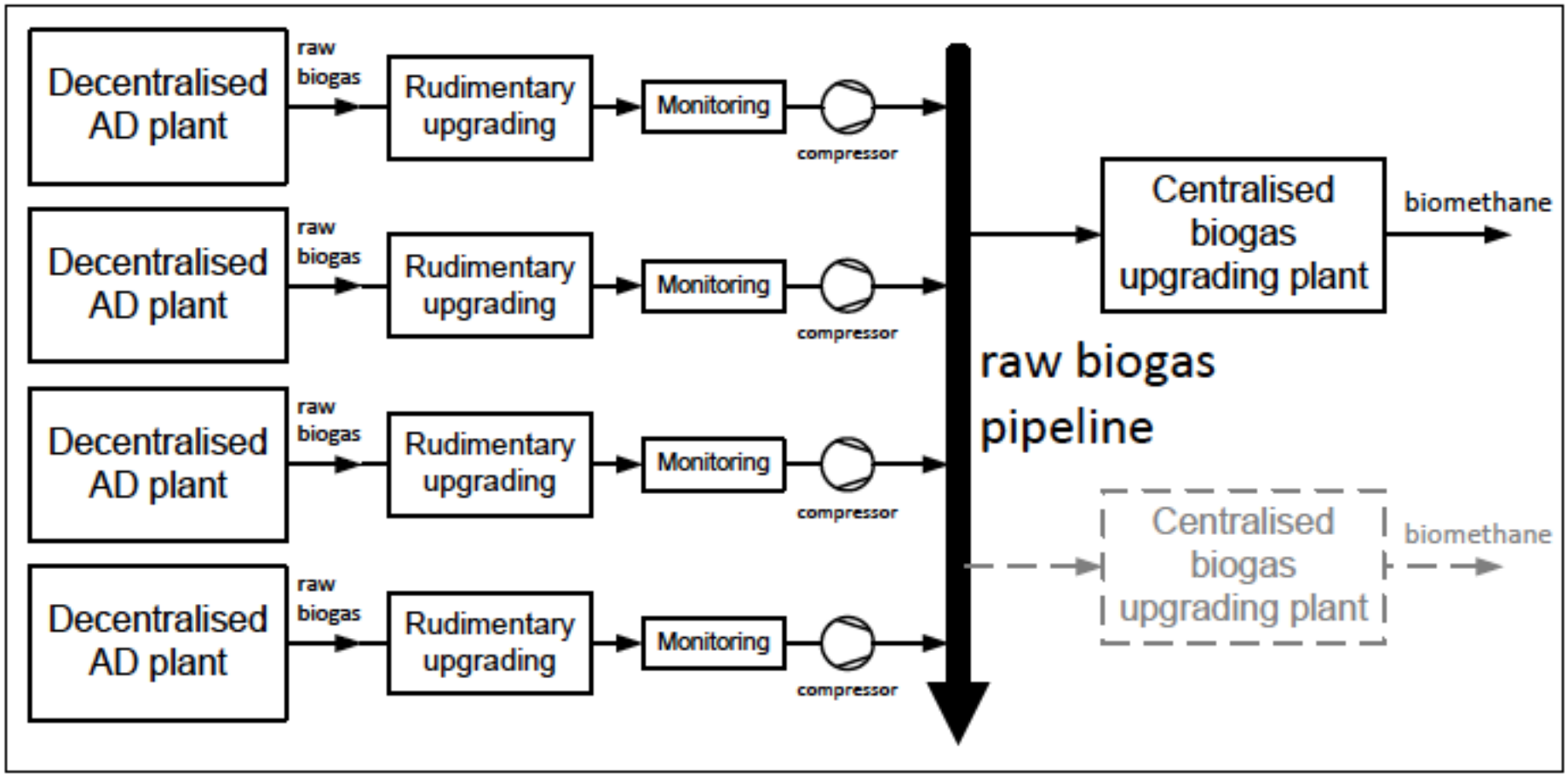


Figure 8: Time schedule of biogas upgrading plant handling 4 small-scale AD-plants including raw biogas storage tank filling levels; Source: Vienna University of Technology

Economics of Concept: Results

	Cooperative upgrading	Decentralised upgrading
Investment costs upgrading plant	1 mobile plant: 1.292.819 €	Sum of 4 plants: 2.076.574 €
Investment costs raw biogas storage	Sum of 4 plants: 421.500 €	-
Considered total investment costs	1.714.319 €	2.076.574 €
Annual costs of transportation	98.550 €/a	
Overall annual costs including capital costs, operation and transportation	496.135 €/a	522.695 €/a
Specific production costs	43,7 €ct/m³ biomethane	59,2 €ct/m³ biomethane

Centralized Biogas-Upgrading



BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark

Prerequisites & Conditions

- PE pipes
- 15cm inner diameter => 1000m^3/h (STP)
- Low pressure system: 200mbar(g) – 2bar(g)
- Costs: €120-€200/m

Figure 10: Biomethane pipeline in Bruck/Leitha, Austria during construction; pipe connection by welding (right); Source: Vienna University of Technology

BIO-METHANE REGIONS

INTELLIGENT ENERGY EUROPE

Steiermark LandesEnergieVerein

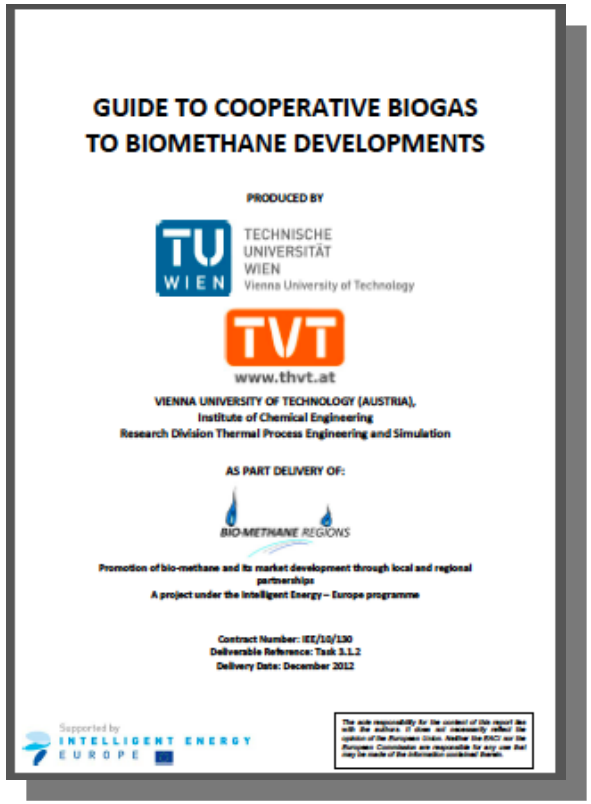
Economics of Concept: Assumptions

- 8 BG-plants in grid (2xA,2xB,2xC,2xD)
- AD-plant capacity 420m^3/h
- Upgrading plant: gas permeation (420m^3/h)
- €130/m pipeline, 20km network
- Low pressure compression
- Rudimentary upgrading (drying, NH_3)

Economics of Concept: Results

	Cooperative upgrading	Decentralised upgrading
Investment costs upgrading plant	1 plant: 1.062.390 €	Sum of 8 plants: 3.175.786 €
Investment costs raw biogas pipeline	2.600.000 €	-
Investment costs raw biogas compression	352.581 €	-
Investment costs rudimentary upgrading	257.501 €	-
Considered total investment costs	4.272.472 €	3.175.786 €
Overall annual costs including capital costs and operation	653.792 €/a	740.836 €/a
Specific production costs	37,0 €ct/m³ biomethane	42,0 €ct/m³ biomethane
Simple payback period	12,6 a	

www.bio-methaneregions.eu



OTHER RELEVANT PROJECT OUTPUTS

INTELLIGENT ENERGY EUROPE

LEV Steiermark
LandesEnergieVerein

BIO-METHANE REGIONS

Suggestions/ Comments/ Questions

INTELLIGENT ENERGY EUROPE

LandesEnergieVerein Steiermark