



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



Solutions

Biogas Competence

Process automation for Biogas

Example for CDM: Biogas

Biogas Competence

Biogas energy measurement

CARBOSYS
CDM – Solution

Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

Competence in Power &
Energy

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Feedstock for Biogas

Stable dung



Old bread



Corn silage



Potatoes



Scraped beet



Food waste



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Process Map ... Bio Chemistry

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Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

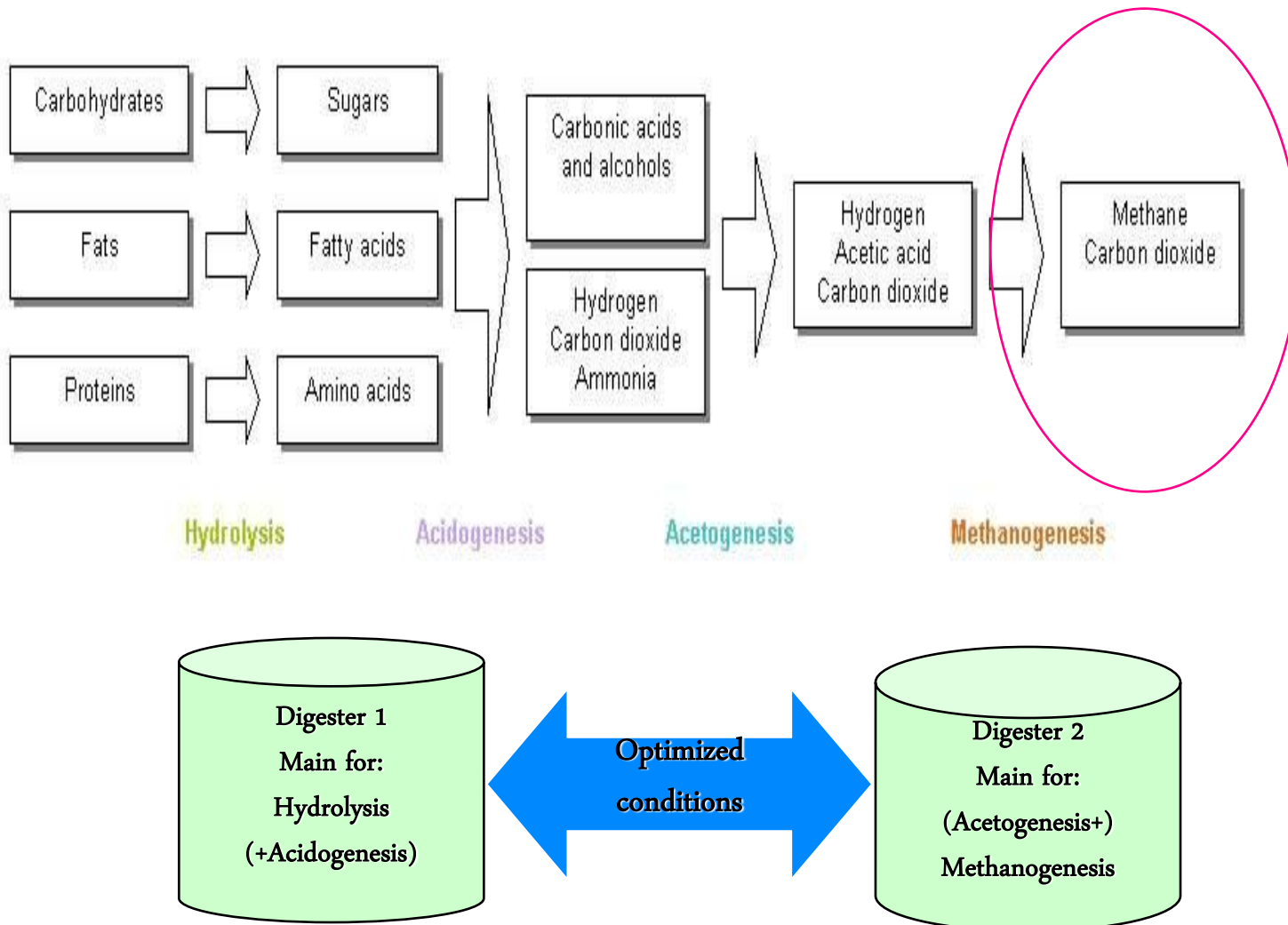
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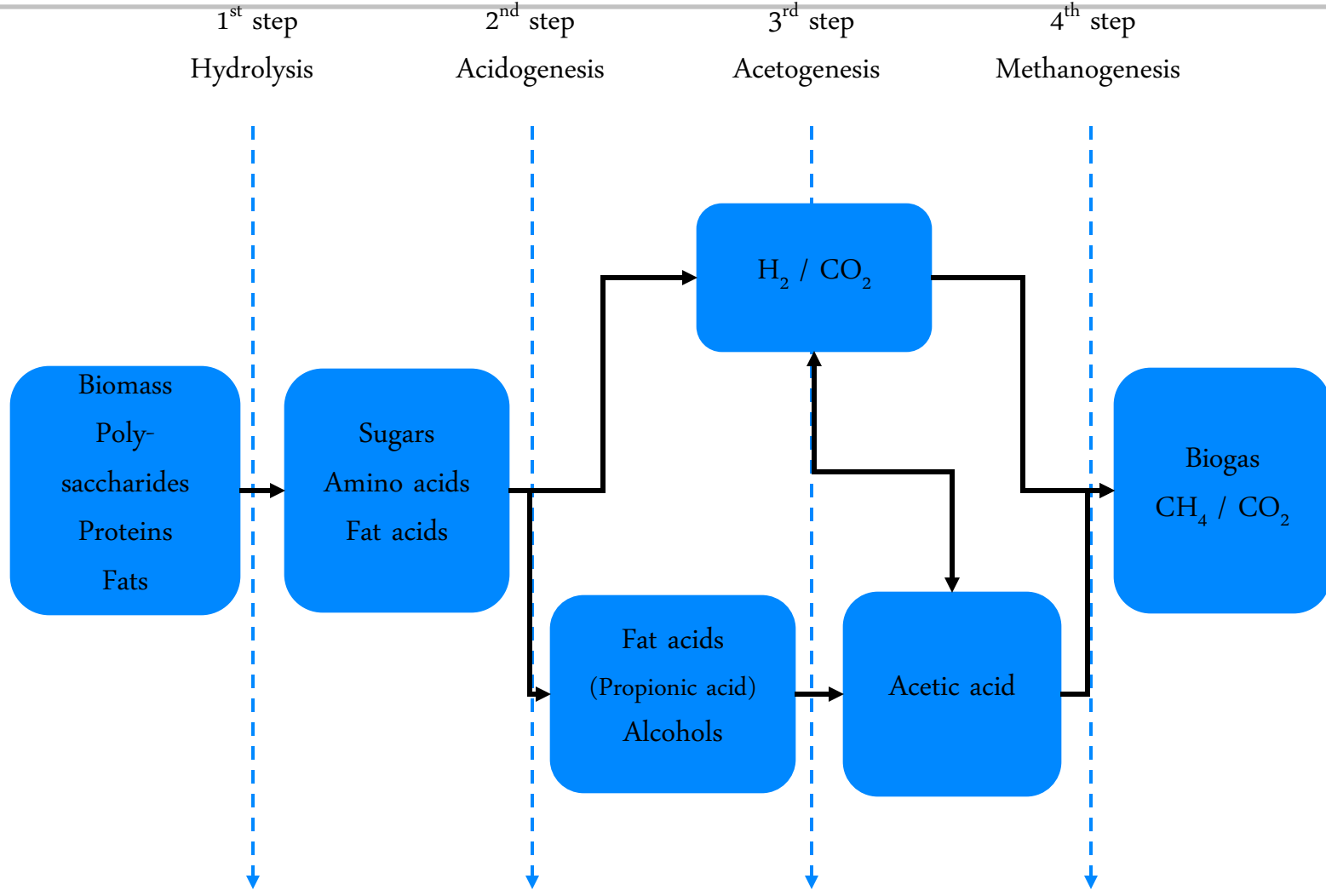
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Process map



- Biogas Competence
- Biogas energy measurement
- CARBOSYS
CDM – Solution
- Biodiesel Competence
- Bioethanol Competence
- Solar PV energy
- Solar thermal power plant
- Competence in Power & Energy
- W@M – Life Cycle Management
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Main Parameter of a Biogas Plant ...

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Biogas energy measurement

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Bioethanol Competence

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The Biogas production isn't a constant process, it's depending on the biological activities of the microorganism and the biomass.

Typical parameter:

- Constant Temperature
 - Mesophil process: 30-38 °C tropic area ?
 - Thermophil process: 50-65 °C
- pH 6-7
 - Preparation of feeding substrate for pH is very important
- Darkness and no Oxygen (<1% !)
 - For Hydrogen sulfate digesting bacteria: 0...< 1% Oxygen
- Mixing:
 - For releasing the gas bubbles
 - Heavy mixing is stressing microorganism
- Constant biomass adding with constant quality – pre-treatment

Process control is optimizing the gas production and protect the plant from
unplanned shut down!

Biogas Process map

Biogas Competence

Biogas energy measurement

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Solar thermal power plant

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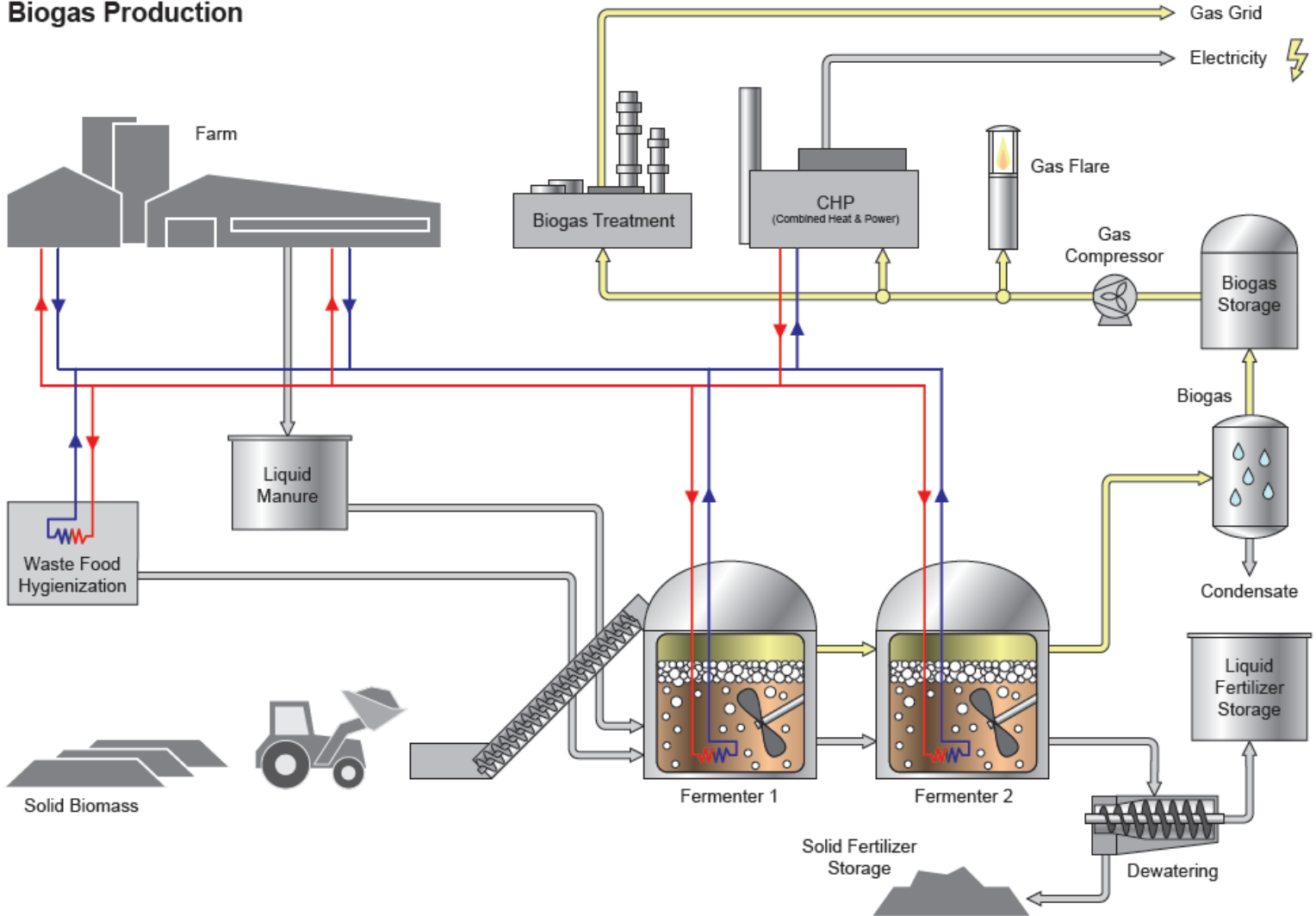
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Biogas Production



3th type process map with tube fermenter

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Biogas energy measurement

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Bioethanol Competence

Solar PV energy

Solar thermal power plant

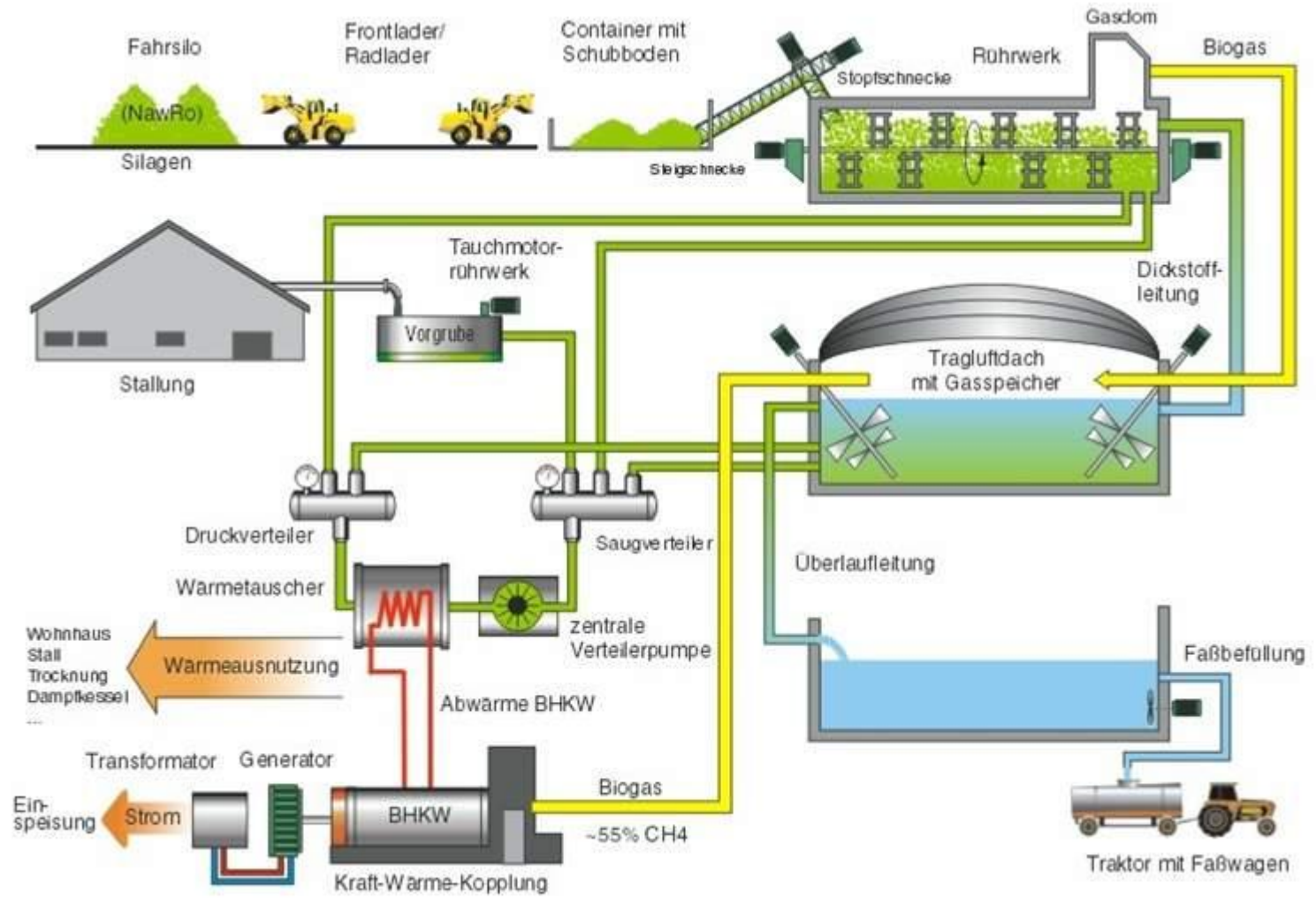
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Biogas "Standard" Process with CDM

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

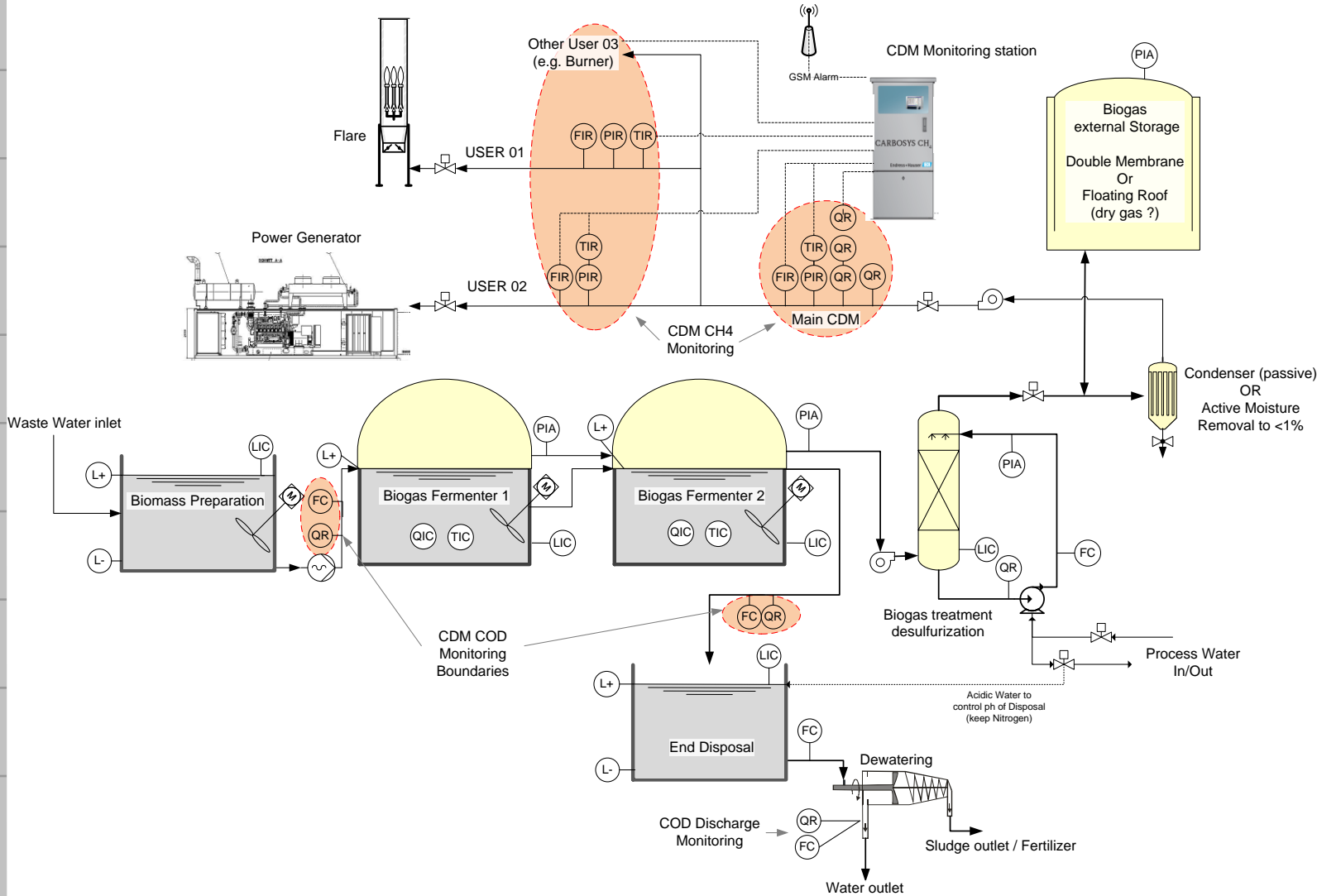
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Biomass distribution

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Bioethanol Competence

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Used instruments

- Promag 53



Note!

With plastic pips it's important to use
grounding disks and Peak electrodes

Main fermenter

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Biogas energy measurement

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Bioethanol Competence

Solar PV energy

Solar thermal power plant

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Used instruments

- FMR 230
- Promag 53
- Cerabar
- DC16 capacitance probe with soiling compensation



Measuring shaft



Note:

Protection pipe DN 400



Main fermenter

Biogas Competence

Biogas energy measurement

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Bioethanol Competence

Solar PV energy

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Used instruments

- pH Measuring with retractable holder
- Cerabar pressure sensor
- Temperature
- DC16 capacitance probe with soiling compensation
- Micropilot M level measurement



45° angle



2nd step fermenter

Biogas Competence

Biogas energy measurement

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Used instruments

- Micropilot M
- DC16 capacitance probe with soiling compensation
- Cerabar



Hydrostatic level measurement

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Biogas energy measurement

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Bioethanol Competence

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Used instrument

- Hydrostatic level measurement with Cerabar



Note: always installation with cleaning neck!!

System solution form Endress+Hauser

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Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

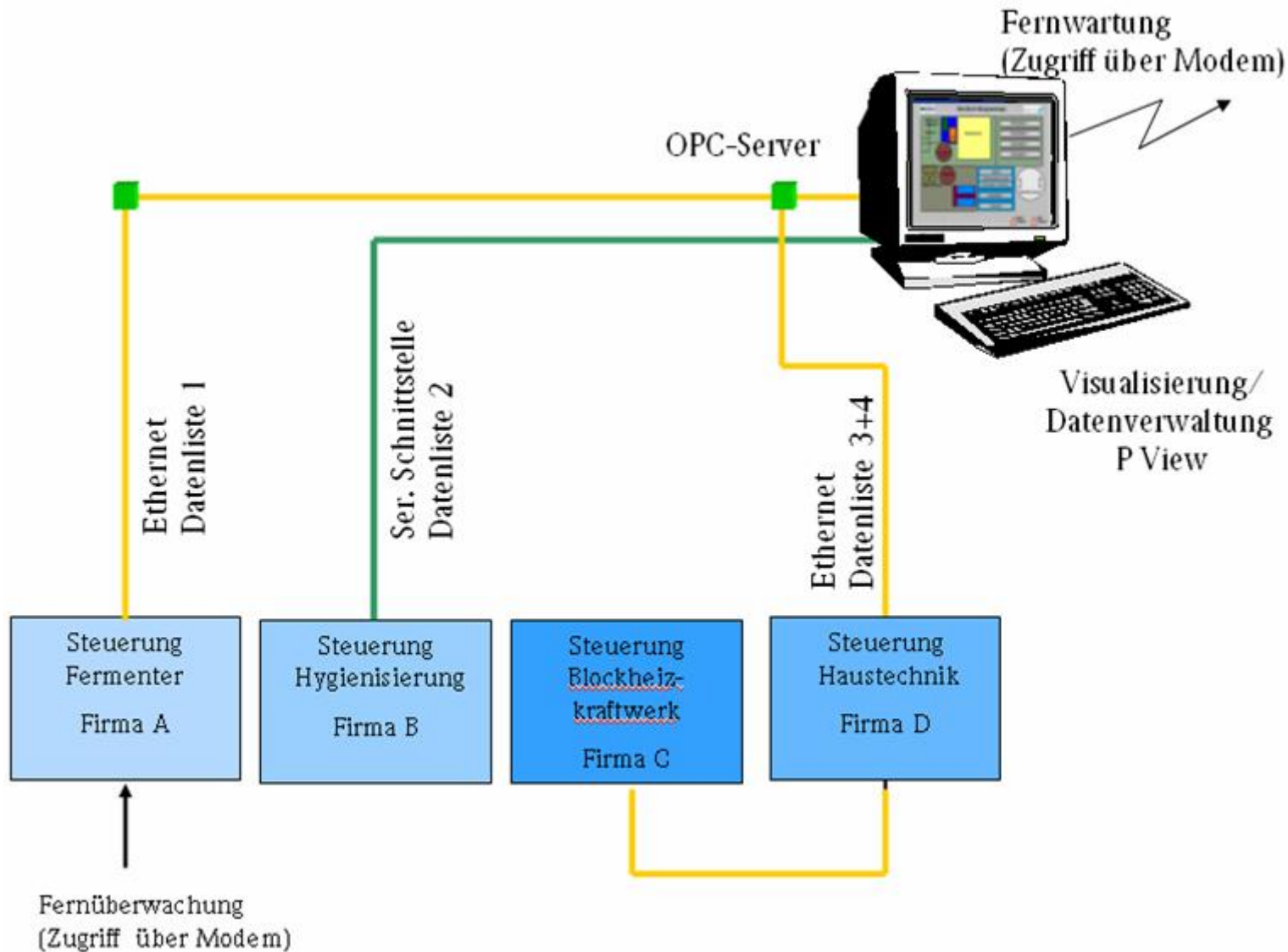
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P View Application

Biogas Competence

Biogas energy measurement

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Bioethanol Competence

Solar PV energy

Solar thermal power plant

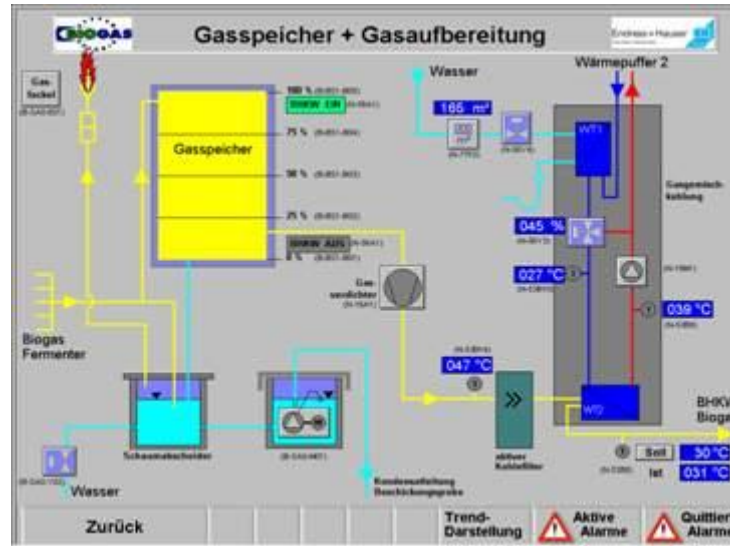
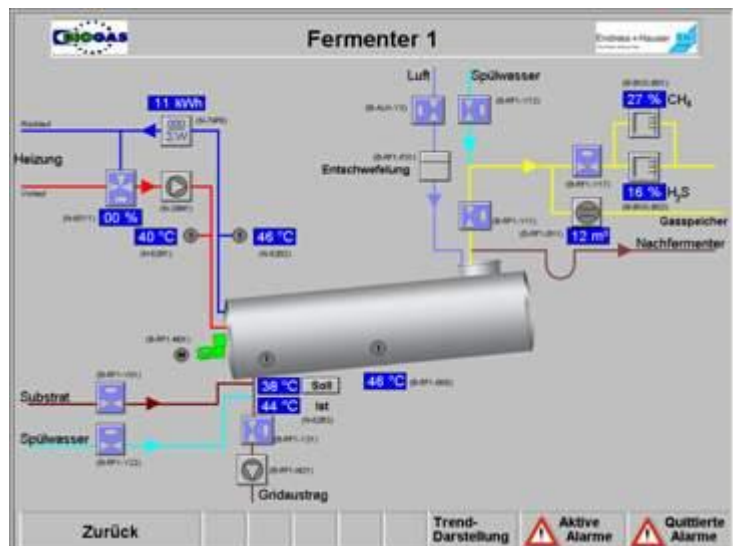
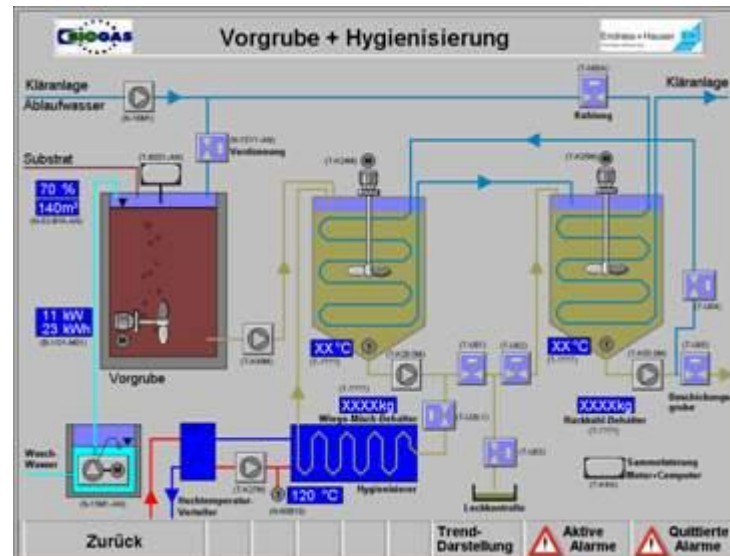
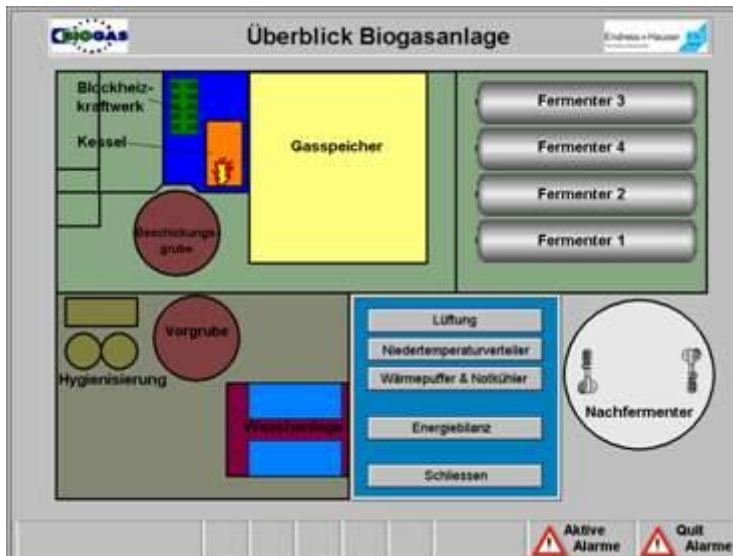
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Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



Solutions

Biogas energy measurement

Solution package out of on hand

Application: Biogas

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

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Management



Application:

CSG (Coal Seam Gas)

Biogas Competence

Biogas energy measurement

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Bioethanol Competence

Solar PV energy

Solar thermal power plant

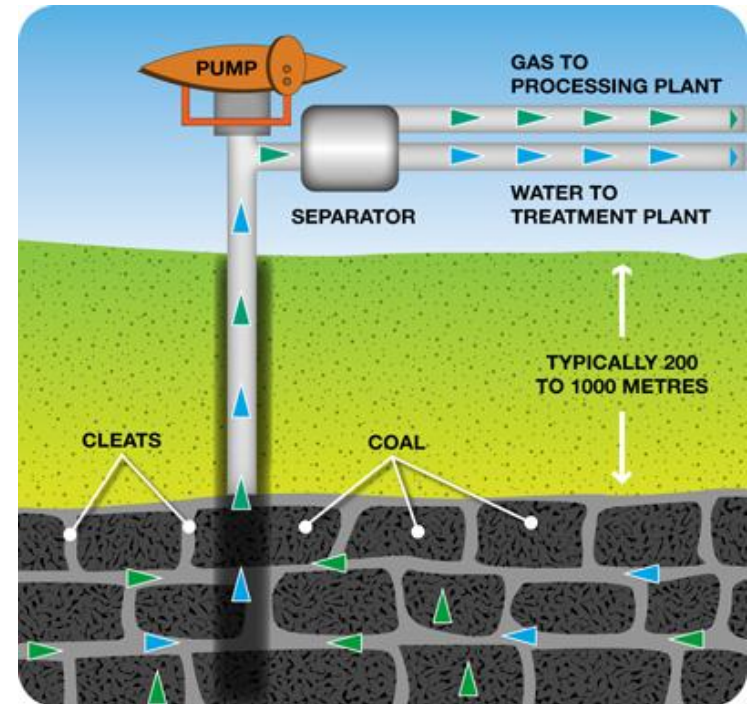
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3. Application: Landfill gas

Biogas Competence

LFG Landfill Gas

Biogas energy measurement

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Bioethanol Competence

Solar PV energy

Solar thermal power plant

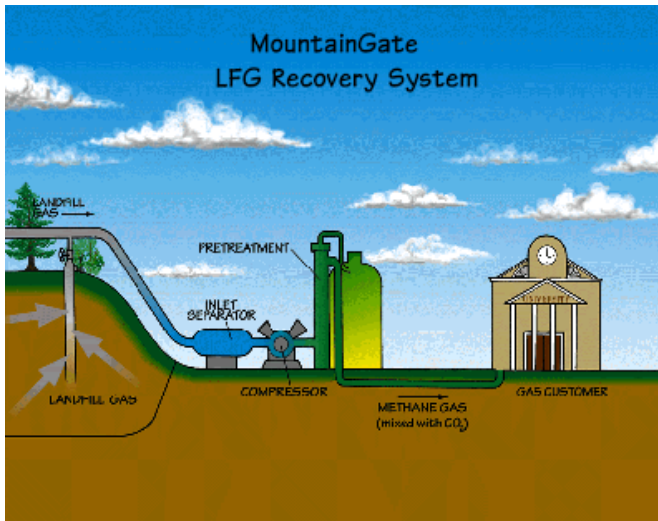
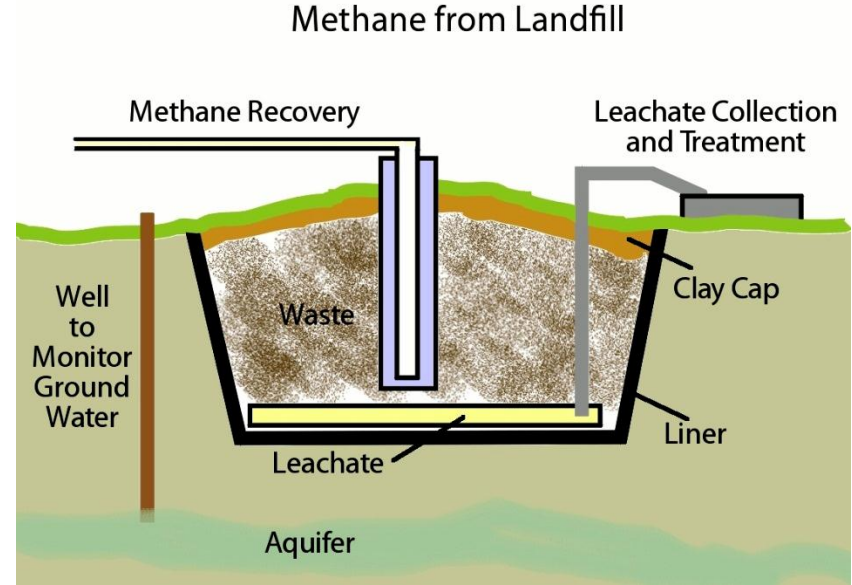
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Biogas energy measurement Solution

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

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Management

Your benefit on a glance:

- Customer tailored solution out of one hand
- Higher benefit through calculation of energy und efficiency
- Optimized controlling of the Biogas plant and CHP
- Modular concept allows customer wishes
- Memorizing measured values and alarm limit values

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Gas delivery to the Combined Heat and Power

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

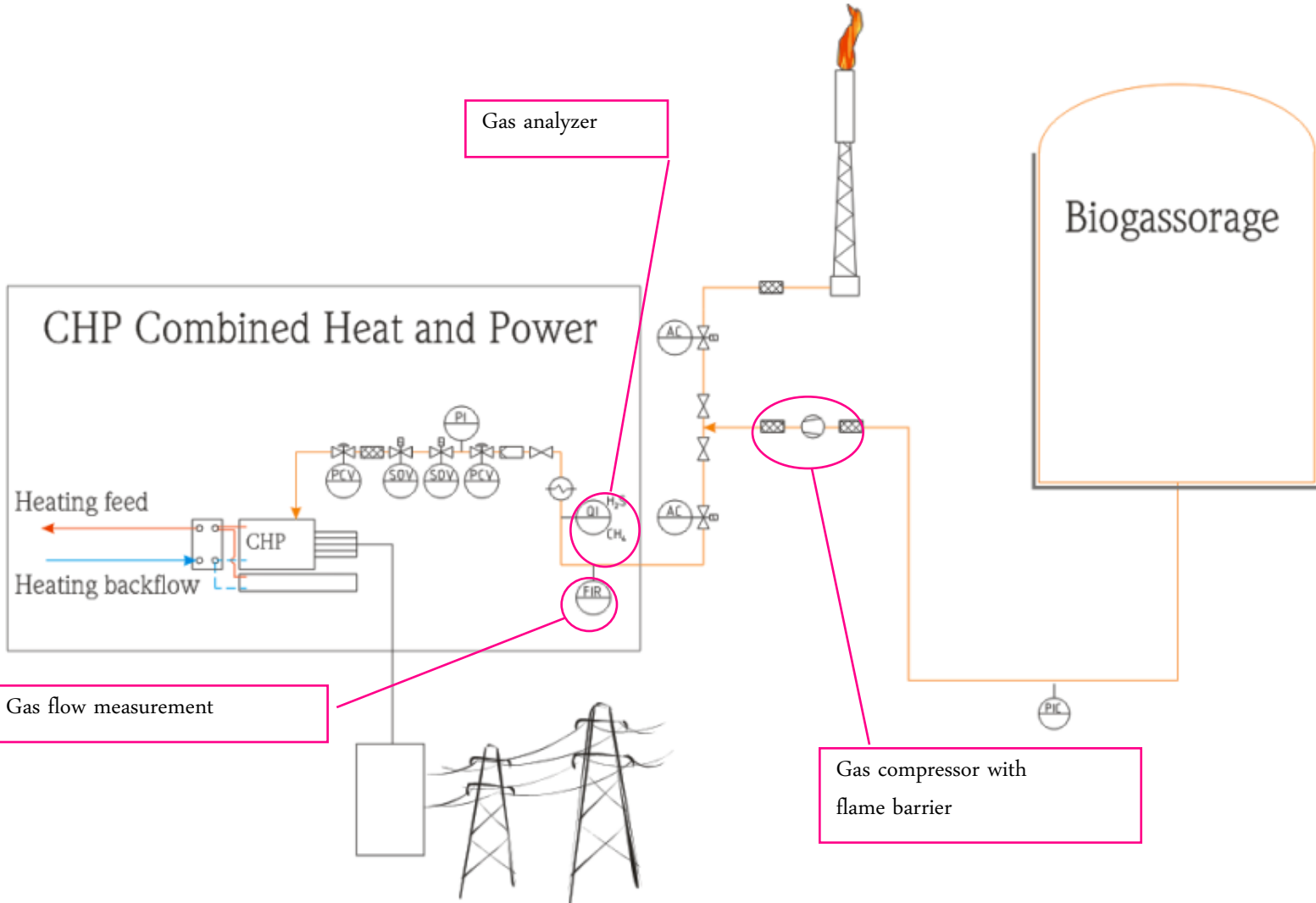
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Flowchart of the value calculation

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Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

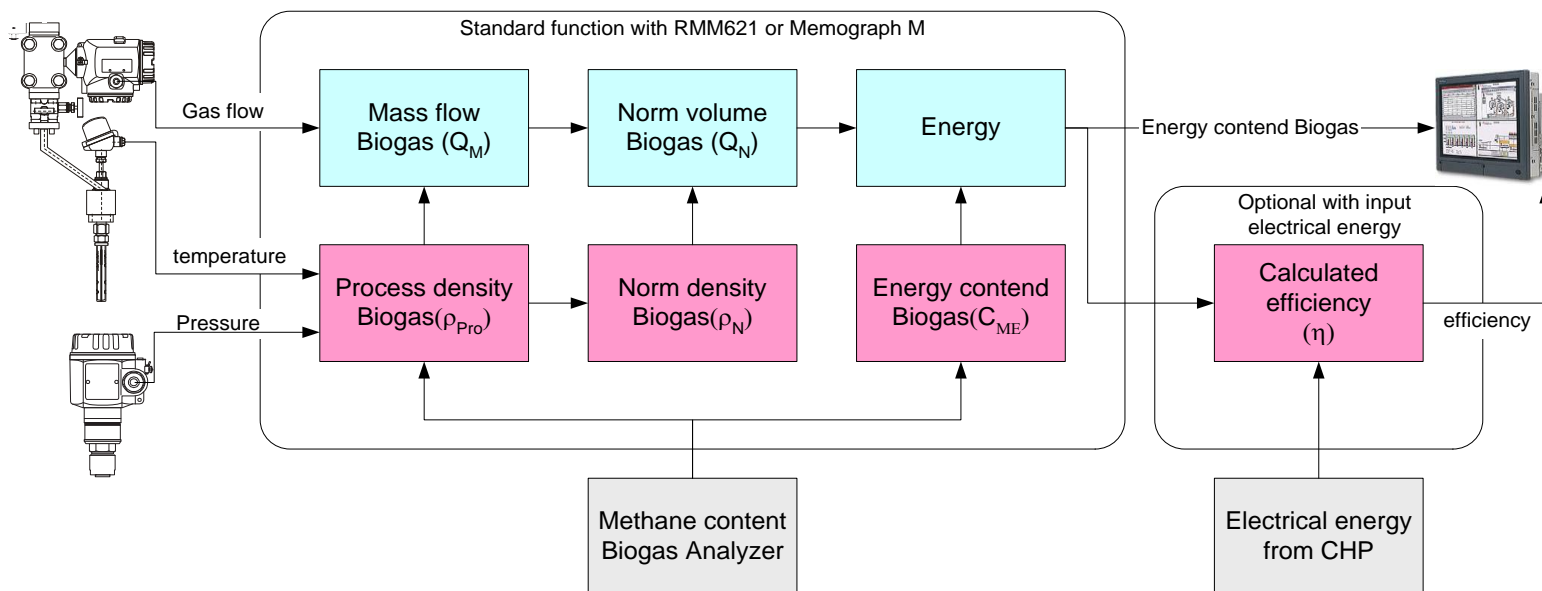
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The Solution package

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Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

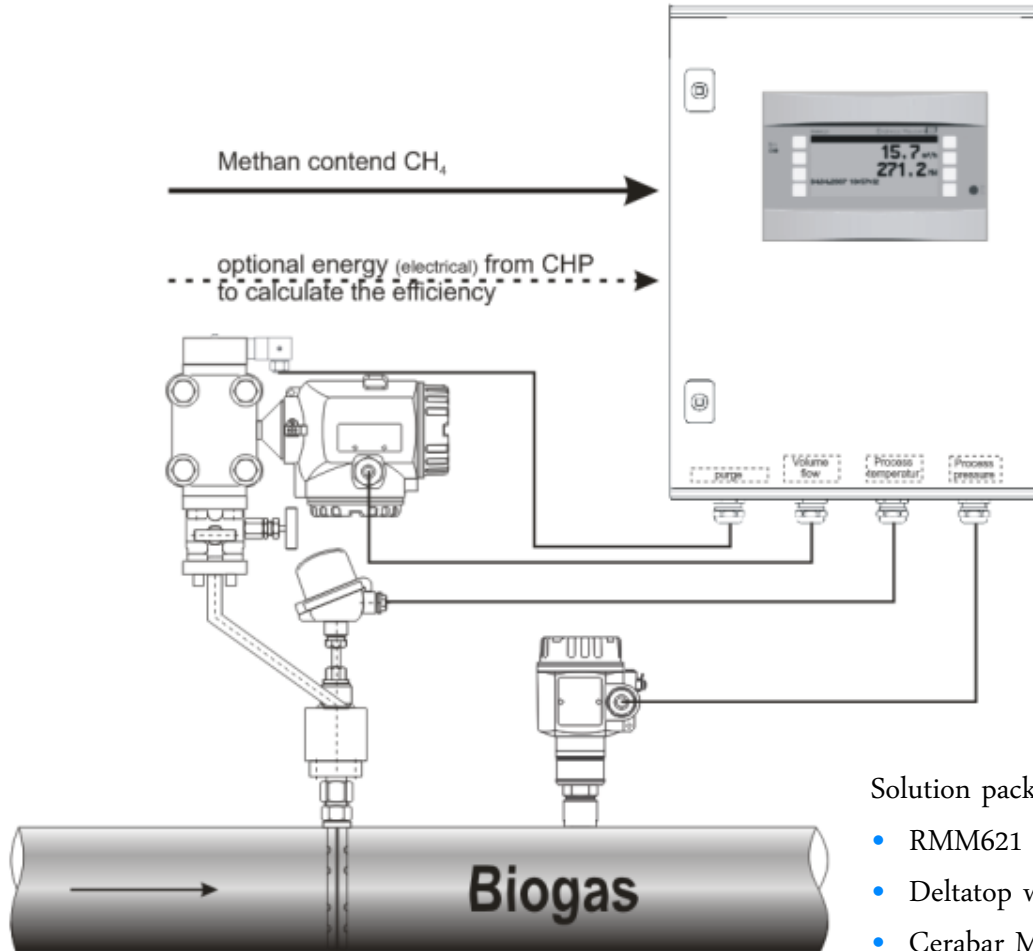
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Solution package with:

- RMM621 or Memograph M
- Deltatop with Deltabar S PMD75
- Cerabar M PMC41
- Measured value from gas analyzer

The Segmentation

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

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RMM621



Memograph M

Mounting	DIN Rail	Panel
Display	160x80 DOT-Matrix	7" TFT
Inputs	<ul style="list-style-type: none"> ■ Analogue (U, I, TC, RTD) ■ Digital (Pulse, Status) 	<ul style="list-style-type: none"> ■ Analogue (U, I, TC, RTD) ■ Digital (Frequency, Pulse, Status)
Outputs	<ul style="list-style-type: none"> ■ Analogue (I) ■ Digital (Pulse, Status) ■ Relays 	<ul style="list-style-type: none"> ■ Analogue (I) ■ Digital (Frequency) ■ Relays
Data storage	512kB	256MB .. 512MB
Interface	<ul style="list-style-type: none"> ■ Ethernet ■ Profibus DP ■ ModBus ■ RS232/485 	<ul style="list-style-type: none"> ■ Ethernet ■ Profibus DP ■ ModBus ■ RS232/485
Additional functions	<ul style="list-style-type: none"> ■ Efficiency calculation ■ Tele alarm 	<ul style="list-style-type: none"> ■ Efficiency calculation ■ Tele alarm ■ Visualization

Measuring principle comparison for Biogas

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

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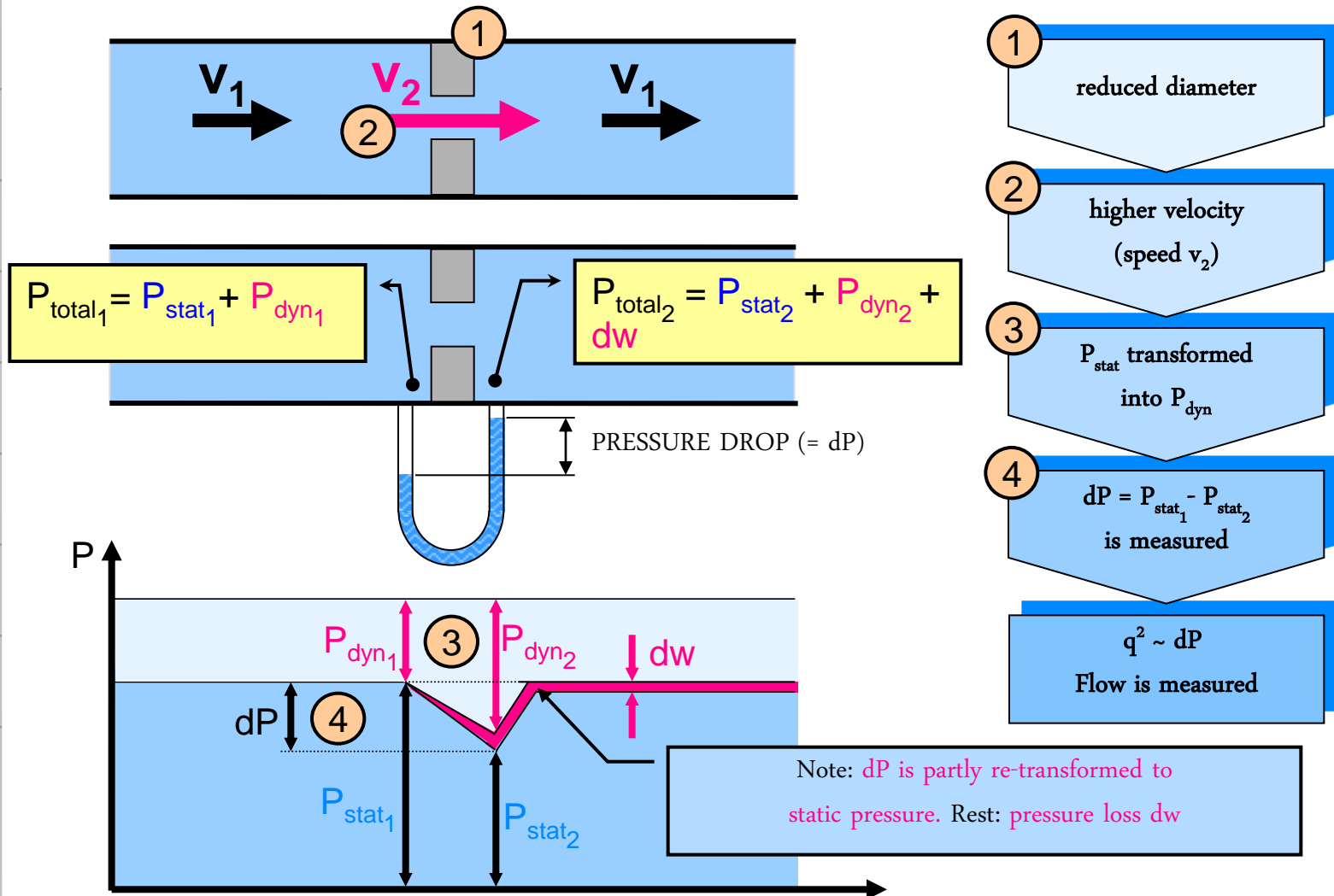
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	Thermal	Orifice	Pitot tubes	Vortex
Pressure drop	low ± 2mbar	average...high	low...average	high
Moisture influence	high	average	low	average
Dynamic	1:100	1:10	1:5 ... 1:10	1:40
Influence of Gas Characteristic (Density, concentration)	yes	average	average	no
Pressure and Temp.-compensation for normalized volume required	no	yes	yes	yes
Nominal Diameter DN	15 ...1500mm	10 ... 1000mm	25 ... 2000mm	15 ...300mm
Upstream length	long	long	average	long

5. Solution with dp-flow Methane measurement

Measuring Principle Orifice plate



Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

Competence in Power &
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W@M – Life Cycle
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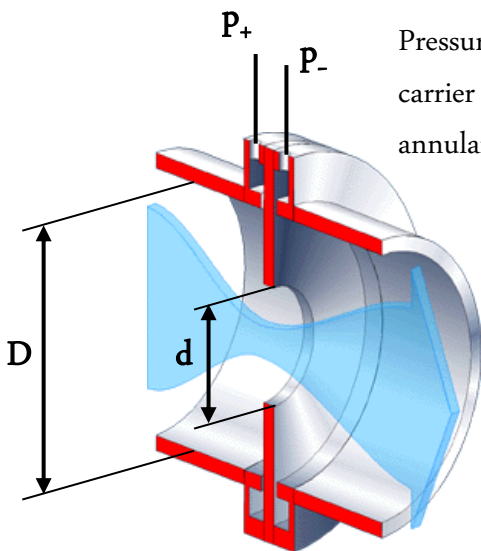
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5. Solution with dp-flow Methane measurement

ISO 5167-1/A1: Orifice plate with corner tapping

The cost-effective standard solution

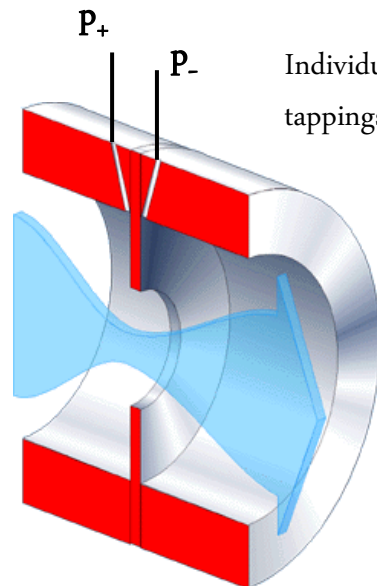


Pressure tapping via carrier ring and annular slot

$$\Delta p = p_+ - p_-$$

$$q_m = K(\beta) \cdot 2\sqrt{\Delta p \cdot \rho}$$

$$q_v = K(\beta) \cdot 2\sqrt{\Delta p \cdot 1/\rho}$$



Individual tapings

Diameter ratio of orifice plate:

$$\beta = \frac{d}{D}$$

5. Solution with dp-flow Methane measurement

Biogas Competence

Biogas energy measurement

CARBOSYS
CDM – Solution

Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

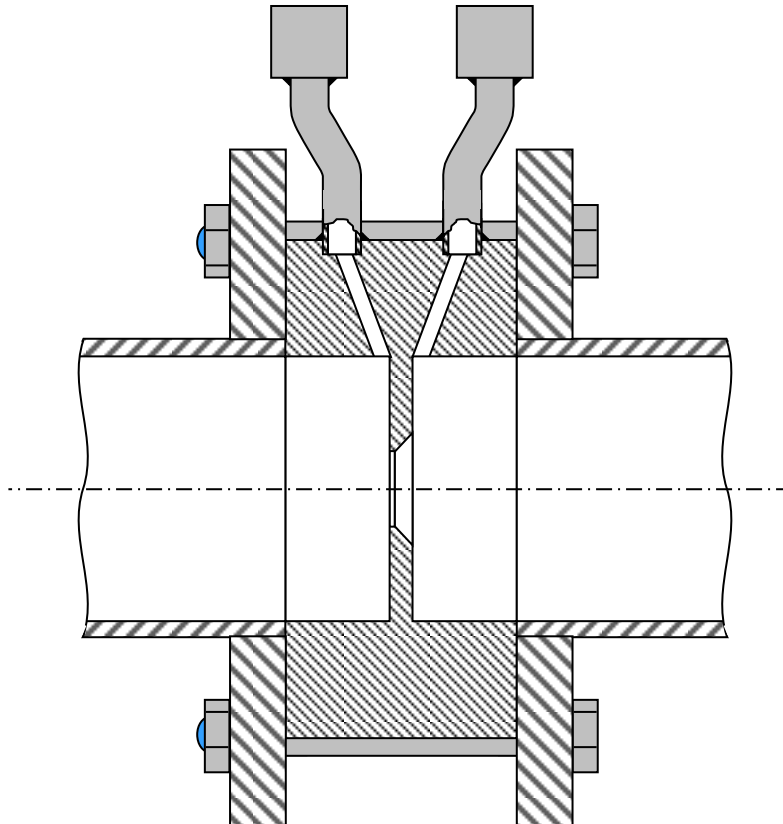
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Management

Undivided orifice with
carrier ring corner taps.

Advantages:

- Cost effective
- According DIN/ISO 5167
- Rugged, only one piece, no internal sealing



5. Solution with dp-flow Methane measurement

Biogas Competence

Biogas energy measurement

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Solar PV energy

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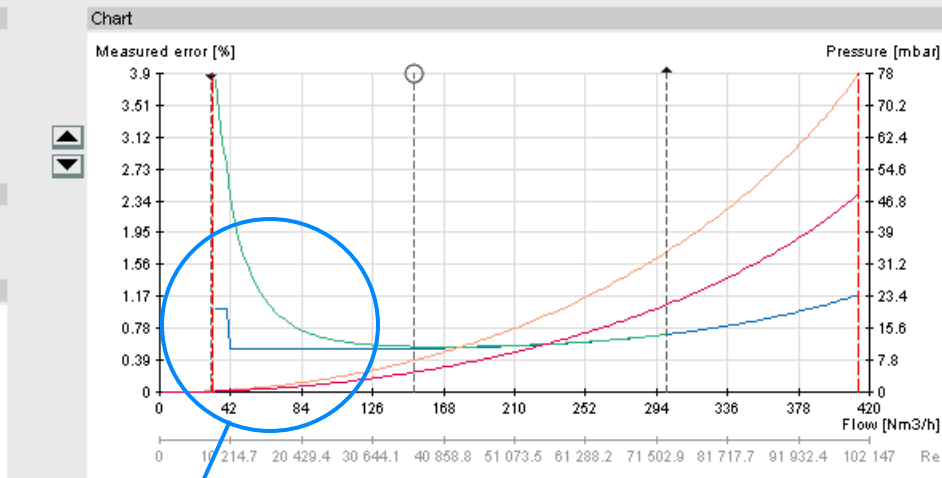
Sizing flow with dp-flow

Applicator Sizing Flow Dimensioning of flowmeters

Choose Applicator Tool

Fluid	 Bio Gas-65%CH4,35%CO2 (Gas)	Pressure	180	mbar_a
Flowmeter	DO61W- Deltatop (DP/O flange tap/orifice flanges)	Temperature	37	°C
Meter/Pipe size	DN 125	Density	0.1804	kg/m3
		Viscosity	0.0134	cP

- Curves
- Uncertainty excl. dp
 - Uncertainty incl. dp
 - Pressure loss
 - Diff. pressure
- Flow limits
- Operating range
 - Requested range
- Legend
- Uncertainty excl. dp
 - Uncertainty incl. dp
 - Diff. Pressure
 - Pressure loss
 - Requested Flow
 - - - - Requested range
 - - - - Min/max operating range



With dp-flow the measurement is according ISO 5167
but underneath minimal flow, the uncertainty is going up.

4. Solution with Vortex Methane flow

Biogas Competence

Biogas energy measurement

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CDM – Solution

Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

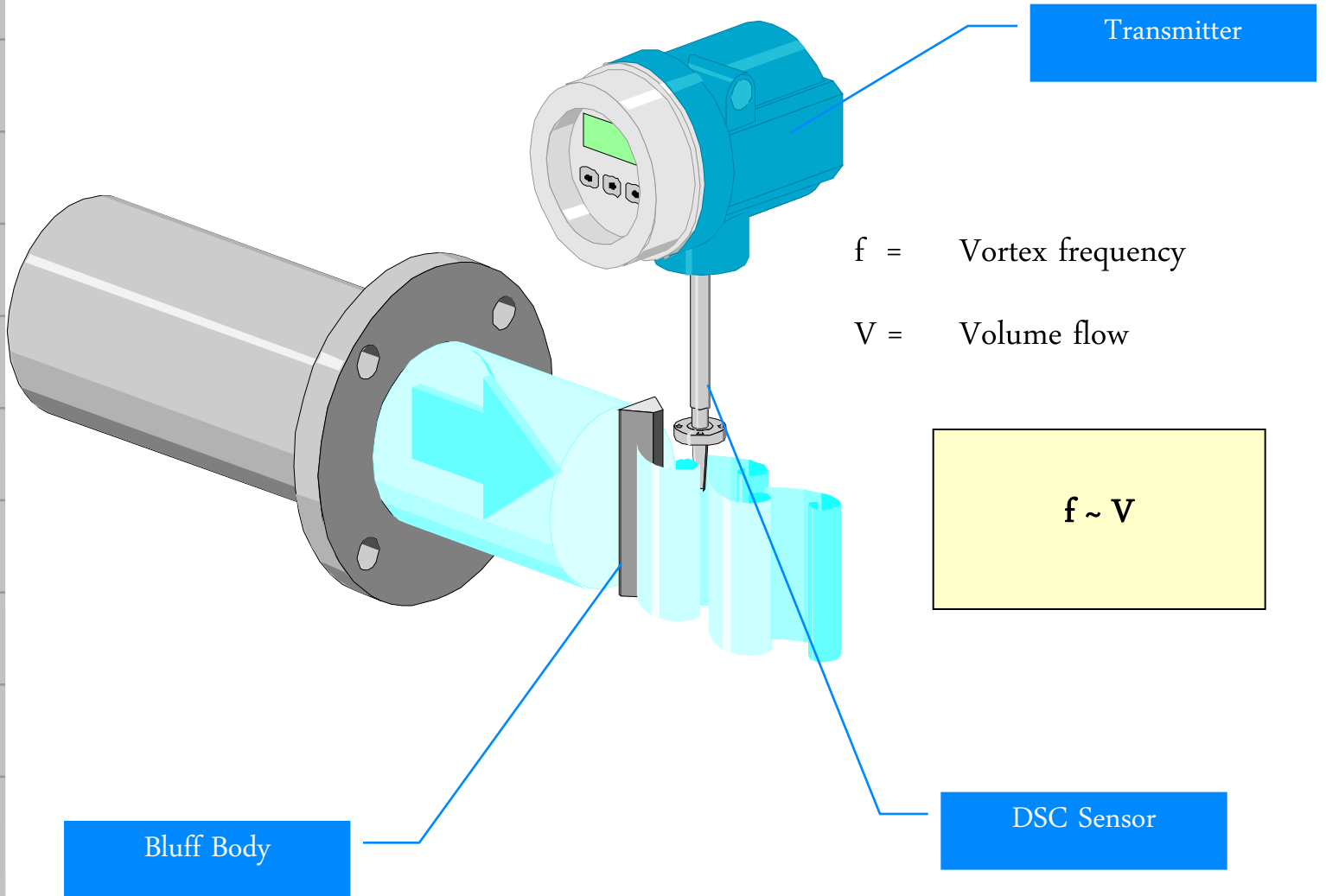
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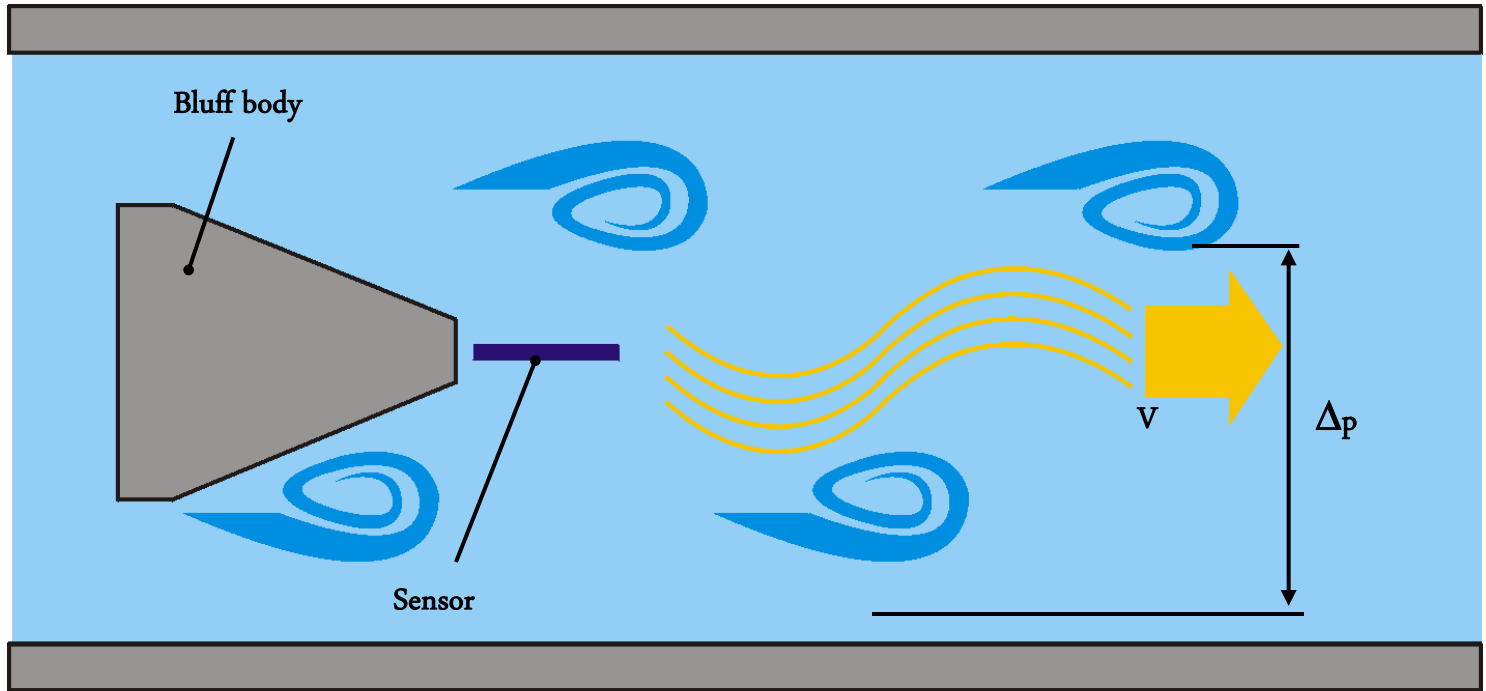
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4. Solution with Vortex Methane flow

Vortex measuring principle



A vortex leads to a pressure difference just behind the bluff body

This is detected with a paddle sensor

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

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4. Solution with Vortex Methane flow

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

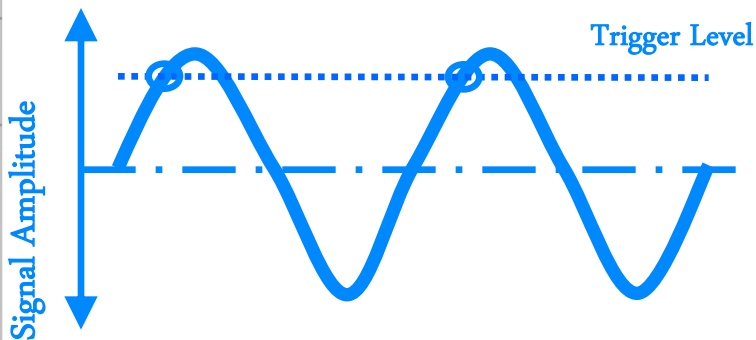
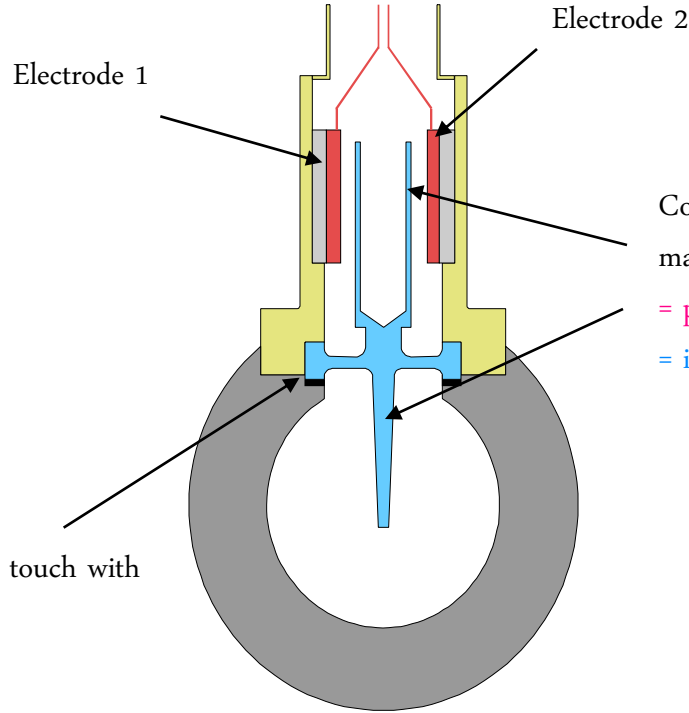
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The movement of the paddle generates sinusoidal voltage change between Electrode 1 and 2

4. Solution with Vortex Methane flow

Biogas Competence

Biogas energy measurement

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CDM – Solution

Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

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Prowirl 72/73 - At a glance

- 4...20 mA / HART®
pulse output PROFIBUS PA / FF
- Ex i / Ex d, CE, NAMUR
- -200...400°C
- up to PN 250 / ANSI class 1500
- Wafer version DN 15...150
- Flanges DN 15...300
- Dual sense available for
redundant measuring
- Accuracy 0.75% for liquids
1.00% for gases



4. Solution with Vortex Methane flow

Sizing flow with Vortex Prowirl 73F

Biogas Competence

Biogas energy measurement

CARBOSYS

CDM – Solution

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Bioethanol Competence


Solar PV energy

Solar thermal power plant

Competence in Power & Energy

W@M – Life Cycle Management

Process data

Fluid	 Bio Gas-65%CH ₄ ,35%CO ₂ (Gas)
Flowmeter	73F - Prowirl (VFM)
Meter/Pipe size	DN 80

Pressure	180	mbar_a
Temperature	37	°C
Density	0.1804	kg/m ³
Viscosity	0.0134	cP

Curves

Measured error Vol.

Pressure loss

Flow limits

Operating range

Requested range

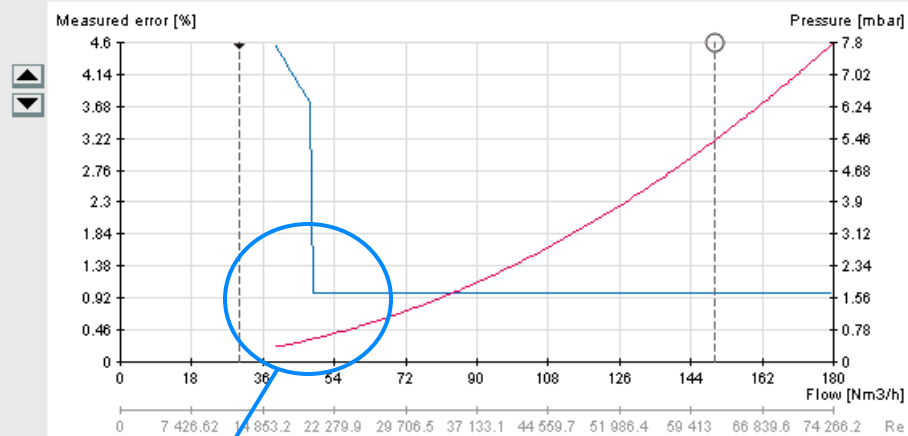
Legend

— Measured error Vol.

— Pressure loss

- - - Requested Flow

Chart



Underneath the minimal flow, Vortex does not measure

Application landfill gas measurement

Biogas Competence

Biogas energy measurement

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Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

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RMM621 in the separate housing
for panel mounting.



Application landfill gas measurement

Biogas Competence

Biogas energy measurement

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CDM – Solution

Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

Competence in Power &
Energy

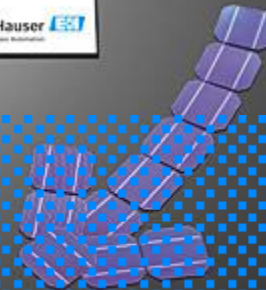
W@M – Life Cycle
Management



- The gas flow is measured by differential pressure with orifice
- Compact power plants based on Land fill gas burning
- About 100 sides in Australia
- Government is paying carbon credits if sustainable CH_4 is turned into CO_2
- The carbon credits provide about 30% of the revenue for the operator, so the accuracy is very important.



The power of sustainable solutions.



Level



Pressure



Flow



Temperature



Liquid Analysis



Registration



Systems Components



Services



Solutions

CARBOSYS CDM – Solution

CDM = Clean Development Mechanism

1. General Information CDM

Biogas Competence

Biogas energy measurement

CARBOSYS
CDM – Solution


Biodiesel Competence

Bioethanol Competence

Solar PV energy

Solar thermal power plant

Competence in Power &
EnergyW@M – Life Cycle
Management

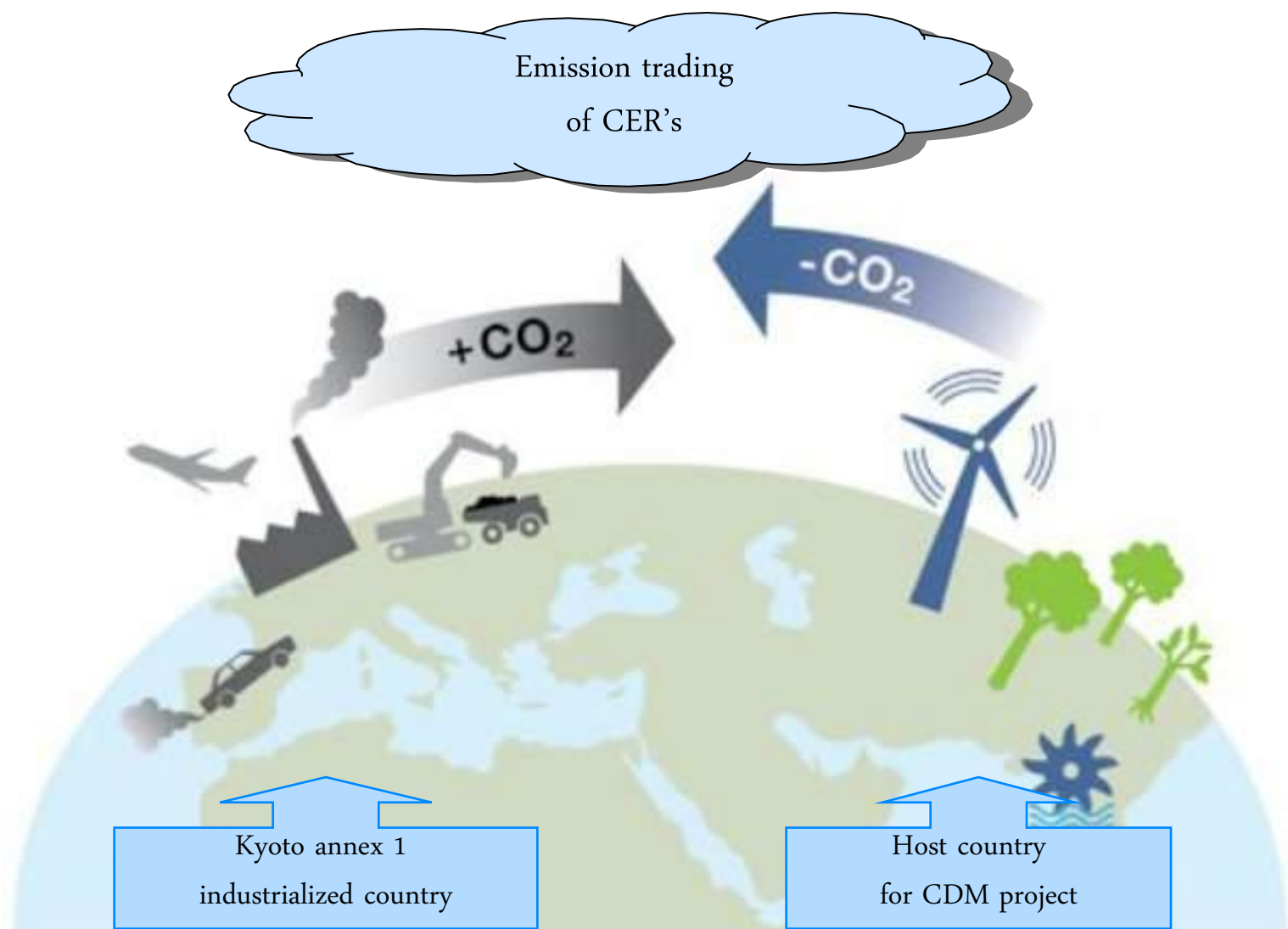
- The Kyoto protocol is a protocol from the [UNFCCC](#)  (United Nations Framework Convention on Climate Change), which describes the international target to the stabilization of greenhouse gas concentrations (GHG) in the atmosphere at a level that would prevent a dangerous “man-made” interference within the climate system.

Per definition, Methane is a 21 times stronger GHG than CO₂

Some governments desired flexibility in the way that emission reductions could be achieved and proposed international emissions trading as a way of achieving cost-effective emission reductions. The purpose of the CDM was defined under article 12 of the Kyoto Protocol.

1. Basics: General Information CDM

How the CDM system is working



Biogas Competence

Biogas energy measurement

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Bioethanol Competence

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Solar thermal power plant

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1. General Information CDM

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How the CDM system is working

Biogas energy measurement

Project development

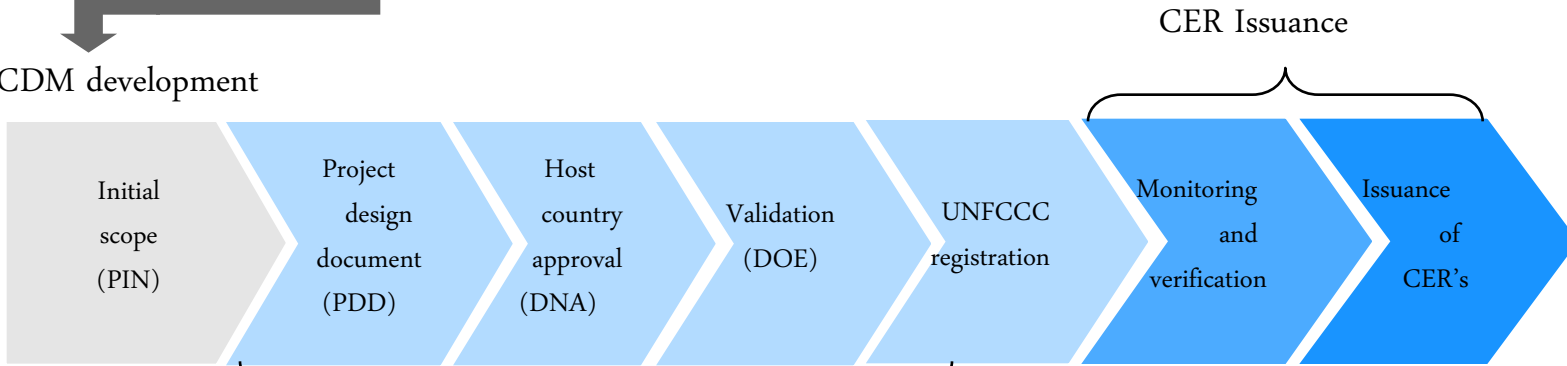
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Abbreviation:

PP	Project Participant
DOE	Designated Operational Entities
EB	Executive Board
DNA	Designated National Authority
COP	Conference of Parties
MOP	Meeting of Parties
AE	Applicant Entity
CER	Certified Emission Reduction

1. Basics: CDM, how to get CER's ?

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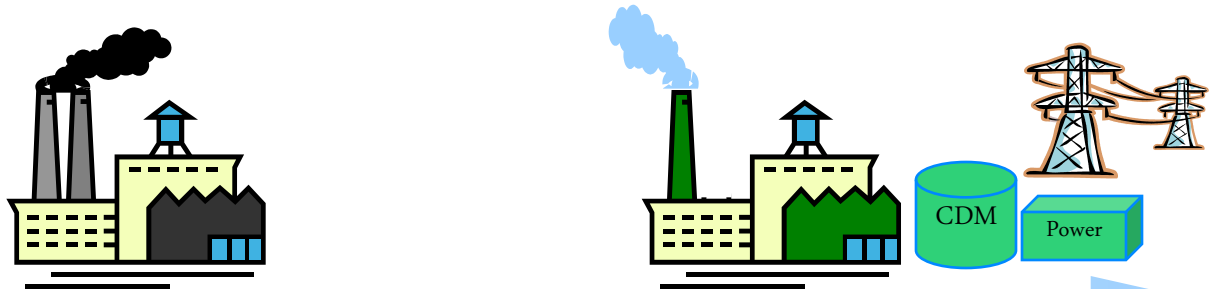
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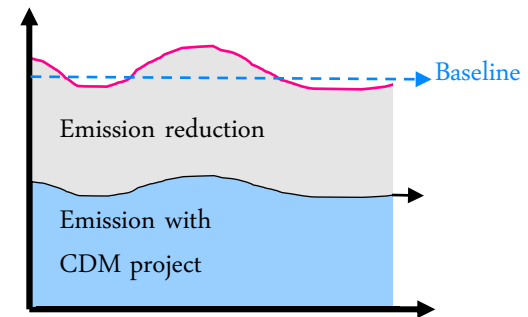
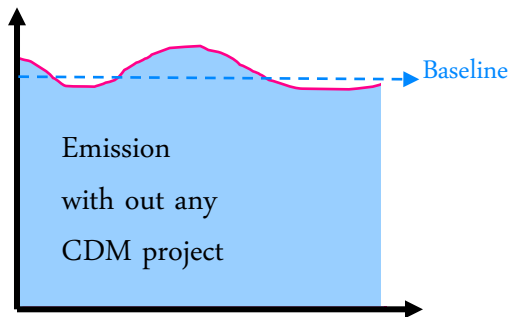
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CDM project development



2. What are the drivers for CDM investors?

On the example of a PDD:

- Fossil fuel replacement with Methane capture from anaerobic digestion of bio waste.

The solution has to be:

- As efficient as possible
- Easy and fast to implement
- Lowest risk in CDM validation process
- Fastest return of investment
- Traceability
- Durable to ensure the verification after years of operation

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2. What are the drivers for CDM investors?

There are different ways to build a Biogas plant



The simple way without any technology...

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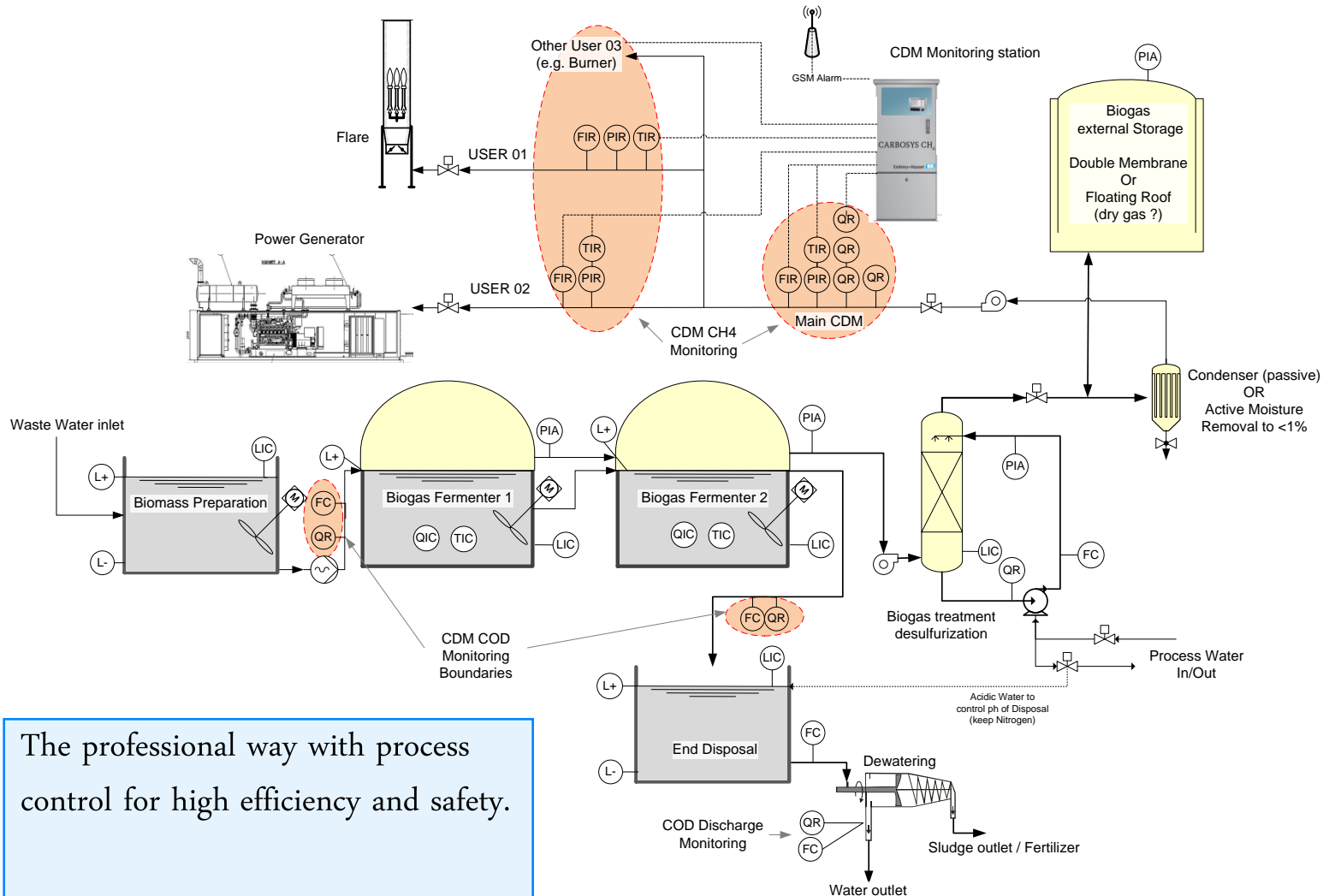
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2. What are the drivers for CDM investors?

There are different ways to build a Biogas plant



The professional way with process control for high efficiency and safety.

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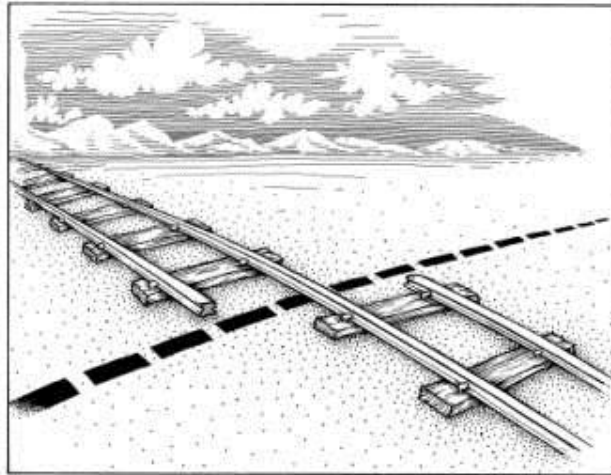
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2. What are the drivers for CDM investors?

Of course, there are many other ways within building a Biogas plant, but there is not much flexibility in the way of engineering a CDM project.



How a system integration should not look like!

Our competence and our solutions will help to implement the CDM Biogas projects much faster and doubtless proven.

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3. Focus on Methane flow and CDM monitoring

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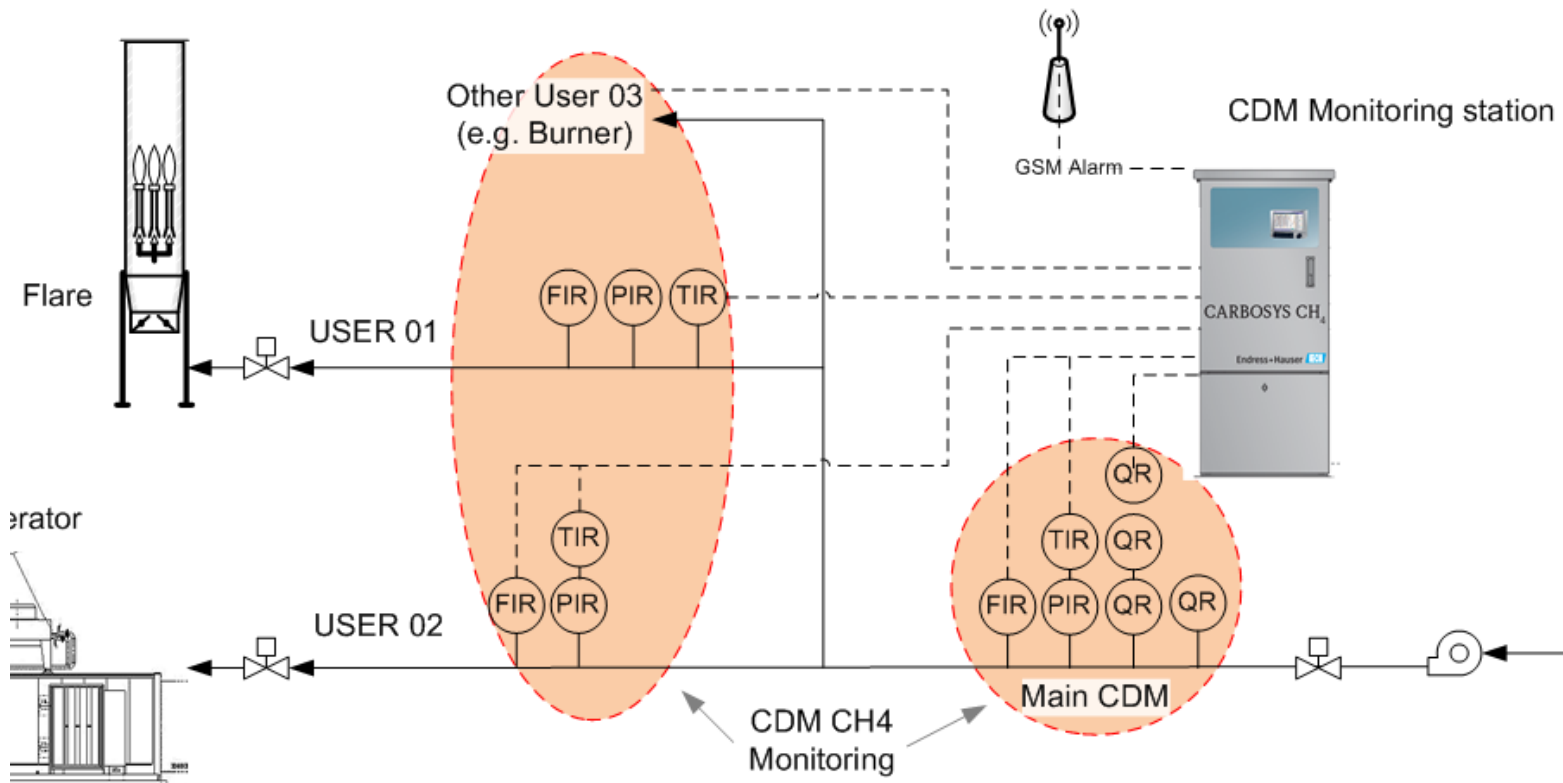
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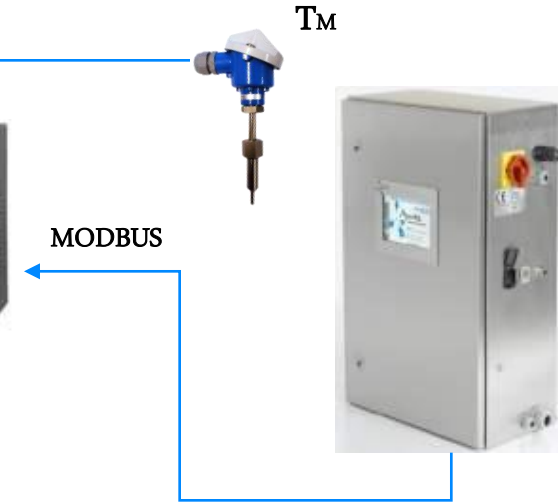
4. Solution with Vortex Methane flow

Complete calculation inside Memograph M

Humidity: If the Biogas is water saturated Temperature is = °C dew point



Volume Flow Q_v
Pressure P
Temperature T



Gas composite measurement
- Methane %V dry gas
- CO₂ %V dry gas

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5. Solution with dp-flow Methane measurement

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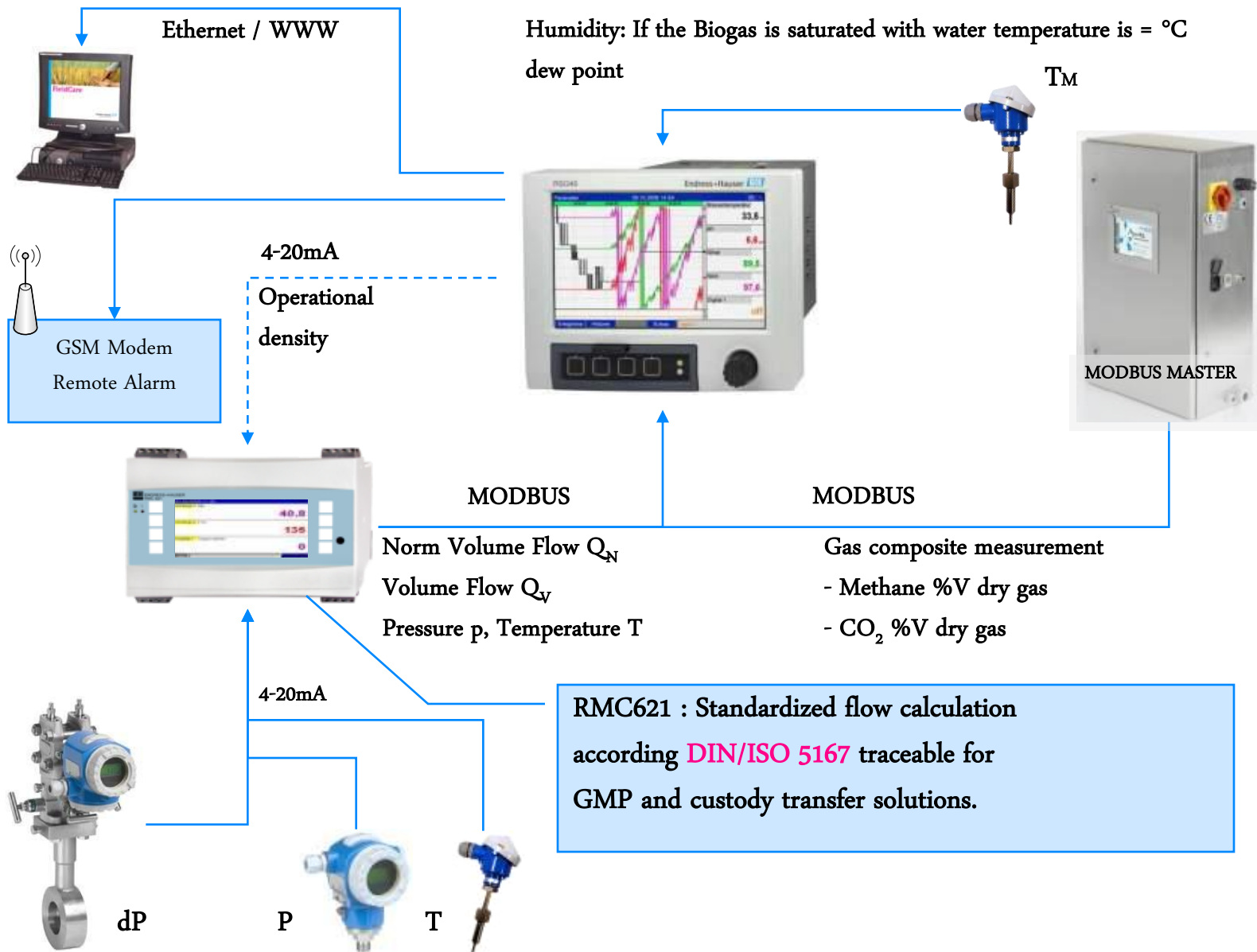
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6. The CDM Monitoring Solution

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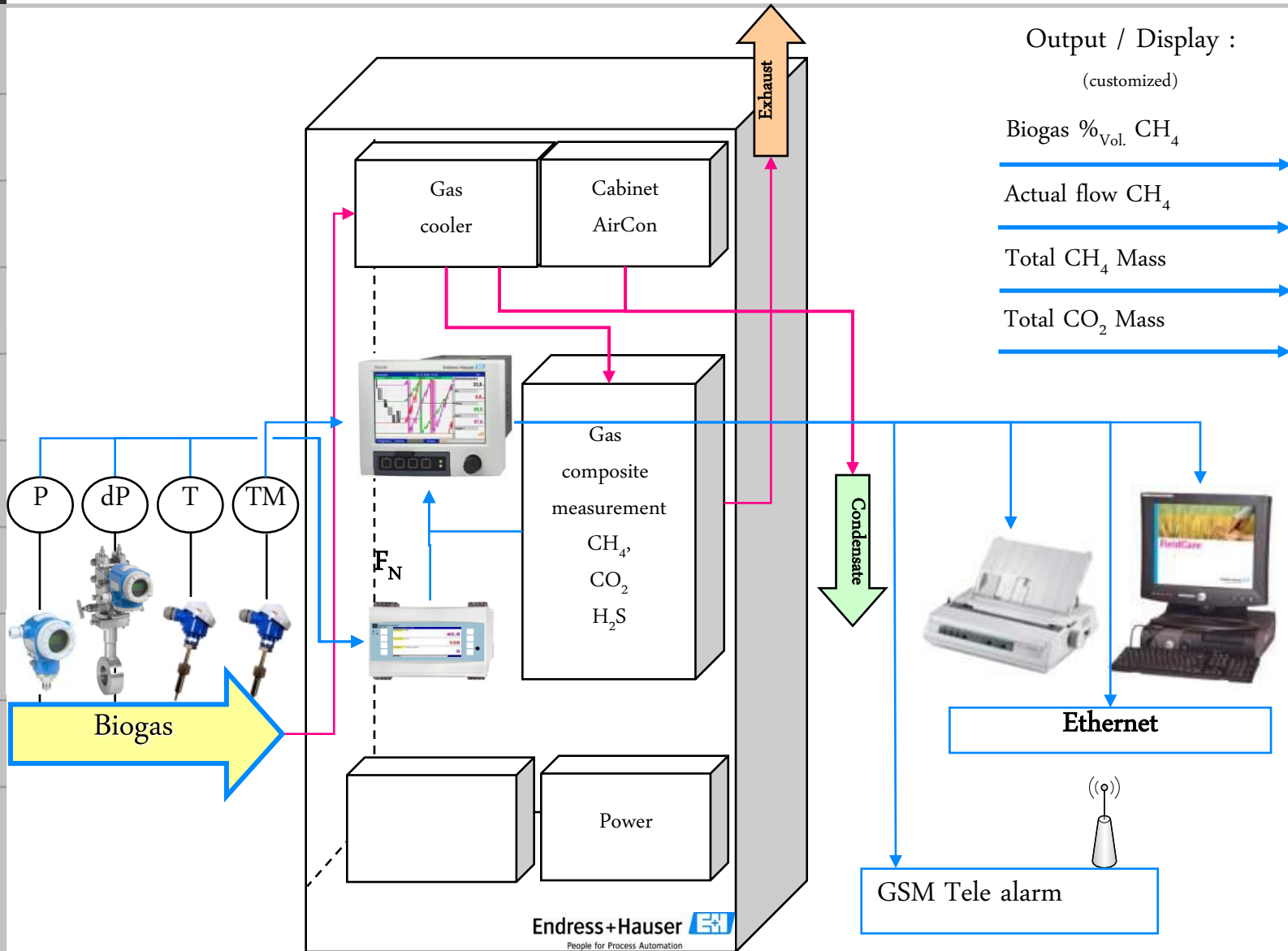
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7. Accuracy is important

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CARBOSYS CH₄

Is a fully integrated system, build in an air conditioned cabinet with Memograph, gas composition measurement and gas humidity measurement.

The solution is engineered with a safety concept for hazardous areas and highest availability.

Each solution will be sold together with the needed gas flow measurements.

Accuracy is important:
Each % accuracy loss will cause
3000-7000 EUR loss/a of CER's

Our max. uncertainty is 4.09% at the standard unit, with auto cal of gas composition measurement we reach <2.5%



Patent and name
declaring is in progress

8. Customer benefits at a glance

Customer added value:

Fast ROI: Optimized project timing due to complete solution package with CDM compliant documentation.

Easy: Preparation of PDD with pre-engineered and customized parameter, SOPs and documentation.

Safety: Data Manager provides safety for all recorded data against loss and manipulation.

Services: Competent and long term sustainable service for traceable field-recalibration and documentation during the CDM validity period.



Patent pending

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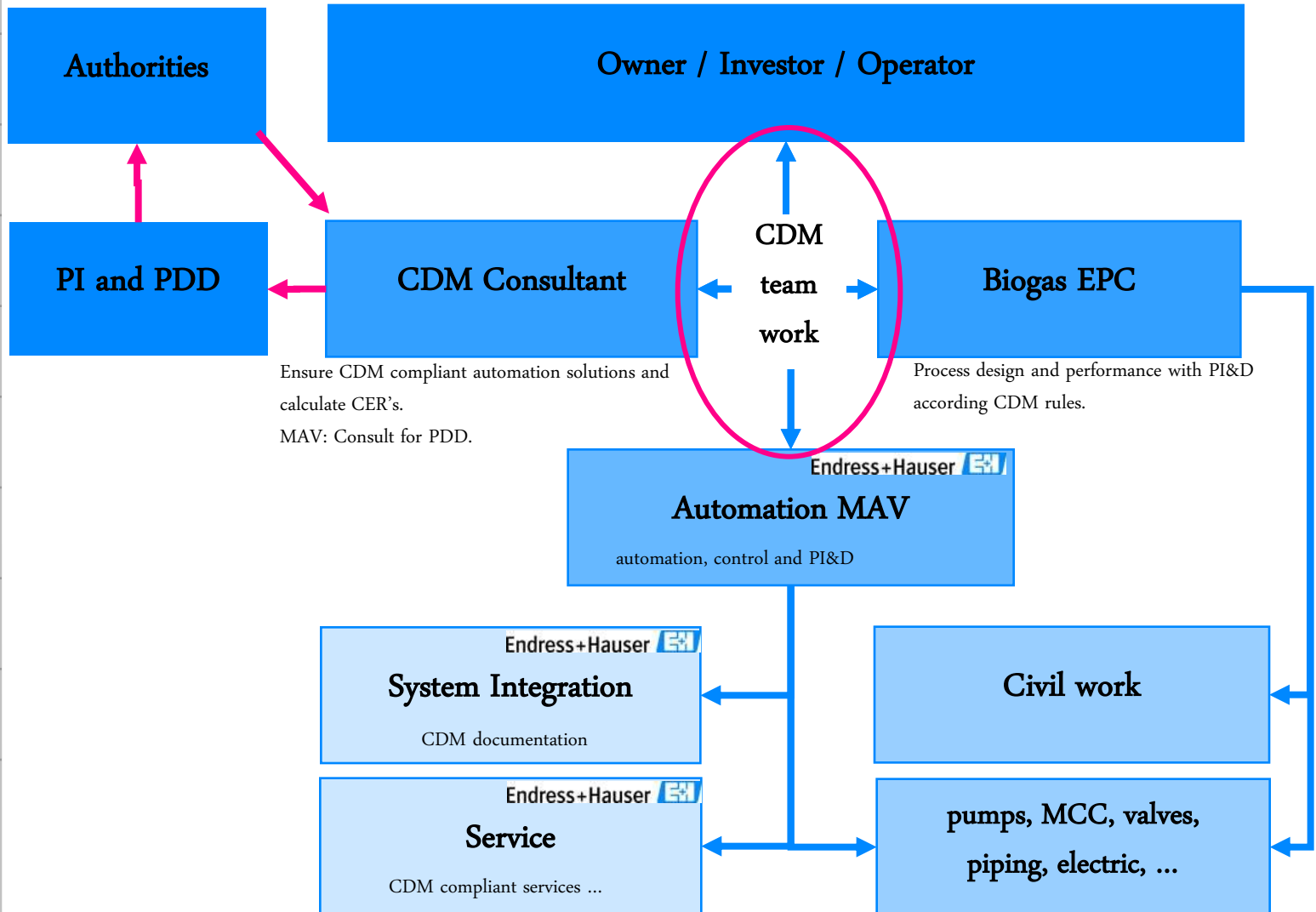
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9. CDM project structure



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