Process Analytics Optimizes Advanced Biofuel Production Processes

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Biofuels market

Make use of biomass and renewables
for a decarbonized energy future

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The world is growing and yet needs to become sustainable
A balancing act with opportunities along traditional and new paths

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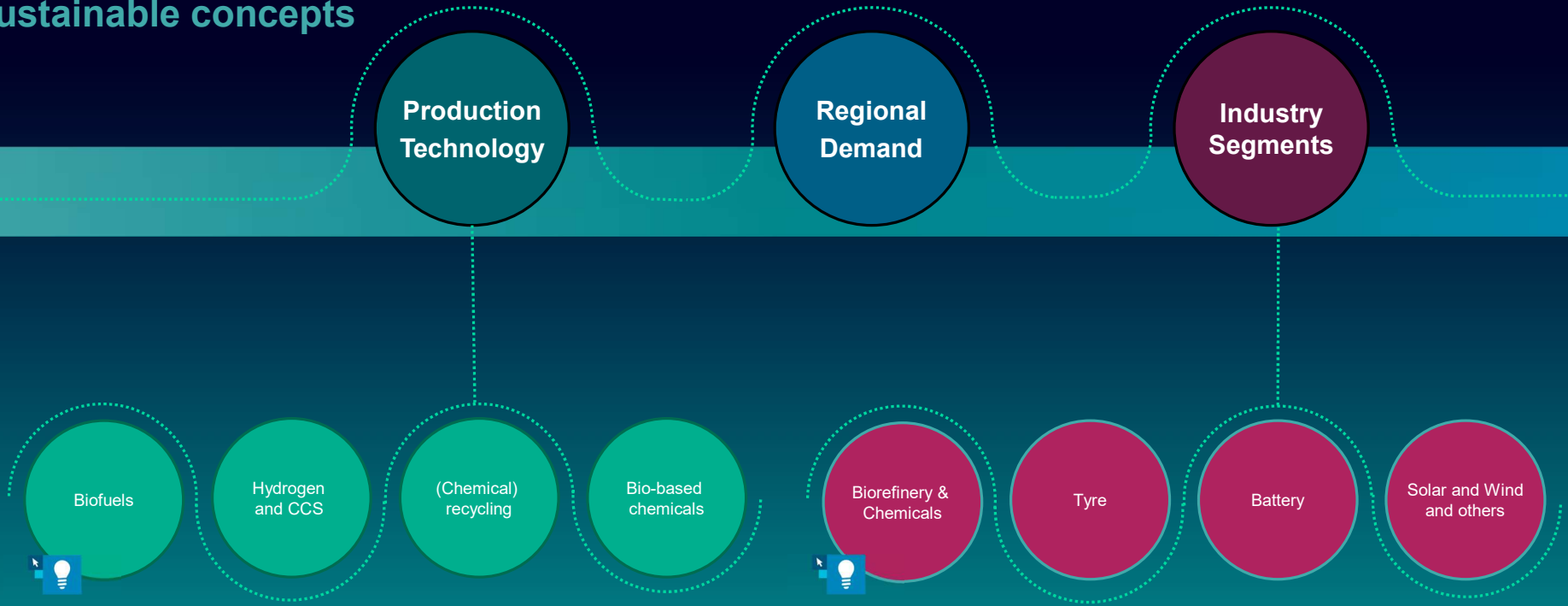
Emerging markets trends for Process Instrumentation and Analytics

Sustainable concepts



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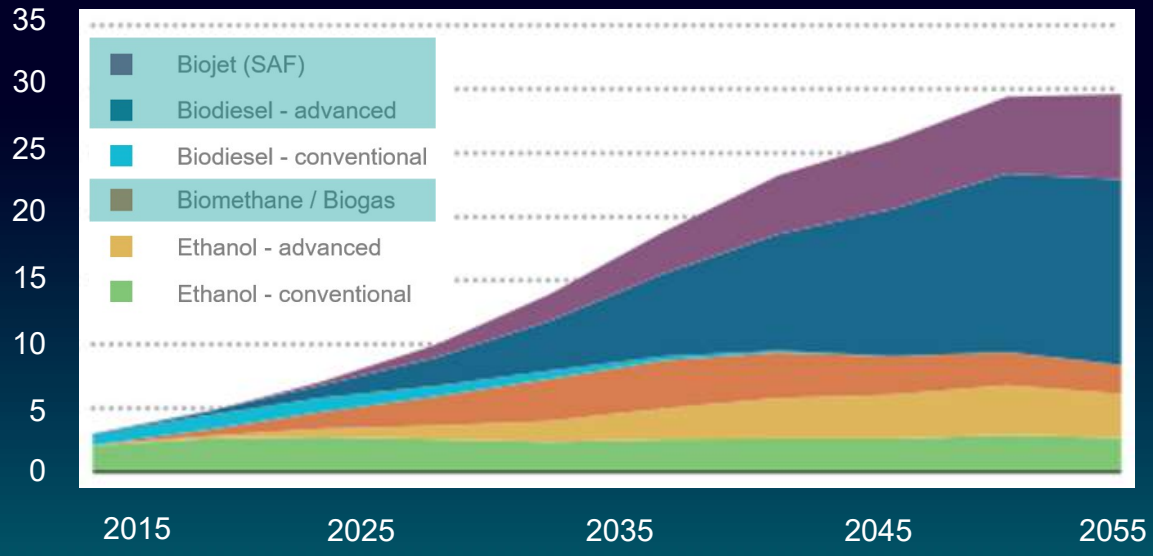
Biofuels final transport energy demand by fuel type
IEA 2DS Scenario



Note: Conventional biodiesel refers to crop-based FAME biodiesel; advanced biodiesel refers to a range of advanced biofuels suitable for use in the diesel pool.

Source: IEA_Technology_Roadmap_Delivering_Sustainable_Bioenergy.pdf

- Major growth by liquid fuels such as **biojet** and **advanced biodiesel** due to better GHG performance
- The role of **biomethane** is likely to expand where fossil compressed natural gas (CNG) and liquefied natural gas (LNG) vehicles are available.
- Geographically, a more diverse use of biofuels for transport with much more **regional balance**.

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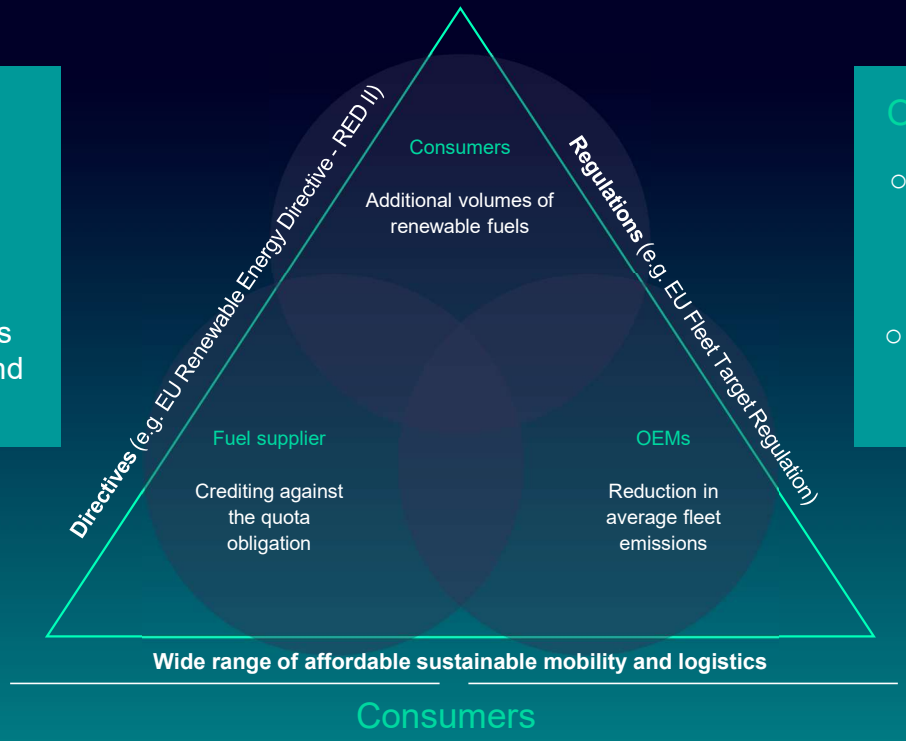
Motivation to renewable fuels for producers and investors
Functionality of crediting scheme

Fuel suppliers

- Compensation of GHG reduction obligations from government agency
- Significant factor in refinery profits based on the current tax credit and the average national fuel price



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- Finance additional renewable fuels and receive respective credits from the government
- Achieve true emission savings by a voluntary crediting scheme

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Process Analytical Technolgies

General application aspects for biofuel producers

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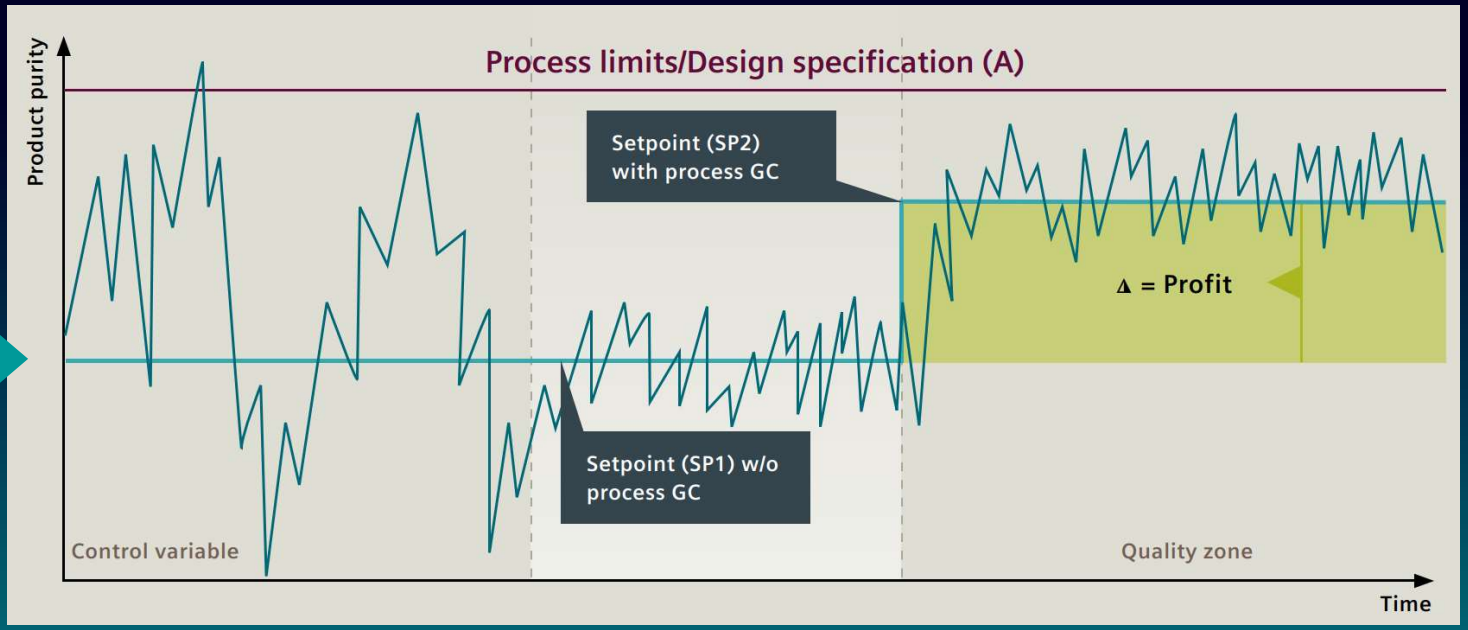
Why to use online process analyzers?
Run chemical processes at the economic optimum by using process analytics

- Guarantee quality
- Increase throughput
- Minimize energy



React fast to process changes and avoid to get “out of spec.” !

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Process Analyzer Technologies & application fields

- Process control
- Quality control
- Safety monitoring
- Environmental protection
- Fiscal purposes

IR Spectroscopy	**UV-VIS** Spectroscopy	**Laser** Spectroscopy
MS Spectroscopy	**GC** Chromatography	**TCD** Thermal conductivity
Moisture Various	**FID** Ionization	**O_2** Magnetic behavior

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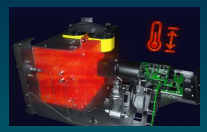
Siemens MI offers a portfolio for a wide range of applications in biofuel related industries

Continuous Gas Analysis

SIPROCESS GA 700 – One platform, many combinations
The modular system can accommodate up to two modules in one housing: Wall mounting, or 19" rack housing

OXYMAT 7
Paramagnetic
Safety-relevant O_2
Measurement

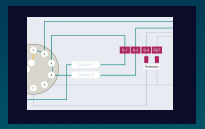


CALOMAT 7
Thermal
Conductivity
H_2 Measurement

ULTRAMAT 7
NDIR
CO, CO_2, CH_4,
SO_2, NO etc.

Online Gas Chromatography

MAXUM ed II
Flexible, energy saving oven concepts, parallel chromatography using multiple single trains as well as a wide range of detectors.



Online gas chromatography for diverse applications for **multicomponent analysis** of **gaseous** and **liquid process streams**

H_2, He, N_2, O_2, Ar, CO, CO_2, C_1 – C_6…C_{20} hydrocarbons (saturated, unsaturated), H_2S, COS, Mercaptans, Methanol, Ethanol, Acetone, Ethers and Aldehyse, Water, Ammonia, etc.

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Biofuel processes

Pathways to superior sustainable fuels

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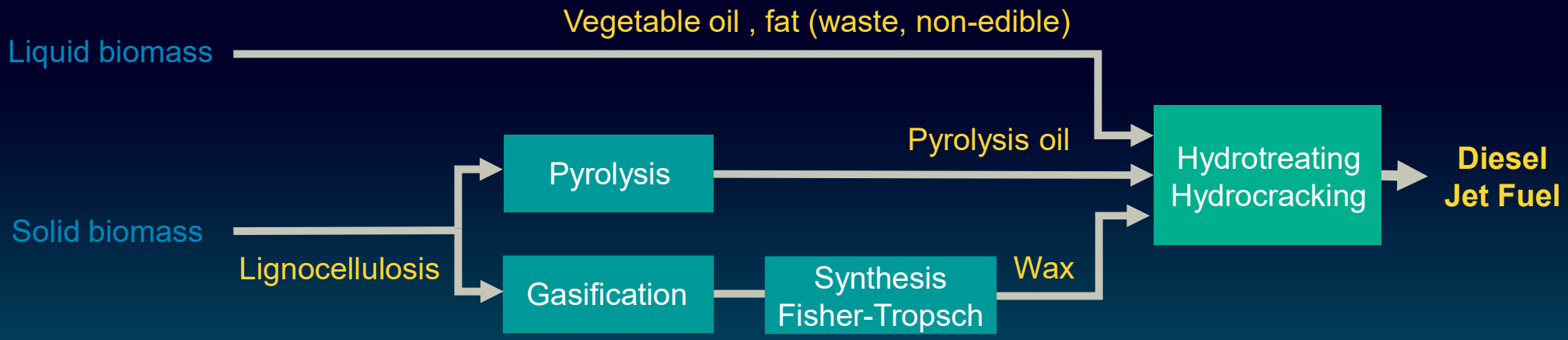
Bio Jet & Biodiesel: 2nd generation approach
Industrial pathways to superior sustainable fuels



Other pathways:

Traditional refineries	crude oil / natural gas / coal chemical based	GHG intensive
1st generation biofuels	via edible crops/ food (e.g. esterification)	competing with the food chain
Carbon neutral synfuels	via electrolysis of „green“ electrical power & water	other decarbonized channel

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Liquid biomass pathway – HVO diesel
Analyzer measuring points

GC measuring points at HVO hydrotreater

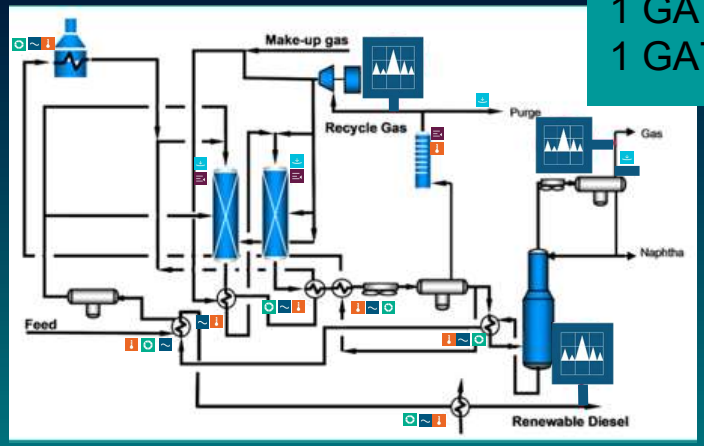
H_2 recycle after treatment – option 1
Measurement: Fast H_2

H_2 recycle after treatment – option 2
Measurement: H_2, C_1–C_{6+} and H_2S

Stabilizer column off gas
Measurement: H_2, CO, CO_2, C_1–C_{6+} and H_2S

Diesel product (optional)
Measurement: Total Sulfur
(alternatively to UV technology)

Analytics package 1 (new hydrotreater)
2 MAXUM GCs



Analytics package 2 (Option: *Grey H2 plant*)
1 CEMS
5 Others (NIR/ FTIR, Mol. Weight, 1 O_2 in-situ)

(Option: Green H2 plant)
1 GA700 CALOMAT
1 GA700 OXYMAT

Gas Analyzers
Gas Chromatographs
Flowmeters
Weighing
Positioners
Pressure
Temperature
Level

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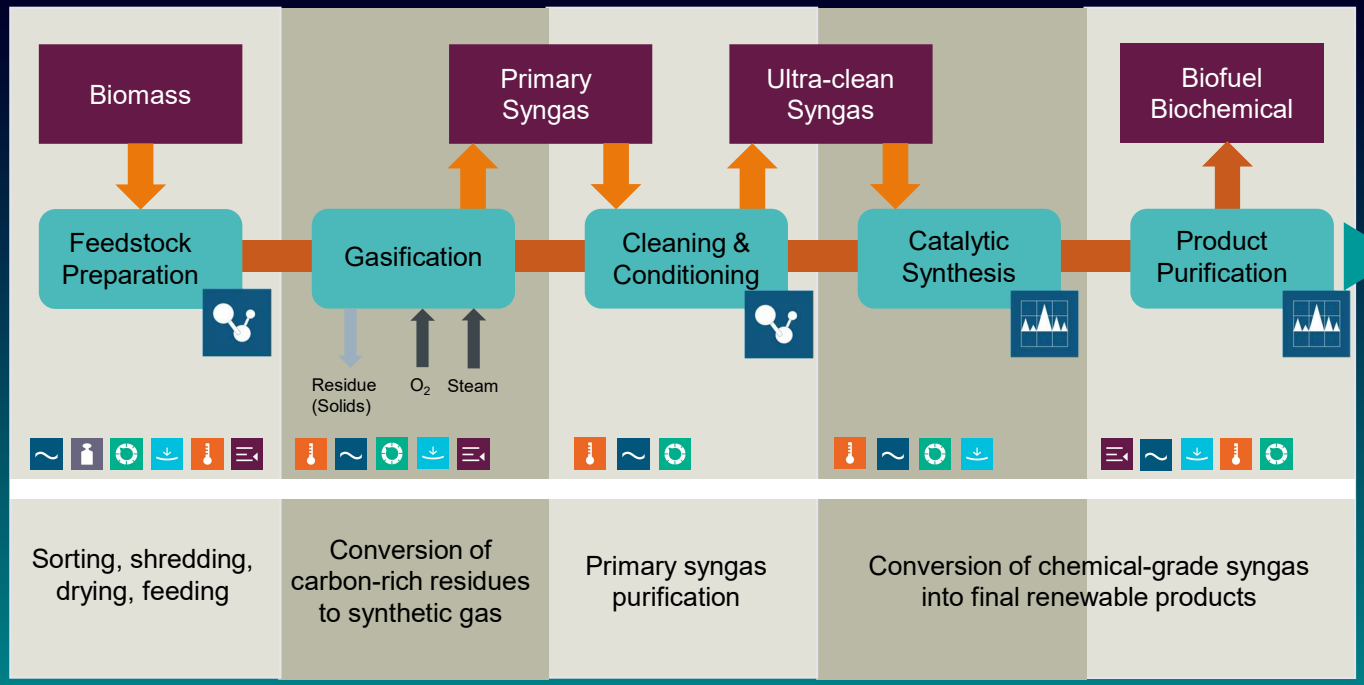
Lignocellulosis pathway via gasification and FT synthesis – BioTFuel diesel
Analyzer measuring points



Process section	Measuring point	Analysis	Recommended analyzer
Feedstock	Biomass silo safety	CO	Ultramat 23
Cleaning & Conditioning	Raw gas after quenching	CO, CO_2, H_2	GA700 U7/ C7
Cleaning & Conditioning	Synthesis clean gas after CO_2 scrubber	CO, CO_2, H_2	GA700 U7/ C7
Catalytic synthesis	Raw methanol	CO, CO_2, H_2, N_2, CH_4, MeOH	MAXUM Ed. II Stream 1
Catalytic synthesis	Synthesis gas fine cleaning	CO, CO_2, H_2, N_2, CH_4,	MAXUM Ed. II Stream 2
Product purification	Product quality MeOH	CO, CO_2, H_2, N_2, CH_4, MeOH	MAXUM Ed. II Stream 3

- Gas Analyzers
- Gas Chromatographs
- Flowmeters
- Weighing
- Positioners
- Pressure
- Temperature
- Level

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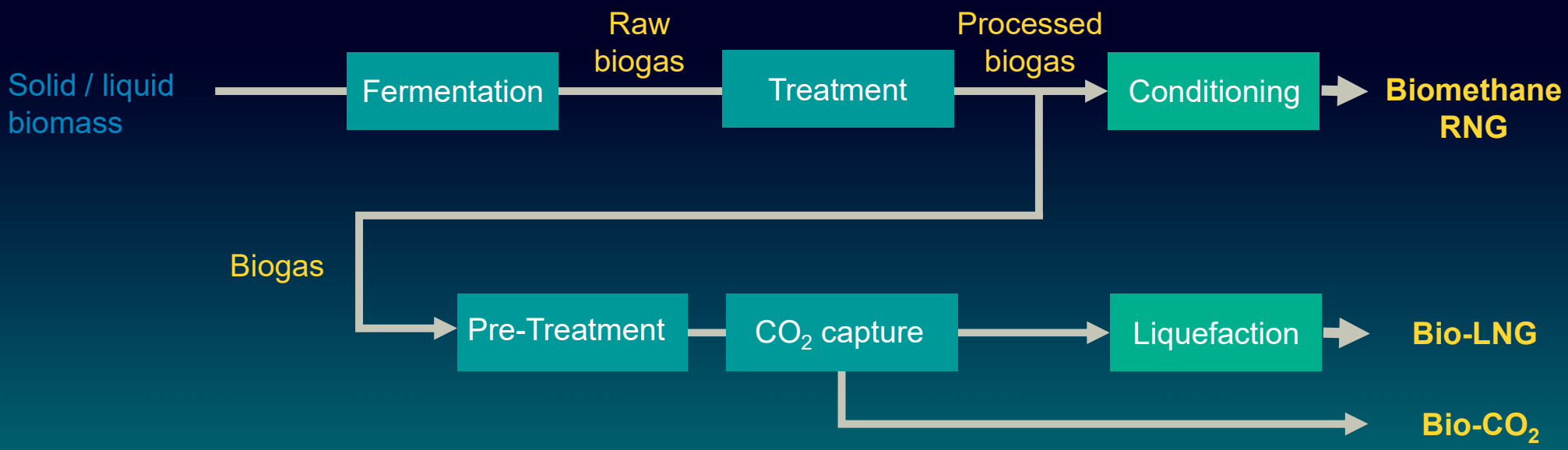
Biomethane & Bio-LNG approach
Industrial pathways to superior sustainable fuels



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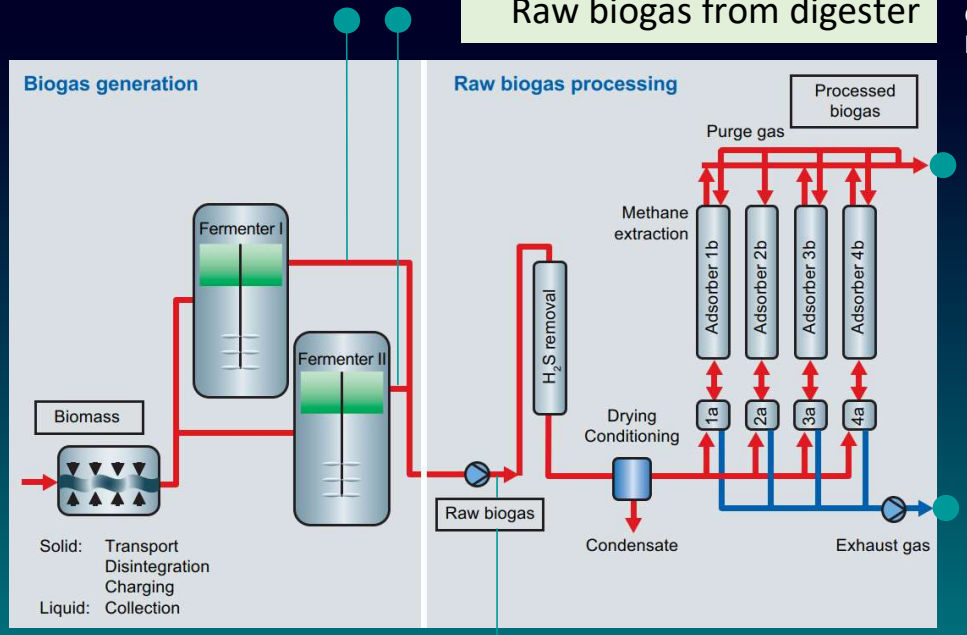
Biogas / Biomethane pathway
Conversion route from biogas to processed RNG

CH_4
CO_2
H_2O
O_2
H_2S



GC - MAXUM
Raw biogas from digester

CH_4 % level
CO_2
H_2O
O_2
H_2S ppm level

CGA
U23 / Trace O2 & H2O
RNG product gas

CH_4 % level
CO_2
H_2S ppm level

CGA - U23
Off-spec gas to flare

CH_4 % level
CO_2
H_2S ppm level

CGA - U23
Biogas from field compressors

CH_4 % level
CO_2

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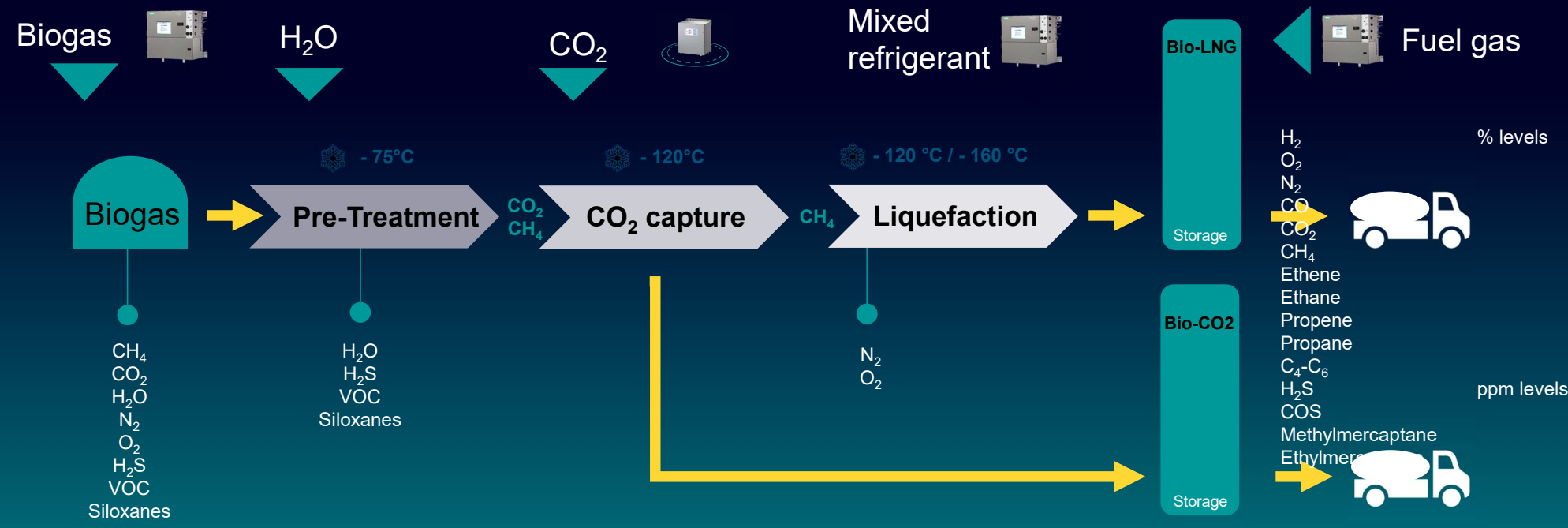
Biogas pathway
Bio-LNG production route



From rawgas through conditioning to the final product

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Standaradization and Digitalization trends

Biofuel producers benefit by optimized CAPEX and OPEX for process analyzers

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Motivation for Standardization, Modularization and Digitalization in Process Analytics

Optimized and lean production process

Enhanced quality standards

Reduction of costs

Improved reliability

Best value product

Faster delivery

Continuous Gas Analyzers
Modular analyzer platform

Flexibility

Plug & measure

Same look & feel

Predictive maintenance

SIPROCESS GA700

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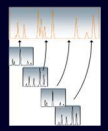
Process Gas Chromatography
SiCAT - Siemens Consistent Application Technology

Innovative Standardization Approach
by Design

1 Analytical components

Parallel Chromatography
Measurement technique is the prior step to standardization



2 Method Development

Applets Concept
Analytical Method Standardization

Applet 101…126

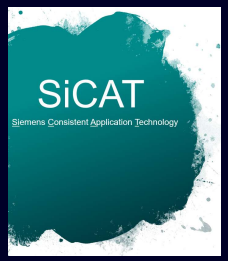
Specific component separations
Permanent gases
Lower hydrocarbons / CV
Aromatics
H2S
C3 / C4 / C5+

3 Analyzer Module

Modular Oven Concept
Hardware standardization with additional benefits from modularity for the maintenance and simplifi-cation of the GC solution

4 SiCAT

Application consistancy
Further standardization step with additional benefits from consistency in application delivery for the maintenance and standardization of the GC solution



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How can we achieve the optimum added value for process analytics?

While the analyzer meets the process specification...

... are other aspects also crucial for maximum value-add!

Efficient service

Measurement accuracy

Measurement availability

Measurement stability

How?

Performance Transparency

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Analyzer System Manager (ASM)
Optimized & profitable process when using AMADAS

Centralized Software for entire installed base of Process Analytics to…

… optimize accuracy by intelligent validation evaluation
… predict maintenance need analyzing device data
… monitor sample preparation and other sensors
... automatize maintenance planning and execution
… enable performance transparency of each analyzer

- On-Premise Application for one or several plants
- Communicates via all interfaces from 4..20 mA, PROFIBUS, Modbus
- Scalable from 10 to +1000 analyzers

Value-add by using ASM

Improvement of product quality

Improvement of analyzer availability

Maintenance Effort Reduction

- Compliant to IEC62243-1 (international Cybersecurity Norm)
- Cybersecurity is realized throughout complete delivery process from project management to installation
- Customizable Cybersecurity Concept defined by ASM Cybersecurity Experts

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Sustainable biofuels
Global process analyzer installation expertise

Processes
Various technology pathways equipped for efficiency optimization

Highlights
Essential for operating and controlling the plant to achieve the desired quality

Solution
Innovative analyzer technologies with focus on performance and maintainability

Benefit
From a single analyzer to the complete measure-ment equipment incl. sample systems and turnkey solution.

★★★★

Process Analyzers for advanced biofuel production plants

References: Netherlands

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Advanced Biofuel Production & Process Analytics Outlook and Future Potential

Global growth
Sustainable market processes reduce the carbon footprint

Market players
Diversified market with many new small and mid sized companies

Innovative processes
require process instrumentation and analytics to optimize the production technology

Process Analytics Optimizes Advanced Biofuel Production Processes

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