POSTER SESSION

Pentair (Union Engineering / HAFFMANS)

NIELS GRAVE

APRIL 10 - 2019

130 locations

In **34** countries

10,000

employees

United in our belief that the future of water depends on us

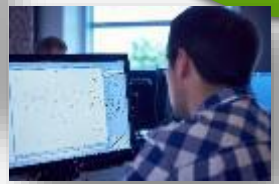
Leading partner within CO_2 and biogas

1400+ CO_2 PLANTS

20.000+ QC DEVICES

300+ AMINE PLANTS

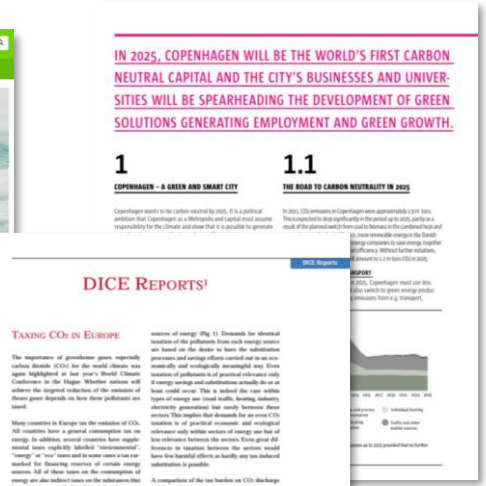
40+ BIOGAS PLANTS

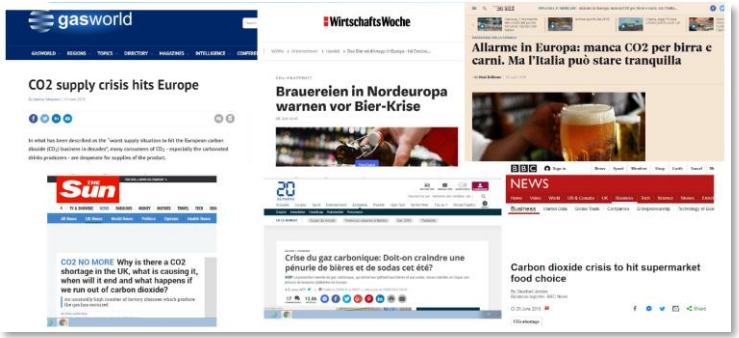


Combined product portfolio

Several issues influence the market changes

- CO_2 crisis in Europe
- EU taxation/ penalties
- Ambitious Political projects
- Minimizing use of fossil fuels
- New sources (e.g. biogas) with useful by-products





Leading to new markets and technologies

Traditional sources vs. new reliable sources

Traditional Sources:

- Byproduct from Ammonia NH_3
- Fermentation
- Ethylene Oxide E/O
- Syngas
- Combustion
- Natural Wells

	CO_2%
Ammonia production	> 95
Fermentation	> 95
Bioethanol Fermentation	> 95
Ethylene Oxide	> 95
Natural Wells	> 95
Gas sweetening, MDEA	> 95
PSA Off Gas (Hydrogen Plant)	< 55
Flue Gas Amine Extraction	< 12
Self-generation, Combustion	< 12

New Reliable Sources:

- Fluegas from
  - Power plants
  - Process plants
- Tail Gas PSA
- MDEA

(Steam Methane Reformer)

- Biogas
- (Bioethanol)
- Ambient Air
- Complex Gas compositions

Complex technology > CAPEX

Reuse all the available sources

Biogas example:

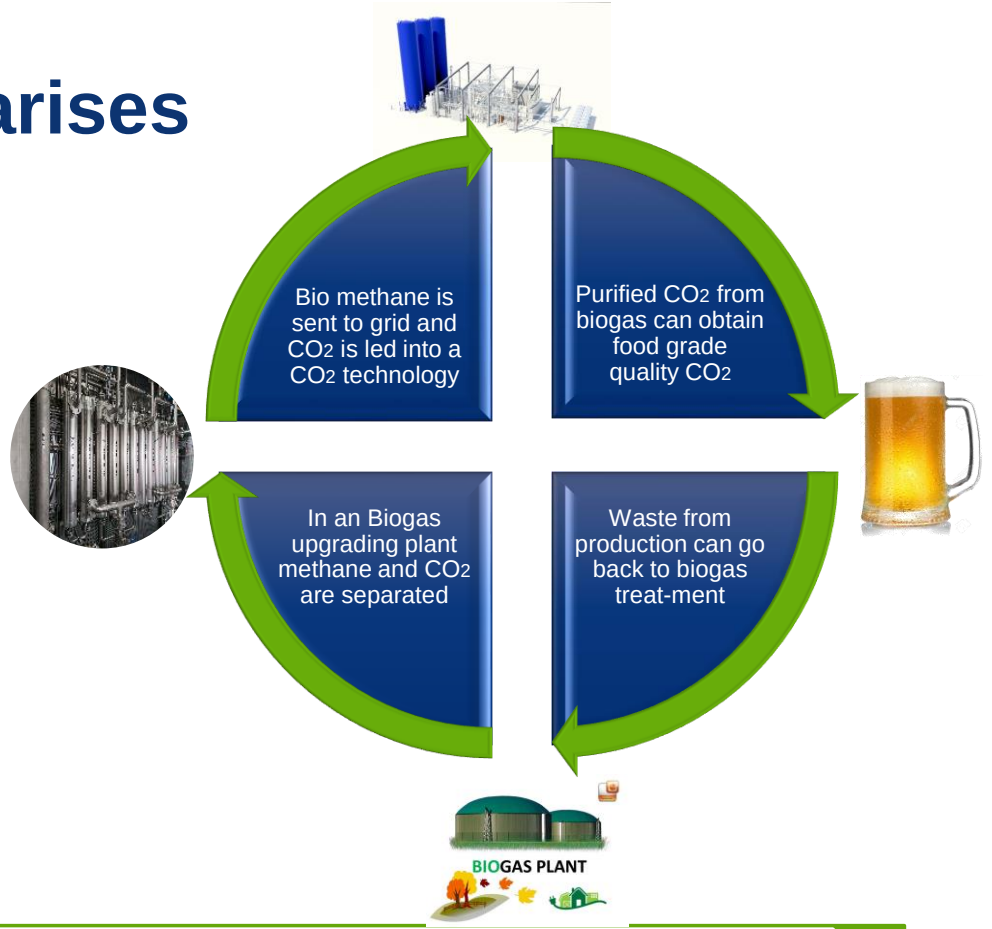
- a 1.000 Nm3 biogas plant
- Normal split: 60% Methane + 40 % CO_2
- 40% CO_2 = approx. 800 kg/h CO_2
- Petrol car emission factor 0,130 CO2/km (https://www.transportenvironment.org/what-we-do/cars-and-co2)
- CO_2 Emission equal to a driving distance of some 6.150 km each and every hour

Biogas CO_2 is a low hanging fruit

New reliable sources arises

Biogas case: Strandmøllen/Korskro

- Biogas has been taken to next level
- 6,000 Nm3 biogas plant
- 48 tpd CO_2 recovery
- Upgrading both Methane and CO_2 is an environmental gain:
  - Methane can be utilized on gas grid
  - CO_2 can be utilized for different purposes:
    - Food grade
    - Green houses
    - Fire fighting
    - Welding
    - Dry Ice



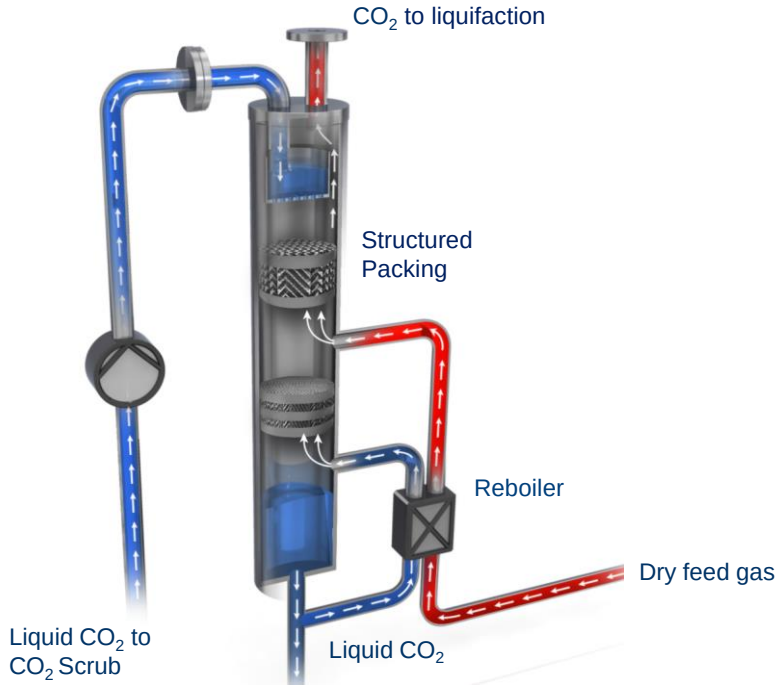
Biogas CO_2 is a low hanging fruit

Example of technology development

CO2Scrub Version 1.0 is developed and launched by Union Engineering

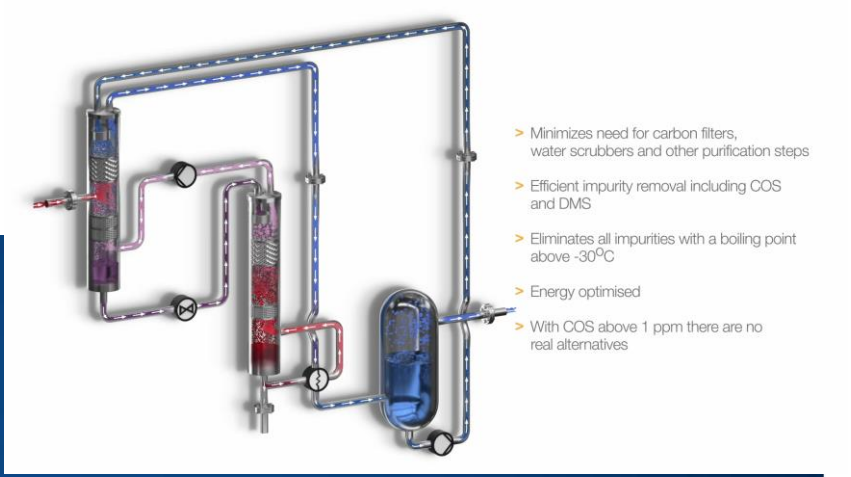
BENEFITS

- Excellent system for final CO_2 polishing
- Possible replacement of regenerable activated carbon beds
- Elimination of water scrubber
- Continous replacement of absorbent - not needed.
- Tolerant for varying hydrocarbon content in raw gas
- No use of additional external sources is elliminating the risk of contamination
- Reduced amount of waste
- No use of water



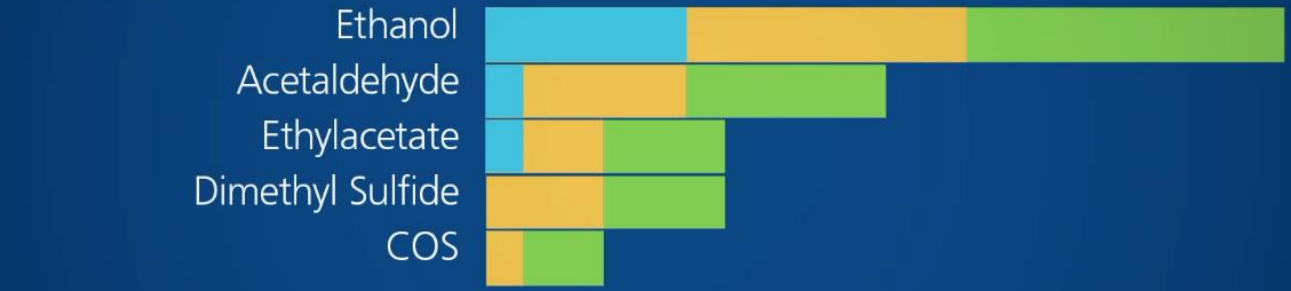
But more demaning raw gasses call for a new version

CO2Scrub Version 2.0



- Minimizes need for carbon filters, water scrubbers and other purification steps
- Efficient impurity removal including COS and DMS
- Eliminates all impurities with a boiling point above -30°C
- Energy optimised
- With COS above 1 ppm there are no real alternatives

Removal capabilities of different compounds



CO2 purification - BIOGAS

- **Operational benefits – CO2 Scrub:**
  - continuous operation (no manual controlled batch)

		BIOGAS	AC	CO2 Scrub / CO2 Scrub 2
Impurities of concern	BTEX	X		
	Methanol	X		
	Ethanol	X		
	Acet Aldehyde	X		
	Dimethyl sulfide [DMS]	X		
	Carbonyl sulfide [COS]	X		(2)
	Halogenated compounds	X		
	Ketoner	X		
	Terpener	X		
	Silotaner	X		

- By adding the CO2 Scrub solution, has CO2 from Beer fermentation been fully approved by all major soft drink companies

- Clean and odorless CO2 =>
  - CO2 > 99,9% (ISBT)
  - Several of the above components has to be reduced to a few ppb (0,0000005%)

PENTAIR

THANK YOU

www.pentair.com

PENTAIR

THANK YOU

www.pentair.com