Ammongas

METHANE LEAKAGE FROM BIOGAS UPGRADING TECHNOLOGIES

AGENDA

1. Introduction
2. The environmental impact of methane slippage
3. The 4 different upgrading technologies
4. Comparison of the upgrading technologies
5. Methane removal in off gas
6. Conclusion
7. Questions

INTRODUCTION

- Engineering company specialized in air- and gas purification systems.
- Located in Glostrup, Denmark.

- Scrubber systems, biogas upgradi
  NH_3 separation & concentration,

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Global Business Engineer

Biogas industry since 2016

ENVIRONMENTAL IMPACT OF METHANE SLIPPAGE

- Methane slippage: The percentage of inlet biomethane that does not come out as product gas.

- Methane slippage has two environmental effects:

1. Methane is a greenhouse gas
   - Methane as a greenhouse gas is more than 25 times as potent as CO_2[1,2]

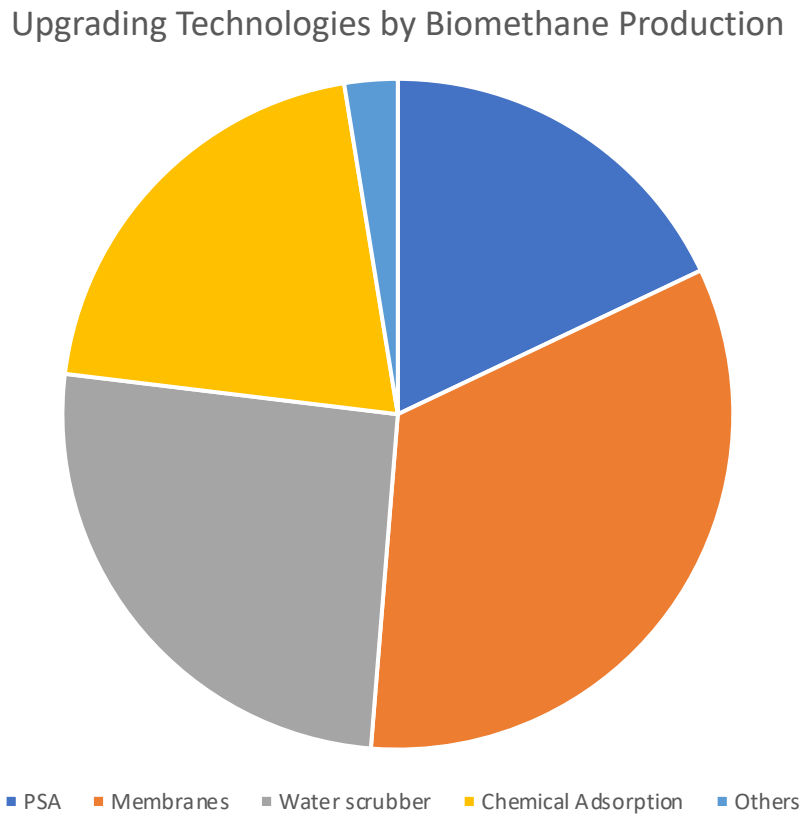
2. The methane loss is lost energy that would replace natural gas
   - Each m^3 of methane lost would have replaced a m^3 of natural gas, which must now be produced.

1) EPA, 2021
2) DGC, 2018

BIOGAS UPGRADING

- In general, we see four different upgrading technologies:[3][5]

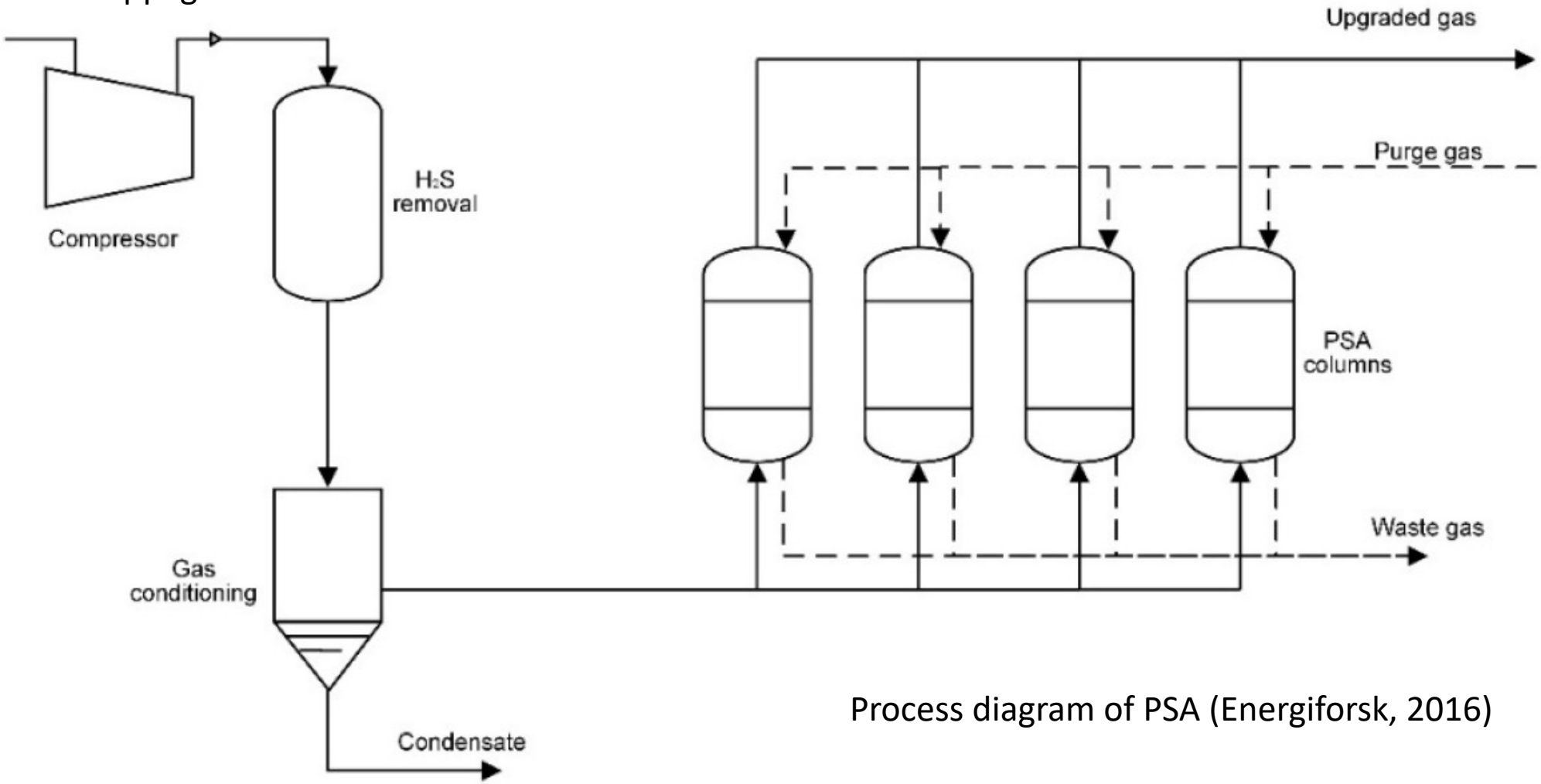
1. Membranes
2. Water Scrubbers
3. Chemical Adsorption
4. PSA
5. Others



3) Energiforsk, 2016
5) Biogas World, 2020

PRESSURE SWING ADSORPTION (PSA)

Methane slippage: 1.8-2 % [4]

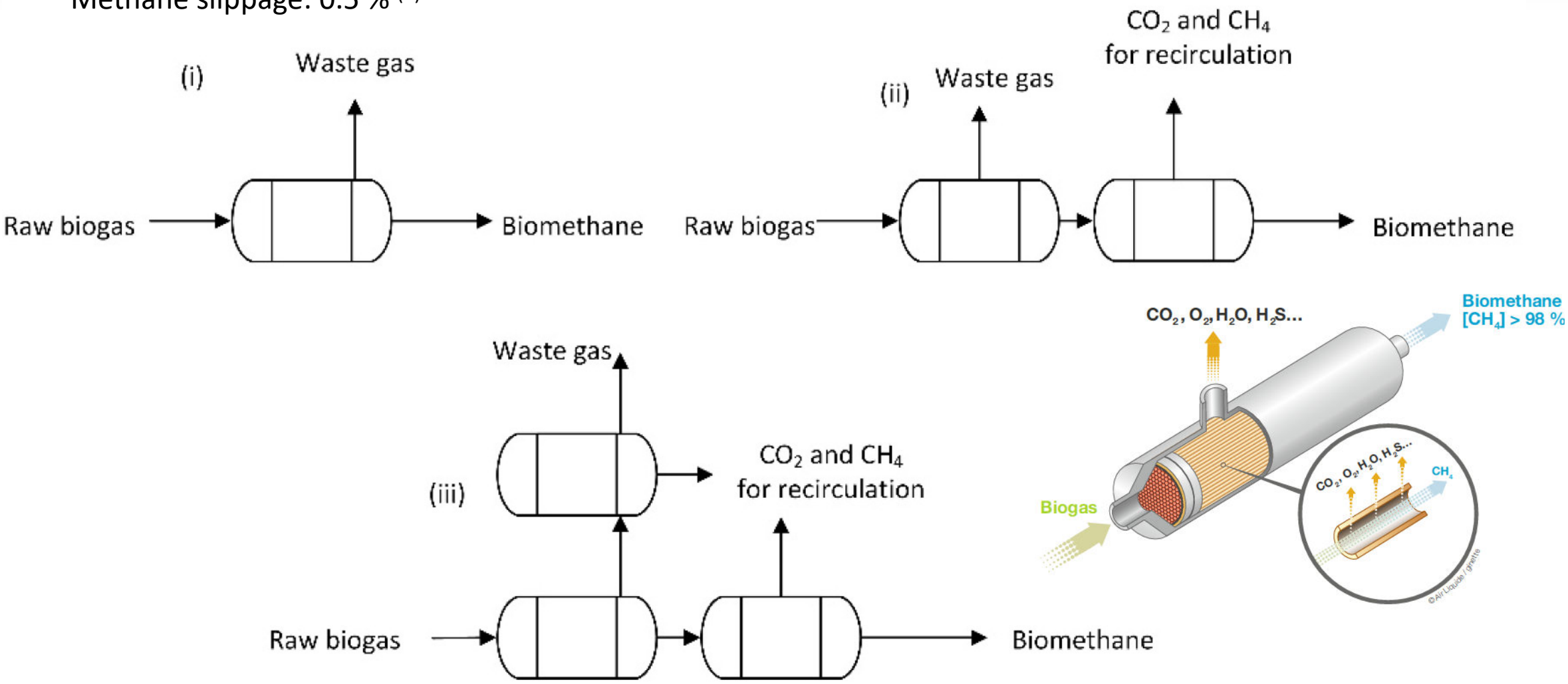


Process diagram of PSA (Energiforsk, 2016)

4) SGC, 2013

MEMBRANES

Methane slippage: 0.5 % (2)

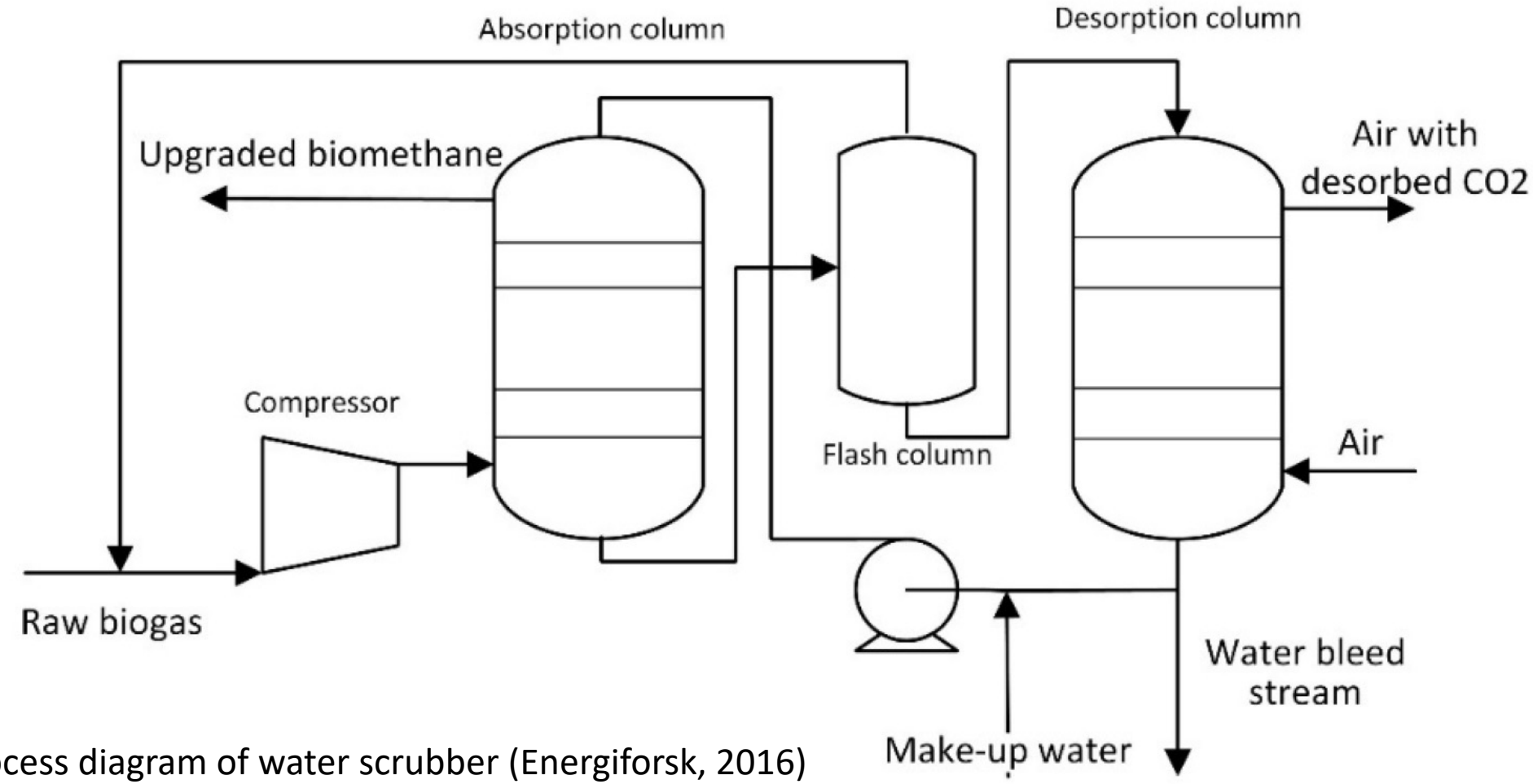


Process diagram of membrane (Energiforsk, 2016)

2) DGC, 2018

WATER SCRUBBING

Methane slippage: 1.5 % [2]



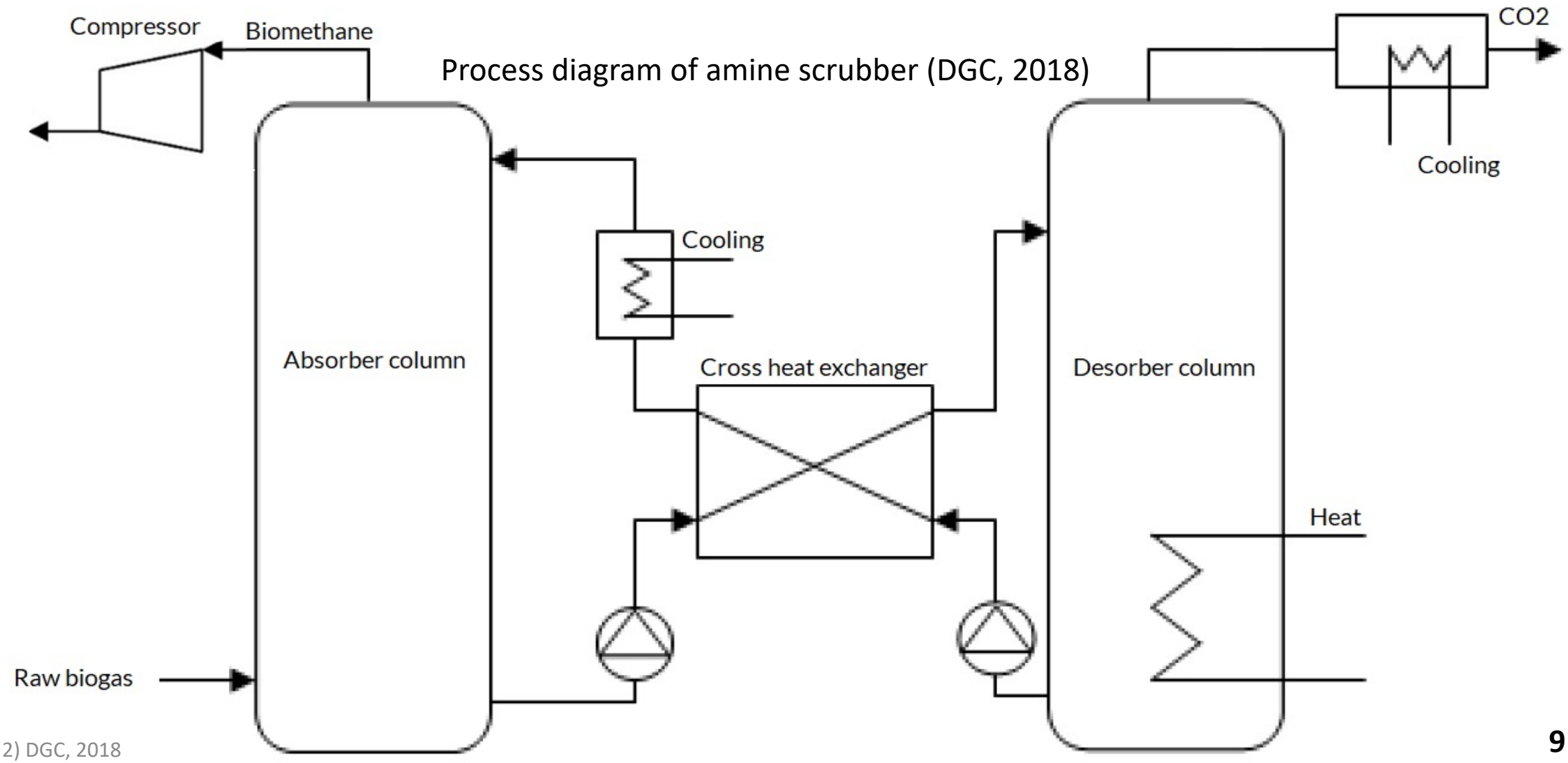
Process diagram of water scrubber (Energiforsk, 2016)

2) DGC, 2018

AMINES

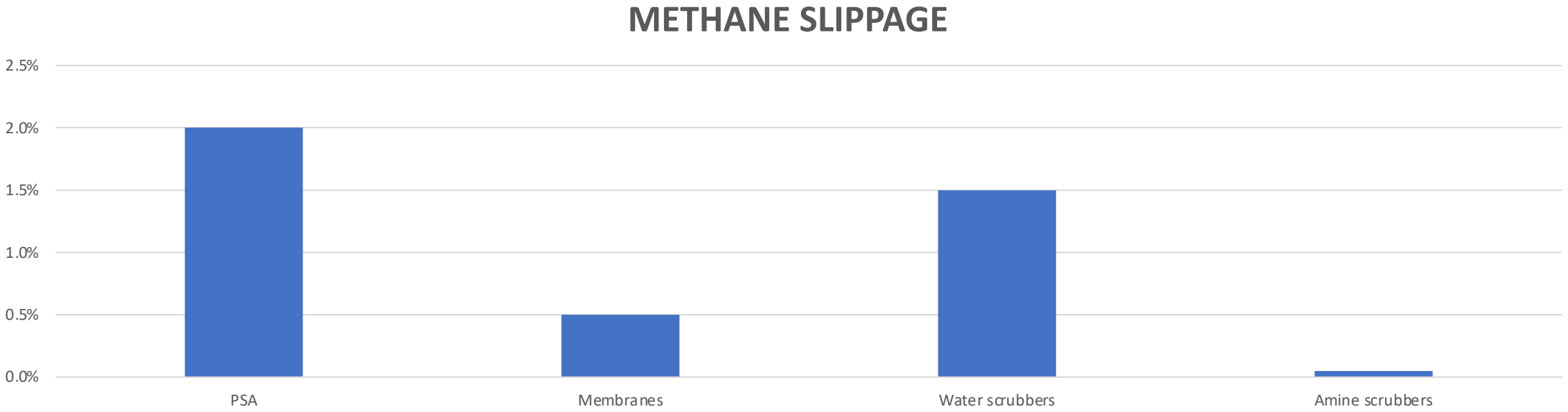
Methane slippage: 0.05 %[2]

Process diagram of amine scrubber (DGC, 2018)



2) DGC, 2018

COMPARISON



UPGRADING	METHANE SLIPPAGE (2,4)
PSA	1.8 – 2 %
Membranes	0.5 %
Water scrubbers	1.5 %
Amine scrubbers	0.05 %

2) DGC, 2018
4) SGC, 2013

METHANE REMOVAL IN OFF GAS

- Regenerative Thermal Oxidation (RTO)[3]
  - Operates at 750 – 1000 °C to combust the off gas.
- Regenerative Catalytic Oxidation (RCO) [3]
  - Like RTO but with a catalyst bed to run at 250 – 500 °C
- Genset[3]
  - Small combustion engine running on off gas + a fraction of the biogas
- Cryogenic Distillation[3]
  - Performed at 18 bar(g) and -24 °C, creates liquid CO_2 with <10 ppm CH_4

2. The methane loss is lost energy that would replace natural gas
   - Each m^3 of methane lost would have replaced a m^3 of natural gas, which must now be produced.

3) Energiforsk, 2016

CONCLUSION

- Figures of methane slippage is “easy” to judge from:
  - PSA 1.8 – 2 %
  - Membranes 0.5 %
  - Water scrubber 1.5 %
  - Amine scrubber 0.05 %

- Need to look at the specific situation
  - What heat is available?
  - Is there a need for liquid CO_2?
  - Is it upgrading of landfill gas?

Questions?

REFERENCES

1) U.S. Environmental Protection Agency, (2021, June 30). https://www.epa.gov/. Retrieved from https://www.epa.gov/gmi/importance-methane

2) DGC. (2018). Metantab ved opgradering. Danish Gas Technology Centre.

3) Energiforsk. (2016). BIOGAS UPGRADING – TECHNICAL REVIEW. Energiforsk.

4) SGC. (2013). SGC Rapport 2013:270. Malmö: Svenskt Gastekniskt Center AB.

5) Biogas World. (2020). Biomethane Market Intelligence Report – North America and Europe