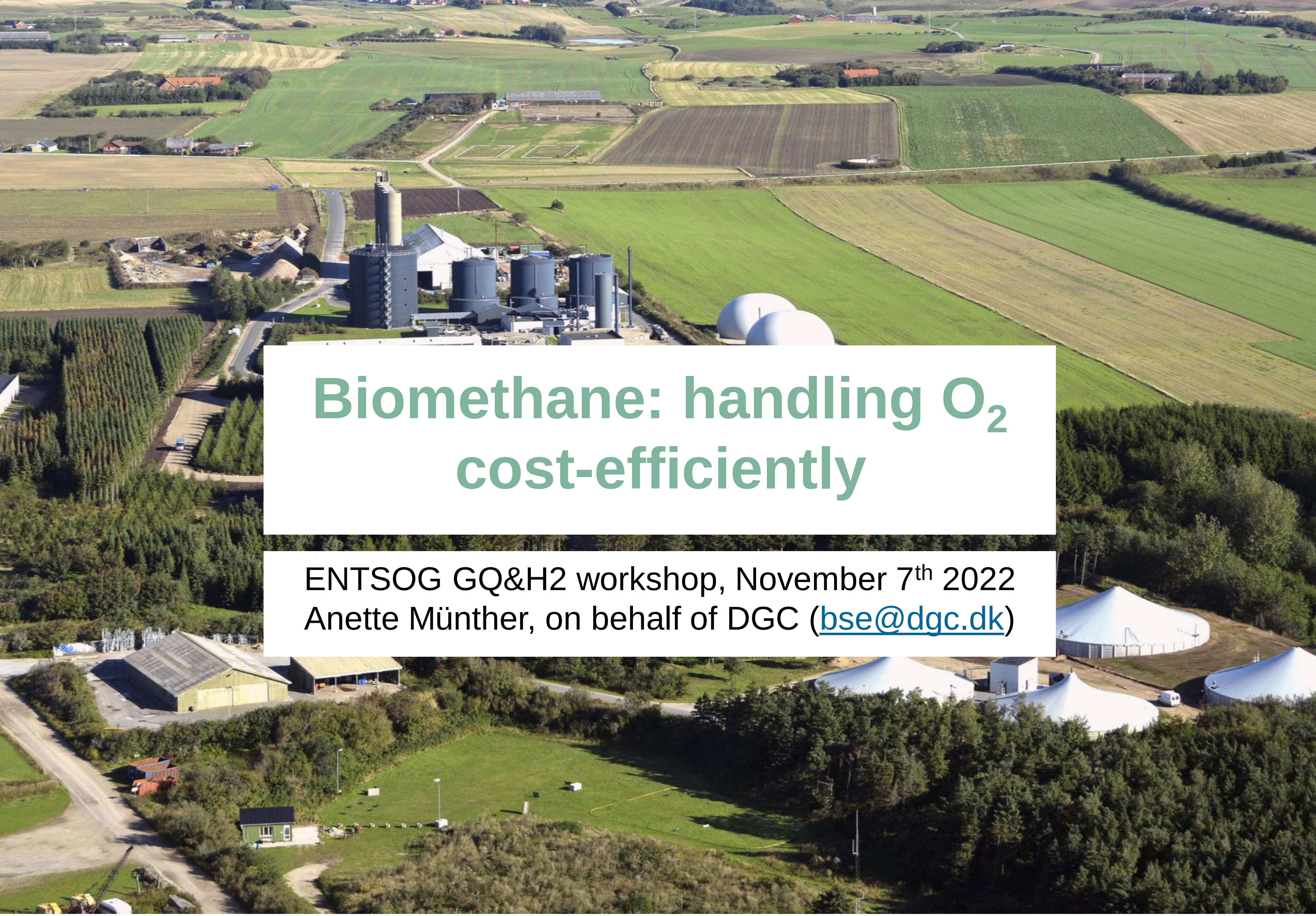
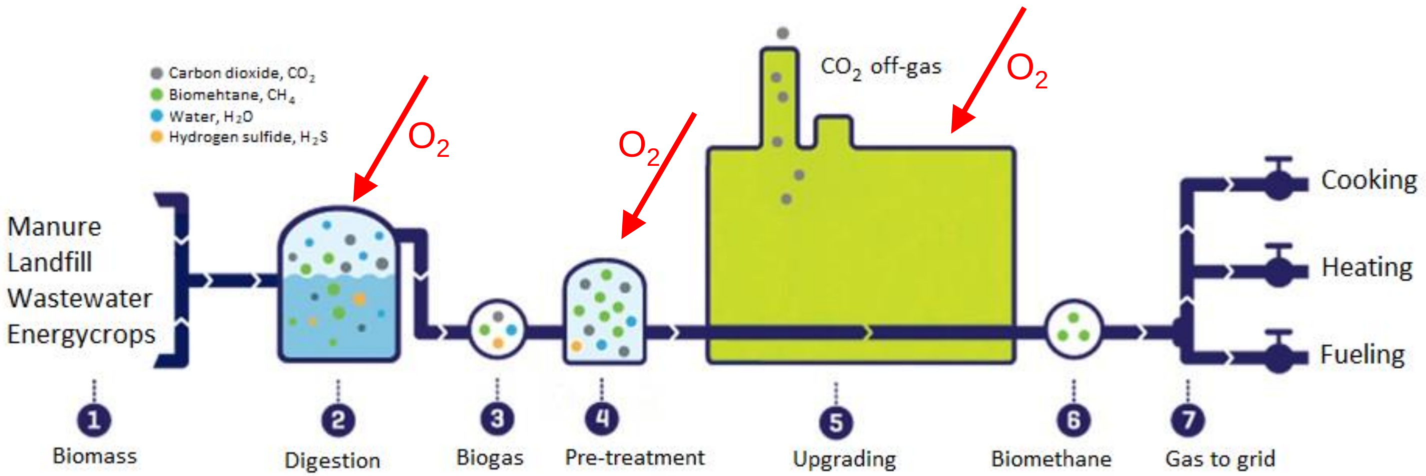


Biomethane: handling O_2 cost-efficiently

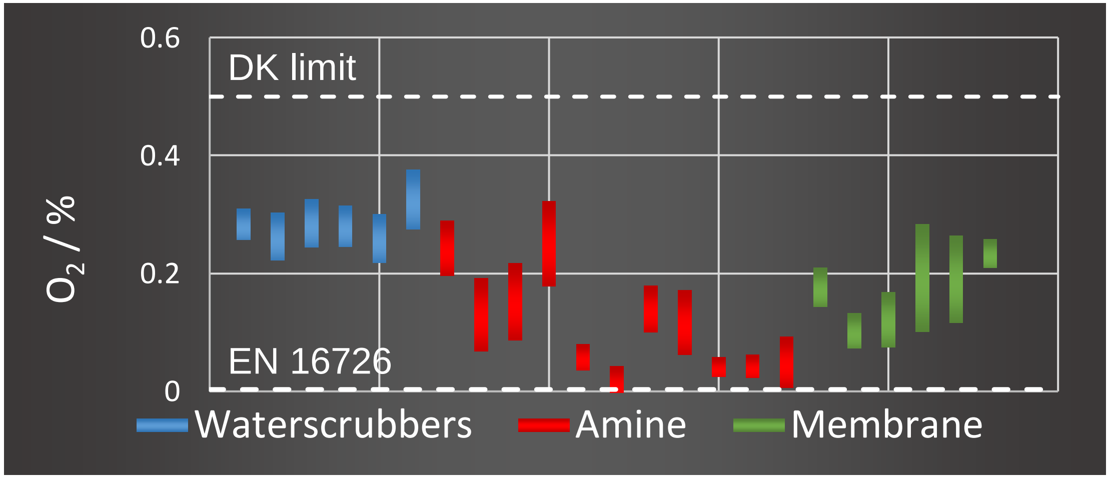
ENTSOG GQ&H2 workshop, November 7th 2022

Anette Münther, on behalf of DGC (bse@dgc.dk)

Background – O_2 in biomethane



Picture modified from www.dmt-et.com



Data from Evida

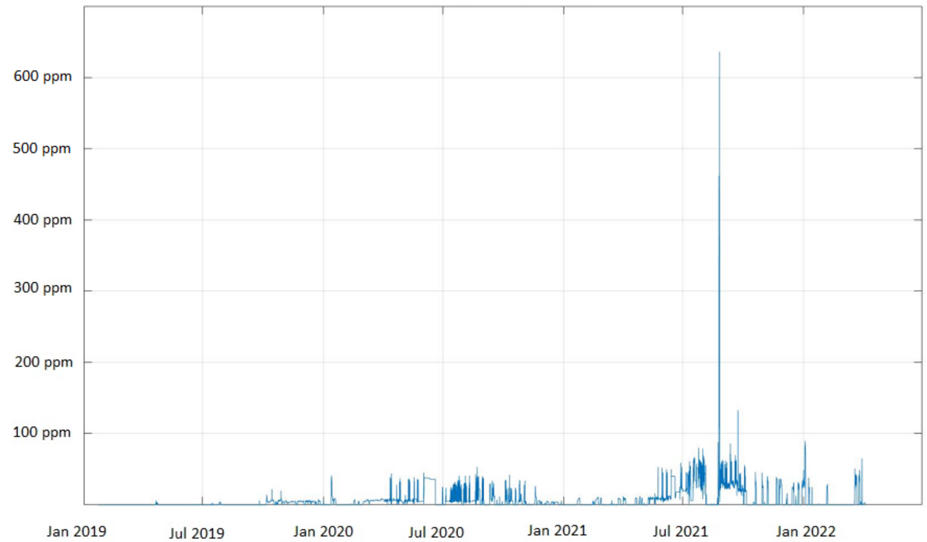
Background – O_2 & sensitive infrastructure

Underground gas storages (UGS):

- Limited experience with O_2
- Potential risk:
  - Corrosion?
  - Microbial contamination?
  - H_2S production?
- Irreversible damage

Some chemical industry also sensitive to O_2

Picture from Gas Storage Denmark



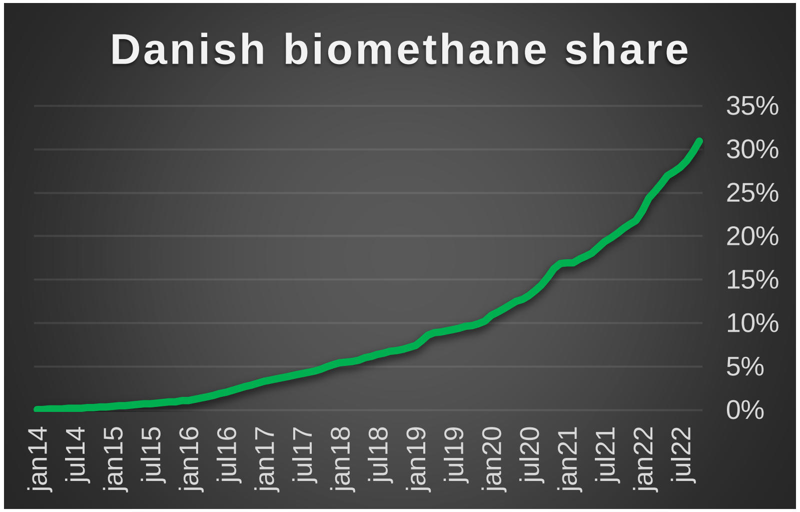
Simulated data from Gas Storage Denmark

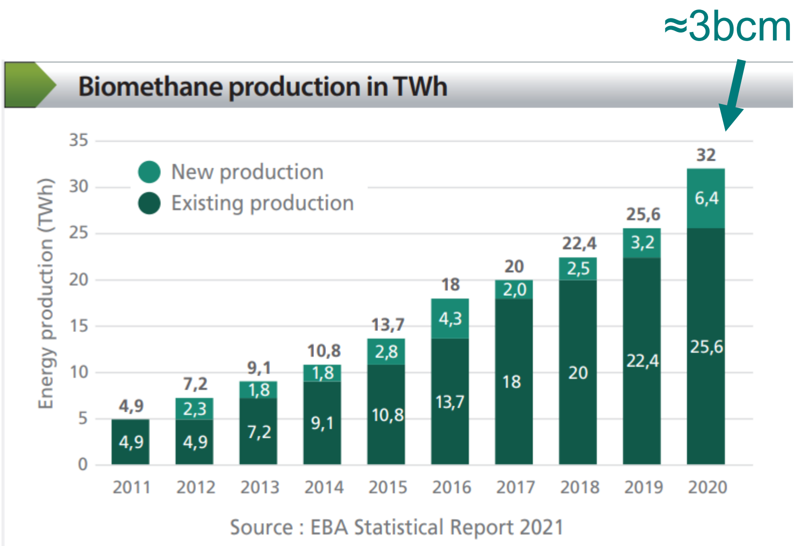
Background – biomethane production

- Increasing biomethane production
  - Green transition
  - Energy independance
  - REPowerEU: 35 bcm biomethane

- Will influence gas quality and gas grid

- Important to handle oxygen in cost efficient way
  - How?



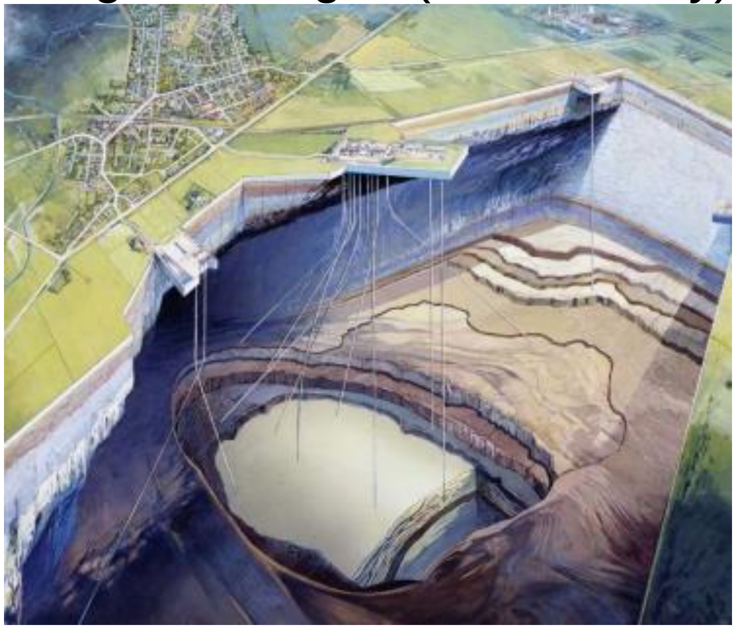


Two options for handling the oxygen:

Avoid or remove O_2 at all biomethane plants

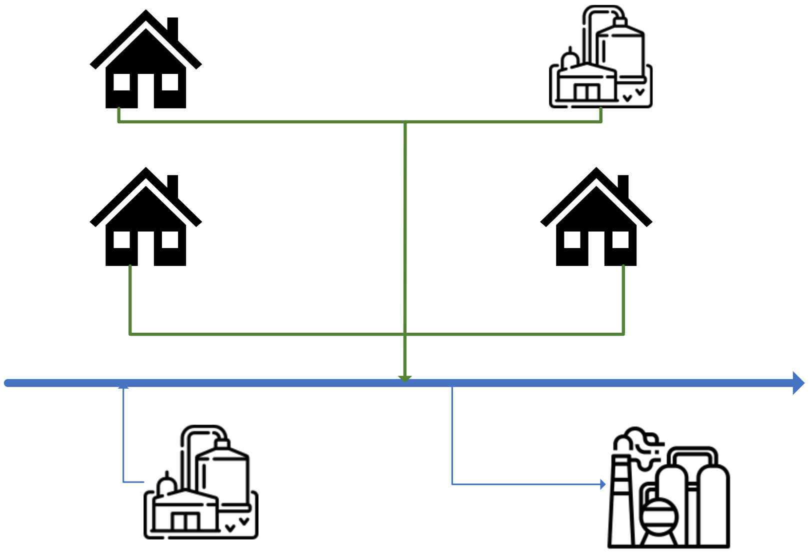
Picture from Supplier Association LF - Biogas

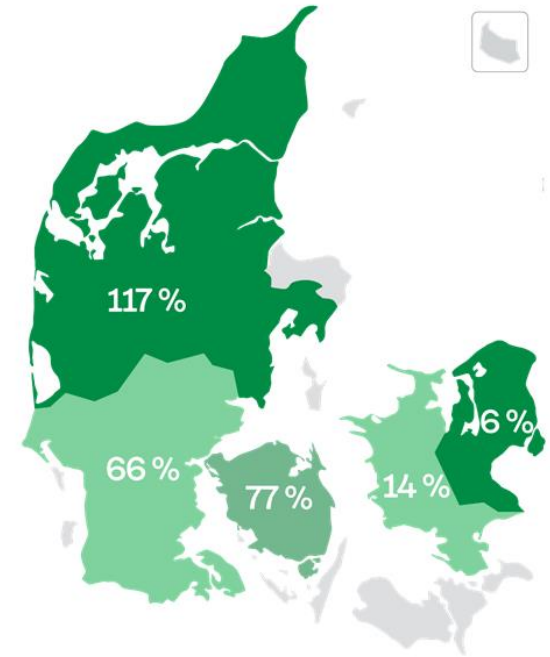
Catalytically remove O_2 at gas storages (if necessary)



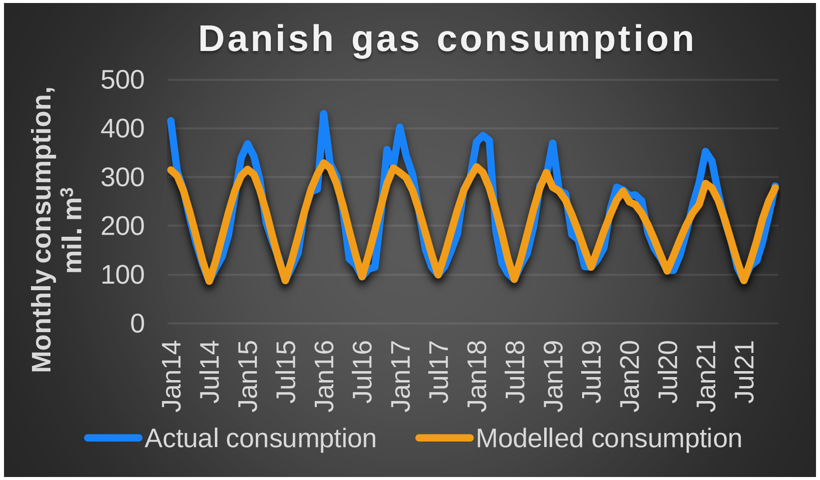
Picture from Gas Storage Denmark

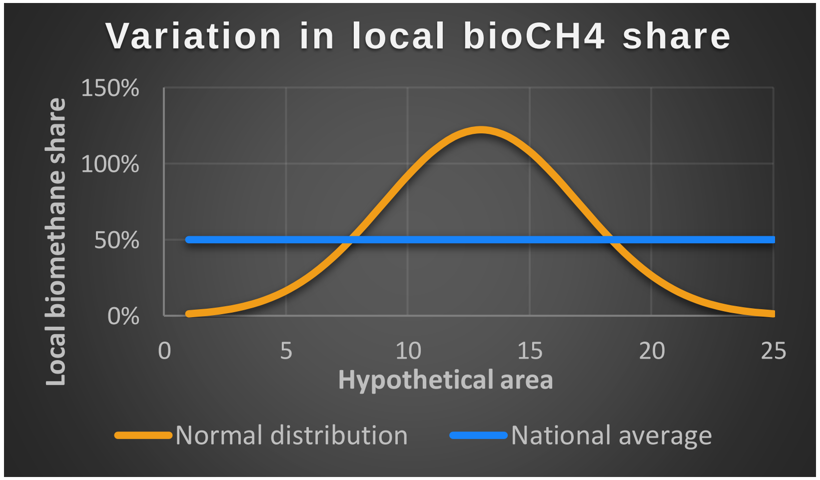
Method – oxygen in the grid





Picture from www.evida.dk, data for July 2021



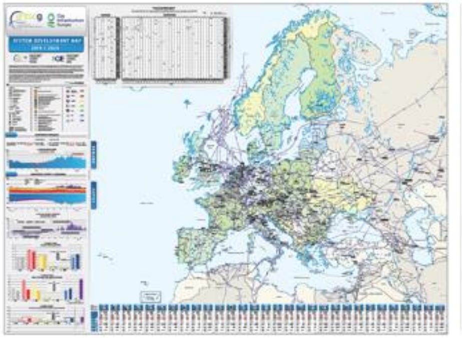


Assumptions and input data

- Future growth in biomethane like existing:
  - Size
  - Sulphur cleaning
  - Upgrading technology
- Chepest solutions (CAPEX+OPEX) for O_2-free production chosen
- 2000 ppm H_2S in raw biogas
- Max. 10 ppm O_2 injected in storages
- Prices collected from technology suppliers
- Input data from GIE gas maps

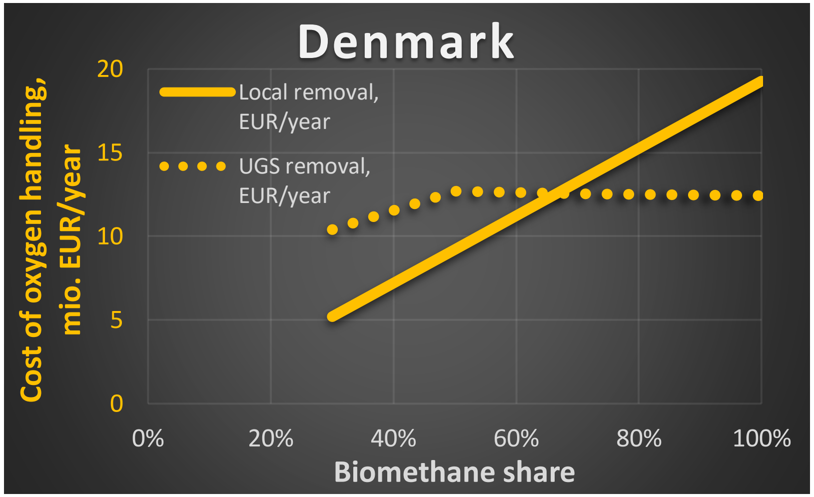
GIE Storage Map

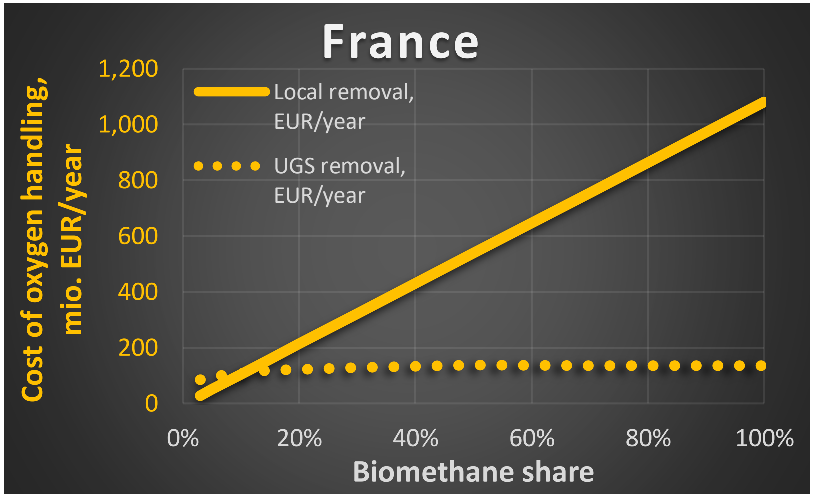
European Biomethane Map

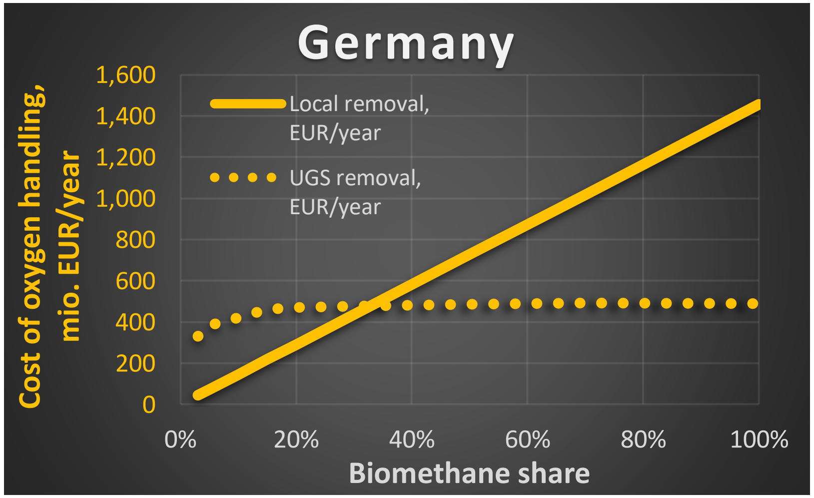


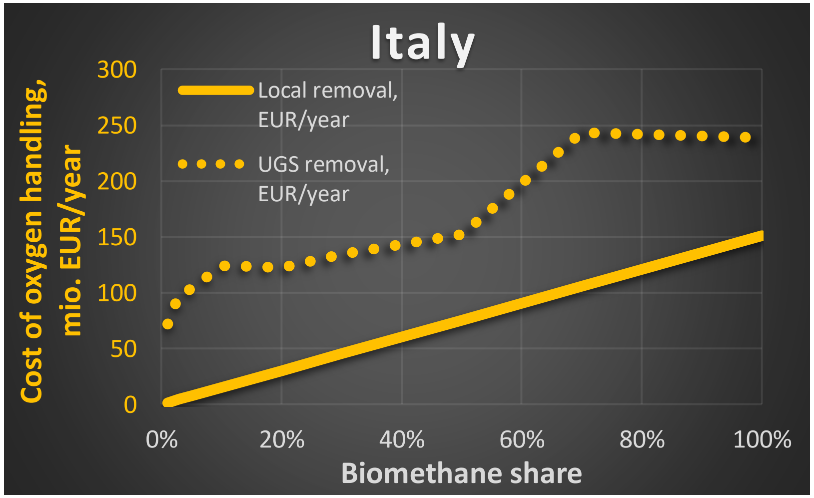
System Development Map

Country results



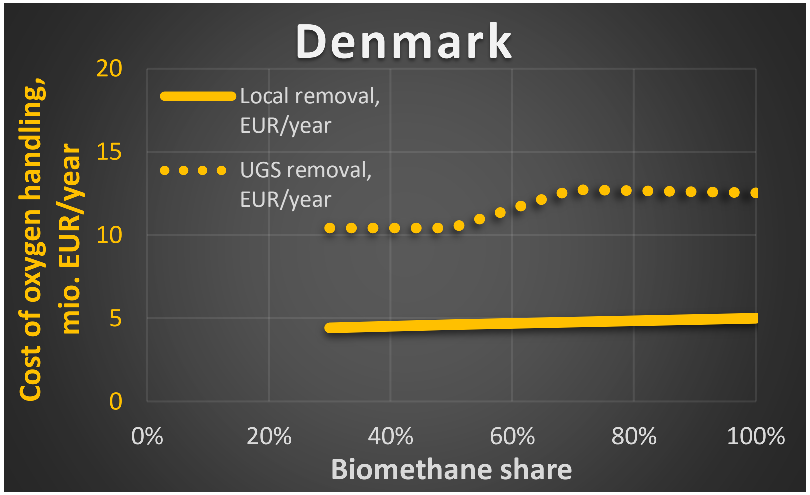


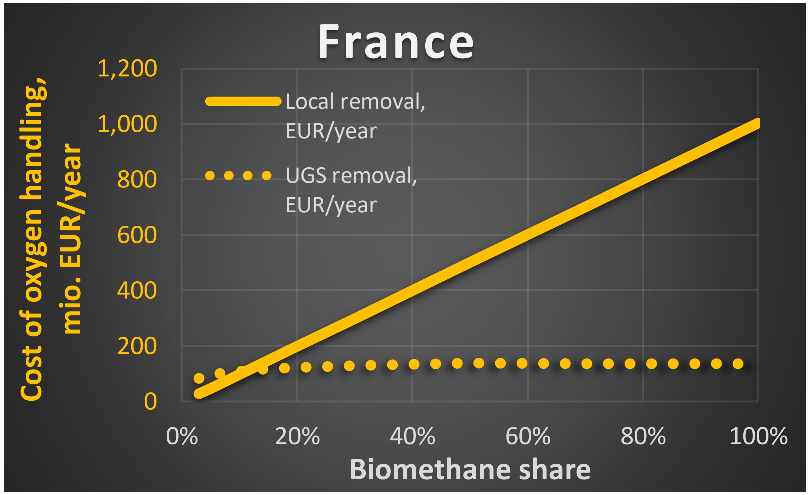


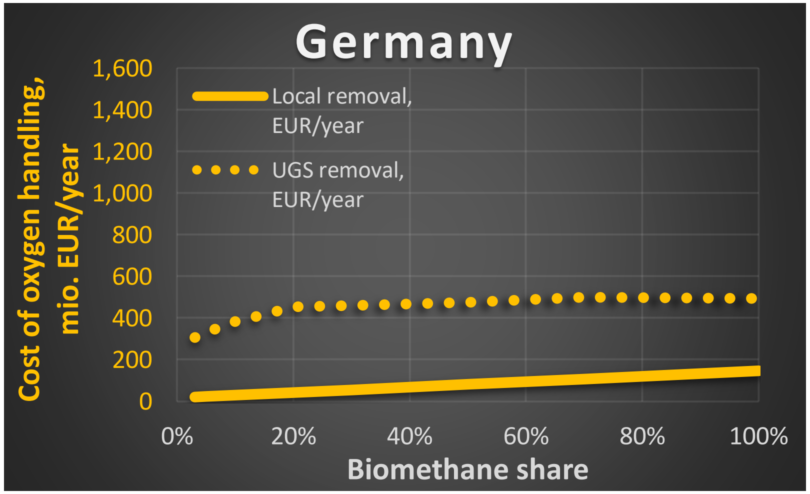


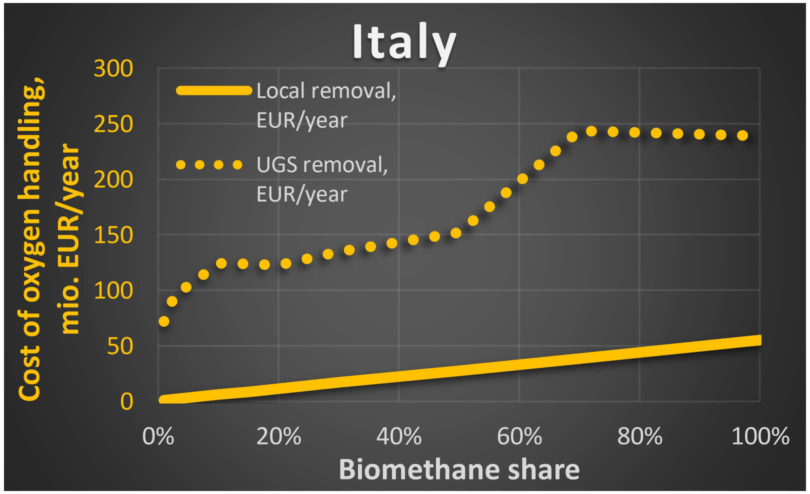
Country results

– no local catalytic removal



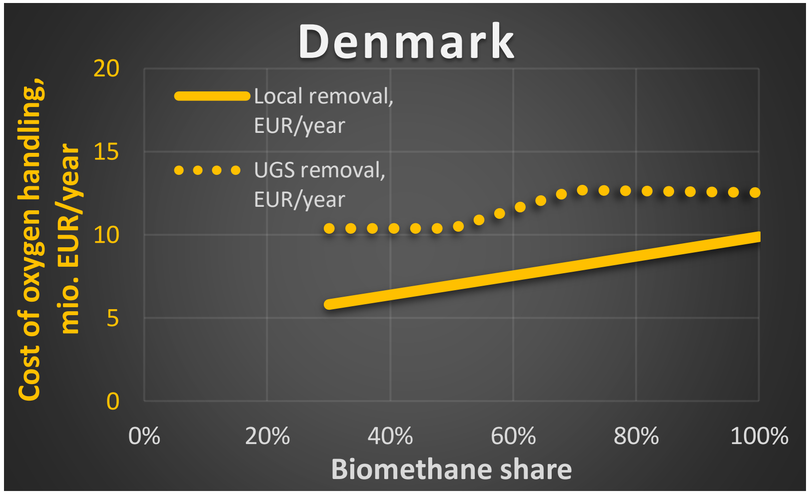


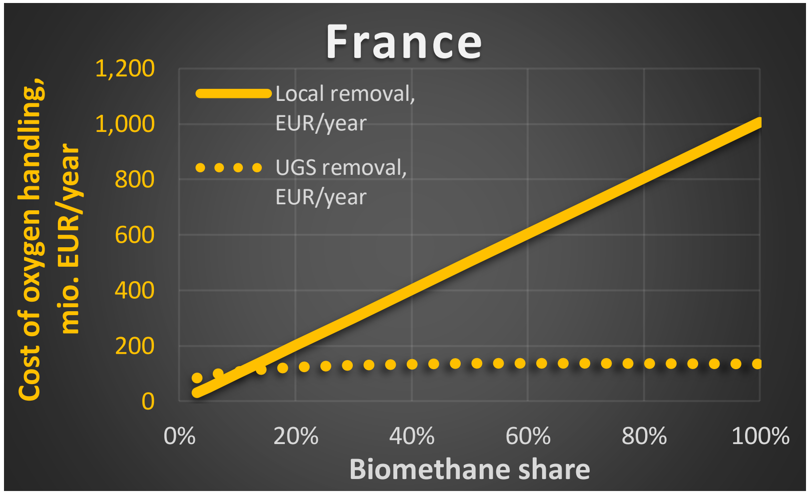


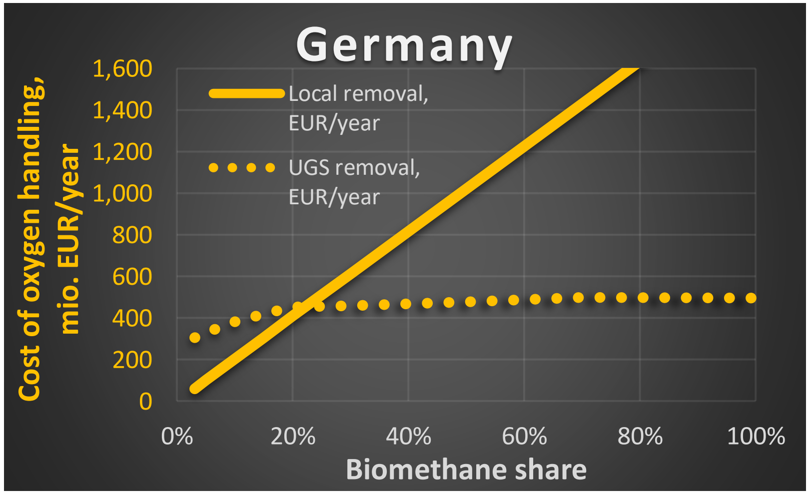


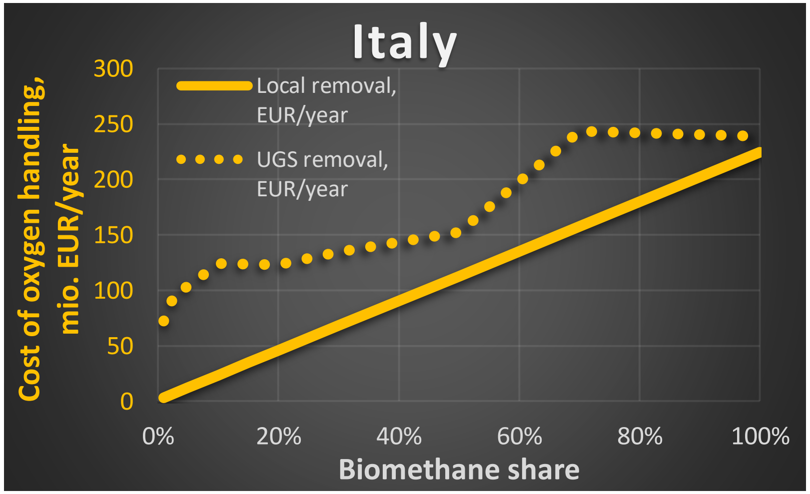
Country results

– no local catalytic removal + no bioclean for small plants (<800Nm^3/h)

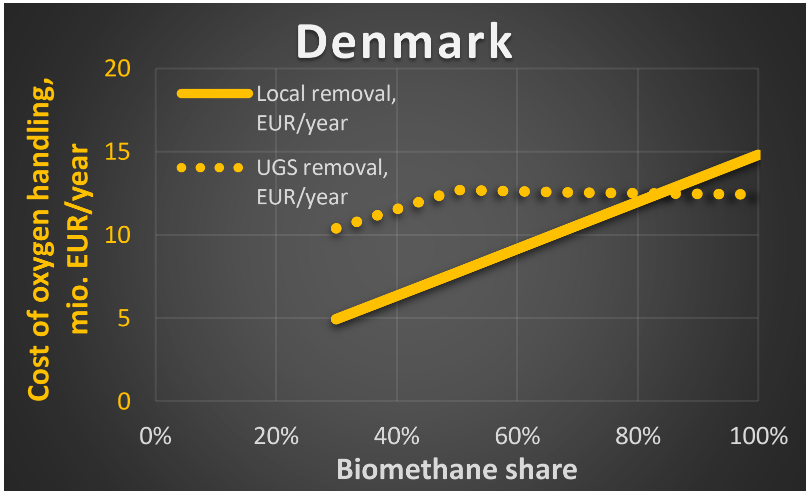


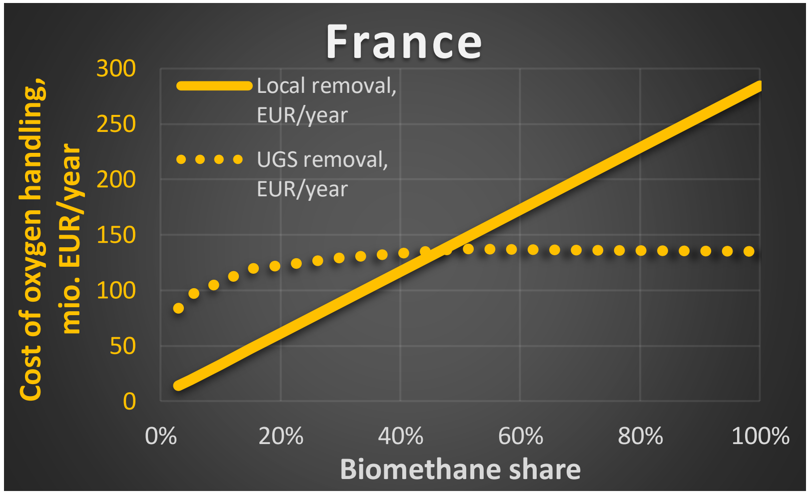


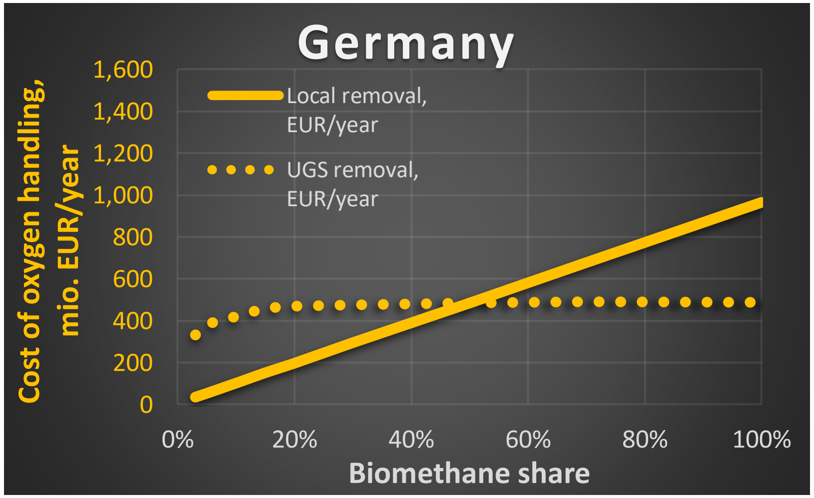


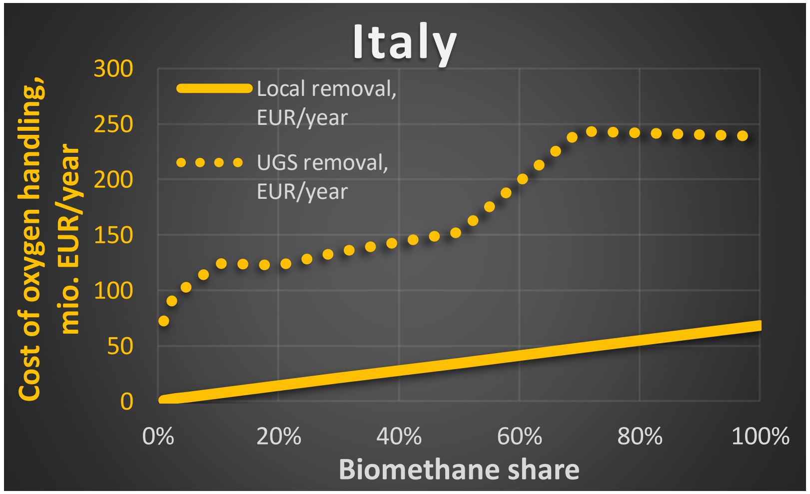


Country results
– Plant size +100% (basic assumptions)



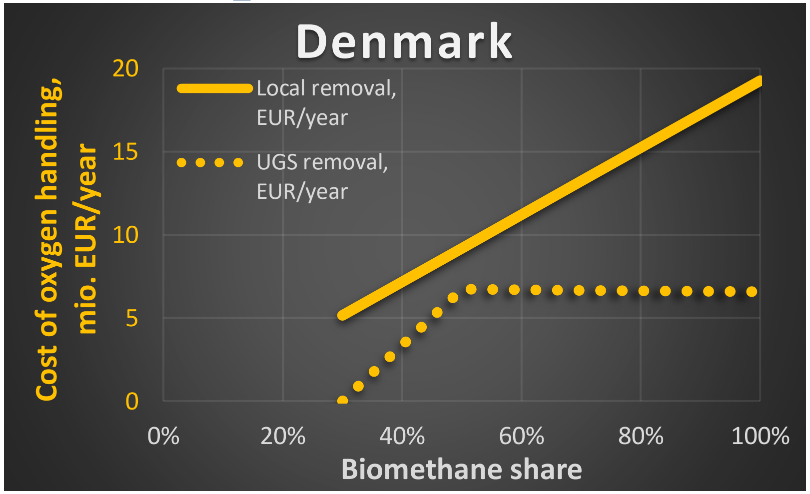


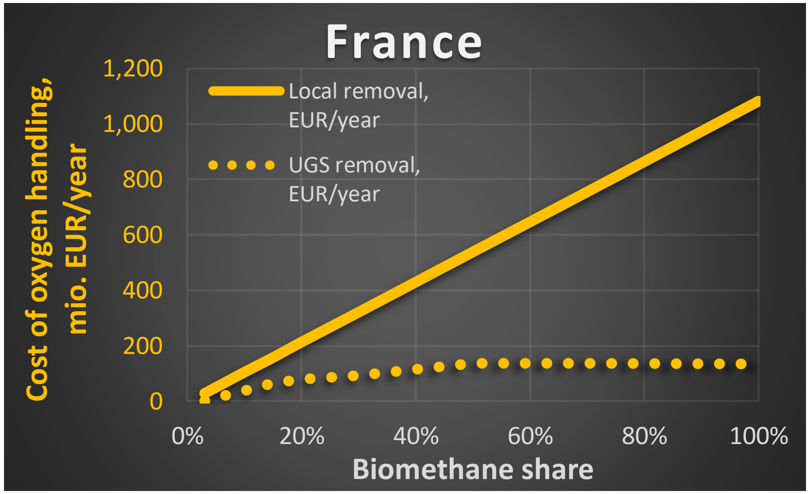


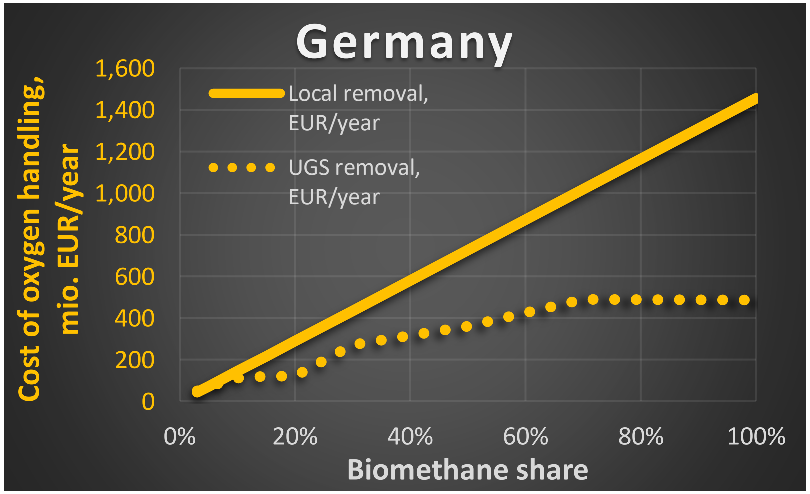


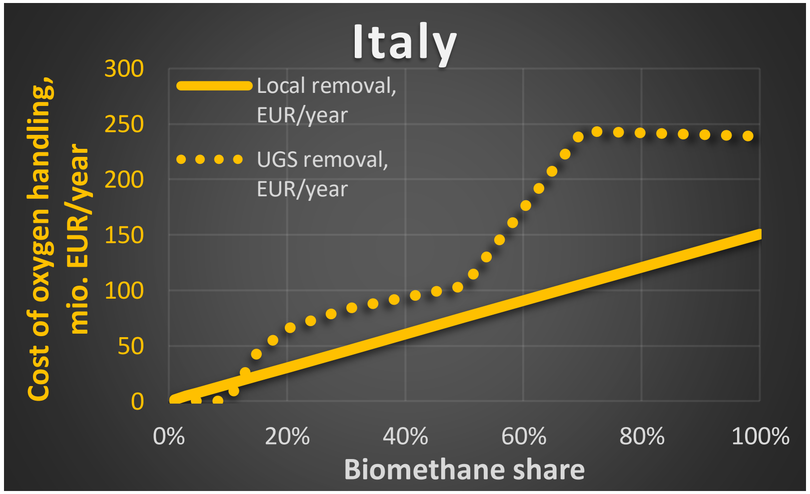
Country results

– More O_2 in UGS: 1000 ppm in caverns, 100 ppm in others









Oxygen removal and trade across borders

Max flow 1000 Nm^3/h	Avg. flow 1000 Nm^3/h	30% bioCH4 Mil. €/year	100% bioCH4 Mil. €/year
400	100	8	10
1.000	250	15	20
2.000	500	31	40
3.000	750	46	60
4.000	1.000	62	80

→Neighbouring countries with different O_2 limits will add substantial extra expenses for oxygen handling

Summary of findings

Favours removing O_2 at UGS	Favours avoiding/removing O_2 at $bioCH_4$ plants
• No restrictions on tech for new $bioCH_4$ plants • No bio-cleaning at small $bioCH_4$ plants • UGSs accept higher O_2-content • High biomethane share ambitions	• New $bioCH_4$ plants built so no catalytic removal needed • Large biomethane plants • Neighbouring countries with 10 ppm O_2 limit • Low biomethane share ambitions

Conclusions

- Avoiding O_2 at bioCH_4 plants has potential to be most cost-efficient solution overall
  - Will require ”help” to coerce technology choice, support investments and train staff
  - Could delay or hinder new investments in bioCH_4 plants
- Removal of O_2 at UGS is the ”safe” choice
  - UGSs have professional staff and experience with advanced process equipment
  - No risk of hindring or delaying bioCH_4 investments
  - Expenses should be minimized by smart grid planning
- Financing of handling O_2 should be shared somehow
  - Decision should not depend on who accepts/is forced to pay
- Neighbours with different O_2-solutions will add extra expenses


Questions
?
?
Answers
?