Microbial risks in hydrogen storage in porous media

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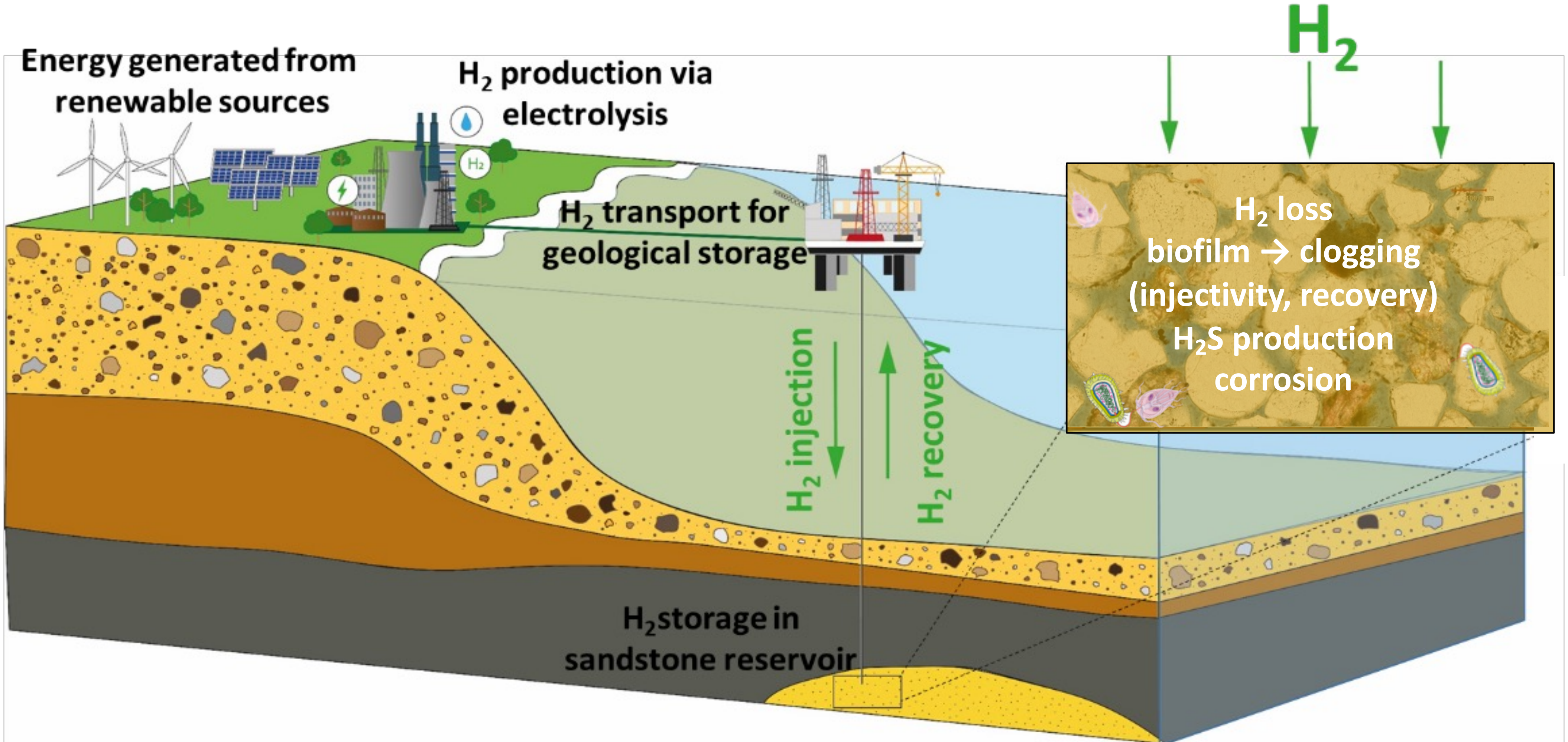
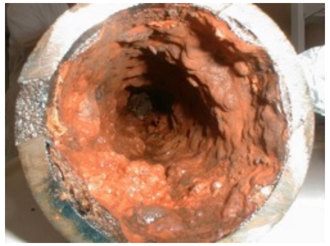
Microbial risk in UHS

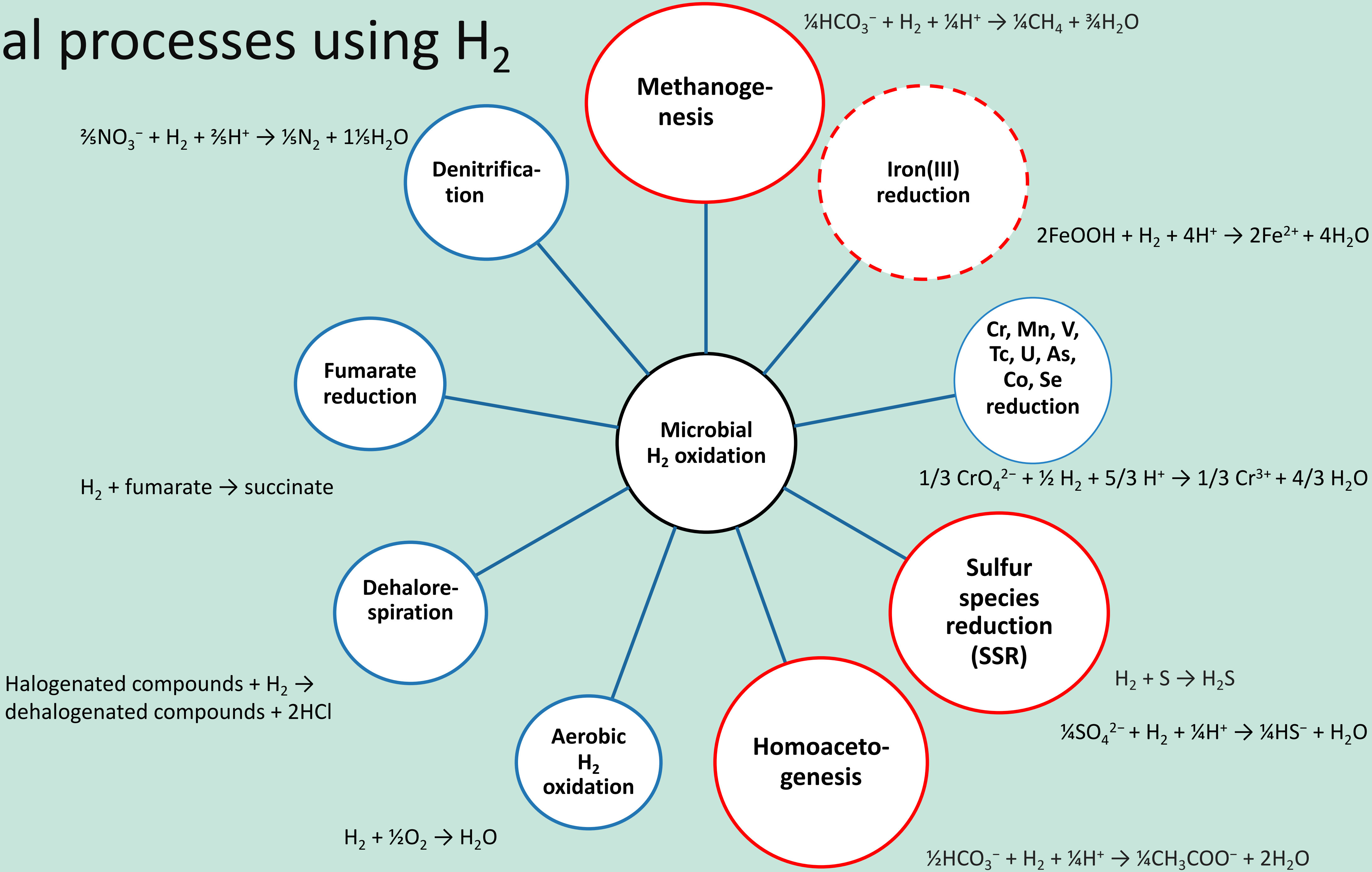




clogging and corrosion

corrosion

Microbial processes using H_2



Methodology

- Creation of a microbial risk register based on a novel collection of microbial growth constraints (incl. DIRB)
- Collection of temperature and salinity data for 75 DGF on the UK continental shelf
- GIS-mapping of suitability for hydrogen storage in terms of the risk of adverse microbial effects
- Overlaying of the microbial risk register with data on wind and solar operational capacities as well as offshore gas and condensate pipeline infrastructure to optimize geographical centers of green hydrogen production, transport infrastructure and underground storage

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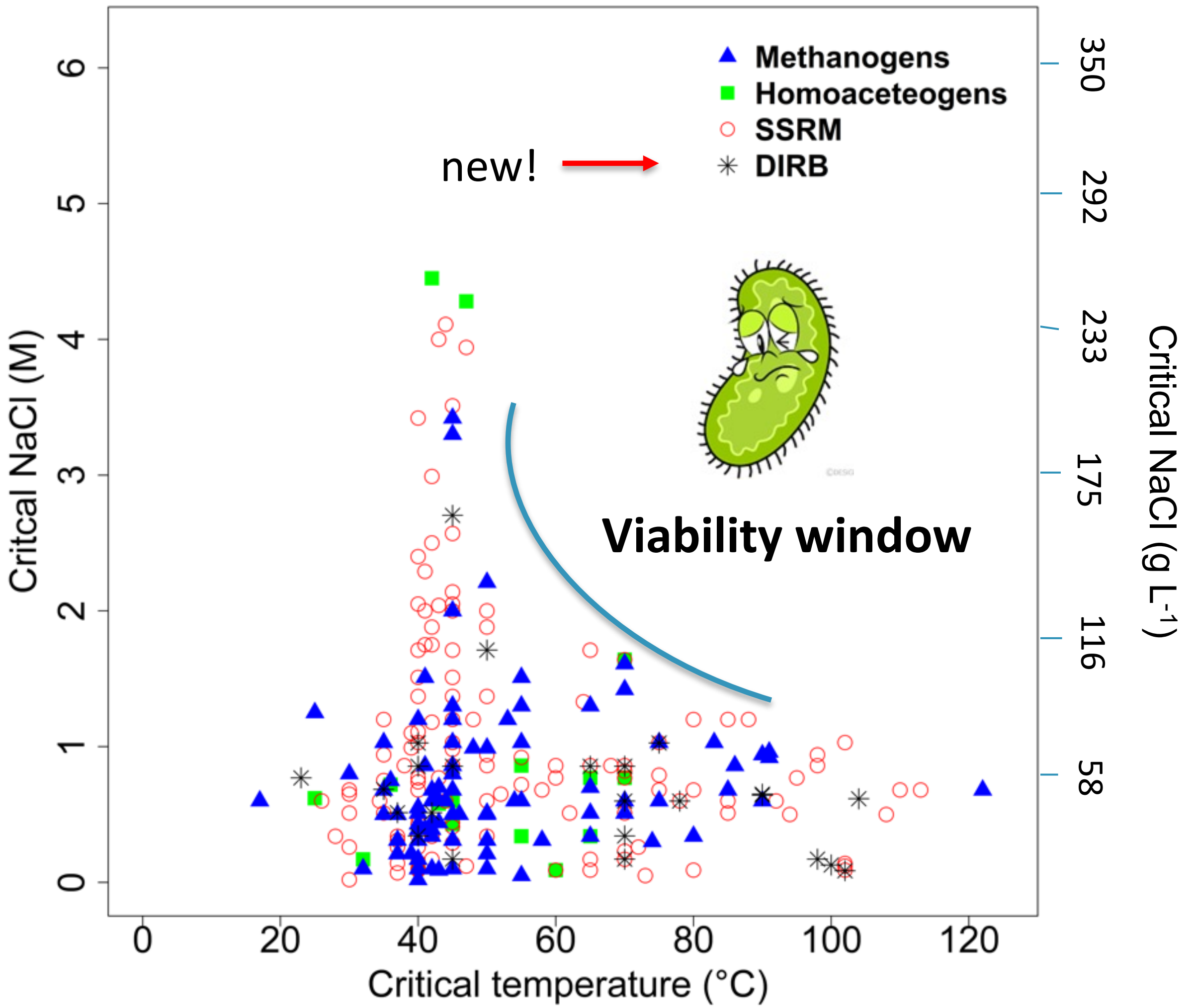
Amplification of collection of microbial strains



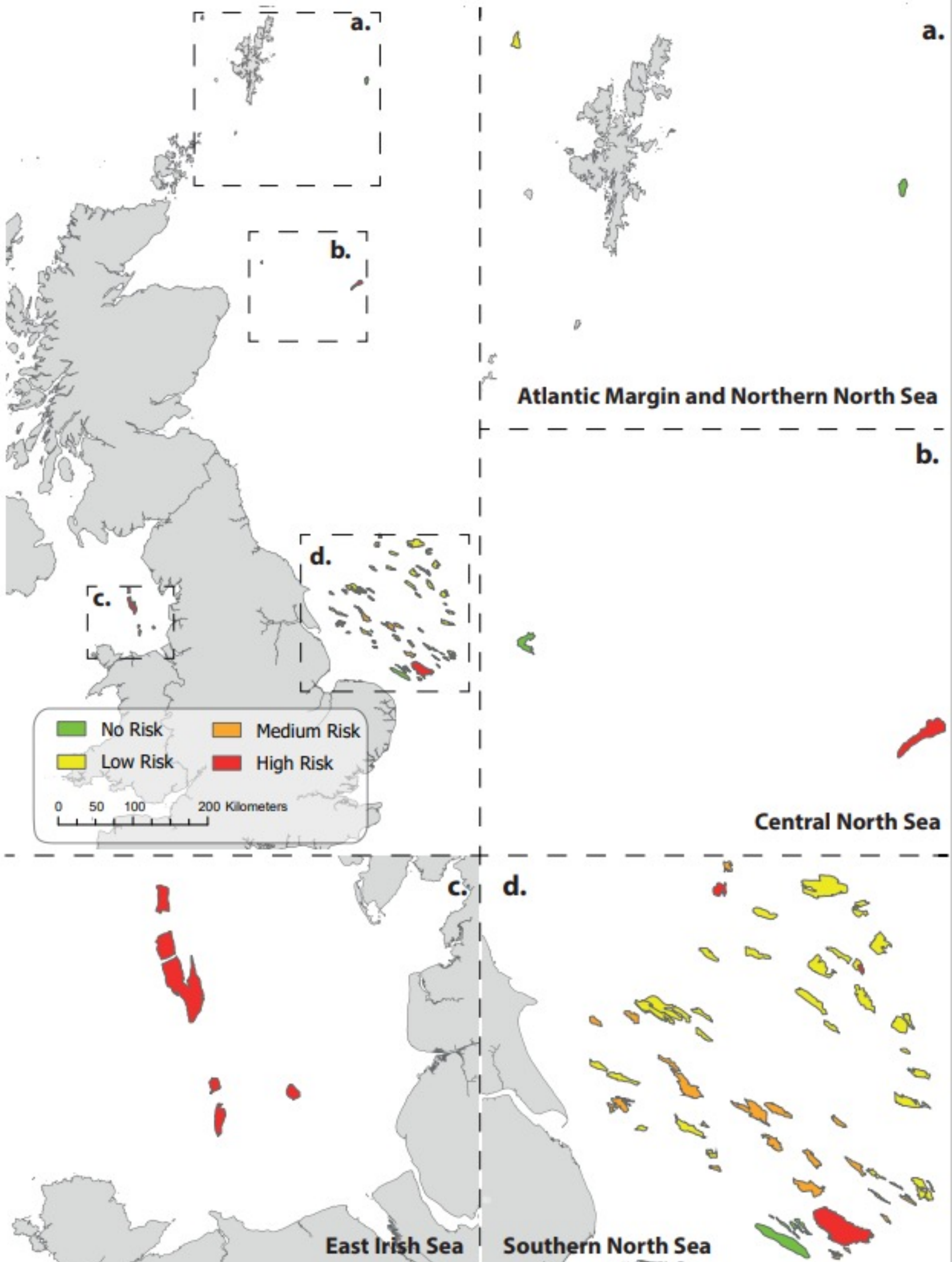
- Site selection may be based on the most important factors for controlling microbial growth: salinity and temperature
- Aquifers with **temperatures >122 ° C and salinities > 4.4 M have reduced risk** for adverse microbial effects
- **Storing H_2 >55 ° C and >1.7 mol L^{-1} NaCl reduces the risk of H_2 loss**

uncertainty: not cultivable microbes

Thaysen et al., 2023, Microbial risk assessment for underground hydrogen storage in porous rocks

Microbial risk site screening of UKCS gas fields

- **No risk**: fields with a temperature >122°C can be considered as sterile, as no H_2 consuming bacteria have been found above this temperature. **9 UKCS gas fields**
- **Low risk**: fields >90 °C are considered paleosterile. **35 UKCS gas fields**
- **Medium risk**: fields >55°C and a salinity > 1.7 mol L^{-1} NaCl, as no cultivated H_2 consuming bacteria can grow in this combination. **22 UKCS gas fields**
- **High risk**: fields <55°C because these are conditions optimal for growth. **9 UKCS gas fields**



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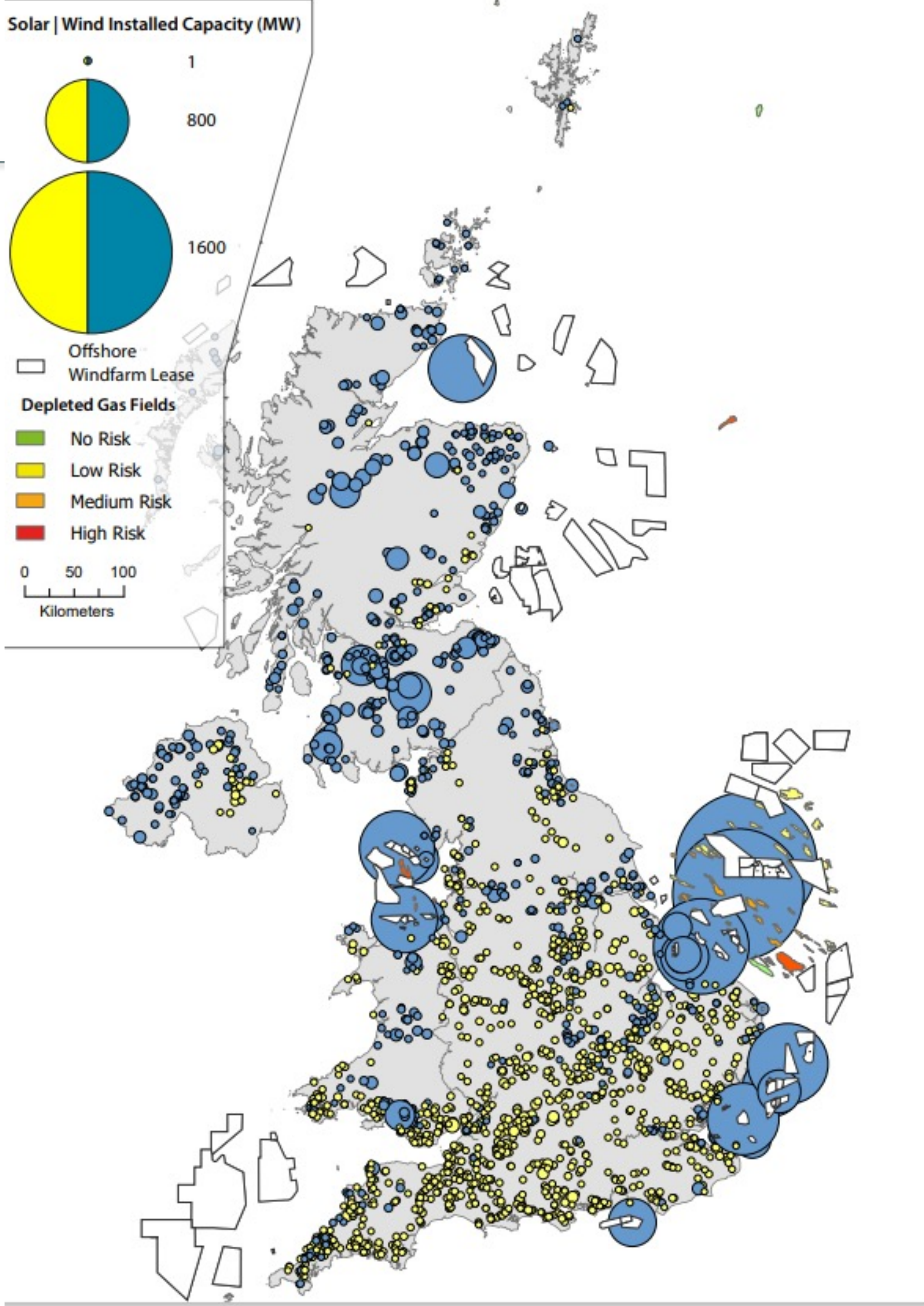
Alignment with centres for renewable energy production

- **Largest capacities** for renewable electricity production from offshore windfarms can be found **in the SNS and NNS**
- **Only the SNS holds ´no risk´ or ´low risk´ depleted gas fields that are connected up to windfarms**



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Alignment with not-in-use pipelines

Southern North Sea holds many not-in-use pipelines which could be repurposed for H_2 transport to ´no risk´ or ´low risk´ depleted gas fields

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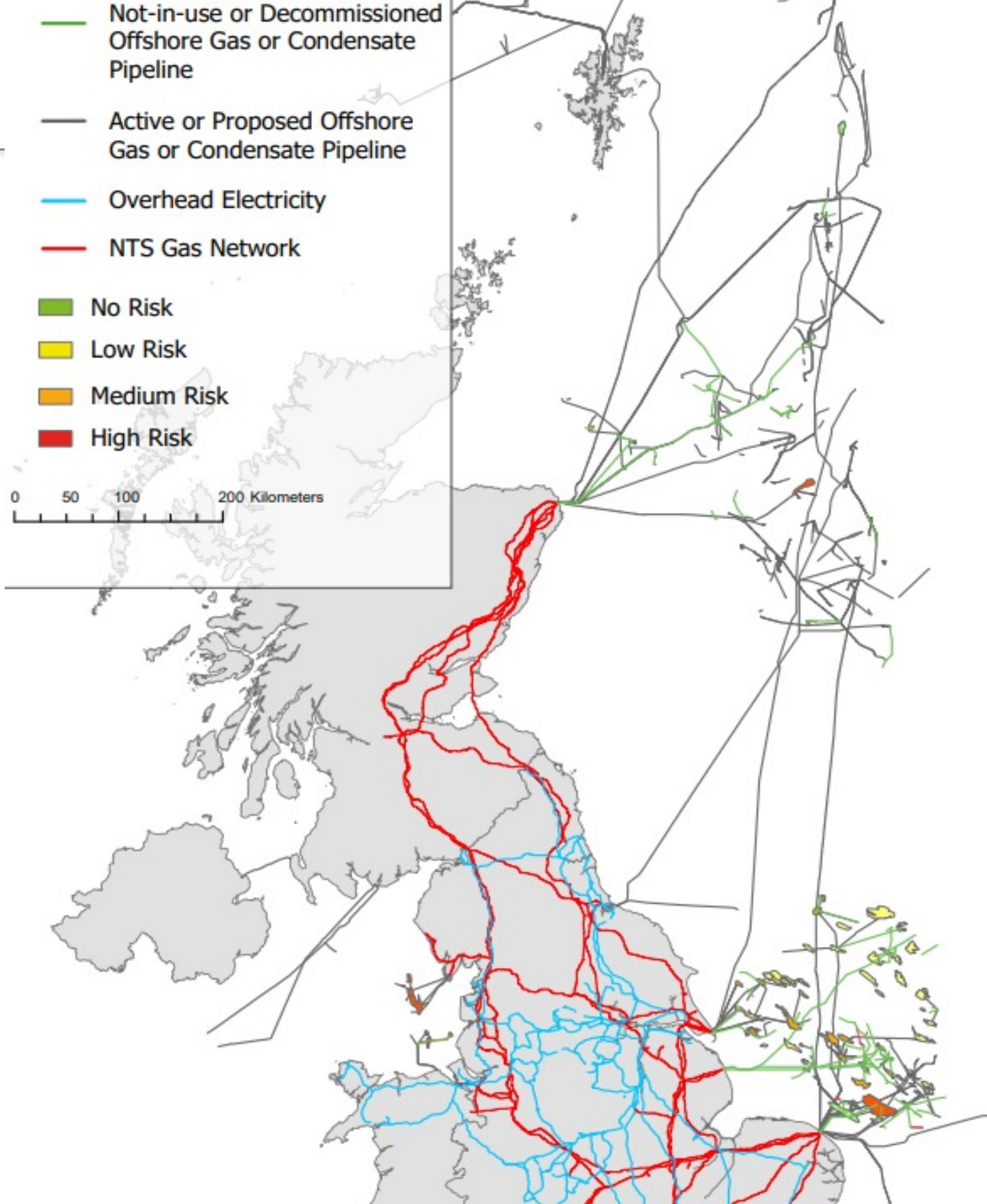

Conclusions

- 9 DGT are ’no risk ’
- 35 DGF are ‘low risk’
- 22 fields are ‘medium risk ‘

may be considered as potential H_2 storage sites after careful evaluation of the microbial community

- Alignment with wind farms and out-of-use pipelines suggests that No Risk or Low Risk DGF in the SNS are the most suitable candidates for H_2 storage

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Full Length Article

Microbial risk assessment for underground hydrogen storage in porous rocks

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A R T I C L E I N F O

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A B S T R A C T

Geological hydrogen storage, e.g. in depleted gas fields (DGF), can overcome imbalances between supply and demand in the renewable energy sector and facilitate the transition to a low carbon emissions society. A range of subsurface microorganisms utilise hydrogen, which may have important implications for hydrogen recovery, clogging and corrosion. We gathered temperature and salinity data for 75 DGF on the UK continental shelf and