GIS FOR UNDERGROUND H2 STORAGE

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Keywords: Hydrogen storage, Infrastructure, Transport

ABSTRACT

A geographic information system (GIS) creates, manages and visualizes specific information from various databases associated with locations on the globe. All kinds of datasets can be used if they are specified by a minimum of two coordinates. The energy transition towards a carbon emission free world demands handling of datasets from various providers and knowledge areas such as renewable energy production and underground storage operators. Locations of end-userss are essential to assess the relationships between components of this energy network. It is forecasted that green hydrogen will have a central role in the future energy systems. Large-scale underground storage will be necessary to bridge gaps between energy production and demand [1]. In Europe, the North Sea has a critical location, offering large areas for wind power production, underground CO_2 and hydrogen storage capacities and cheap transportation via ships or pipelines from western Europe industrial hubs. Considerable open datasets are available from the North Sea neighbors (UK, Netherland, Germany, Denmark, Norway) and can be used for data interpretation analysis and optimization (Figure 1).

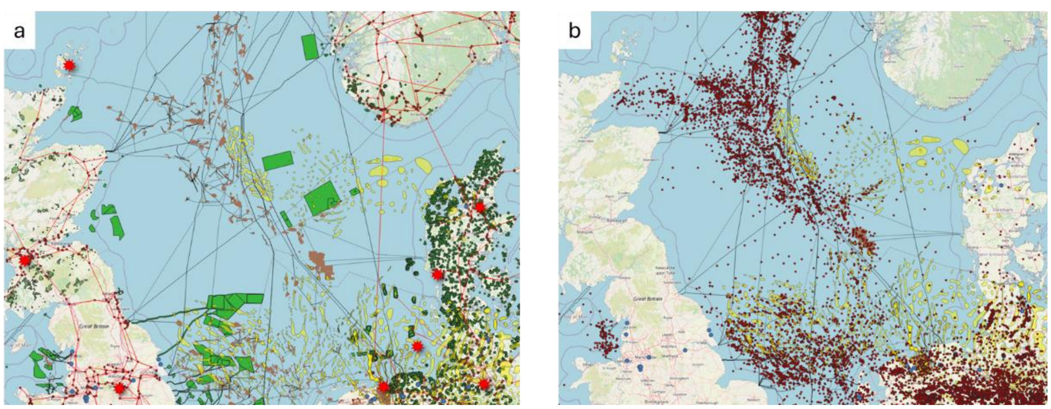

Figure 1: GIS data from the North Sea. a) Infrastructure necessary for the energy transition including locations of windparks (green), salt deposits (yellow) hydrocarbon fields (brown), pipelines (black lines), electricity grid (red lines) and large scale electrolyzer locations (red stars). b) Locations of hydrocarbon wells.

The QGIS software [2] offers a convenient platform to develop custom plugins which can help to analyze data related to transport and underground hydrogen storage. At SINTEF Industry Applied

Geoscience group, we are developing three QGIS plugin prototypes for the initial storage potential screening phase (Figure 2).
The *H2salt* plugin allows the user to estimate the volume of a salt structure and the number and features of the potentially manufactured caverns, while considering the composition of the rocks and the fluid properties at the chosen location (Figure 2). It is designed to estimate the storage capacity of hydrogen in salt caverns on the Norwegian continental shelf.

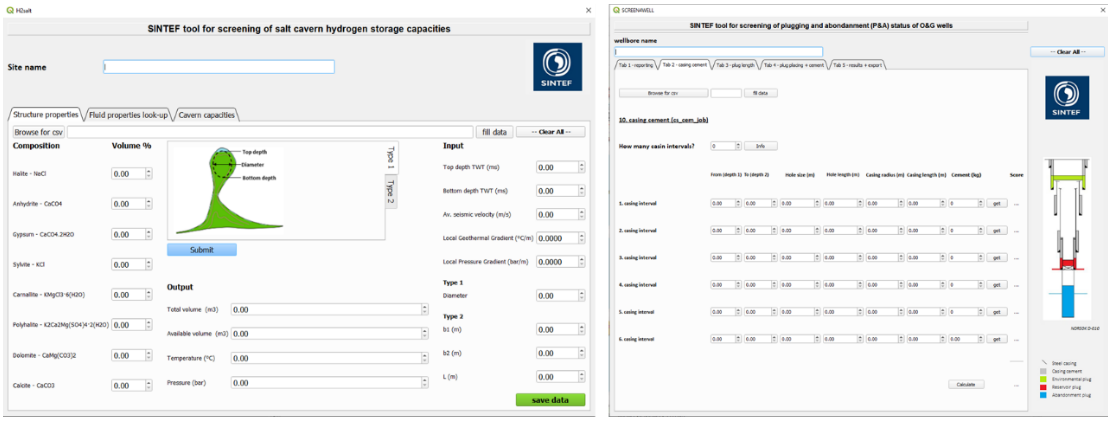

Figure 2: Examples for graphical user interfaces for the *H2salt* and *SCREEN4WELL* plugins.

With the *StoreH2* plugin, we can collect data from hydrocarbon fields and use production and volumetric data to estimate maximum hydrogen storage capacities. We assume that volumes taken before by hydrocarbons can be replaced by hydrogen, i.e. the original oil or gas in place which has been produced gives a first assumption on hydrogen storage capacity. Additionally, a simple volumetric calculation can be applied using rock pore volumes and hydrogen densities at reservoir pressure and temperature as main input.
The *SCREEN4WELL* plugin uses publicly available data to analyze the P&A (plugging and abandonment) status (Figure 2) of legacy wells [3]. Legacy wells are a major threat for underground storage projects as they can act as a preferential leakage path (if in poor conditions) and need to be identified.
These tools allow fast quantification of hydrogen storage capacities and major leakage threats from legacy wells. Results can be integrated in more sophisticated optimization tools such as *HyOpt* [4].

References

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