Geophysical Research Abstracts
Vol. 21, EGU2019-4205, 2019
EGU General Assembly 2019

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Estimating Potential for CAES (Compressed Air Energy Storage) in the bedded halites of the UK.
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CAES is an enabling technology to achieve lower-C energy worldwide. In the UK, transition to renewable energy sources driven by a requirement to reduce CO_2 production to meet environmental obligations by 2050, will sustain a diverse energy mix, improving national energy security of supply. In order to level the variability in renewable power production and match demand there is a need for bulk storage of surplus energy created by renewables in off-peak periods and fast ramping to meet demand at peak periods. With Compressed Air Energy Storage (CAES), electricity (energy) generated during off-peak periods is used to compress air to high pressure, to be stored either in above-ground or near-surface pressurized air pipelines or by injecting into subsurface storage (depleted hydrocarbon fields, aquifers, lined mined voids or salt caverns). During peak demand periods, air is released to drive gas turbines to generate electricity. Two 'conventional' (diabatic) CAES facilities are currently operational at Huntorf, Germany and McIntosh, Alabama, USA. These operational plants demonstrate that CAES is at mature a TRL-level and commercially viable in solution-mined underground salt caverns. Halite is the most suitable lithology for solution mining caverns and CAES because it is highly soluble, impermeable to gas, and unless strain rates are very high, deforms by creep and flow rather than by brittle deformation formation or faulting. Thick-bedded halite deposits exist in the UK at suitable depths to host CAES and a number of natural gas storage cavern facilities already exploits these providing infrastructure and information on underground storage in halite. We describe a novel technique using Esri's ArcGIS Geographic Information System software and the spatial distribution, thickness and insoluble content of the halite beds to derive potential storage cavern locations and an estimate of the physical volumes that might be available for further storage purposes, including for CAES. We also describe a tool that has been developed to predict the exergy ('useful energy') stored when charging caverns, providing a prediction of the potential of the caverns because their storage capacity not only relies on their volume, but also their depth and consequently depth dependent parameters like pressure and temperature. The model predicts how these factors change and effect exergy storage throughout a filling cycle to give a final maximum exergy storage prediction for a single cavern, salt basin and ultimately the UK.