Potential CO_2 storage sites in Greece – A review

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The New Policy Scenarios (NPS), released by the International Energy Association (IEA), which incorporate existing energy policies as well as an assessment of the results likely to stem from the implementation of announced policy intentions, have identified a slight increase, compared to the previous years, to the CO_2 emission worldwide. On the other hand, according to the Organisation for Economic Co-operation and Development (OECD) and the IEA report "CO_2 Emissions from Fuel Combustion" (IEA, 2018), the CO_2 emissions in Greece since 2012 and up to 2016 (last published data) have been decreased from 7000 to 5900 tonnes/cappita.

Based on the strategy paper that was published by the European Commission (EC, 2018), the use of carbon capture and storage (CCS) technologies is "still necessary" to achieve long-term climate goals. Taking this into account and the continued high fossil fuel dependency of the Greek power sector, the potential for CCS opportunities within Greece should be investigated as a way of mitigating the greenhouse gases, in line with other options.

Different potential sites for CO_2 storage have been identified in Greece with total storage capacity in deep saline aquifers and hydrocarbon fields estimated at 2190 Mt. The total effective storage capacity in aquifers alone in Greece was estimated to be around 184 Mt (Hatziyannis, 2009). The aforementioned CO_2 storage capacity concerns the Tertiary sedimentary basins of Prinos, West Thessaloniki and a part of the Mesohellenic Trough (Hatziyannis, 2009) (Figure 1).

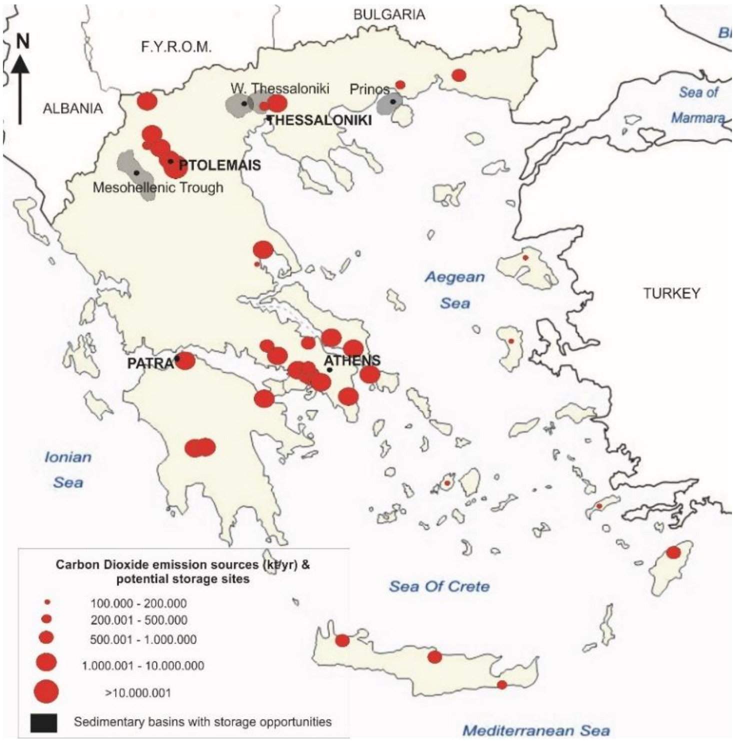

Figure 1. CO_2 emission sources and potential storage sites in Greece

Based on available information, Koukouzas et al. (2009) have conducted a Basin-Scale Assessment (Bachu et al., 2007), identify the best Basin for a potential CO_2 storage. The authors concluded that the tectonically stable offshore Prinos Basin has favourable characteristics for CO_2 geological storage as well as sufficient storage potential to take in the total amount of CO_2 produced by the nearby Komotini gas fired power station (0.7 Mt/year CO_2) for several decades. In addition, the offshore location of the potential reservoir and seal units increases the transportation costs but it is countered by the well-established infrastructure framework within 30–40 km of the coast (pipelines, wells and platforms).

The onshore Thessaloniki Basin appears to have very good technological and economic potential for CO_2 storage. Favourable factors include limited faulting, optimal depth ranges for CO_2 storage capacity, and relatively low drilling costs within the closures identified. It appears to have the capability to store all the regional stationary CO_2 emissions (one cement plant and one refinery with its 400 MW Combined Cycle Gas Turbine Unit emitting in total around 1.9 Mt CO_2/year) or the total lifetime.

The CO_2 storage potential of the Mesohellenic Trough is unclear due to sparse drilling across the basin although suitable reservoir and seal units appear to be present at appropriate depths, but the extensive faulting should be considered as a potential risk. Tasianas and Koukouzas (2015), have examined further the area for its potential in storing CO_2. According to their research, CO_2 storage can take place in the Pentalofos sandstone (Figure 2), a reservoir extending throughout the entire MT and it is located below the Tsotylli Formation (Fm) caprock (Zelilidis et al. 2002).

More specifically, the geological modelling conducted in the Mesohellenic Trough, allowed the assessment of the CO_2 storage potential and provided an estimation of the CO_2 storage capacity for the Pentalofos reservoir. The Pentalofos formation is also capped by an effective cap rock, the Tsotylli Formation, and can be, thus, potentially be used as a storage area for CO_2 regionally. According to the geological model, the deepest point where the CO_2 can be stored corresponds to the base of the Tsarnos formation, at 2544 m depth. The estimated amount of potential CO_2 storage is up to 1435 Gt.

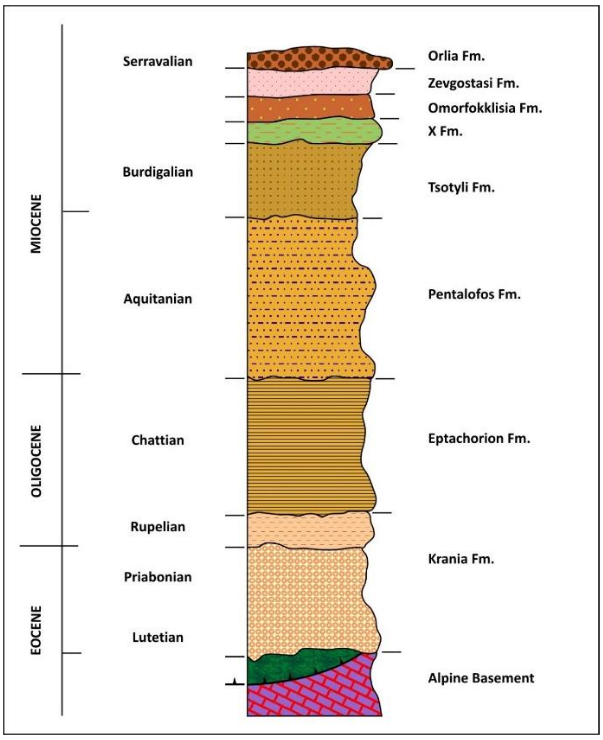

Figure 2. Stratigraphic column of Mesohellenic Trough

In addition to the geological modelling, geochemical experiments and modelling were also conducted for the Mesohellenic Trough, which support the fact that Pentalofos and Tsotyli sandstone formations are suitable for the long-term storage of CO_2 produced in the neighbouring lignite-fired power plants, at least in terms of mineralogy and geochemistry.

To conclude, the large-scale implementation of CCS at large point sources of CO_2 in Greece would reduce the national CO_2 emissions by 25–28%. The geological settings of the Tertiary and Neogene-Quaternary sedimentary basins in Greece appear to provide a promising option for CCS implementation. The identified potential reservoirs and overlying seal units occur within approximately 100 km of the significant stationary CO_2 emissions in NW Greece, which is favourable in terms of infrastructure costs. Continued optimisation of the models used, combined with more information on the structural properties of the potential reservoirs of the sedimentary basins, could help in their further evaluation as a potential storage structures for CO_2.

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