



The Need for a CO₂ Geological Storage European Atlas

What is CO₂ Geological Storage? Capturing carbon dioxide (CO₂) emissions from various point sources and storing it underground is a crucial technology to reduce the global warming impact of fossil fuels such as coal and hydrocarbons, on which the world will continue to depend for decades. This method of restricting the release of CO₂ into the atmosphere is termed carbon capture and storage (CCS), or CO₂ geological storage, when referring only to the downstream part of CCS.

CCS usually involves a series of steps:

- Separating the CO₂ from the gases produced by large power plants or other point sources,
- Compressing the CO₂ into dense (supercritical) form,
- Transporting it to a given location,
- Injecting it into deep underground geological formations.

The science and technology behind CCS is already manifested and has been in use for enhanced oil recovery (EOR) since the 1960's and for CO₂ geological storage since 1996. Further development of CCS is needed, however, if it is to be implemented on a large scale. A number of CCS demonstration projects are now at various stages of development in Europe and other parts of the world.

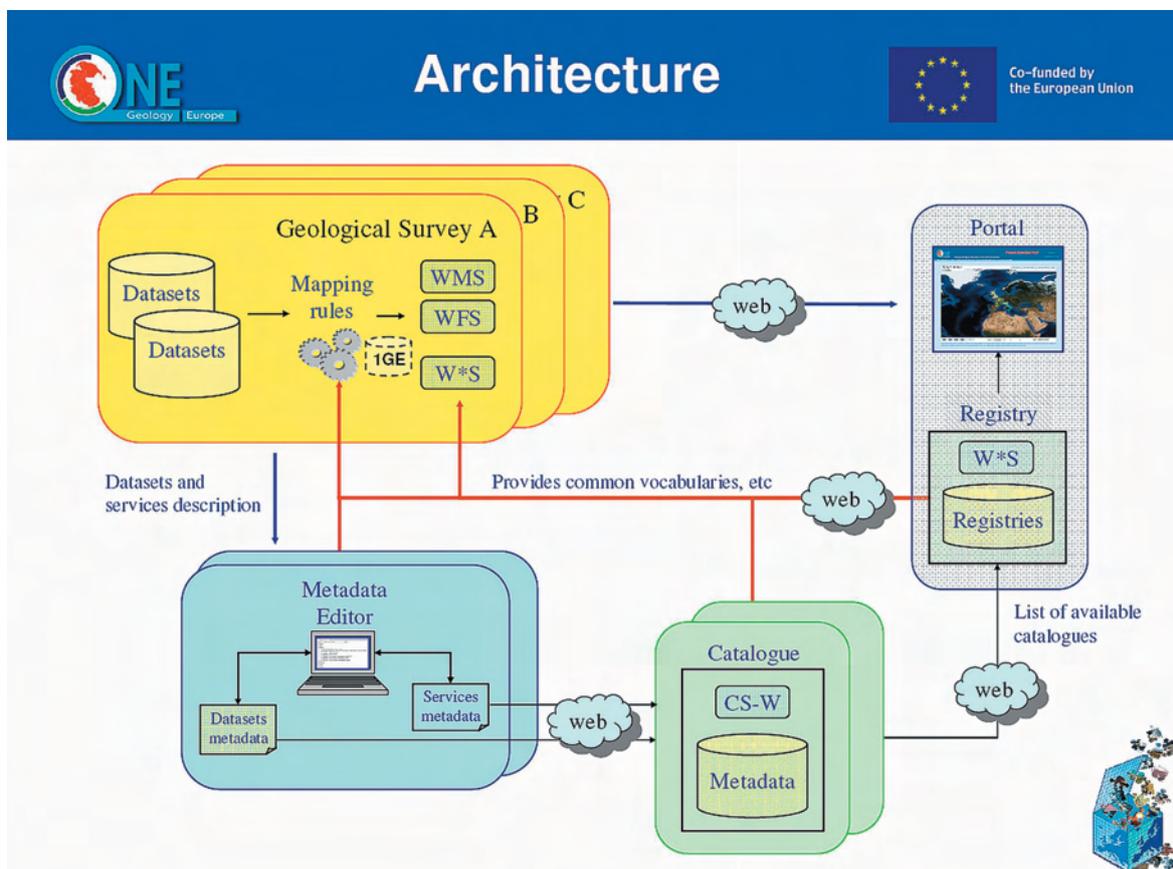
The EU aims to promote the construction and operation of a number of CCS demonstration projects by 2015. In order to stimulate the role that CCS can play in a portfolio of greenhouse gas mitigation options, ENeRG is aware that we require coherent information about effective CO₂ storage capacity, where this storage capacity is and when it will be available.

Storage Atlas: Most of the EU member states and associated countries participated in the EU GeoCapacity project and even more countries are now involved in the CO₂StoP project. The European Commission initiated the project CO₂StoP to establish a database on publicly available data on CO₂ storage potential in Europe. The CO₂StoP project is building upon the basic work and results generated by the previous projects, the EU GeoCapacity FP6 R&D project (2006–2008) which again was based upon the results of the Joule II project (finalised 1995), the GESTCO project (finalised 2003), and the CASTOR project (finalised 2007). ENeRG considers the CO₂StoP project as a very important step and that this area needs to be further developed.

The CO2StoP database will be the first step towards a European Storage Atlas. In 2007, the USA National Energy Technology Laboratory (NETL) released the first Carbon Sequestration Atlas of the United States and Canada, and in 2012, the fourth version was published. The latest version (The North American Carbon Storage Atlas 2012) includes also Mexico and identifies the potential CO₂ geological storage capacity in North America. In 2011, the Norwegian Petroleum Directorate published the CO₂ Storage Atlas, Norwegian North Sea. Furthermore, the Queensland Carbon Dioxide Geological Storage Atlas, the first storage atlas from Australia, was published in 2011.

ENeRG considers that an interactive web-based CO₂ Storage Atlas for Europe is of high priority. ENeRG suggests that the atlas should be made available in a way similar to the OneGeologyEurope map, and linked to the individual countries databases for CO₂ storage data. Ideally, the access to the data produced through CO2StoP should be made available through EuroGeoSurveys (EGS), according to EGS' standards (data policy, technical specifications for data services etc.), and accessible through a portal operated by EGS. In a few years, such a portal will probably be established through the EGDI (EU pan-European Geological Data Infrastructure) project. Already today map-based data objects can already today be made accessible through the OneGeology-Europe portal.

An ideal atlas would not only include data, but also the analysis of data, which could be provided through OneGeology-Europe. The technical solution of consolidation from national data servers, as addressed in the EuroGeoSource project, is/will be one of the EGDI models.



These data services can of course also be used for other portals, e.g. geothermal data, which would include many of the datasets used for CO₂ geological storage, e.g. borehole porosity, permeability, temperature etc.

CO₂ geological storage is also connected with the separation and capture of CO₂ at the point of emission and the transportation of CO₂, and these data should preferably be in the database as they were in the EU GeoCapacity project.

Production of a European CO₂ Storage Atlas will be the result of collaboration among carbon storage experts from national and EU agencies, as well as industry and academia. Providing access to the Atlas using web technologies will ensure that storage potential data across most of the Europe will always be available in an up-to-date version. The primary purpose of a European Atlas is to provide updated information on the CO₂ storage potential for the European planning of CCS activities including the locations and storage potential of various geological storage sites. A key aspect of a European Storage Atlas will be the availability of the latest and best available estimates of potential CO₂ storage resource determined by a methodology applied consistently across all of Europe, Canada, USA and Australia.

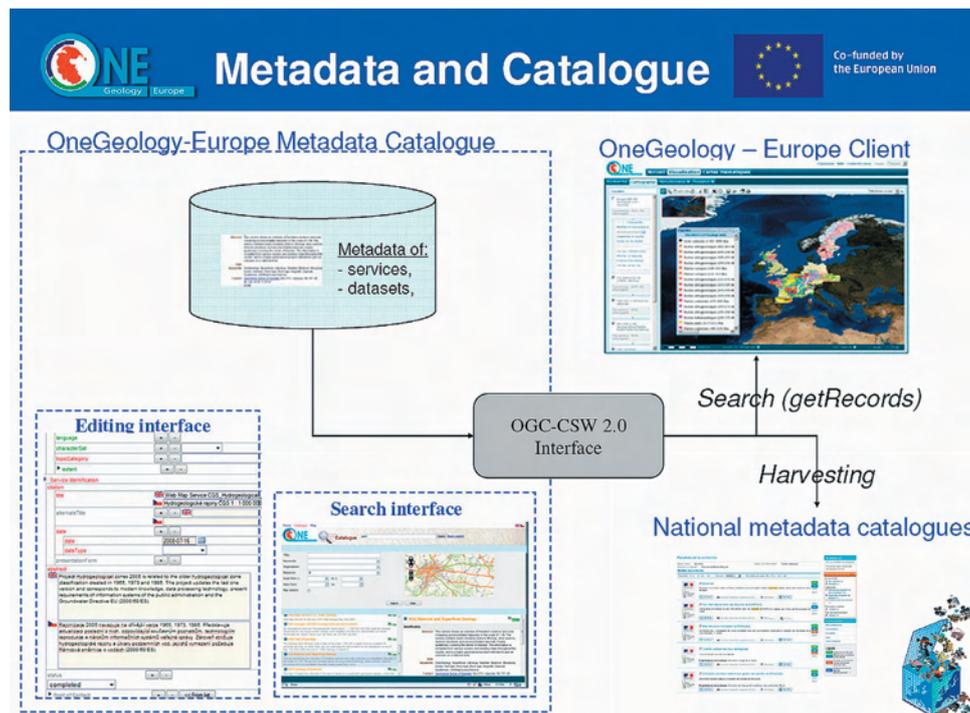
A CO₂ storage estimate is defined as the fraction of pore volume of porous and permeable sedimentary rocks available for CO₂ storage and accessible to injection of CO₂ via boreholes. CO₂ storage capacity assessments ideally include economic, geochemical, or regulatory constraints, not only physical constraints applied to define the accessible part of the underground.

Geological storage is defined as the placement of CO₂ into a subsurface formation such that it will remain permanently stored. CO2StoP is investigating two types of underground formations for CO₂ geological storage, saline formations, and oil and gas reservoirs. Other structures potentially suitable for CO₂ storage are unmineable coal seams or areas, organic-rich shales, and basalt formations. These other structures, which have the potential for CO₂ storage, should also be included in the database in the long term.

The CCS process also includes monitoring, verification, accounting and risk assessment at the storage site. The database will be a useful tool for accurate accounting of stored CO₂ and for the development of the CO₂ plumes to give a high level of confidence that the CO₂ will remain permanently stored. The database may also be used for risk assessment research to identify and quantify potential risks to humans and the environment associated with carbon geological storage, and to identify appropriate measures to ensure that these risks remain low.

Approach: The concept is a completely modern paradigm: the basis is a GIS, an interactive web database server drawing the available storage data from the individual countries databases and a calculation engine. The formulae for estimating capacity shall be based on those developed by the CSLF (which are essentially identical to those used by the US DoE Regional Carbon Sequestration Partnerships). These formulae were also used in the earlier GeoCapacity project and in the on-going CO2StoP project. It is anticipated that new formulae may also need to be developed. The data for the web portal will be updated and improved regularly on a national basis by the individual geological surveys and other bodies. The concept will ideally contribute to:

- A harmonization of CO₂ storage data in Europe,
- The development of a web GIS system with a multilingual system to identify, access, use and reuse aggregated geographical information on geo energy and mineral resources,
- Providing services for the registration of data sets from different countries, such as the visualization and overlay of the information layers obtained from distributed sources and spatial analysis,
- Providing geological risk data so that the proportion of the total storage capacity that can be relied on is visible,
- Making existing storage data from all countries in Europe accessible.



Technical details: The domain part of the architecture is a storage portal, together with a monitoring platform, and the registry. The storage portal is software that requests the metadata catalogue to discover the datasets, and that provide tools for viewing and querying the datasets. In order to insure the smooth integration of the national datasets, a common data specification is needed.

Thanks to the EGDI web services, the geological storage map will always acquire the latest updated data from the studied region or country.

The methodology should have international credibility and be compatible with other advanced methodologies used internationally. Further development and updates of the methodology can easily be implemented on all data through the joint calculation regime.

By developing web services for sharing publically available spatial data on the total accessible CO₂ storage capacity, the CO₂ storage atlas will enable the creation of value-added services for the CO₂-free energy supply of Europe.

Niels E. Poulsen
ENeRG president