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A strategic project for CO_2 sequestration into depleted oil & gas reservoirs.

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The growing use of fossil fuels for energy caused the increase in the amount of anthropogenic carbon dioxide (CO_2) emitted into the atmosphere that, in about half century, has risen from about 280 parts per million to over 350 ppm (*Scripps, Ornl, IPC)*. The global energy used suggests a continuous increase in carbon emission for the present century and a consequent rising concentration of CO_2 into the atmosphere.

By now it is clear and worldwide shared that the winning strategy to be able to guarantee the reduction of greenhouse gases is to devise a new approach to provide a type of energy free or, at least, with a low carbon fuel content, by the capture, separation and sequestration of CO_2 emissions.

Three are the main solutions to remove the big amount of greenhouse gas emissions into the atmosphere:

- storage in the terrestrial biosphere, biomass and soils;
- injection of CO_2into the ocean zones deeper than 1000 meters;
- capture and sequestration of CO_2 into depleted oil and gas reservoirs, deep saline aquifers, and underground coal-beds.

The greenhouse gases sequestration into rock formations should involve multidisciplinary investigations to identify a methodology able to evaluate the CO_2 storage ca-

pacity and the potential volume to be injected into exhausted gas and oil fields, well characterized from the reservoir properties point of view.

Oil Companies, like Eni Exploration & Production, have a large know-how resulting from tens of years of oil and gas exploration and exploitation both in Italy and in a large number of foreign countries; from the other side the CO_2 emissions from their refineries and power plants must be a point of attention for the companies.

Thence, the cooperation between universities and industry can be very useful, resulting in jointed activities finalised at the study of a possible limitation in carbon emissions. On this basis, since 2003, the University of Perugia has been one of the institutions involved in a strategic multitask project managed by Eni Exploration & Production Division. The project is focused on the identification of depleted reservoirs to be used to ensure the CO_2 confinement for a long period without any risk and with all the safety conditions.

In fact, specialists from the Earth Science department of the University of Perugia, together with their students, are contributing to the project with their knowledge in regional and applied geology.

A joint group between Eni E&P specialists and University representatives has developed the screening of the Italian fields on the basis of a wide set of properties.

The first phase of this task has been dedicated to the definition of a screening methodology: the properties affecting the CO_2 confinement have been identified, grouped, and analysed in order to be able to assess the suitability of all the depleted reservoirs managed by ENI E&P to store CO_2, taking into account also safety and economical aspects.

For this reason, both seal rock and reservoir characteristics have been widely and accurately studied. A large number of parameters have been identified as critical, such as seal rock's integrity, reservoir bulk volume, petrophysical characteristics, threshold pressure, basin type, stress regime, tectonic setting, depositional environment, seismicity, geographic location, number and type of existing wells and existing facilities, distance from CO_2 source, etc.

The reservoir information is then weighted on the basis of its criticality in order to select the most appropriate candidates for CO_2 storage.

In a second phase, on the basis of the above mentionned screening parameters, organized in a hierarchical structure, more than 20 reservoirs (from an initial DB containing about 150 fields) have been selected. A synthetic reservoir description in terms of petrophysics, lithology and seal integrity has been produced for all the fields.

Moreover, the mapping of all Eni's carbon dioxide emission sources in terms of emitted volumes and plant characteristics have been performed.

The potential volume of CO_2 to be injected into the depleted reservoirs with suitable characteristics have been calculated through a material balance procedure, on the basis of the data of the initial volumes of hydrocarbons in place, calculated during the conventional reservoir studies. An exhaustive evaluation has been carried out considering practical and economical aspects like the availability of the reservoirs in terms of the exhausted production time, the distance from the CO_2 sources and the presence of pipelines and connected facilities.

The results of the above described activities will be the basis of Eni's programme, whose objective is the design and drilling of a CO_2 injection pilot well, allowing the storage of a small quantity of carbon dioxide into one of the selected reservoirs and the monitoring of its behaviour.