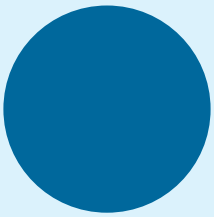
OIL AND GAS CLIMATE INITIATIVE

Multinational CO_2 Storage Resource Assessment

Availability of CO_2 storage capacity in key markets

November 2017



Commercial
0.2 GT

Injecting or firm intention to proceed

Sub-Commercial
361 GT

Discovered with some potential for development

Undiscovered
11,569 GT

Prospective storage resources

North America, China, Indian Subcontinent, Australia, Brazil, Norway, United Kingdom

Executive Summary

A global deployment of Carbon Capture and Storage (CCS) requires investment level confidence in the availability of suitable CO_2 storage resources around the world. Much research has been completed and is progressing in the field of CO_2 storage resource evaluation, but the absence of an international system against which to report estimated CO_2 storage resources will challenge investor and financier decision making in this space.

The Petroleum Industry has international systems such as the Society of Petroleum Engineers (SPE) Petroleum Resources Management System to support it in a range of activities including resource valuation, financing, and investment decisions. This is now in use by stock exchanges all over the world, including the London Stock Exchange.

In April 2017 the SPE introduced a CO_2 Storage Resource Management System (SRMS) to support the evolving CCS industry. This will serve a similar purpose but in addition will:-

1. Enable nations to map the progression of storage resource maturity in the evolving industry.
2. Improve the consistency and rigour used to track the progression of national, industrial and corporate readiness to deploy CO_2 storage on a commercial basis.
3. Establish consistency in the use of resource terminology to improve communication of key issues between practitioners, financiers, regulators and policy makers.
4. Improve confidence regarding resource assessments with policy makers and potential customers of CO_2 storage who may be unfamiliar with subsurface resources but who need to make important decisions that are dependent upon them.

Once the SMRS was in place, the question was "how do current resource assessments measure up"? To answer this, the OGCI workgroup on “Availability of CO_2 Storage Capacity in Key Markets” commissioned an external project to review existing CO_2 storage assessments. This was based on the SRMS and developed a preliminary multinational statement of the classification of existing CO_2 storage resource estimates.

The analysis was based upon regional CO_2 storage resource estimates from North America, the UK, Norway, China, Brazil, Australia and the Indian Subcontinent. The project was supported and guided by experts from across the OGCI member organisations and a summary has been submitted for publication in the International Journal of Greenhouse Gas Control.

The team has also made an attempt to assess the effort and approaches needed to restate certain CO_2 storage estimates with a view to supporting progression of regional CO_2 storage readiness.

The completed project is one of the first broad deployments of the SRMS. It has developed guidance to support continued improvement of the SRMS by the SPE to ensure that storage resource estimates can be consistently classified and be clearly differentiated in terms of their technical risk and commercial maturity levels.

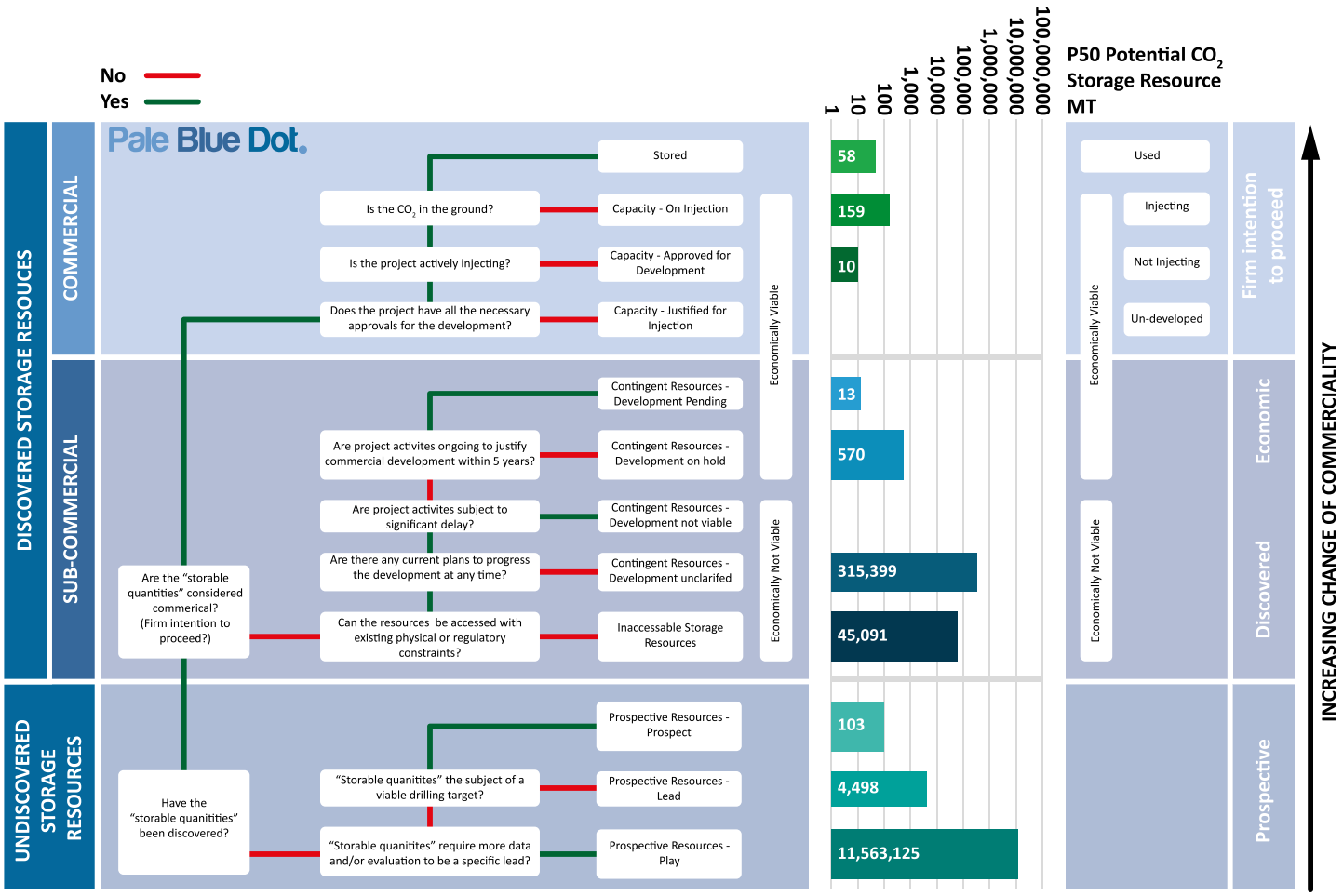
Key conclusions of this project include:-

- 12,000 GT of multinational CO_2 storage resource potential has been identified.
- Although 97% of this storage resource is prospective in nature and requires exploration effort to progress, a significant CO_2 storage resource can be matured without large drilling programmes.
- 70-90% of the currently discovered CO_2 storage resource lies within oil and gas fields.
- More effort and evidence is required globally to establish an effective and timely CO_2 storage resource maturation pipeline.
- The process of maturing storage resources within subsurface structures, such as four way closures, fault blocks and stratigraphic traps, has distinct parallels with progressing petroleum resources.
- There is a lack of experience globally in the quantification and maturation of storage resources in unstructured saline aquifers where the petroleum industry presents fewer useful analogues. Specifically this includes:-
  1. How to define and quantify discovered resources.
  2. How to deploy appropriate range of storage efficiency factors “E” at a basin or sequence scale.

What does the SRMS do?

The SRMS establishes a system against which prospective and discovered storage resources can be classified on the basis of their commercial maturity. It also helps to describe the level of subsurface technical uncertainty and specifically the range of potential storage resources at a given level of maturity. A well deployed storage resource management system will enable many aspects of commercial CCS development. Specifically, regular annual monitoring of resource progression through the system will help to assure governments and industry that storage resources are being matured in a timely manner. This will support corporations, industries and nations as each strives to meet their emissions control commitments under the 2015 Paris Agreement.

Preliminary workflow & results of storage resource classification



North America, China, Indian Subcontinent, Australia, Brazil, Norway, United Kingdom

What are the key project takeaways?

The SPE Storage Resource Management System

The SPE SRMS is a solid foundation for an effective storage resource management system. Care needs to be taken when applying the SRMS in two key areas:-

1. Defining the extent of discovered resource in assessment of unstructured saline aquifer systems. These dominate the prospective storage resource.
2. Effectively addressing the fundamental role of both vertical and lateral containment in the assessment of CO_2 storage resources.

These issues come together in the challenge of estimating what quantity of CO_2 would be retained within a site 1000 years after injection has come to an end rather than what can be injected into a site during its operational phase.

An outline workflow has been developed to support the classification of storage resources based upon the SRMS. This is illustrated here and should be considered a "work in progress" as it will evolve over time.

CO_2 Storage Resource Maturity

Together, the UK, Norway, North America, Australia, China, Brazil and the Indian Subcontinent have a huge potential estimated P50 CO_2 total storage resource of some 12,000 GT. This is more than 1000 years of global emissions at the annual 2016 global CO_2 emissions rate.

Whilst the nature and purpose of the regional assessment reporting has probably led to an underestimation of the maturity of the estimated storage resource in this preliminary assessment, it is estimated that almost 97% of the total storage resource is of a prospective nature. Only around 3% is considered as discovered.

As a result of extensive drilling in the search for petroleum, a significant resource can be matured through careful geoscience and engineering analysis rather than through drilling programmes. Of the currently discovered storage resource across this geography, enough work has been completed to mature around 750 MT (or about 0.2%) into investment ready storage resources.

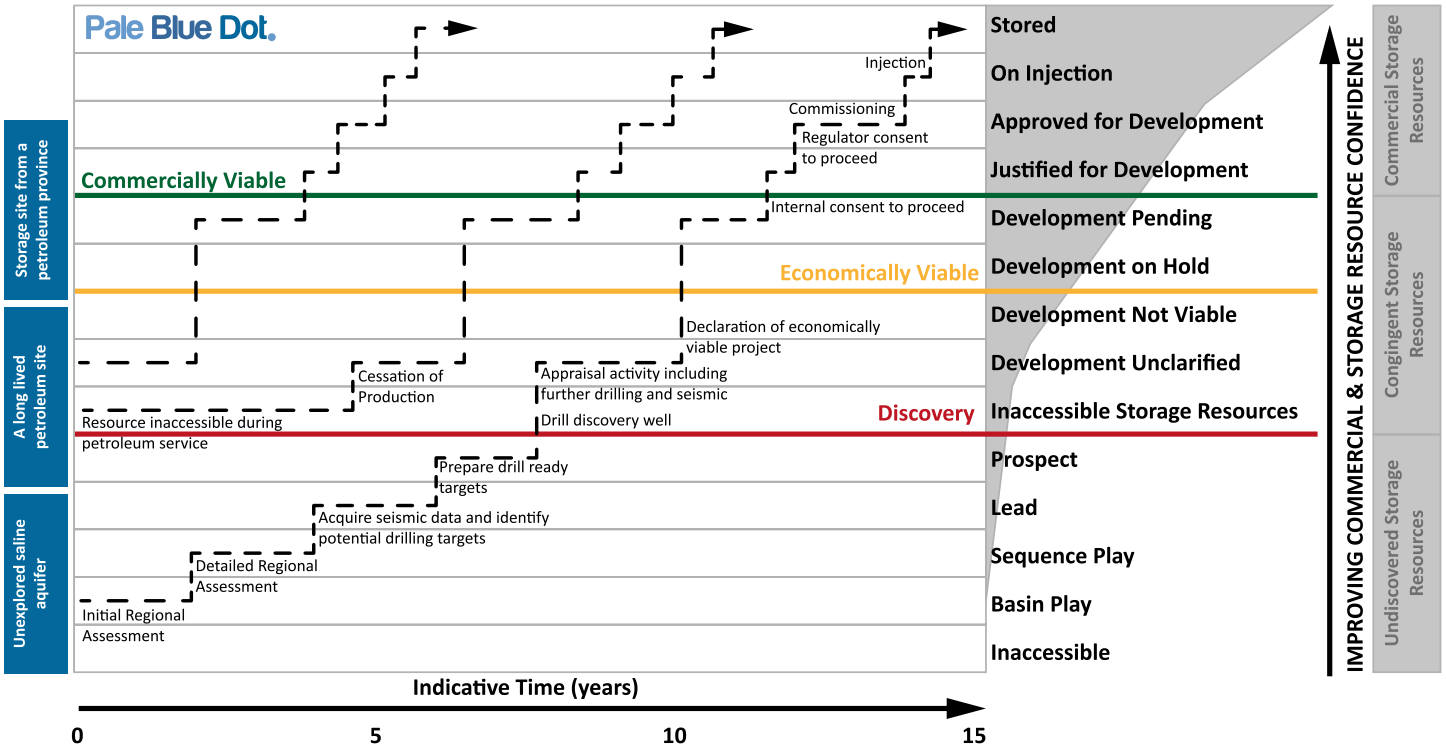
The Advances in CO_2 Storage Resource Research

Over the past 20 years, CO_2 storage research has made significant progress in understanding storage efficiency and the role of subsurface pressure constraints in CO_2 storage resource assessment. All future storage assessments should include careful consideration of these factors. Failure to address these issues with sufficient robustness in CO_2 storage assessment can lead to significant resource overestimation.

Regulatory System Evolution

All economies should be encouraged and supported to adopt or build upon the existing standards, such as ISO 27914 CO_2 Storage Standard and ISO 27913 CO_2 Transportation Standard and of course the SRMS, to build mature CO_2 storage regulatory systems. The lack of a national regulatory system for CO_2 storage will suppress the commercial maturation of CO_2 storage in some economies.

Timeline required to mature CO_2 storage resources



Future Focus

More effort and evidence is required to establish the effective CO_2 storage resource maturation pipeline that will be needed to service the international carbon reduction commitments of the Paris Agreement. Groups such as the GCCSI should be encouraged to include this progression in their annual reporting so that progress can be globally monitored.

The time required to mature CO_2 storage resources depends on many factors including the nature of the storage site as well as financing and regulatory approvals. The figure above illustrates the pathway for three sites from different environments. A site from a petroleum province may be advantaged because of the legacy petroleum data available in the province. This can support the development of both saline aquifers and depleted hydrocarbon fields and can assist the rapid progression of resource maturity, often without significant further drilling. Elsewhere in long lived petroleum provinces, CO_2 storage resource may be classed as inaccessible until petroleum production has finished. Once cessation of production is reached the maturity of the storage resource can again be readily progressed towards being investment ready. Finally, a saline aquifer outside a petroleum province is less likely to benefit from legacy subsurface data acquisition and will require much more time to explore, discover, appraise and develop. These are key factors in overall planning to ensure that investible CO_2 storage resource is available at the time that it is needed by industry.

Further Information

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