

GHGT-10

# Drivers and barriers towards large scale Carbon Capture and Storage (CCS) deployment and possible government responses

## Current insights from the Dutch perspective

Marten W. Slagter<sup>1\*</sup> and Edmund Wellenstein<sup>1</sup>

<sup>1</sup> *Energie Beheer Nederland B.V., Moreelsepark 48, 3511 EP Utrecht, Netherlands*

---

### Abstract

This paper aims to provide insight into the current drivers and barriers and the possible government responses needed to overcome these hurdles towards large scale CCS deployment in the Netherlands.

© 2011 Published by Elsevier Ltd. Open access under [CC BY-NC-ND license](#).

Keywords: large scale CCS; CCS development; CCS value drivers; government roles; EU ETS price

---

### 1. Introduction

Large scale Carbon Capture and Storage (CCS) is seen as an important technology to substantially reduce global CO<sub>2</sub> emissions. However, CCS is not a mature technology yet. Value drivers behind (large scale) CCS deployment are currently not sufficient to overcome the current (not only economic) hurdles on the road towards (large scale) CCS projects.

Main aim of this paper is to provide an answer to the question “What government role or response is most appropriate to tackle the main obstacles towards large scale CCS deployment?”

In order to answer this question, a number of sub questions is formulated. The first section of this paper will deal with the question: What are the main drivers for large scale CCS deployment? The drivers will be differentiated among the various parts in the CCS value chain (capture, transport and storage).

---

\* Corresponding author. Tel: +31 30 2339023; Fax: +31 30 2339051; e-mail [marten.slagter@ebn.nl](mailto:marten.slagter@ebn.nl)

The second section will address the following research question: What are the main barriers towards large scale CCS deployment? Based on a recently undertaken CCS stakeholder consultation, a number of regulatory-, financial-, technical-, organisational- and policy issues towards large scale CCS deployment is identified.

The third part deals with the question: What are possible government roles/ responses to stimulate and enable CCS? On the basis of the answers to the previous research questions, this section will identify which measures and/or other government actions are needed in which part of the CCS chain, to reinforce current drivers and to remove the barriers towards large scale CCS in the Netherlands. In the final section, conclusions will be presented in terms of the most appropriate government role and response needed, in order to realise large scale CCS.

The research questions will be answered from a theoretical perspective together with the insights gathered from interviews with almost all CCS stakeholders represented in the Netherlands.

## 2. Main drivers for large scale CCS deployment

In order to realise large scale CCS, drivers are needed to mobilise all (possible) actors in the CCS value chain, such as (large) emitters (e.g. power companies), CO<sub>2</sub> transport companies and CO<sub>2</sub> storage operators such as oil and gas exploration and production companies.

The injection of CO<sub>2</sub> into almost depleted oil reservoirs (CO<sub>2</sub> enhanced oil recovery) might result in higher production, and thus the use of CO<sub>2</sub> as a mining resource can be an economic driver for oil and gas production parties. Enhanced oil recovery (EOR) is a proven technology to increase oil production by injecting a gas such as CO<sub>2</sub>. Although the primary objective of CO<sub>2</sub>-EOR is not to store CO<sub>2</sub>, this technology might drive the development of, at least, parts of the CCS value chain towards commercialisation. Common elements between CO<sub>2</sub>-EOR and CCS, such as CO<sub>2</sub> capture technology, CO<sub>2</sub> transport and CO<sub>2</sub> injection will accelerate the development of CCS. Delaying the abandonment of production facilities through the re-use of facilities and platforms for CO<sub>2</sub> storage might also be a value driver for E&P parties and thus an indirect driver for CCS.

Private parties currently undertaking CCS projects have various reasons for participating in CCS demonstration projects. Emitters have the most direct incentive to participate in CCS, as they will have to pay for their emissions in the future and possibly have to anticipate to a future capture obligation. Besides potential first mover advantages, parties are willing to participate in (low risk) CCS demo projects through government (EU and national) subsidies, the European Energy Programme for Recovery (EEPR) and funding for CCS demonstration projects from the New Entrants Reserve 300 (NER-300) funding.

A schematic representation of CCS value drivers and possible government driven measures is depicted below.

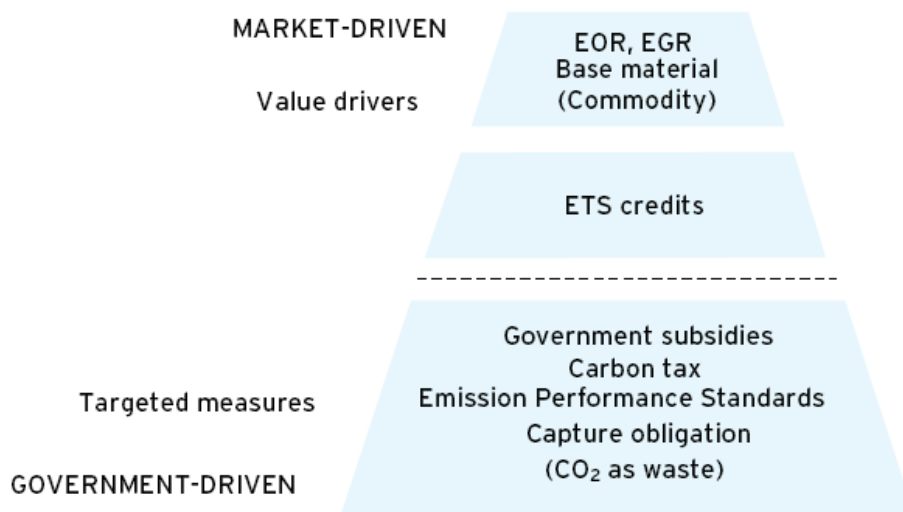


Figure 1: CCS value drivers and targeted measures (market and government driven) (Source: EBN / Gasunie Transport and Storage strategy, 2010)

The amount of CO<sub>2</sub> that can be used as a base material (e.g. CO<sub>2</sub>-EOR) is relatively small and will not be sufficient to meet carbon reduction targets. As a consequence, additional value drivers are needed to meet carbon reduction targets, largely by means of CCS. On top of the current ETS price, a more stable and reliable economic driver is needed to mobilise private parties from demo scale CCS projects towards realisation of large scale CCS. If no economic driver (market) exists for CCS around 2020, further government driven targeted measures are needed in order to realise government CO<sub>2</sub> reduction targets in the Netherlands [1].

### 3. Main issues towards large scale CCS deployment

Although large scale CCS is evident from a government perspective (to meet Dutch carbon reduction targets by 2020), private parties are faced with a large number of issues that need to be resolved to facilitate large scale CCS deployment. Based on interviews with Dutch CCS stakeholders, these financial-, legal-, technical-, and organizational issues will be elaborated in the paragraphs below.

#### 3.1 Financial

First and foremost, the current uncertainty around the ETS price as a stable and reliable long term economic driver, seems the main barrier on the road towards realisation of large scale CCS. A stable and sufficiently high ETS price is of critical importance. In addition, the current gap between the ETS price and the cost of CCS requires (additional) government support to close this economic gap in time (as outlined in figure 2).

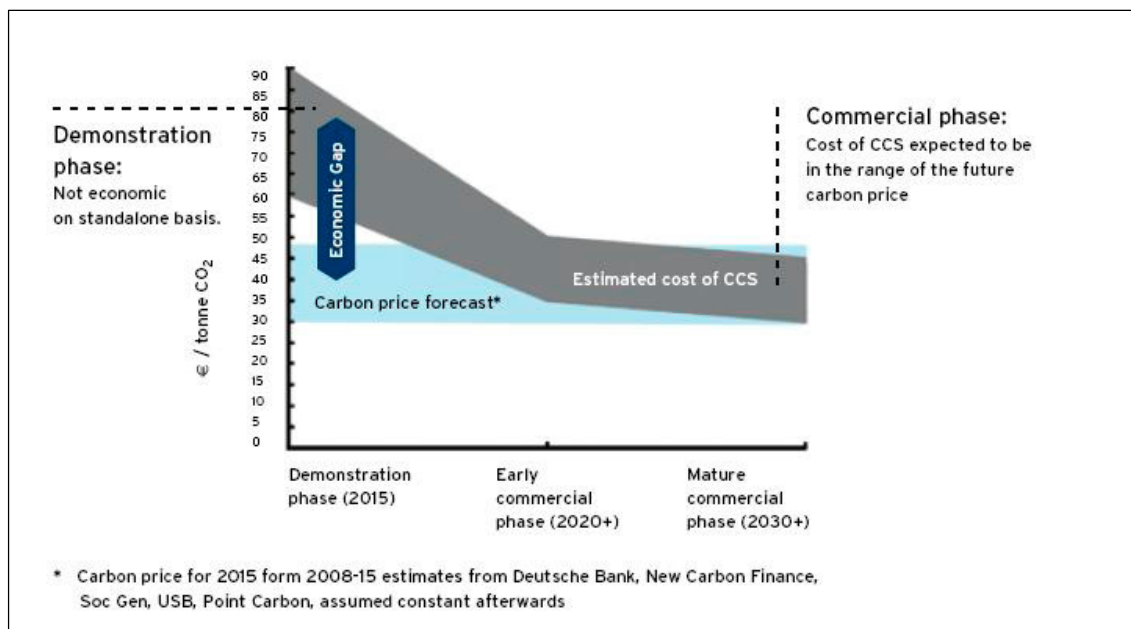


Figure 2: CCS economic gap: carbon price versus cost of CCS (Source: McKinsey, 2008)

#### 3.2 Legal and regulatory

A number of legal and regulatory issues need to be solved in order to enable CCS. Emitters would also like to see new legislation on CCS, implemented as soon as possible. Furthermore, access to storage sites is crucial for emitters, otherwise they cannot close the CCS-chain and their capture project will become useless.

With respect to legal issues, the storage parties consider the current liability period in The Netherlands too long. The trend among operators is that they will definitely not participate in CO<sub>2</sub> storage unless this period is reduced to, say, five or ten years or even less. A shorter period of liability will result in lower storage tariffs, which, in turn, will have a positive effect on the other parts of the value chain. Clarity about legal aspects and boundary conditions is needed in the short term, in particular about the transfer of liability for stored CO<sub>2</sub>.

Operators also emphasise the importance of a legal framework for the continuation of the existing gas production joint ventures, giving priority and a “right of first refusal” to the current operator. In general there is a need for fast implementation of clear CCS legislation that is designed to help the transition from hydrocarbon production to CO<sub>2</sub> storage.

### *3.3 Technical*

Emitters expect few problems with technological challenges. They would like to get clarity about norms and specifications for CO<sub>2</sub> to be captured and transported, but stress that they do not wish government-imposed norms.

Operators realise that there are still many technical challenges, especially involving injection under high pressure (e.g. phase change of CO<sub>2</sub> during injection), but they also indicate that these challenges can be met by carrying out demonstration projects.

### *3.4 Organizational*

The most obvious problems are probably in the organisational realm. Public acceptance is the potential show stopper for (large scale) CCS. As a consequence there is an urgent need for a strategy for informing inhabitants of the regions concerned about the decision-making process and involving them in it.

Emitters consider the timely availability of onshore (depleted) storage sites as another main barrier for CCS deployment. Together with transporters they therefore expect, a government “CO<sub>2</sub>-fields strategy”, which clearly states which fields will become available for CO<sub>2</sub> storage and when. On the basis of such a strategy, the owners of the earmarked fields and other involved or interested parties can enter into negotiations. CO<sub>2</sub> transport companies see an initiating role for emitters with the government “closing” the chain, and also endorse the urgency of doing so.

In addition, emitters foresee an important role for the Dutch government in creating a stable and sustainable framework for investment in CCS.

## **4. Possible government responses to stimulate and enable large scale CCS deployment**

As outlined in the previous sections, the value drivers will probably be insufficient to induce the market parties to invest in CCS during the demonstration phase and probably also in the early commercial phase. Combined with the aforementioned obstacles towards large scale CCS deployment, a government response is needed on top of the current stimulating measures to enable large scale CCS.

From the perspective that the government’s role should be complementary to market initiatives, three potential roles for the government can be distinguished in increasing order of intervention in the CCS market [1].

### *4.1 Supervisor role*

If drivers and hurdles are more or less balanced, the government response is limited to providing the necessary conditions for large scale CCS, acting as a supervisor.

As a supervisor, the government focuses on facilitating private parties in the CCS market by creating the right circumstances and setting boundary conditions. This may include implementing adequate legislation, regulation and supervision. This is a natural role for governments, and needs to be continued into the commercial phase.

#### 4.2 The instigator role

If the provision of necessary conditions for large scale CCS is not enough, and the ETS price is not sufficiently high to cover CCS cost, additional (temporary) government measures are needed to stimulate CCS. In this role the government acts as an instigator. Such a role might include developing a strategy for the fields that will become available for CO<sub>2</sub> storage, granting subsidies to emitters or facilitating the over sizing of infrastructure. In this context, political decisiveness and (public) support for CCS should also be mentioned. In this instigator role, the government would intervene only where the market is not yet functioning.

#### 4.3 The owner role

In case a stimulating government approach turns out to be insufficient to mobilise private parties into large scale CCS, the government can participate in the CCS value chain as an owner in order to realise large scale CCS. In this most intense form of government involvement, the government will also participate financially in the CCS market. The interviewed parties referred mainly to participation in transport and storage infrastructure, which may otherwise not get off the ground. In the most far-reaching case, the government will offer a waste-disposal service to emitters, by taking care of the entire infrastructure for CO<sub>2</sub> transport and storage (as a ‘public good’).

#### 4.4 Recommended government role per CCS development phase

To give market parties as much freedom as possible in implementing CCS and to focus the government role only on those aspects that cannot be implemented or picked up by the market, it is recommended to tailor the government role to the various stages of development of the CCS market. As depicted below, the Dutch government should maintain its Supervisor role into the commercial phase. On top of the Supervisor role, as an Instigator, the Dutch government should provide perform additional activities to enable further deployment of CCS. Government ownership of the entire transport and storage infrastructure (Owner role) is at this moment not expected in any stage of CCS development.

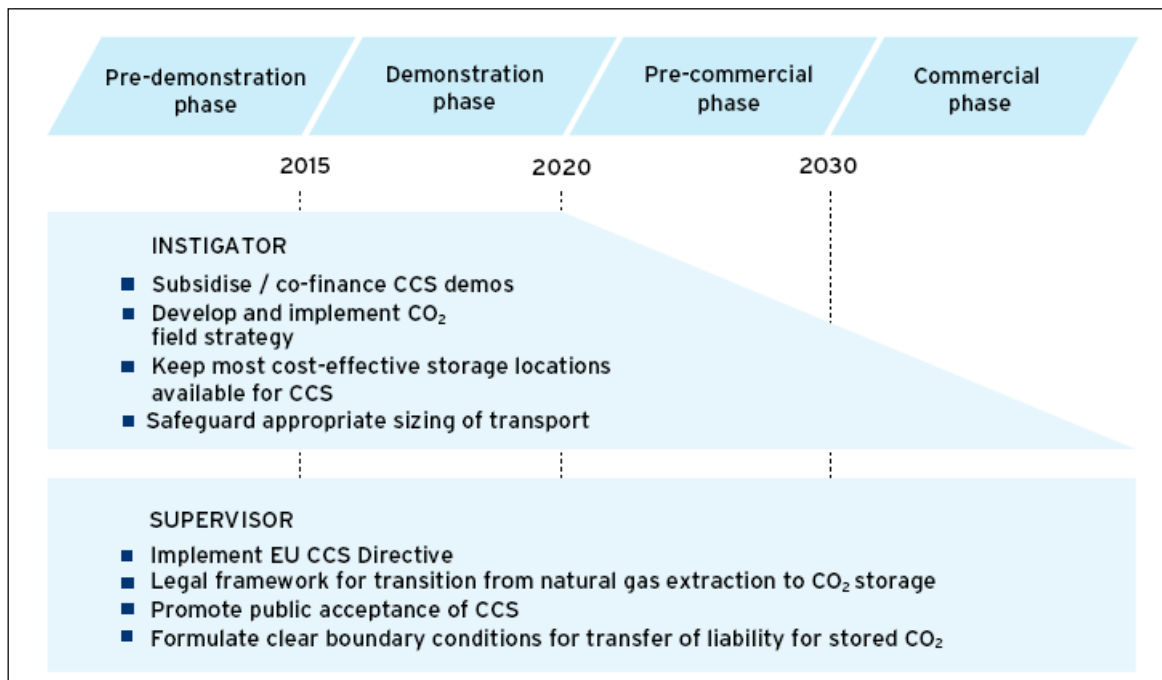


Figure 3: Recommended government roles per CCS development phase (source: EBN / Gasunie Transport and Storage strategy, 2010)

## **5. Conclusions & recommendations**

In view of the current market initiatives in The Netherlands, the identified market shortcomings and the current major uncertainties, the government taking the supervisor role is, as corroborated by the interviews, a basic prerequisite for the CCS market to function. The government will - in addition to setting boundary conditions (the supervisor role) - also have to act as instigator in the pre-demonstration-, demonstration- and early commercial phase. In this role the government could provide co-funding to (EU subsidised) integrated demonstration projects and could implement a field strategy in order to use the available storage capacity as cost-effectively as possible.

As there are too many uncertainties in the demonstration phase about the feasibility of large-scale CCS, it is at this stage premature and unnecessary for the government to invest on a large scale in transport and storage infrastructure in the Netherlands. A participant / owner role seems, for the time being at least, premature.

## **References**

- [1] EBN/ Gasunie, CO<sub>2</sub> transport and storage strategy, April 2010, on: [www.ebn.nl/en/](http://www.ebn.nl/en/)
- [2] McKinsey & Company, Carbon capture and storage: assessing the economics, 2008