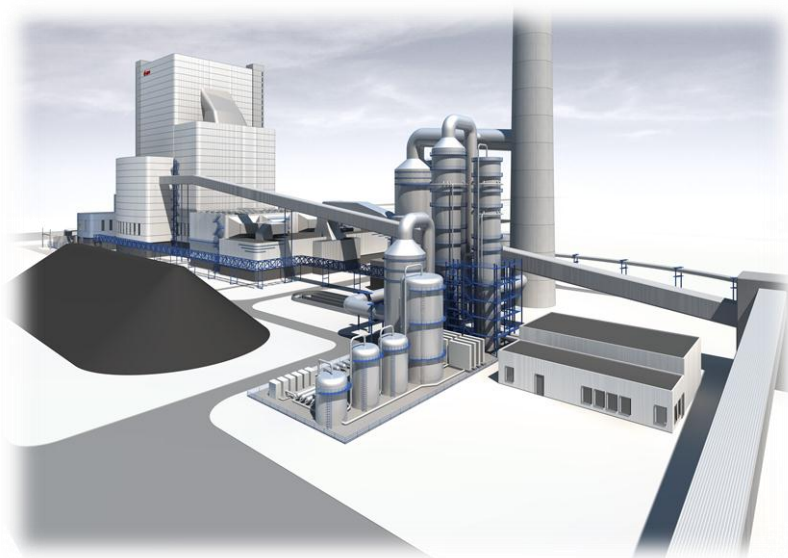


Permitting Process

Special report on getting a CCS project permitted



Maasvlakte CCS Project C.V.

January 2013

SUPPORTED BY



Government of the Netherlands



Co-financed by the European Union
European Energy Programme for Recovery

Title

The permitting process
Special report on getting a CCS project permitted

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4 January 2013

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Executive Summary

The ROAD project is the first of its kind in The Netherlands and applying for all of the necessary permits was one of the most challenging aspects of the project. CCS projects indeed face a complex and time consuming permitting process, linked to the provisions of the CCS Directive and the wide range of permitting authorities involved.

In the Netherlands, a CCS project requires several permits. In order to build and to operate a capture plant, the following permits must be obtained:

- All-in-one permit for physical aspects;
- Water permit;
- Nature Protection Act 1998 permit;
- Emission permit.

With a view to the transport of CO₂ to the injection facilities, ROAD requires the following permits:

- Amendment State zoning plan;
- Water permit;
- Railway Act Permit;
- Flora and Fauna Act Exemption;
- Emission permit.

The storage of CO₂ in P18-4 requires the following permits:

- All-in-one permit for physical aspects;
- Storage permit;
- Emission permit.

Prior to certain government decisions concerning the permitting, the Environmental Management Act requires that an Environmental Impact Assessment (EIA) be carried out. This EIA takes capture, transport and the storage of CO₂ into consideration as a whole.

CCS Directive

The storage permitting process is the most challenging. The EU CCS Directive is the most important piece of legislation with regard to the storage of CO₂. The content of the storage permit derives almost entirely from the CCS Directive. The CCS Directive provides several important requirements for the storage of CO₂ which leave room for interpretation to the Member States. The Dutch legislation does not elaborate on these requirements. This means that the key elements of the CCS Directive are directly reflected in the storage permit. ROAD managed to solve most of these issues together with the competent authority and other stakeholders, however, not all the issues have been resolved and in ROAD's opinion these issues should be taken into account with the review of the CCS Directive in 2015.

The CCS Directive mainly regulates the storage of the CO₂, however, there are some provisions concerning capture and transport which are intended to facilitate the integration of the

different phases of the CCS chain: capture, transport and storage. According to the CCS Directive, new combustion plants with a capacity greater than 300 megawatts must be 'capture ready'. Furthermore, the Directive requires Member States to ensure that all potential transport (and storage) operators can obtain 'fair and open' access to the transport network (or to the storage site). Although the Directive gives some general factors that should be taken into account by Member States when regulating the third-party access, many stakeholders in the EU believe that the CCS Directive leaves too many uncertainties if Member States do not elaborate the third-party access in national legislation. However, at this moment in time, ROAD expects that if a third party requests access, this party would be more than welcome. Sharing the costs for the transport and storage infrastructure (but also synergetic costs for example for monitoring of the storage site) is more than welcome.

With a view to the storage of CO₂, the Directive provides several requirements regarding the selection of storage site, the exploration, financial and technical requirements of the operator, composition of the CO₂, etc., and several plans. In summary, the following plans have to be developed and accepted by the competent authority:

- Risk management plan;
- Monitoring plan;
- Corrective measure plan;
- Closure plan.

There is a great consistency between all these plans. This report elaborates on all these plans and provides insights in the ROAD approach on developing these plans. The competent authority must approve all these plans and the European Commission may also give its opinion. Although this opinion is not legally binding (the competent authority may deviate from the opinion, but must give reasons for its decision), in practice the opinion is deemed to be a binding opinion.

Finally, the Directive provides for the eventual transfer of responsibility for the site to the competent authority after the storage site has been closed. Upon this transfer, the operator is released from obligations relating to monitoring and corrective measures under this Directive, together with any liabilities under the EU ETS and the Environmental Liability Directive.

It is expected that the work on the review of the CCS Directive will start in the beginning of 2013. Stakeholders are already preparing their opinion on the review. In ROAD's opinion, the CCS Directive is a good first attempt to regulate CCS in Europe and provides guidance and security for CCS projects. The CCS Directive review provides a substantial opportunity to implement the experiences of the CCS community into the CCS Directive. A thorough amendment could establish more clarity for industries wanting to invest in CCS and to give an incentive for the development of CCS. Also the process of developing and implementing technical standards has started. Standardization can be useful to ensure that CCS can be safely and reliably deployed. However, the development of standards should not limit the development of CCS. A solid assessment is needed to see what specific elements of CCS could benefit from standardization but also which elements first need to be developed further before being standardized.

Key issues storage permit

As mentioned above, the Dutch legislation does not elaborate on the several key requirements of the CCS Directive. ROAD managed to solve most of these issues together with the competent

authority and other stakeholders, however, not all the issues have been resolved and in ROAD's opinion these issues should be taken into account with the review of the CCS Directive in 2015. These issues are crucial for developing any CCS project in Europe:

- **Storage permit process vs. FID.** In ROAD's opinion, the permitting process in the CCS Directive is not realistic for a project, because the Directive requires that all the required plans (i.e. monitoring, corrective measures, etc.) are fully ready at the moment a project submits its application. In reality, developing all the studies, collecting all necessary information, and issuing reports will only be completed after an FID is taken, and in order to take an FID, a granted storage permit is necessary. To overcome this issue, ROAD came up with the following solution: lower the level of details of all plans (i.e. monitoring, corrective measures, financial security etc.) in the application and update these plans prior to the injection.
- **Financial Security.** The ROAD project faced three important questions regarding financial security: (1) what are the exact activities that must be covered by the financial security, (2) what is the amount of money that should guarantee these activities and (3) what kind of financial instrument is accepted by the competent authority? The scheme below provides answers to the first two questions. Regarding question 3, the Dutch Competent Authority prefers a bank guarantee or escrow account, but may also accept a solid balance sheet of the proponents or its parent companies.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10 - 29
Monitoring	12	10	9	8	7	6	5	4	3	0,1
Contingency monitoring	10	10	10	10	10	10	10	10	10	10
Abandonment	15,5	15,5	15,5	15,5	15,5	15,5	15,5	15,5	15,5	0
FC	2	2	2	2	2	2	2	2	2	2
EU-ETS	0	1	2	3	4	5	6	7	8	8
Sub Total	47	46	46	46	46	46	46	46	46	39,5
Contingency 20%	9,4	9,2	9,2	9,2	9,2	9,2	9,2	9,2	9,2	7,9
Total	56,4	55,2	55,2	55,2	55,2	55,2	55,2	55,2	55,2	47,4

- **Transfer of responsibilities.** The CCS Directive states that when a storage site has been closed, the responsibility for all legal obligations can be transferred to the competent authority of the Member State, subject to several conditions. The main concern of the ROAD project is in which way and under which conditions the minimum period of 20 years (one of the Directive's conditions) can be reduced. Although the post-closure plan and monitoring plan provide comfort to a certain extent, this still does not provide sufficient certainty; in ROAD's opinion, the CCS Directive still leaves too much room for Member States to reject the transfer based on the handover criteria even if all evidence indicates that the stored CO₂ will be completely and permanently contained. The competent authority could simply reject the abandonment request in order to keep the

well and the monitoring possibilities open. This creates unlimited liabilities and provides no certainty that the transfer of responsibilities will be established overtime.

- **Financial Mechanism.** Although this financial contribution could be a hurdle for a CCS project in Europe, ROAD successfully argued that the financial contribution only includes: monitoring after the handover for a period limited to 30 years. On the basis of these starting points, a provisional amount of EUR 2M will be included in the financial security.

Legal liabilities

Finally, CCS projects face several legal liabilities that can prove to be showstoppers for projects in Europe. In the scheme below, an overview of all liabilities is provided. On basis of this overview, ROAD concludes that the climate liability for storing CO₂ (EU ETS) is the main risk for CCS projects.

	Liability regime	Potential grounds for liability	Law	EU law ¹	Dutch law	Applicable	Risk assessment ²
Capture	Civil	Tort	6:162 Civil Code	No	Yes	Yes	+/-
	Civil	Superficies	6:174 Civil Code	No	Yes	Yes	+
	Civil	Hazardous substances	6:175 Civil Code	No	Yes	Probably not	+
	Environmental	Environment damage	Env. Liab. Dir. / Wm	Yes	Yes	Probably yes	+
	Climate	Emissions	EU ETS / Wm	Yes	Yes	Yes	+
Transport	Civil	Tort	6:162 Civil Code	No	Yes	Yes	+
	Civil	Superficies	6:174 Civil Code	No	Yes	Yes	+
	Civil	Hazardous substances	6:175 Civil Code	No	Yes	Probably not	+
	Environmental	Environment damage	Env. Liab.	Yes	Yes	Yes, but limited ³	+

¹ 'Yes' means that this legislation is also applicable in other Member States.

² '+' means that ROAD assess the risk that liability will apply is low or that the costs related to this liability are low.

			Dir. / Wm				
	Climate	Emissions	EU ETS / Wm	Yes	Yes	Yes	+
Storage	Civil	Tort	6:162 Civil Code	No	Yes	Yes	+
	Civil	Superficies	6:174 Civil Code	No	Yes	Yes	+
	Civil	Hazardous substances	6:175 Civil Code	No	Yes	Probably not	+
	Civil	Landfill	6:176 Civil Code	No	Yes	Maybe	+
	Civil	Mining works	6:177 Civil Code	No	Yes	Yes, but limited ⁴	+
	Environmental	Environment damage	Env. Liab. Dir. / Wm	Yes	Yes	Yes, but limited ⁵	+
	Climate	Emissions	EU ETS / Wm	Yes	Yes	Yes	-

³ Liability is limited to damage to protected species and natural habitats.

⁴ Only liabilities arise for damage caused by soil movement, not for damage caused by outflow of CO₂.

⁵ Liability is limited to damage to protected species and natural habitats.

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Abbreviations

752.4 Partners

GDF SUEZ Energie Nederland

GDF SUEZ Energie Nederland is a leading player in the Dutch energy market and part of the GDF SUEZ Group. With six state-of-the-art production locations and a total capacity of 5,103 MW GDF SUEZ Energie Nederland is the largest electricity producer in the Netherlands. GDF SUEZ Energie Nederland is a supplier of electricity and gas to both private and business customers. GDF SUEZ Energie Nederland has 1,250 employees.

E.ON Benelux

E.ON Benelux concentrates on the production and supply of electricity and gas to private customers and business customers in the Netherlands and Belgium. E.ON Benelux is primarily an electricity-generating company; the company can trade internationally and has its own professional sales organization. The company was established in 1941 and since 2000 has been part of E.ON Energie AG. E.ON Benelux's power stations with a total capacity of 1,850 MW are located in the province of South Holland, the economic heart of the Netherlands. The company has approximately 600 employees. E.ON Benelux is based in Rotterdam.

TAQA Energy

TAQA Energy is part of the Abu Dhabi National Energy Company PJSC (TAQA), an energy company that has worldwide interests in power generation, combined heat and water, desalination, upstream oil & gas, pipelines, services and structured finance. TAQA has a workforce of 2,800 employees and is located in Abu Dhabi, The Hague, Ann Arbor, Michigan, Aberdeen, Calgary and Amsterdam. In addition, TAQA has sustainable partnerships with

companies in Africa, the Middle-East, Europe, North-America and India. TAQA is listed at the Abu Dhabi Securities Exchange (ADX).

In the Netherlands, TAQA Energy explores and produces gas and condensates from wells located onshore in the Alkmaar region and offshore in the Dutch North Sea. TAQA also operates a gas storage facility in Alkmaar and has interests in Dutch North Sea pipelines. 200 people work for TAQA Energy directly and indirectly in the Netherlands, both onshore and offshore.

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GDF SUEZ E&P Nederland is one of the largest operators in the Dutch sector of the North Sea. With more than thirty production platforms and 300 employees, it is at the basis of the provision of energy to the Netherlands and several other countries.

Since its first successful drilling results in the Dutch North Sea, approximately forty years ago, GDF SUEZ E&P Nederland has grown into a leading operator. It has ample expertise and experience, always chooses the safest option and is continuously working towards the development of new techniques and improved methods. Continuity is ensured through exploration, takeovers and acquisition.

2.5 Financial contributors

The ROAD-project is co-financed by the European Commission within the framework of the European Energy Programme for Recovery ("EEPR"), the Government of the Netherlands and the Global CCS Institute.

In response to the economic crisis, the European Council and the European Parliament adopted the Commission proposal for a European Energy Programme for Recovery ("EEPR") in July 2009. The EEPR funds projects in the field of gas and electricity infrastructure as well as offshore wind energy and CO₂ capture and storage (CCS). In total 12 CCS-projects applied for assistance under the EEPR. In December 2009, the European Commission granted financial assistance to six projects that could make substantial progress with project development in 2010. These projects will receive overall funding of €1 billion under the EEPR.

1. Introduction

In July 2009, Maasvlakte CCS Project C.V. (the 'MCP') submitted its project proposal to the European Commission, to apply for funding under the framework of the European Energy Program for Recovery ('EPR'). This marked the start of the 'ROAD-project' ('Rotterdam Opslag en Afvang Demonstratieproject'; Rotterdam Storage and Capture Demonstration project).

The ROAD-project is the first of its kind in The Netherlands and applying for all of the necessary permits was one of the most challenging aspects of the project. CCS projects indeed face a complex and time consuming permitting process, linked to the provisions of the CCS Directive and the wide range of permitting authorities involved. Also, because of funding requirements, time to obtain all the permits is limited before the Final Investment Decision (FID) date.

The permitting process for the ROAD-project is described and evaluated in this report; with all relevant legislation and regulations described and all permits discussed. Special attention will be given to the storage permitting process because this proved the most unprecedented. The CCS Directive, providing the legislative framework for the storage permit, and the key issues arising from this Directive will also be extensively assessed.

This report aims to help similar projects (carbon capture and storage projects using post combustion capture technology, transport CO₂ by pipelines and store CO₂ in depleted gas reservoirs) identify the important considerations for a successful permitting process.

Finally, it must be noted that ROAD is a joint partnership initiated by E.ON Benelux N.V. and Electrabel Nederland N.V. (GDF SUEZ Group). ROAD collaborates closely with partners on capture, transport and storage. ROAD did not apply for all the permits itself. The power plant operator E.ON Benelux applied for the capture permits. ROAD applied for the transport permits. TAQA Energy applied for the necessary storage permits. If in the report the ROAD permit is discussed, it is actually the permit of E.ON Benelux, ROAD or TAQA Energy. Since this report is drafted to inform similar projects, ROAD uses it to describe their view on the process from a full chain project view. As this report is drafted by the ROAD-project, it only represents the views and opinions of the ROAD joint-venture parties.

1.1 Outline special report

The structure of this report is as follows:

- Chapter 2 presents a brief description of the ROAD-project, providing a high-level overview of the project, the partners, the financial contributors and a factsheet.
- Chapter 3 gives an overview of the ROAD permitting process. All permits will be briefly discussed and the relationship between all permits will be considered. All the relevant timelines for a permitting process in the Netherlands are explained, including descriptions of the key topics that caused delays or accrued time advantages.
- Chapter 4 describes the role of the Environmental Impact Assessment, as it plays a crucial part in the permitting process. Chapter 5 provides an extensive overview of the

CCS Directive, which has proven a substantial challenge for getting a CCS project permitted. The chapter summarizes and assesses the Directive's provisions and the manner in which these are transposed into Dutch legislation. The chapter concludes with the anticipated review of the Directive and the potential influence of standardization processes that have already commenced.

- Chapter 6 identifies the key issues arising from the CCS Directive. Due to the discretions afforded to Member States in the CCS Directive and the fact that the Netherlands did not elaborate on these norms in Dutch legislation, the storage permit has been required to address a number of issues. The chapter gives insight into possible solutions for resolving these issues.
- Chapter 7 provides an overview and assessment of the legal liabilities CCS projects have to bear. European legislation imposes several liabilities, which may lead to a severe financial burden for CCS projects. Civil liability must be regulated at Member State level. This chapter concludes with an assessment of these liabilities.

2. ROAD-project

2.1 Project overview

ROAD is the **R**otterdam **O**pslag and **A**fvang **D**emonstratieproject (Rotterdam Capture and Storage Demonstration Project) and is one of the largest integrated Carbon Capture and Storage (CCS) demonstration projects in the world.

The main objective of ROAD is to demonstrate the technical and economic feasibility of a large-scale, integrated CCS-chain. In the power industry, to date, CCS has primarily been applied in small-scale test facilities. Large-scale demonstration projects are needed to show that CCS is an efficient and effective CO₂ abatement technology within the next 5 to 10 years. With the knowledge, experience and innovations gained by projects like ROAD, CCS could be deployed on a larger and broader scale: not only on power plants, but also within energy intensive industries. CCS is one of the transition technologies expected to make a substantial contribution to achieving climate objectives.

ROAD is a joint project initiated by E.ON Benelux N.V. and GDF SUEZ Energie Nederland (GDF SUEZ Group). Together they constitute the limited partnership Maasvlakte CCS Project C.V. The intended partners of ROAD are GDF SUEZ E&P Nederland B.V. for the CO₂ transport and TAQA Energy B.V. for the CO₂ injection and permanent storage. The ROAD-project is co-financed by the Government of the Netherlands, the European Commission within the framework of the European Energy Programme for Recovery (EEPR) and the Global CCS Institute. At this moment additional financial partners are being sought in order to get the project across the line.

2.2 Project specifications

ROAD applies post combustion technology to capture the CO₂ from the flue gases of a new 1,100 MWe coal-fired power (Maasvlakte Power Plant 3) in the port and industrial area of Rotterdam. The capture unit has a capacity of 250 MWe equivalent and aims to capture 1.1 million tonnes of CO₂ per year. The capture installation is planned to be operational in 2015/2016.



Location of the ROAD-project CCS chain: Rotterdam port and industrial area and North Sea



Location of the capture unit: Maasvlakte Power Plant 3 (photo: E.ON)

From the capture unit the CO₂ will be compressed and transported through a pipeline: 5 kilometers over land and 20 kilometers across the seabed to the P18 platform in the North Sea. The pipeline has a transport capacity of around 5 million tonnes per year. It is designed for a pressure of 175 bar and a maximum temperature of approximately 80 °C.

ROAD intends to store the captured CO₂ in a depleted gas reservoir under the North Sea. This gas reservoir is located in block P18 (P18-4) of the Dutch continental shelf, approximately 20 kilometers off the coast. The depleted gas reservoir is at a depth of around 3,500 meters under the seabed of the North Sea. The CO₂ will be injected from the platform into the depleted gas reservoir. The estimated storage capacity is approximately 8 million tonnes, however, the P18 block offers two other gas reservoirs with a storage capacity of approximately 27 million tonnes.

2.3 Facts & Figures

Base installation: E.ON Maasvlakte Power Plant 3 (Rotterdam, The Netherlands)

- Output : 1.070 MWe
- Efficiency : 46%
- Operational : 2013
- Capture ready

Capture Plant

- Technology : Post-combustion
- Capacity : 250 MWe equivalent
- Capture rate : 90%
- CO₂ captured : ~1.1 megatonnes / year
- Operational : 2015/2016

Transport

- Pipeline
- Diameter : 16 inch
- Distance : 5 km onshore, 20km offshore

- Capacity : Gas phase : 1.5 megatonnes/year
: Dense phase : 5 megatonnes/year
- Design specifications : 175 bar, 80 °C

Storage

- Depleted gas reservoir : P18-4
- Operator : TAQA
- Depth : 3,500 meters
- Estimated capacity : ~8 megatonnes
- Available : 2014

2.4 Partners

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3. Permits

This chapter provides an overview of all the permits that are required for an integral CCS-project in the Netherlands. The following sections discuss in detail these permits and the relevant legislative frameworks. Section 3.4 concludes with a detailed overview that includes all permits, competent authorities and the permit applicants.

3.1 Capture permits

This paragraph covers the law and regulations that are applicable on capture. In order to build and to operate a capture plant in the Netherlands, the following permits must be obtained:

- All-in-one permit for physical aspects;
- Water permit;
- Nature Protection Act 1998 permit;
- Emission permit.

Presently, all capture permits (except for the emission permit⁶) have been granted by the competent authority. Furthermore, all capture permits are irrevocable (no more court procedures). The four permits are described in detail below.

All-in-one permit for physical aspects

ROAD will capture CO₂ from the flue gases of the new build coal fired power plant MPP3 on the Maasvlakte, Rotterdam. MPP3 will be an ultramodern power plant with a total electrical capacity of about 1,100 MWe. It will burn coal and secondary fuel sources (biomass).

The capture activities are not covered by the existing all-in-one permit for physical aspects for the production of power in the MPP3. To make the capture facility as environmentally sound as possible, the General Environmental Conditions Act (Wabo in Dutch) requires an amendment to the existing all-in-one permit for physical aspects. The all-in-one permit for physical aspects – environmental permission will fall under this amendment.

The General Environmental Conditions Act came into effect on 1 October 2010. This Act introduced a single permit application for all actions taken in the environment.⁷ The Act also introduced digital submission of permit applications through a web-based service (the ‘online environmental desk’). Since both ROAD’s consultants and the authorities had previously only worked with both the Act and the web-based service in a controlled environment or during training courses, there were a number of ambiguities in the Act and technical issues bugs in the web-based service to be resolved.

An all-in-one permit for physical aspects – construction permission, is required by the Wabo for the construction of “buildings”.⁸ The capture facility is a “building” and therefore requires an all-in-one permit for physical aspects.

⁶ ROAD will submit the emission permit application when the capture plant is built in 2014.

⁷ All surroundings, geological formations, organisms, animals, etc.

⁸ According to the model ordinance of the Association of Dutch Municipalities, a building is, “Any construction of any size made from wood, stone, metal or another material, that in the designated place, is in direct or indirect contact with the ground, is directly or indirectly supported in or on the ground, and is meant to function in that place.”

The capture installation falls under the current designation 'Utility' in the zoning plan 'Maasvlakte 81' of the City of Rotterdam. This means that the planning situation does not need to be changed before the building of the capture facility.

Both the environment and building sections of the all-in-one permit for physical aspects for the capture facility follow the expanded procedure according to the Wabo. When the request was submitted, the appropriate authority, in this case the Province of Zuid-Holland, held a consultation for the draft environmental permit. For six weeks, any person could submit comments regarding the draft all-in-one permit for physical aspects. The final all-in-one permit for physical aspects was then granted by the authority. The time for the procedure, including the draft phase and until the final all-in-one permit for physical aspects is granted, was six months.

The final all-in-one permit for physical aspects can be brought before the courts by affected parties and appealed to the Administrative Division of the Council of State. The total appeal process can last one and a half to two years. However, no appeals were brought forward.

Water permit

Cold water will be used in the capture process to cool the emitted gases. The water needed will be taken from the Europe Port via the existing cool water supply pipe for the MPP3. The warmed water will be discharged via a new separate pipe and released with the cooling water from the three power stations (MMP1, MPP2 and MPP3) located on the E.ON's production site, into the Princes Margriet Port (Maasvlakte 2).

For operations in water systems such as the release of materials into a water body, the Water Act requires a water permit. For the discharge of heat and a small amount of non-environmentally damaging substances from the capture facility, a water permit is therefore required.

The Water Act contains a coordination clause that provides for a coordinated application for the water permit and the environmental permit.⁹ Under the Wabo, the coordination is not (yet) arranged for the digital application form, which means that agreement must be reached between the two authorities for both permits.

For the water permit concerning the discharge of cooling water, the uniform public preparation procedure under Section 3.4 from the General Administrative Act applies. When the request was submitted, the appropriate authority, the Ministry of Infrastructure and Environment, held a consultation for the draft water permit. For six weeks, any person could submit comments regarding the draft water permit. The final water permit was afterwards then granted by the authority. The time for the procedure, including the draft phase and until the final water permit is granted, is six months.

The final water permit can be brought before the courts by affected parties and appealed to the Administrative Division of the Council of State. The total appeal process can last one and a half to two years. However, no appeals were brought forward.

⁹ Article 6.27 of the Water Act.

Nature Protection Act 1998 permit

Two European Directives, the Birds Directive and the Habitats Directive, help to protect Europe's most important natural assets.¹⁰ Amongst other provisions, these Directives designate special areas as protected. Together, these areas are known as Bird and Habitat Directive Areas and form the Natura 2000 network. They may also be known as Natura 2000 areas.

The legal protection of the Natura 2000 areas is regulated by the Nature Protection Act 1998. Any actions or projects in or near a Natura 2000 area that are likely to have a negative impact on the conservation objectives of that area require a Natural Protection Act 1998 permit (in Dutch: "Nbw 1998" permit).

The procedure for the Nbw 1998 permit begins with an application which the appropriate authority, in this case the Province of Zuid-Holland, must process within 13 weeks, with one possible extension of 13 weeks. Affected parties can object to the final Nbw 1998 permit. Subsequently they can appeal to the Administrative Division of the Council of State. The total appeal process can last one half to one year

The procedure by which the CO₂ will be removed from the gases uses materials that include N-connections (e.g., aminos, such as MEA). These materials will be reused within the capture facility. A very small amount will remain in the gases and be deposited via atmospheric deposition into sensitive areas within the nearby Natura 2000 areas of Westduinpark & Wapendal, Solleveld & Kapittelduinen, Voornes Duin, Duinen Goeree & Kwade Hoek and Voordelta (dune and delta habitats).

As a result of the atmospheric deposition of N-connections, the conservation objectives of the natural values of the aforementioned Natura 2000 areas will be negatively affected, and an Nbw 1998 permit is required.

The capture facility requires an Nbw 1998 permit. The emissions from this facility are combined with those from the MPP3. On 4 May 2011, the Administrative Division of the Council of State (ABRvS in Dutch), ruled on the Nbw 1998 permit needed for MPP3.¹¹ On appeal, the ABRvS repealed the Province's decision regarding the Nbw 1998 permit. The ABRvS ruled that the expected effects of the MPP3 would be insignificant and therefore refused the permit.

The combination of the capture and MPP3 Nbw 1998 permits means that the application for the Nbw 1998 permit for the capture facility can only be submitted in a later stage of the process because the repealed Nbw 1998 permit for MPP3 must first be reissued. After the Nbw 1998 permit for the MPP3 is reissued, the application for the Nbw 1998 permit for the capture facility can be submitted.

¹⁰ Directive 1997/409/EEG from the Council from 2 April 1997 on the conservation of wild birds (*PbEG* 1997, L 103) and Directive 1992/43/EEG from the council from 21 May 1992 on the conservation of natural habitats and wild flora and fauna (*PbEG* 1992, L 206).

¹¹ Administrative Division of the Council of State 4 May 2011, nrs. 2009013/1/R2 and 200901311/1R2

Emission permit

The entire ROAD-project must fulfill the requirements of the European Emission Trading System (EU-ETS). This applies to the capture installation as well as the transport network and the storage location. Each of these installations, networks and locations must have a CO₂ emission permit from the moment that they become operational. In order to receive a CO₂ emission permit, a CO₂ monitoring plan needs to be submitted to the appropriate authority. In summary, a CO₂ monitoring plan must include the following:

- determination of the yearly CO₂ emissions;
- compilation of a yearly emission report (measurement, recording and reporting);
- validation activities (e.g., calibrating the instruments);
- (internal) quality assurance.

The capture of CO₂ means that the emitting party has to purchase fewer emission rights. If CO₂ leaks (from any part of the chain), then it needs to be monitored until no further leakage can be detected. A leak can therefore lead to the requirement to surrender EU Emissions Allowances (EUAs).

For the award of an emission permit, the uniform public preparatory procedure under Section 3.4 of the General Administrative Act needs to be followed. The proponent must prepare a monitoring plan before submitting the application. After the application and the monitoring plan have been submitted, the appropriate authority, the Dutch Emission Authority, grants a draft permit. For a period of six weeks, any person can submit comments regarding the draft permit. After that, the authority grants the final permit. The time for the entire procedure, from the submission of the application to the granting of the final permit, is six months. The final permit can be appealed by affected parties to the Administrative Division of the Council of State. The total appeal process can last about a year and a half to two years.

ROAD has not yet applied for the capture plant's emission permit. The application will be submitted after the capture plant has been built (2014).

3.2 Transport permits

This paragraph covers the legal framework that applies to the transport aspect of the ROAD-project and the permits that are required. First, a brief description of the CO₂ transport is given.

The pipeline will be connected to the capture installation on the E.ON grounds. A compressor will be used to compress the captured CO₂ to the desired pressure for transport. From the capture facility, the CO₂ will follow the existing utilities access corridor. Where the pipeline reaches the future Yangtze Port and the coastline, it will be laid under the Yangtze Port and the mouth of the Maas River by means of a borehole.

Once it reaches the sea, the pipeline will be laid on or in the sea floor for a length of about 20 kilometres. The pipeline will follow an existing TAQA gas pipeline for most of its length. Finally, the pipeline will be connected to the platform.

In contrast to the permits needed for the capture facility, the permits and approvals needed for the CO₂ pipeline and the storage facilities are governed by the National Coordination Scheme.¹² Through the coordination scheme, the permit process becomes one procedure. This means that comments can be submitted for all draft permits at one time and the appropriate authority decides on all permits at once. The National Coordination Scheme is integrated in the Spatial Planning Act.

According to the Mining Act, the procedure of the Spatial Planning Act, applies to:¹³

- a. (...);
- b. a mining facility for the storage of materials;
- c. pipelines exclusively or primarily meant for the transport of minerals or the transport of materials in connection with the exploration or production of minerals or the storage of materials with use of a mining facility as described in (...) section b.

This implies that the National Coordination Scheme from the Spatial Planning Act applies to the ROAD-project. The public consultations and approval of permits needed for the transport (and storage) of CO₂ as mentioned in the National Coordination Scheme Implementation Decision for energy infrastructure projects are coordinated by this scheme. For the ROAD-project, this applies to the all-in-one permit for physical aspects, the water permit and the Flora and Fauna Act exemption.

All procedures that can be coordinated are governed by the uniform public preparation procedure as per Section 3.4 of the General Administrative Act. After the application has been submitted, the Ministry of Economic Affairs, Agriculture and Innovation determines the term for the drafting of the draft permits and final permits and provides for a coordinated notification and disclosure process. The appropriate authority remains involved in the coordinated procedure and decides on the various applications and permits. All (draft) permits are granted at the same time. For six weeks, any person can submit comments regarding the draft permits. After that, the final permits are granted by the appropriate authority.

The final permits may be appealed by affected parties once, in one procedure, to the Administrative Division of the Council of State. The total appeal process can last one and to one and a half year.

With a view to the transport of CO₂ to the injection facilities, ROAD requires the following permits:

- Amendment State zoning plan;
- Water permit;
- Railway Act Permit;
- Flora and Fauna Act Exemption;
- Emission permit.

These permits are governed by the National Coordination Scheme and are discussed below.

¹² Article 141a from the Mining Act in conjunction with Article 3.35 from the Spatial Planning Act.

¹³ Article 141a from the Mining Act in conjunction with Article 3.35 from the Spatial Planning Act.

State zoning plan

As described above, the transport of CO₂ falls within the scope of the Mining Act. This means that planning permission for the laying and use of the CO₂ pipeline becomes possible, in principle, through a State Zoning Plan.¹⁴

A State Zoning Plan is not needed when the current zoning plan provides for the laying of the pipeline. The laying of (a part of) the CO₂ pipeline is actually contrary to the provisions of the current zoning plans 'Maasvlakte '81' and 'Maasvlakte 2'. This means that a State Zoning Plan needs to be approved to grant planning permission for the CO₂ pipeline.

The procedure for the State Zoning Plan runs concurrently in the frame of the National Coordination Scheme as the scheme includes the necessary permits.¹⁵

The State Zoning Plan is prepared and sent to the municipalities, water authorities and provincial services involved for consultation. Next, the draft Zoning Plan is presented for public consultation to allow any person to submit comments against the draft. After that, the appropriate authorities, the Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Infrastructure and the Environment, grant the State Zoning Plan. Finally, affected parties can appeal to the Administrative Division of the Council of State. The total appeal process can last one and to one and a half years.

Water permit

The pipeline crosses a weir as it goes over the land to the North Sea. The pipeline will then be laid in the floor of the North Sea (surface water body).

A permit is required by the Water Act for a use of water works that performs a function in, on, above, over or under the works, creates or maintains a work, or deposits, places or lays down solid substances or objects or lets them remain in place, other than those uses in agreement with the function of those works.¹⁶

The weir and the North Sea qualify as water works. Because the pipeline will not be laid in agreement with the normal function of those works, which is providing a barrier and the storage of water, a water permit is required for the laying and use of the pipeline.

The water permit is covered by the National Coordination Scheme and therefore follows the National Coordination Scheme procedure as described in paragraph 3.2.

¹⁴ See again Article 3.35 in conjunction with Article 3.28 from the Spatial Planning Act. A State Zoning Plan is a zoning plan at the national level that is determined by the Ministry of Economic Affairs, Agriculture and Innovation, together with the Ministry of Infrastructure and Environment. The State Zoning Plan is, just as municipal zoning plans, set to ensure good spatial planning. If the State Zoning Plan is not approved, the pipeline will not be allowed. The Act mentions a 'zoning plan', but because this is determined by the ministries, and thus at a national level, this section will refer to it as a 'State Zoning Plan' to maintain clarity.

¹⁵ A zoning plan will be determined for a section of the pipeline, because of which, this project falls under Category 2.1 from Attachment 1 of the Crisis and Recovery Act. The essence of this Act is that new and/or amended procedures will be in force to work on employment and sustainability. The measures in the Crisis and Recovery Act are mostly to speed up processes. For the ROAD project, the applicability of the Crisis and Recovery Act means that judicial procedures are shorter and that appeals can only be lodged by affected parties who have been negatively affected by the aforementioned activity.

¹⁶ A water works is a surface body of water, storage area, dyke or supporting work.

Railway act permit

The pipeline will be laid near the railway on the (First) Maasvlakte and crosses this railway four times.

The Railway Act governs the construction, maintenance, access and use of the railways in the Netherlands, as well as traffic over those railways. In order to prevent physical damage to the railways and to assure safe rail traffic and the uninterrupted transfer of travelers and goods, a permit is required to carry out certain activities in, near, on, above or under the railway. A permit will therefore be required under the Railway Act for the laying of the pipeline near the railway in the (First) Maasvlakte.

The Railway Act Permit falls under the National Coordination Plan and therefore follows the National Coordination Scheme procedure as described in paragraph 3.2.

Flora and Fauna Act Exemption

The Birds and Habitats Guidelines contain not only a provision for territorial protection, but also a provision for species protection. Both provisions are also implemented in the Flora and Fauna Act, which regulates a large number of species of plants and animals. These species cannot be disturbed, hunted, caught or killed, amongst other activities, as described in the prohibitions of this Act. When these prohibitions are violated, an exemption is required.

There are species strongly protected by the Flora and Fauna Act present in the area needed for the laying and use of the pipeline, such as the bee orchid and the root vole. These species might be disturbed by the laying and use of the pipeline and therefore an exemption is needed.

The Flora and Fauna Act exemption falls under the National Coordination Scheme and therefore follows the National Coordination Scheme procedure as described in paragraph 3.2.

Emission permit

The entire ROAD project must fulfill the requirements of the European Emission Trading System (EU-ETS). This applies to the capture installation as well as the transport network and the storage location. Each of these installations, networks and locations must have a CO₂ emission permit from the moment that it is operational. Paragraph 3.1 describes this emission permitting process in greater detail.

3.3 Storage permits

This section describes the legal and regulatory situation and the permits required for the storage aspect of the project (including the platform). First a brief description of the storage process is given.

The CO₂ will be stored using the existing natural gas production platform 'P18-A', operated by TAQA Offshore B.V. (TAQA). Wells were drilled to a depth of 3,500 meters from platform P18-A to three reservoirs, designated as P18-2, P18-4 and P-18-6. At present, only P18-4 will be used

for storage so a permit will only be applied for this reservoir. The existing well (borehole) will be used and needs to be adapted for the switch from gas production to CO₂ storage.

In contrast with the permits needed for the capture facility, the permits and approvals needed for the CO₂ pipeline and the storage facilities are governed by the National Coordination Scheme (as described in paragraph 3.2).¹⁷

The storage of CO₂ in P18-4 requires the following permits:

- All-in-one permit for physical aspects;
- Storage permit;
- Emission permit.

These permits are described below.

All-in-one permit for physical aspects

TAQA has an (mining) environmental permit for the use of the platform for natural gas production. The transport and injection activities related to the storage of CO₂ are not covered by this existing permit. Therefore, an all-in-one permit for physical aspects (environmental permission for a facility/mining building) is required to allow the activities to proceed.

The all-in-one permit for physical aspects is governed the National Coordination Scheme and therefore follows the National Coordination Scheme procedure as described in paragraph 3.2.

Storage permit

The CCS Directive has been transposed into the Dutch Mining Act. The Mining Decree and Mining Regulations have also been amended to reflect these changes. With these changes, the substantive requirements of the storage permit have changed from the requirements that applied under the Mining Act before the transposition of the CCS Directive. But when the permit application was submitted in July 2010, the transposition was not completed yet. Therefore, it was decided to request a 'new style' storage permit to begin with. The permit application adhered as closely as possible to the bill to amend the Mining Act and the CCS Directive because the substantive requirements that the application must fulfill were not yet fully known at the time of the application.

The storage permit is described in detail in paragraph 5.3.

The storage procedure is governed by the National Coordination Scheme and follows the National Coordination Scheme procedure as described in paragraph 3.2.¹⁸

¹⁷ Article 141a from the Mining Act in conjunction with Article 3.35 from the Spatial Planning Act.

¹⁸ The Ministry of Economic Affairs, Agriculture and Innovation has the power under Article 141c of the Mining Act to place permits needed for projects that do not automatically fall under the National Coordination Scheme under that program. The Minister of Economic Affairs, Agriculture and Innovation is now determining whether he will make use of this power.

Emission permit

The entire ROAD-project must fulfill the requirements of the European Emission Trading System (EU-ETS). This applies to the capture installation as well as the transport network and the storage location. Each of these installations, networks and locations must have a CO₂ emission permit from the moment that it is operational. Paragraph 3.1 describes this emission permit in more detail.

3.4 Overview required permits

Table 3.1 provides a summary of the required permissions and permits described in the preceding sections. It describes the legal basis for the permissions and permits, the appropriate authority responsible for granting the permissions and permits, and the party required to apply for the relevant permission or permit.

Table 3.1: Regulatory Overview for the ROAD Project

Legislative requirement	Law	Appropriate Authority	Applicant
General			
Environmental Impact Assessment	Environmental Protection Act	Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Infrastructure and Environment; Province of Zuid-Holland (delegated to DCMR (Environmental Protection Agency for the Rotterdam Area))	Proponent
Emission permits	Environmental Protection Act	Dutch Emission Authority	Proponent
Capture			
All-in-one permit for physical aspects	General Environmental Conditions Act	Province of Zuid-Holland (delegated to DCMR (Environmental Protection Agency for the Rotterdam Area))	Proponent
Environmental Permission			
Building Permission			
Natural Protection Act Permit	Nature Protection Act 1998	Province of Zuid-Holland	Proponent
Water Permit	Water Act	Ministry of Infrastructure and Environment (delegated to the State Water Authority, Department South Holland)	Proponent
Transport			
State Zoning Plan	Spatial Planning Act	Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Infrastructure and Environment	Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Infrastructure and Environment
Environmental Impact Assessment	Environmental Protection Act	Ministry of Economic Affairs, Agriculture and Innovation and	Ministry of Economic Affairs, Agriculture

		the Ministry of Infrastructure and Environment	and Innovation and the Ministry of Infrastructure and Environment / Proponent
Water Permit	Water Act	Ministry of Infrastructure and Environment (delegated to the State Water Authority, Department Zuid-Holland)	Proponent
Railway Permit	Railway Act	ProRail	Proponent
Flora and Fauna Act Exemption	Flora and Fauna Act	Ministry of Economic Affairs, Agriculture and Innovation	Proponent
Storage			
All-in-one permit for physical aspects	General Environmental Conditions Act	Ministry of Economic Affairs, Agriculture and Innovation	TAQA
Storage Permit	Mining Act	Ministry of Economic Affairs, Agriculture and Innovation	TAQA

4. Environmental Impact Assessment

Prior to certain government decisions concerning the implementation of environmentally sensitive activities, such as licensing, can be taken; the Environmental Management Act requires that an Environmental Impact Assessment (EIA) be carried out.¹⁹ The EIA procedure is described in detail in Appendix I.

On the 1st of April 2011, a new Decree on the EIA came into force. This new Decree was adapted because of a European Court of Justice ruling, stating that the Netherlands did not correctly apply the EU EIA Directive in their EIA Decree. This was subsequently addressed in the new Decree. Although the new Decree had little influence on ROAD's own EIA, this again created some uncertainty about who the authorities should be that have to assess the EIA and which categories of activities in the new Decree apply to ROAD.

In the EIA Decree, applicable at the time the EIA was prepared, the following EIA activities relevant to the ROAD-project are described.²⁰

Table 4.1: Overview of decisions requiring an EIA during the ROAD project

EIA Decree Category	Activity Requiring EIA	ROAD Project	Decision
C 22.1	The construction, change or expansion of a facility meant for the production of electricity, steam or warmth, with a thermal capacity of 300 or more megawatts	Capture facility with a capacity of more than 300 megawatts	All-in-one permit for physical aspects Water Permit
C 5.3	The construction of facilities or buildings in, on or above the sea floor, or under the sea floor where the activity has an area of 1 ha or more	The construction of a pipeline on and in the sea floor – over a length of more than 1 km through the dunes and in the sea – with an area of more than 1 ha	Water Permit
C 18.5	The building of a facility meant for the dumping or underground placement of non-dangerous waste, where 500,000 or more cubic meters of non-dangerous waste shall be dumped or stored	Storage of 1.1 million tons of CO ₂ per year, injected into reservoirs	All-in-one permit for physical aspects Storage Permit

¹⁹ Through systematic and objective research, the expected environmental effects of the designated activities can be determined. The information collected for the EIA helps ensure that the environmental impacts are not undervalued compared to other interests in the decision making.

²⁰ As of 1 April 2011, the EIA Resolution has been changed. The activities from categories C 5.3 and C 18.5 no longer require an EIA under this change.

5. CCS Directive

The European 2009 CCS Directive²¹ is part of the European Union's Climate Policy and is aimed at limiting the emissions of CO₂ into the atmosphere and ensuring that captured CO₂ is stored permanently underground. The Directive sets out an overarching regulatory framework aimed at ensuring permanent containment of CO₂ and, where this is not possible, minimise the possible negative effects and any risks to the environment and human health.

The CCS Directive mainly regulates the storage of the CO₂, however, there are some provisions concerning capture and transport which are intended to facilitate the integration of the different phases of the CCS chain: capture, transport and storage.

The EU CCS Directive is the most important piece of legislation with regard to the storage of CO₂. The content of the storage permit (discussed in paragraph 5.3 and chapter 6), derives almost entirely from the CCS Directive. Therefore, this chapter provides an analysis of the CCS Directive, divided into three sections for capture, transport and storage.

Furthermore, paragraph 5.4 provides an overview of the transposition of the CCS Directive in Dutch national legislation. Some of the provisions of the CCS Directive allocate wide discretion and leave room for interpretation; it is therefore important to take a closer look at the transposition to ascertain (1) how the Dutch Government elaborated these provisions and (2) if the Dutch Government introduced additional regulations that are not covered by the CCS Directive.

This chapter concludes with section 5.5 in which possible future amendments of the CCS legislation are discussed. A review of the CCS Directive is anticipated in 2015 and the International Organization for Standardization (ISO) started a technical committee on CCS which may have an impact on legislation and regulation.

5.1 Capture

In the case of CO₂ capture, the Directive stipulates that new combustion plants with a capacity greater than 300 megawatts must be 'capture ready'. This capture readiness requirement means that the combustion plant must retain sufficient space to build a capture installation and to build all necessary installations for the transport of the CO₂ (compressor station, pipe lines, etc.). However, the new build plant only has to be 'capture ready' if the following three criteria are cumulatively met:²²

- suitable storage sites are available;
- transport facilities are technically and economically feasible;
- it is technically and economically feasible to retrofit for CO₂-capture.

The three criteria are unlikely to be met at this stage of the development of CCS. For example, if a combustion plant in the Netherlands is not built near the coastline, suitable storage sites are

²¹ Directives 2009/31/EG from the European Parliament and the Council from 23 April 2009 concerning the geologic storage of carbon dioxide and the change of Directive 85/337/EEG of the Council, Directive 2000/60/EG, 2001/80/EG, 2004/35/EG, 2006/12/EG and 2008/1/EG and Regulation (EG) nr. 1013/2006 from the European Parliament and the Council.

²² Article 33 CCS Directive.

almost certainly not available because the Dutch government prohibits storage of CO₂ in onshore storage sites. Therefore, this power plant would not have to be capture ready. But even more important is that the transport networks and modernization of the plant (in order to capture CO₂) must be technically and economically feasible. At the present time, with only the European Emissions Trading System as an financial incentive for CCS, deploying CCS is not economically feasible.

5.2 Transport

The CCS Directive foresees the possibility that lack of access to CO₂ transport networks (and storage sites) could become a barrier for those parties interested in CCS, but who do not have their own infrastructure. The Directive therefore requires Member States to ensure that all potential transport (and storage) operators can obtain 'fair and open' access to the transport network (or storage site).²³ Member States are given discretion to determine the precise means of providing this access, as long as they are set in a transparent and non-discriminatory manner. In doing this, Member States are required to take account of four factors:²⁴

- The storage and/or transport capacity is or can reasonably be made available. In other words, the physical and technical capabilities of the network/storage site must be taken into account.
- The proportion of the Member State CO₂ reduction obligations pursuant to international and European law that it intends to meet through CCS. This means that, in the process of allowing external operators to access the network, a Member State can consider its national emission reduction targets.
- The need to refuse access where there is an incompatibility of technical specifications which cannot be reasonably overcome. If different levels of purity, concentration or pressure of CO₂ streams could have a harmful effect on the integrity of the network or storage site causing, for example, fractures or leakages, third-party access can be denied.
- The need to respect the duly substantiated reasonable needs of the owner or operator of the storage site or transport network and the interests of all other users of the storage site or the network who may be affected.

Additionally, the CCS Directive states that Member States shall take all measures necessary to ensure that an operator, refusing access on the grounds of lack of capacity or a lack of connection, makes any necessary enhancements as far as it is economic to do so or when a potential customer is willing to pay for them, provided this would not negatively impact the environmental security of transport and storage of CO₂.²⁵ This provision seems to be deducted from the so-called 'essential facilities doctrine'.²⁶

²³ Article 21 (2) CCS Directive.

²⁴ Article 21 (2) CCS Directive.

²⁵ Article 21 (4) CCS Directive.

²⁶ The essential facilities doctrine is a legal doctrine which describes a particular type of claim of monopolization made under competition laws. In general, it refers to a type of anti-competitive behaviour in which a firm with market power uses a "bottleneck" in a market to deny competitors entry into the market. Under EC law, the development of the essential facilities doctrine has been based on Article 82 of the EC Treaty. This provision prohibits abuses of dominant position within the common market.³ A refusal to deal can indeed constitute an abuse of dominant position under Article 82.

The operator of the network or storage site can be seen as a monopolist. Especially since CCS is only in the demonstration phase and without subsidies infrastructure cannot be commercially constructed. The CCS infrastructure is an essential facility. If the owner of the CCS denies access to other competitors, this can be qualified as an abuse of its dominant market position. If a competitor is required to build its own infrastructure, this could lead to unbearable costs.

However, at this moment in time ROAD expects that if a third party requests access, this party would be more than welcome. Sharing the costs for the transport and storage infrastructure (but also synergetic costs for example monitoring of the storage site) are more than welcome.

5.2.1 Third-party access elaborated

Although the Directive gives some general factors that should be taken into account by Member States when regulating the third-party access, many stakeholders in the EU believe that the CCS Directive leaves to many uncertainties if Member States do not effectuate the third-party access into national legislation. To the ROAD-project's knowledge, only very few Member States are addressing this issue at the moment.

In the UK, regulators are developing legislation to elaborate the third-party access requirement. It is unsurprising that the UK is leading on this topic, because the Government there has established a number of funds for CCS and several projects are being developed.

In the Netherlands on the other hand, no additional regulation for third-party access is under development; this is primarily because no potential problems are foreseen in the short term. Besides ROAD, there is only one other CCS project under development: Air Liquide's Green Hydrogen project.²⁷ Furthermore, as described above, there is already a lot of case law regarding the essential facility doctrine and the provisions developed in this case law are most likely also applicable on the CCS infrastructure. Most important, however, is that CCS interested parties will rather work together on the development of the infrastructure to reduce costs (no natural monopoly).

For CCS to become commercially feasible, industries will need more guidance from the legislator. Legislation must explain under which specific conditions third-party access can be denied. Maybe more guidance and regulations will come when the CCS Directive is reviewed and revised in 2015. Otherwise it is up to the Member States themselves to develop a regulatory framework that ensures clarity on which conditions third-party access can or cannot be denied.

5.3 Storage

The CCS Directive mainly regulates the storage of the CO₂. In summary, the Directive states that the purpose of environmentally safe geological storage of CO₂ is permanent containment of CO₂ in such a way as to prevent and, where this is not possible, eliminate as far as possible negative effects and any risk to the environment and human health.²⁸

²⁷ Selected on the NER300 shortlist.

²⁸ Article 2 (1) CCS Directive.

5.3.1 Selection of storage site

The Directive requires that injection and storage of CO₂ may only take place in sites that do not pose any risk of leakage or damage to the environment and human health. This is determined through a detailed process of site characterisation and assessment of the potential storage complex and surrounding.²⁹ Data must be gathered and assessed in order to create a computerised three-dimensional model of the storage area, which is then used to predict and model the way in which CO₂ will behave in the formation. A distinction is drawn between the storage site (a defined space within a geological formation into which CO₂ is to be injected, together with its associated surface and injection facilities) and the storage complex (the storage site and the surrounding geological features which can affect storage integrity). Site characterisation will involve a consideration of the entire storage complex. In paragraph 5.3.3.3 is the process of this site characterization further described.

5.3.2 Exploration permit

If a storage site has yet to be fully explored, more investigative activities (drilling, testing, etc.) may be necessary to obtain sufficient information. The CCS Directive regulates these types of activities: the process of exploration is allowed, but it cannot be carried out without an exploration permit. Although Member States must ensure that the procedures for the granting of storage permits are open to all entities and that the permits are granted on the basis of objective, published and transparent criteria, it is remarkable that the CCS Directive states that priority for the granting of a storage permit for a particular site shall be given to the holder of the exploration permit for that site, provided that:³⁰

- the exploration of that site is completed;
- that any condition set in the exploration permit has been complied with;
- that the application for a storage permit is made during the period of validity of the exploration permit.

But what if exploration is not necessary because there are already sufficient data available for a specific site? The ROAD project intends to store CO₂ in a gas reservoir that will be in production at least till the end of 2014. The reservoir has been producing for many years and the current operator has sufficient data which was used to do a detailed process of site characterisation and assessment of the potential storage complex and surrounding.³¹ This means that no further exploration activities and therefore no permit are needed.

However, if the current operator would apply for an exploration permit, for example to do some extra information-gathering, this would mean that it has priority for the granting of the storage permit. If in the future more parties are competing for the same CO₂ storage sites, no matter how much knowledge and data are already available, applying for an exploration permit gives the applicant probably decisive head start over the competitors.

But in the current ROAD case, no exploration permit application has been submitted and therefore the current operator is not given priority in applying for a storage permit and does not have priority over possible competitors for the storage permit. Fortunately, no other parties

²⁹ Outlined in Annex I CCS Directive,

³⁰ Article 6 (3) CCS Directive.

³¹ Outlined in Annex I CCS Directive,

were interested to submit a competing storage permit application. However, the relation between the exploration permit and the storage permit should be considered in the review of the CCS Directive.

5.3.3 Storage permit

The CCS Directive states that Member States shall ensure that no storage site is operated without a storage permit.³² The Directive provides a lot of criteria and provisions that the storage permit application must take into account. The most important provisions are described in the following paragraphs.

5.3.3.1 Technical requirements operator

First of all, the operator must demonstrate that it is technically competent and reliable to operate a storage site, including that necessary technical training and development of staff has been provided.³³

In general, if an operator is already prudently operating in mining activities (for example in gas- or oil production) it is not that difficult to demonstrate competence and reliability. ROAD's partner TAQA Energy is already active for many years in the Netherlands and the competent authority endorsed its competence and reliability. Furthermore, probably no operator will apply for a permit without being absolutely sure it can operate the storage site prudently. Only in the event that the permit applicant is unknown to the competent authority, problems for the applicant to demonstrate its competence and reliability could arise.

5.3.3.2 Financial requirements operator

Additionally, operators are required to show that they are financially sound.³⁴ Eventually, the storage permit holder must provide financial security prior to the injection of CO₂, to cover the costs relating to the operation and post-closure periods of the storage site until responsibilities are transferred to the competent authority. This financial security can be drawn upon by the competent authority should the operator default on its obligations under the storage permit. Proof that this can be established must be submitted with the permit application. In paragraph 6.2 this financial security is described in detail because it can be a huge hurdle for CCS projects and is one of the key issues arising from the CCS Directive.

Another key issue is the financial mechanism. After injection and when a storage site has been closed, all responsibilities can be transferred to the competent authority if certain criteria are met. One of the conditions is that the operator must make a financial contribution available to the competent authority before the transfer of responsibilities has taken place. The contribution from the operator may be used to cover the costs borne by the competent authority after the transfer to ensure that the CO₂ is completely and permanently contained after the transfer of responsibility.

³² Article 6(1) CCS Directive.

³³ Article 8(1) CCS Directive.

³⁴ Article 8(1) CCS Directive.

The contribution should cover at least the anticipated cost of monitoring for a period of 30 years, but it also may be used to cover costs for handover of allowances in case of leakage, corrective measures etc. This financial contribution, and especially the uncertainty on the magnitude of this contribution, is a key issue for CCS projects and will be discussed in paragraph 6.4.

5.3.3.3 Plans

A major part of the risk management scheme adopted under the CCS Directive is the process of developing a series of plans concerning the operation and closure of the site. In these plans, operators must elaborate on the proposed method of monitoring the site, on the details of the corrective measures to be taken in the case of CO₂ leakage, significant irregularities, risk of leakage and risk to health or the environment, and the proposed course of action for the post-closure period.

All the plans need official approval of the competent authority and must be updated regularly. In any case every five years it must take account of changes to the assessed risk of leakage, changes to the assessed risks to the environment and human health, new scientific knowledge, and improvements in best available technology.

In summary, the following plans have to be developed and accepted by the competent authority:

1. Risk management plan;³⁵
2. Monitoring plan;
3. Corrective measure plan;
4. Closure plan.

There is a great consistency between all these plans. For example, if the monitoring results show that CO₂ is leaking from the storage complex, the corrective measure plan must become operational and if for example the leakage is caused by fractures in the well, the closure plan also may needed to be amended in order to abandon the well in a way the CO₂ remain stored.

The monitoring plan is 'risk based'. This means that the level of detail of the plan depends on the results of the location-specific risk assessment, as recorded in the risk management plan. Because of this, the monitoring plan not only closely interacts with the corrective measures plan, but also with the risk management plan. This is illustrated in figure 5.1.

³⁵ There is actually no obligation under the CCS Directive to develop a risk management plan. Annex I of the Directive requires several risk assessments, characterisations and operational conditions. ROAD combined all of these requirements in a 'risk management plan', as will be explained on the next page.

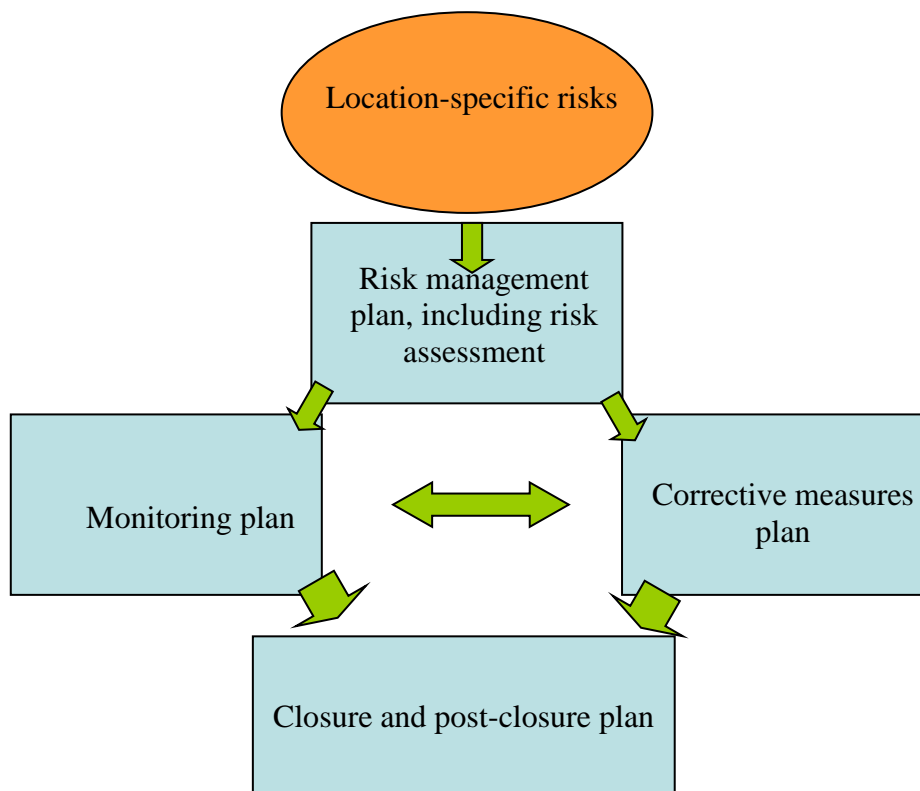


Figure 5.1: Consistency between plans

1. Risk management plan

The suitability of a geological formation for the use as a storage site must be determined through a characterisation and assessment of the potential storage complex and surrounding area pursuant to the criteria specified in Annex I of the CCS Directive.³⁶ This characterisation and assessment must be carried out in the following three steps.

Step 1: Data collection

Sufficient data must be accumulated to construct a volumetric and three-dimensional static (3-D)-earth model for the storage site and storage complex, including the caprock, and the surrounding area, including the hydraulically connected areas.

Step 2: Building the three-dimensional static geological earth model

Using the data collected in Step 1, a three-dimensional static geological earth model, or a set of such models, of the candidate storage complex, including the caprock and the hydraulically connected areas and fluids shall be built using computer reservoir simulators.

Step 3: Characterisation of the storage dynamic behaviour, sensitivity characterisation, risk assessment

The characterisations and assessment shall be based on dynamic modelling, comprising a variety of time-step simulations of CO₂ injection into the storage site using the three-

³⁶ Article 4 (3) CCS Directive.

dimensional static geological earth model(s) in the computerised storage complex simulator constructed under Step 2.

The next step is to undertake a hazard characterisation by characterising the potential for leakage from the storage complex, as established through dynamic modelling and security characterisation described above. This shall include consideration of, inter alia:

- potential leakage pathways;
- potential magnitude of leakage events for identified leakage pathways (fluxrates);
- secondary effects of storage of CO₂, including displaced formation fluids and new substances created by the storing of CO₂;
- critical parameters affecting potential leakage (for example maximum reservoir pressure, maximum injection rate, temperature, sensitivity to various assumptions in the static geological Earth model(s));
- any other factors which could pose a hazard to human health or the environment (for example physical structures associated with the project).

The hazard characterisation shall cover the full range of potential operating conditions to test the security of the storage complex.

Annex I of the CCS Directive lists many criteria regarding the characterisation and assessment that have to be met. However, derogations from one or more of these criteria may be permitted by the competent authority provided the operator has demonstrated that the capacity of the characterisation and assessment to enable the determinations pursuant to Article 4 is not affected.

This characterisation and assessment should not only lead to the conclusion that the CO₂ storage can take safely place, but also to operational conditions that have to be met in order to safeguard the integrity of the storage site (for example a limit on the reservoirs pressure).

ROAD combined all of these requirements in a 'risk management plan'. There is actually no obligation under the CCS Directive to develop a risk management plan, but developing one integral plan, that includes all of characterisation and assessment aspects described above, is the most logic thing to do.

The risk management plan consists of the risk analysis (risk assessment) and the corresponding control (risk management). The risk analysis also forms the basis for the corrective measure plan and for the provisional closure plan. And all these plans together provide the input for the monitoring plan. Although the risk management plan is location-specific and the ROAD plan is therefore not really helpful for other projects, one important topic of the ROAD plan is outlined more specifically below.

The standard risk approach consists of the calculation of a QRA (quantitative risk assessment). This methodology provides estimates of risks, given the parameters defining them.³⁷ On basis of this QRA, the competent authority determines whether the risks are acceptable or whether additional measures are necessary.

³⁷ http://en.wikipedia.org/wiki/Quantitative_risk_assessment_software.

However, for underground storage of CO₂ it is not (yet) possible to carry out a QRA. There are not enough empirical data available to statistically assess the different possibilities of failure. Additionally, there is still too little experience with the consequences of failure. As a result, the quantitative assessment is not possible.

But it is possible to do a qualitative assessment, in which the same issues are discussed. This is called a 'bow-tie approach', as is illustrated in figure 5.2.

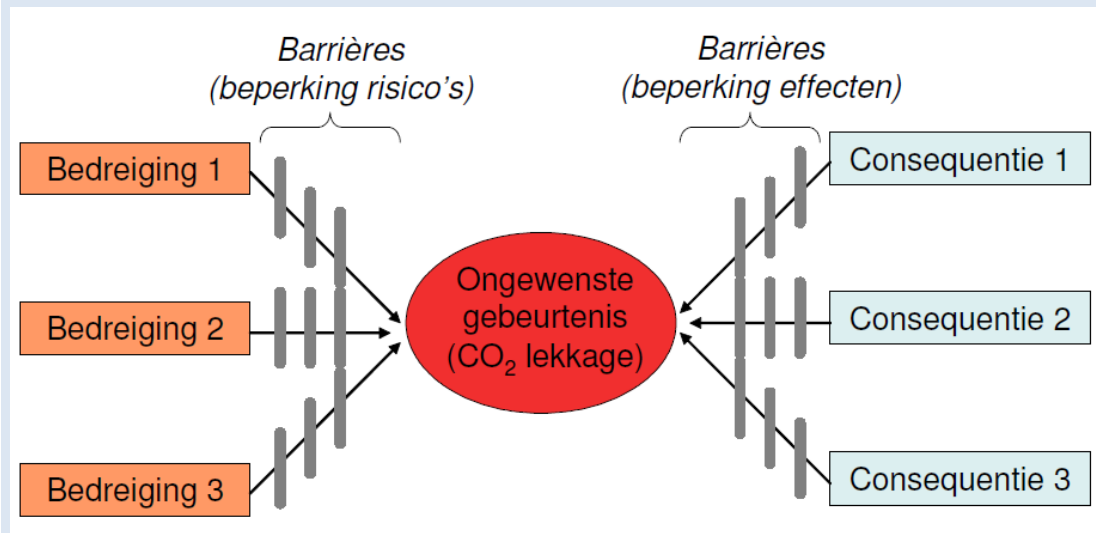


Figure 5.2: Bow-tie

In the bow-tie the undesirable occurrences (also called 'events') are in the centre. The most important unwanted event is: any significant irregularity in the injection or storage operations or in the condition of the storage complex itself, which implies the risk of a leakage or risk to the environment or human health.

The bow-tie indicates on the left side what kind of threats can lead to such an undesirable event. For example, if there is a problem in the well, CO₂ could leak. The well is therefore a possible threat on the left of the bow-tie. Between the threat and the event, there are barriers to prevent that a threat leads to an event. These are the risk management measures. For example, limiting the maximum pressure in the reservoir is a barrier to prevent leakage.

On the right side of the bow-tie the possible consequences of the event are listed. For example, if CO₂ would leak (event) this could cause damage to the environment. Also between the consequences and the event barriers can be put in place. These are the corrective measures as described in the corrective measure plan in this paragraph under 3.

2. Monitoring plan

The monitoring plan is the key instrument to ensure the safe storage of CO₂. The main goal of the monitoring plan is to detect any problems affecting the storage integrity of the site and potential impacts on the surrounding environment, including drinking water, human

populations and users of the surrounding biosphere. More specific, the purpose of the monitoring is to:³⁸

- compare the actual and modelled behaviour of CO₂ and formation water, in the storage site;
- detect significant irregularities;
- detect migration of CO₂;
- detect leakage of CO₂;
- detect significant adverse effects for the surrounding environment, including in particular on drinking water, for human populations, or for users of the surrounding biosphere;
- assess the effectiveness of any corrective measures taken;
- update the assessment of the safety and integrity of the storage complex in the short and long term, including the assessment of whether the stored CO₂ will be completely and permanently contained.

The monitoring plan must not only target the storage site, but also the injection facilities, the storage complex (including, if possible, the CO₂ plume), and where appropriate the surrounding environment. Please note that the storage site is not the same as the storage complex.

The 'storage site' is a defined volume area within a geological formation used for the geological storage of CO₂ and associated surface and injection facilities.³⁹ The 'storage complex' is the storage site and surrounding geological domain which can have an effect on overall storage integrity and security; that is, secondary containment formations.⁴⁰ Figure 5.3 illustrates the different monitoring areas.

³⁸ Article 13 CCS Directive.

³⁹ Article 3 (3) CCS Directive.

⁴⁰ Article 3 (6) CCS Directive.

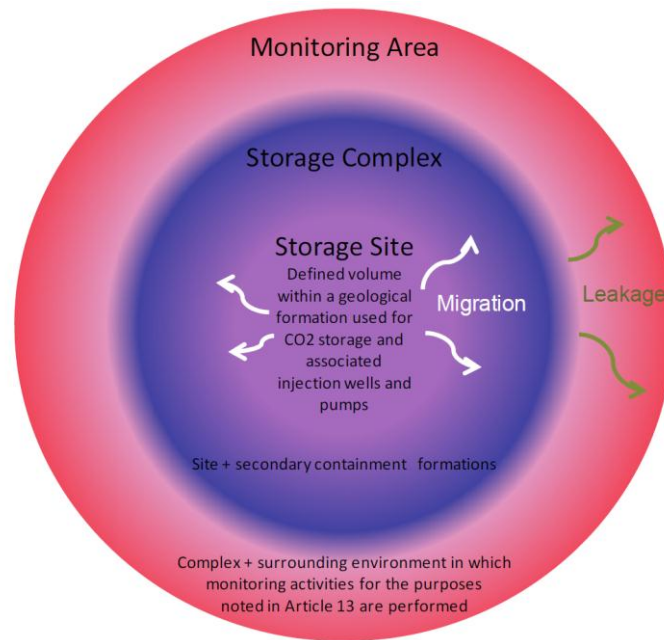


Figure 5.3: Monitoring area

Finally, the monitoring plan must comply with the guidelines established pursuant to the EU ETS Directive⁴¹ and with all the requirements set out in Annex II of the CCS Directive. According to the Annex II the monitoring plan shall provide details of the monitoring to be deployed at the main stages of the project, including baseline, operational and post-closure monitoring. The following shall be specified for each phase:⁴²

- parameters monitored;
- monitoring technology employed and justification for technology choice;
- monitoring locations and spatial sampling rationale;
- frequency of application and temporal sampling rationale.

The parameters to be monitored are identified so as to fulfil the purposes of monitoring. However, the plan shall in any case include continuous or intermittent monitoring of the following items:

- fugitive emissions of CO₂ at the injection facility;
- CO₂ volumetric flow at injection wellheads;
- CO₂ pressure and temperature at injection wellheads (to determine mass flow);
- chemical analysis of the injected material;
- reservoir temperature and pressure (to determine CO₂ phase behaviour and state).

The choice of monitoring technology is to be based on best practice available at the time of design. The following options shall be considered and used as appropriate:

⁴¹ These guidelines are established pursuant to the Article 14 and Article 23(2) of Directive 2003/87/EC.

⁴² Annex II CCS Directive.

- technologies that can detect the presence, location and migration paths of CO₂ in the subsurface and at surface;
- technologies that provide information about pressure-volume behaviour and areal/vertical distribution of CO₂-plume to refine numerical 3-D simulation to the 3-D-geological models of the storage formation;
- technologies that can provide a wide aerial spread in order to capture information on any previously undetected potential leakage pathways across the aerial dimensions of the complete storage.

Road monitoring plan

The ROAD monitoring plan complies with all regulations described above. And although the specific monitoring technologies, parameters, etc. will depend on the location-specific risks for every storage site, it may be helpful to explain what the approach of the ROAD monitoring plan is.

The monitoring is based upon the so-called ‘stoplight model’, illustrated in figure 5.4.

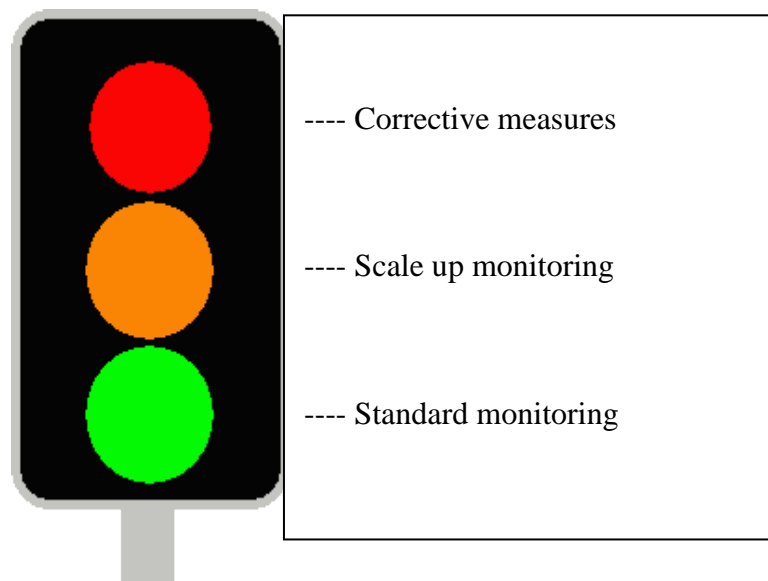


Figure 5.4: stoplight model

The ‘stoplight model’ means that for the measurements, the expected values are indicated in ranges. If all measurements are within these ranges, it is to be assumed that the CO₂ injection process is proceeding as expected. When the monitoring plan is updated prior to the start of injection, the ranges will be quantified and these values will be presented to the competent authority for approval.

In the stoplight model, a green zone is given for each operational parameter, indicating the measurement values within the predicted behaviour. Outside of this range, there is also an orange zone indicated for each type of measurement. If a measurement value falls within the orange zone, there is a deviation from the predicted behaviour, but there is no direct cause for corrective measures. It is important, however, that insight is gained into the cause of the anomalous results. For that reason, a measurement in the orange zone will lead to additional measurements (extra measurements and/or the use of other measuring techniques, depending on the circumstances). Finally, there is the red zone, indicating measurements that are so far outside of the expected range that corrective measures are necessary. This could mean, for example, that CO₂ injection is temporarily halted until the reasons for the anomalous observations are explained.

If the injection proceeds predictably, that is to say that the measured values are consistent with the predicted values, the frequency of measurement can gradually be decreased. If the measurements deviate from the expected values, this will lead to higher-frequency measurements if the deviation is limited (within the orange zone). If this does not provide sufficient illumination of the situation, the monitoring programme will be expanded further.

Monitoring leads to information that will be used to further adjust and calibrate the model used. The adjusted model can be used to predict future behaviour with greater reliability, so that the behaviour of the CO₂, the well, the reservoir and the sealing layer can be predicted more accurately as the injection process proceeds.

The monitoring plan of the ROAD project is included in Appendix I of this report. But as stated above, the specific monitoring equipment, predicted values, the frequency of measurement, etc. must be updated before injection.

3. Corrective measure plan

In the event of leakages or significant irregularities the operator must immediately notify the competent authority and take all necessary corrective measures, including measures related to the protection of human health.⁴³ Therefore, prior to injection, the corrective measures must be ready to deploy and are elaborated in the corrective measure plan. This plan is part of the storage permit application and therefore subject to approval by the competent authority.

However, the corrective measures, as described in the corrective measure plan, shall be taken as a minimum on the basis of a corrective measures plan. The competent authority may at any time require the operator to take all necessary corrective measures, as well as measures related to the protection of human health. These may be additional to or different from those laid out in the corrective measures plan. The competent authority may also at any

⁴³ Article 16 CCS Directive.

time take corrective measures itself. If the operator fails to take the necessary corrective measures, the competent authority shall take the necessary corrective measures itself. The competent authority shall recover the costs incurred from the operator.

An important aspect of the corrective measure plan is 'early warning' and 'early intervention', with the aim to prevent worsening of the situation and the risk of leakage. This includes immediate sharing of information with the competent authorities, when a significant irregularity occurs and as soon as the corrective measures are operational.

Corrective measures are defined in the CCS Directive as: “any measures taken to correct significant irregularities or to close leakages in order to prevent or stop the release of CO₂ from the storage complex”.⁴⁴ They are intended to ensure the safety and effectiveness of geological storage. Corrective measures are part of the overall risk management process that is intended to ensure the safety of geological storage and to manage the risks from leakage during the project life cycle.⁴⁵

In ROAD’s opinion, the principles on which corrective measures are based are generic and applicable on the risk management plan and monitoring plan. Corrective measures:

- are risk-based. This means that the content of the corrective measure plan depends on the results of the site-specific risk assessment. There is a strong link with the risk management plan, in which the site-specific risk analysis is developed;
- closely associate with monitoring. The monitoring plan sets out the values that trigger the use of corrective measures in case of leakages or significant irregularities. Furthermore, the corrective actions should be closely monitored to see whether these taken measures are effective.

In general there are two types of corrective measures:

- corrective actions related to the natural geological system;
- corrective actions related to the 'man-made engineered' system (wellbore).

In the event of a leakage, only corrective measures related to the 'man-made engineered' system will probably be effective to stop the leakage. For example, if there is a blow-out, killing the well can be an effective corrective measure. If CO₂ leaks for example through a fault, the only corrective measure that can be taken is to stop the injection to lower the pressure in the reservoir.

4. Closure plan

Once the storage site is filled with CO₂, the site can be closed. A storage site shall be closed if at least one of the following three conditions are met⁴⁶:

1. the relevant conditions stated in the permit have been met;

⁴⁴ Article 3 (19) CCS Directive.

⁴⁵ EU Guidance Document 2, p. 128

⁴⁶ Article 17 (1) CCS Directive.

2. at the substantiated request of the operator, after authorisation of the competent authority; or
3. if the competent authority so decides after the withdrawal of a storage permit.

In the period preceding the closure, a closure plan must be developed based on the best knowledge at that time. Prior to injection, the storage permit applicant also needs to include a preliminary plan for closure in the application. This preliminary plan must show that safe abandonment (the CO₂ remains contained) is possible on basis of the current state of technology and experience. After the injection is ceased, the provisional post-closure plan shall be:⁴⁷

1. updated as necessary, taking account of risk analysis, best practice and technological improvements;
2. submitted to the competent authority for its approval; and
3. approved by the competent authority as the definitive post-closure plan.

The storage operator remains responsible for maintenance, monitoring and control, reporting, and corrective measures on the basis of this post-closure plan until the responsibility for the storage site is transferred to the competent authority.

Because abandonment procedures and techniques do not differ significantly from gas- and oil activities, no problems are foreseen regarding the closures of sites.

5.3.3.4 European Commission opinion on draft storage permit

In order to ensure consistency in implementation of the requirements of the CCS Directive across all Member States, all storage permit applications should be made available to the European Commission, within one month of their receipt. The draft storage permit must also be transmitted to the European Commission to enable it to issue an opinion on the draft permits within four months of their receipt.⁴⁸ Furthermore, all relevant information (studies, other relating permits, etc.) must be submitted to the European Commission in order to enable the Commission to undertake a thorough review of the draft storage permit. The national competent authority should also take this opinion into consideration when taking a decision on the permit and should justify any deviation from the Commission's opinion. The review by the European Commission should also help to enhance public confidence in CCS.

Although the opinion of the EC is not legally binding (the competent authority may deviate from the opinion, but must give reasons for its decision) in practice the opinion is experienced as a binding opinion. With a view to possible appeals in court, competent authorities are reluctant to deviate from the EC opinion. If for example the EC states in its opinion that a certain provision in the draft storage permit is in breach with the CCS Directive and although the Member State is not agreeing with the EC, it will most of the time adopt the permit in accordance with the opinion. Otherwise opponents have ammunition (the EC's opinion) to use in court. Furthermore, with a view to public acceptance, it is very important to get a positive opinion from the EC.

⁴⁷ Article 17 (3) CCS Directive.

⁴⁸ Article 10 (1) CCS Directive.

On 28 February 2012 the European Commission adopted its first opinion on the draft permit ever for the ROAD-project. The opinion was very positive; only one important suggestion was made by the EC. The status of all plans (described in the previous paragraph) was not sufficient. In the end, the Dutch competent authority and the ROAD project agreed with this suggestion, although there are some good reasons why all the plans cannot be operational yet when a draft storage permit is granted, and a solution was agreed upon. This suggestion of the EC and the solution are described in detail in paragraph 6.1.

5.3.3.5 Other provisions

Storage permits are also to include details relating to:

- The CO₂ that is to be injected;⁴⁹ including the total quantity to be stored, its sources and transport methods, and the composition of CO₂ streams to be injected. A CO₂ stream shall consist “overwhelmingly” of CO₂. According to the Guidance Documents, “overwhelmingly” is a minimum of 90/95% CO₂ in the flue gas. To this end, no waste or other matter may be added for the purpose of disposing of that waste or other matter. However, a CO₂ stream may contain incidental associated substances from the source, capture or injection process and trace substances added to assist in monitoring and verifying CO₂ migration. Concentrations of all incidental and added substances shall be below levels that would:
 - adversely affect the integrity of the storage site or the relevant transport infrastructure; or
 - pose a significant risk to the environment or human health; or
 - breach the requirements of applicable Community legislation
- Reporting and updating. All plans described in the paragraph 6.3 must be updated on a regular basis; every five years to take account of changes to the assessed risk of leakage, changes to the assessed risks to the environment and human health, new scientific knowledge, and improvements in best available technology. Updated plans shall be re-submitted for approval to the competent authority. Furthermore, an annual assessment is needed of the financial security, to ascertain whether the security is still sufficient. The financial security shall be periodically adjusted to take account of changes to the assessed risk of leakage and the estimated costs of all obligations arising under the permit.⁵⁰ This is discussed in detail in paragraph 6.2.

⁴⁹ Article 12 CCS Directive.

⁵⁰ Article 19 (2) CCS Directive.

5.3.4 Post-closure (and transfer of responsibilities)

In order to address the reluctance on the part of potential operators to retain responsibility for a storage site indefinitely, together with the shorter life-span of corporations when compared to the life of a storage site, the Directive provides for the eventual transfer of responsibility for the site to the competent authority.⁵¹ Upon this transfer, the operator is released from obligations relating to monitoring and corrective measures under this Directive, together with any liabilities under the EU ETS and the Environmental Liability Directive (discussed in more detail below).

However, the full extent of potential legal liabilities under the CCS Directive are not transferred, with the Directive making specific reference to a number of situations where any costs incurred by the competent authority are to be recovered from the operator. These relate to fault on the part of the operator, including wilful deceit, negligence, a lack of due diligence or the provision of deficient data. This is an important clarifying provision not included within the original proposal, which should help to address any perverse incentives relating to, for example, false reporting or a lack of due care in the management of the site.

Transfer from the operator to the competent authority can take place when four main conditions have been met:

1. all available evidence indicates that the stored CO₂ will be completely and permanently contained. The overarching qualitative condition is that 'all available evidence indicates that the stored CO₂ will be completely and permanently contained'. The operator is to prepare a report documenting that this threshold has been met for approval by the competent authority. At a minimum, the report must demonstrate: conformity between the actual behaviour of the CO₂ and the expected modelled behaviour; the absence of any detectable leakage; and that the storage site is 'evolving towards a situation of long-term stability';
2. a minimum period, to be determined by the competent authority has elapsed. This minimum period shall be no shorter than 20 years, unless the competent authority is convinced that the criterion referred to in point (a) is complied with before the end of that period;
3. the financial obligations have been fulfilled. The operator must make available to the competent authority a financial contribution to cover at least the anticipated cost of monitoring the site for a period of 30 years. This financial mechanism is described in detail in paragraph 6.4.
4. the site has been sealed and the injection facilities have been removed.

Once satisfied that these conditions have been complied with, the competent authority will adopt a draft approval of transfer. This is also, in a similar fashion as for draft storage permits, to be submitted to the Commission, who may issue a non-binding opinion on it. The competent authority may deviate from this, giving reasons. After the transfer, routine inspections will cease, and monitoring may be reduced to a level which allows for the detection of leakage and significant irregularities.

As a last resort, the competent authority may withdraw the storage permit. If this is the case, the competent authority must either issue a new permit or close the site. In either case, the

⁵¹ Article 18 CCS Directive.

competent authority will temporarily assume all responsibilities relating to the management of the site, although continuing to hold the former operator liable for any costs involved. If the competent authority chooses to close the site, then once all available evidence indicates permanent and complete containment, the site has been sealed and injection facilities removed, the final transfer of responsibility must be deemed to have taken place.

The issues arising from this handover process are described in detail in paragraph 6.4.

5.4 Transposition of the CCS Directive

The EC published the CCS Directive on 25 June 2009⁵², with the implementation deadline of 25 June 2011. The legislative proposal for transposing the Directive into Dutch legislation was published in March 2010 and after the Parliamentary discussions, the proposal came into force in August 2011. In the Netherlands the CCS Directive has been implemented in the:

- Dutch Mining Act;⁵³
- Dutch Mining Decree;⁵⁴
- Dutch Mining Regulation.⁵⁵

The Mining Act is the most important one. The Mining Decree and Regulation only give some general rules for the process of the storage permit application.⁵⁶ Provisions regarding the frequency of reporting to the competent authority, the terms for the competent authority's review of a permit application, which governmental body is responsible, are provided in this Decree and Regulation.

With regards to the transposition of the CCS Directive, the key question was whether the Directive would be implemented in its existing format or whether the Dutch Government would add additional national CCS provisions to the legislative proposal. In ROAD's opinion, the EC Guidance Documents for the implementation of the CCS Directive did not give sufficient clarity and are primarily applicable for storage in aquifers. More importantly, the final versions of the Guidance Documents were not published when the Dutch legislative proposal was drafted and discussed in Parliament.

The Dutch Minister of Agriculture, Economic Affairs and Innovation decided to implement the Directive in its entirety with no additional national provisions or any further interpretation of

⁵² Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006.

⁵³ Wet van 6 juni 2011 tot wijziging van de Mijnbouwwet in verband met implementatie van richtlijn nr. 2009/31/EG van het Europees Parlement en de Raad van 23 april 2009 betreffende de geologische opslag van kooldioxide en tot wijziging van richtlijn 85/337/EEG van de Raad, de richtlijnen 2000/60/EG, 2001/80/EG, 2004/35/EG, 2006/12/EG en 2008/1/EG en verordening (EG) nr. 1013/2006 van het Europees Parlement en de Raad (PbEG L 140) en van Oskar Decision 2007/2 on the storage of carbon dioxide streams in geological formations.

⁵⁴ Besluit van 29 augustus 2011, houdende wijziging van het Mijnbouwbesluit en twee andere besluiten in verband met bepalingen voor het permanent opslaan van CO₂.

⁵⁵ Besluit van 29 augustus 2011, houdende wijziging van het Mijnbouwbesluit en twee andere besluiten in verband met bepalingen voor het permanent opslaan van CO₂.

⁵⁶ Besluit van 29 augustus 2011, houdende wijziging van het Mijnbouwbesluit en twee andere besluiten in verband met bepalingen voor het permanent opslaan van CO₂.

the open elements, for example the third-party access. The resulting legislative proposal was almost a literal translation of the English-language Directive. Despite several procedural elaborations in the Mining Decree and the Mining Regulation, there remains only one additional provision in the Dutch legislative proposal.

According to the CCS Directive, Member States must ensure that the procedures for the granting of storage permits are open to all those entities possessing the necessary capacity and that the permits are granted on the basis of objective, published and transparent criteria.⁵⁷ The Dutch legislator decided, in order to comply with this CCS Directive requirement, that all storage permit application submitted to the competent authority must be published in the 'Staatscourant' (official publication of the Dutch Government). Other interested parties have the opportunity within 91 days after publication to submit a competitive application.

This 91 days period is not required under the CCS Directive and this additional provision caused discussion, especially among the oil and gas operators. In many instances it is likely to be the current production operator of a site that is the applicant for a storage permit.

However, in practice, this 91 day competitive term will probably not lead to competitive offers. For example, ROAD needed almost a year to gather all necessary information and to draw up all the plans (requested by CCS Directive) before the storage permit application was submitted to the competent authority. But except for this provision, the Dutch CCS legislation is an almost literal translation of the English-language Directive and does not impose additional requirements.

However, this also means that all provisions in the CCS Directive that leave room for interpretation are not elaborated in Dutch legislation. As stated before, the EU guidance documents are not that helpful and are not legally binding. This creates uncertainty for industries, but also creates the possibility to elaborate these provisions in the storage permit. Especially the key elements of the CCS Directive must be addressed in the storage permit. Chapter 6 describes how the storage permit addressed four of these key issues.

Most stakeholders agreed with this open and flexible legislation. Also ROAD fully endorsed this approach since each CCS project has its own specific characteristics, and in order to have a proper assessment of a project proposal, a tailor-made approach is essential. The requirements for the storage of CO₂, set by the Government, should be based upon the specific characteristics of each storage site.

5.5 Future amendments legislation and regulation

Although the transposition of the CCS Directive has yet to be completed in all Member States, a review of the CCS Directive starts in 2013. The CCS Directive review has the potential to provide an opportunity for recognizing the experiences of the CCS community in the CCS Directive. An improvement of the CCS Directive can create a boost for the development of CCS in the European Union.

Besides the review of the CCS Directive, other regulatory developments are expected to have an impact on the regulatory framework for CCS. Standardization is a development that may have

⁵⁷ Article 6 (2) CCS Directive.

an impact on regulations. This paragraph discusses the foreseen review of the CCS Directive and the possible influence of standardization processes that already have started.

5.5.1 Review CCS Directive

The CCS Directive obligates the European Commission to transmit a report on the implementation of the Directive to the European Parliament and to the Council. Furthermore, the EC also must transmit, at latest by 31 March 2015, a report in which the EC shall assess on the basis of experience with the implementation of this Directive, in light of the experience with CCS and taking into account technical progress and the most recent scientific knowledge:⁵⁸

- whether permanent containment of CO₂ in such a way as to prevent and reduce as far as possible negative effects on the environment and any resulting risk to human health and the environmental and human safety of CCS has been sufficiently demonstrated;
- whether the procedures regarding the Commission's reviews of the draft storage permits and the draft decisions on transfer of responsibility are still required;
- experience with the provisions on CO₂ stream acceptance criteria and procedure;
- experience with the provisions on third-party access and with the provisions on trans boundary cooperation;
- the provisions applicable to capture readiness;
- prospects for geological storage of CO₂ in third countries;
- further development and updating of the criteria for characterisation and assessment of the storage complex and surrounding areas;
- experience with incentives for applying CCS on installations combusting biomass;
- the need for further regulation on environmental risks related to CO₂ transport.

It is expected that the work on the review of the CCS Directive will start in the beginning of 2013. Stakeholders are already preparing their opinion on the review. In ROAD's opinion, the CCS Directive is a good first attempt to regulate CCS in Europe and provides guidance and security for CCS projects. However, an extensive review is needed. Besides several elements described in this chapter (for example the third-party access and exploration), several key issues arise by the CCS Directive and should be addressed in the review. These issues are described in chapter 7.

The CCS Directive review provides a substantial opportunity to implement the experiences of the CCS community in the CCS Directive. A thorough amendment could establish more clarity for industries wanting to invest in CCS and to give an incentive for the development of CCS. However, the review process is expected to be long and will probably face opposition of the Council because not all Member States support CCS.

5.5.2 Standardization

Although CCS is still in the demonstration phase in many jurisdictions and the CCS community is still learning in many instances, the process of developing and implementing technical standards

⁵⁸ Article 38 CCS Directive.

has already started.⁵⁹ Standardization can be useful to ensure that CCS can be safely and reliably deployed. However, the development of standards should not limit the development of CCS. A solid assessment is needed to see what specific elements of CCS could benefit from standardization but also which elements first need to be developed further before being standardized.

In ROAD's opinion, there is a realistic chance that if standards will be developed, these standards in the near future also will be adopted by the European Commission and/or Dutch Government. In this event, these standards will become mandatory for CCS projects in the EU and/or the Netherlands. This even more subscribes the need to do a thorough assessment on which elements should be standardized and which elements not.

The International Organization for Standardization (ISO) is already developing CCS standardization. Therefore, a brief overview of its progress and the participation of EU Member States and their views are given in the following paragraphs.

5.5.2.1 ISO TC 265

The International Organization for Standardization (ISO) initiated in the end of 2011 a technical committee on Carbon Dioxide Capture, Transportation, and Geological Storage.⁶⁰ The goal of the committee is to standardize design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities in the field of carbon dioxide capture, transportation, and geological storage.

On June 5-6 2012 a first meeting in Paris (France) was held, attended by delegates from Canada, China, Japan, France, Germany, Norway, Portugal, UK, Netherlands, Spain, Brazil and from liaison organisations (IEA, IEA – GHG and GCCSI). The meeting agreed upon the scope of the work and the following working groups were agreed:

- Workgroup 1: CO₂ capture
- Workgroup 2: CO₂ transport
- Workgroup 3: CO₂ storage
- Workgroup 4: Quantification and verification
- Workgroup 5: Cross cutting (including risk)

Prior to session close, IPAC-CO₂⁶¹ provided a brief update on its work with CSA Standard to develop a standard for CO₂ storage in Canada and the United States. The organization developed a document to be used to develop the standard, which is currently being reviewed by North American experts. The standard, which is intended to support the development of general regulatory and legal frameworks for widespread deployment, will address site selection, monitoring and verification, storage, operation and long-term stewardship, amongst other areas. IPAC-CO₂ hopes the standard, which they expect to be finalized in 2012, will be used as a basis for international standards through the International Organization for Standardization. This work can be used as the basis of all the ISO work that will be done in the coming year(s).

⁵⁹http://www.iso.org/iso/standards_development/technical_committees/other_bodies/iso_technical_committee.htm?commid=648607

⁶⁰ ISO/TC 265.

⁶¹ <http://www.ipac-co2.com/>

5.5.2.2 CEN/CENELEC SFEM Working group on CCS

Prior to the ISO meeting in France, the European Committee for Standardization (CEN) together with the European Committee for Electrotechnical Standardization (CENELEC) met in Brussels to discuss the standardization of CCS. Delegates from most EU countries attended and the coordination of the European input to the ISO/TC265 work was discussed.

Most delegates supported the development of standardization and will contribute actively to the ISO work. The meeting concluded that it is important to have an extensive review of the standardization in oil- and gas industries and to see if CCS differs from these activities or that the oil- and gas standards can be applied on CCS. Furthermore, the meeting recommended global standards on CCS to be elaborated under Vienna Agreement with ISO lead.⁶² In summary, a Vienna Agreement provides the means for ISO standards to become CEN standards and vice versa.

Although the ISO process can take a long period, ROAD expects that the outcome of the ISO work can have a great impact on CCS projects. The work is expected to be done in 2014 and is not uncommon for regulators to implement these standards in regulations or to oblige these to industries. Furthermore, standardization can increase the public acceptance if CCS operations can be certified and provides to a certain extent certainty to the competent authorities. But the key question is what specific activities will be standardized.

CCS is still in a demonstration phase and standardization should not slow down or limit the development of CCS.

⁶² European standards are coordinated with International Organization for Standardization (ISO) standards via the ISO/CEN Vienna Agreement.

6. Key issues storage permit

The most important CCS legislation regarding the storage of CO₂ remains the CCS Directive. Paragraph 5.3 above describes in detail the provisions of the CCS Directive. The CCS Directive provides several important requirements for the storage of CO₂ which leave room for interpretation by Member States. The transposition of the CCS Directive in the Netherlands was an almost literal translation of the English-language Directive, as such; the Dutch legislation does not elaborate on these requirements. This means that the key elements of the CCS Directive are interpreted in the storage permit. ROAD managed to solve most of these issues together with the competent authority and other stakeholders, however, not all the issues have been resolved and in ROAD's opinion these issues should be taken into account with the review of the CCS Directive in 2015.

The issues are crucial for developing any CCS project in Europe. This chapter describes how the ROAD project interpreted the outstanding issues and was able to agree solutions with the competent authorities. This chapter assesses the following key issues relating to the storage permit:

- Storage permit process vs. FID;
- Financial Security;
- Financial Mechanism;
- Transfer of responsibilities.

Although the storage permit addresses these issues to a certain extent, the issues are not completely solved. Hopefully, the revision of the CCS Directive will provide a permanent solution.

6.1 Storage permit process vs. FID

In ROAD's opinion there is a huge gap between the requirements of the CCS Directive and the feasibility for a concrete project such as ROAD to comply with these requirements. In ROAD's opinion, the permitting process in the CCS Directive is not realistic for a project, because the Directive requires that all the required plans (i.e. monitoring, corrective measures, etc., as described in paragraph 5.3) are fully ready at the moment a project submits its application. In reality, developing all the studies, collecting all necessary information, and issuing reports will only be done after a FID is taken, and in order to take a FID, a granted storage permit is necessary.

To overcome this issue, ROAD came up with the following solution: lower the level of details of all plans (i.e. monitoring, corrective measures, financial security etc.) in the application and update these plans prior to injections. The plans (not operational yet) in the permit application provide sufficient information and prove that CO₂ can be stored safely, complying with the CCS Directive requirements, but do not include operational parameters, choices for specific monitoring instruments, all of which will be elaborated in the final plans.

At this time, the competent authorities and the EC have stated that they are satisfied with the current levels of detail and have granted respectively sanctioned the permit. The EC concluded

in its opinion that the application “...confirms the suitability of the chosen storage location for the permanent storage of CO₂ as was demonstrated by a detailed characterization and assessment of the storage site and complex”.⁶³

It has been agreed that the final plans will be submitted to the competent authority and the EC a year before the injection of CO₂ starts. The competent authorities must give their approval on the final plans and before adjusting the permit Sodm and TNO (state advisors) will give their expert advice. Also the EC will be enabled in 2014 to give another non-legally binding opinion on the update of the storage permit, when all of the plans have been elaborated.

With this agreement, the draft storage permit has been granted to ROAD (which gives sufficient comfort to take the final investment decision for the ROAD project) and the competent authorities and the European Commission are enabled to approve the final plans before injection starts (which complies with the CCS Directive). This is a pragmatic solution which can be taken into account when the CCS Directive is revised.

6.2 Financial security

The CCS Directive requires Member States to ensure that 'proof that adequate provisions can be established, by way of financial security or any other equivalent, on the basis of arrangements to be decided by the Member States, is presented by the potential operator as part of the application for a storage permit'.⁶⁴ Those provisions must be adequate to ensure that all legal obligations arising under the permit, including closure and post-closure requirements, as well as any obligations arising from inclusion of the storage site under the EU ETS Directive, can be met.

The (CCS) financial security must be valid and effective from before the start of injection until responsibility for the site is transferred to the competent authority after its closure, or, if the permit is withdrawn, until either a new permit for the site is issued or the authority closes the site and subsequently accepts transfer of responsibility.

The competent authority can use the financial security in two circumstances:

1. if the competent authority has to perform obligations because the operator fails to do so. For example, if the operator does not take adequate corrective measures in the event of a CO₂ leakage, the competent authority must take the necessary measures itself and can bore the costs from the financial security;
2. when the authority withdraws the operator's permit and temporarily takes over all the obligations. If the operator overall fails and the competent authority takes over, it can bore all the operational costs, monitoring etc., on the financial security.

The financial security shall be periodically adjusted to take account of changes to the assessed risk of leakage and the estimated costs of all obligations arising under the permit issued.⁶⁵

⁶³ Commission Opinion of 28.2.2012 relating to the draft permit for the permanent storage of carbon dioxide in block section P18-4 of block section P18a of the Dutch continental shelf, in accordance with Article 10(1) of Directive 2009/31/EC of 23 April 2009 on the geological storage of carbon dioxide.

⁶⁴ Article 19 CCS Directive.

⁶⁵ Article 19 (2) CCS Directive.

The ROAD project faced three important questions regarding financial security: (1) what are the exact activities that must be covered by the financial security, (2) what is the amount of money that should guarantee these activities and (3) what kind of financial instrument is accepted by the competent authority?

The first two questions are answered in paragraph 6.2.1 and the financial instrument is being assessed in paragraph 6.2.2.

6.2.1 Activities covered by Financial Security

The CCS Directive states that the financial security must ensure that “all obligations arising under the permit issued pursuant to this Directive, including closure and post-closure requirements, as well as any obligations arising from inclusion of the storage site under Directive 2003/87/EC” can be met.⁶⁶ The key question is which obligations have to be included in the financial security.

The Guidance Document 4 provides some insights. The following activities may be included:

- monitoring;
- corrective measures;
- surrender of emissions allowances in the event of leakage;
- updating the monitoring and provisional post-closure plans;
- site closure (including removal of facilities and sealing of the site);
- temporary continuation of injection following withdrawal of a permit;
- and making the required financial contribution to the post-transfer financial mechanism (discussed in paragraph 6.4).

Some of the costs related to these activities may arise at any time in the project's life, while others will only occur in either the operational or post-closure phases. If the provision on financial security is interpreted strictly, also costs for example the platform, injection facilities, project overhead costs, other operational costs etc., could be included in the financial security while these activities are also necessary for storing CO₂.

Starting with the question of which activities must be included within the financial security, ROAD mapped all of the activities and contingency activities it could think of. ROAD then assessed this list with key questions, which included: if the operator goes bankrupt, which activities are essential to complete the project under current conditions or abandon the project, and how much would it cost the competent authority if it would need to take over the project?

ROAD concluded that the most important activities are:

- Monitoring;
- Contingency monitoring;
- Abandonment;
- Financial contribution;

⁶⁶ Article 19 (2) CCS Directive.

- EUAs in case of leakage.

For the ROAD project, the contingency monitoring will impose the highest costs for the corrective measures plan. Therefore, the costs for contingency monitoring are in fact the costs for the corrective measures plan.

After agreeing on which activities should be included in the financial security, ROAD assessed these activities further and thought about the costs for every activity.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10 - 29
Monitoring	12	10	9	8	7	6	5	4	3	0,1
Contingency monitoring	10	10	10	10	10	10	10	10	10	10
Abandonment	15,5	15,5	15,5	15,5	15,5	15,5	15,5	15,5	15,5	0
FC	2	2	2	2	2	2	2	2	2	2
EU-ETS	0	1	2	3	4	5	6	7	8	8
Sub Total	47	46	46	46	46	46	46	46	46	39,5
Contingency 20%	9,4	9,2	9,2	9,2	9,2	9,2	9,2	9,2	9,2	7,9
Total	56,4	55,2	55,2	55,2	55,2	55,2	55,2	55,2	55,2	47,4

Figure 6.1: Overview financial security ROAD project

The total amount of CO₂ stored in the period 2015-2020 is in the range of 4 Mton CO₂. This CO₂ will be permanently stored. All the risks for potential leakage have been identified and all possible measures will be taken to prevent leakage. The injection of CO₂ will be constantly monitored and also after the abandonment of the well, monitoring will continue. A corrective measures plan is being developed to ensure that in case of a leakage sufficient measures can be taken to prevent further leakage. However, if CO₂ at any time would leak out of the reservoir and reach the atmosphere (for example due to a blowout) the emission permit holder must surrender EU-ETS allowances for the amount of CO₂ that has leaked.

With a view to the storage permit application, ROAD needed to prove that the reservoir is sealed and, if CO₂ did nevertheless happen to leak, what the most likely leakage pathways are. ROAD also needed to calculate the amount of CO₂ that could leak to the atmosphere in case of a leakage. Furthermore, the permit holder needs to handover a financial security, that also covers the value of the EU-ETS allowances that is equivalent to the amount of CO₂ that could leak. ROAD has already taken the financial risks into account that ROAD is going to suffer in case of a leakage, and the risk is set out below:

Risk = (1) amount of CO₂ x (2) allowance price

With a view to the first factor (amount of CO₂), the Guidance Documents state that there are two possible options for estimating amounts of potential leakage, in the absence of experience with geological storage of CO₂:

- a conservative estimate of the maximum percentage of CO₂ that can be released (which, it says, “in most situations, will be much less than 100%”); or
- a calculation based upon a probability distribution of the amount of leakage.

The Guidance Documents explain that factors such as site geology and facility design, statistical modelling, etc., can be used to generate a probability distribution for the amount of leakage at a site, for each individual leakage and for the expected sum of all leaks over a period of time. This would give an indication of the size of each leak or series of leaks and could be combined with a separate probability function for their frequency.

The uncertainty for ROAD mainly lies in (2) the allowance price, while ROAD has a solid estimation of the maximum amount of CO₂ that could leak to the atmosphere in case of a leakage. A sufficient and well thought corrective measures plan has been developed and ROAD is confident that in case of a leakage, ROAD can take sufficient corrective measures to stop the leakage.

ROAD considered one of the most serious risks to be the price of an EU-ETS allowance. Since the EU-ETS allowances must be handed over in the year that the leakage occurs, ROAD would need to pay the price at that time (this risk can to some extent be covered by banking). For example, if a leakage occurs in 2022, ROAD is obligated to pay the price in that year. At this time, almost everybody agrees that the price will increase, but there remains uncertainty as to how high the price will rise. Estimations differ from €15 in 2020 to €140 in 2020. Furthermore, ROAD remains liable for leakage after the well and platform have been abandoned until the responsibilities are handed over to the competent authority. According to the CCS Directive, this could even take 20 years after the stop of injection. Under certain conditions, ROAD could even be liable for leakage after the handover of responsibilities. The extended period of liability increases the risk of high costs in case of leakage. The biggest concern is that an accurate estimation of the development of the EU-ETS price is not possible, but the amount of CO₂ that could leak will remain the same over time. To further illustrate this point: the EU Commission writes in its Guidance Document 4 on the Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide regarding Article 19 Financial Security and Article 20 Financial Mechanism:⁶⁷ “There is unavoidable uncertainty about the future price of EU Allowances (EUA) at the time of any potential leakage. There is no cap on the EUA prices; the penalty for excess emission (€100 per tonne) does not relieve the operator of the need to provide allowances to cover the emissions, and is not therefore a cap on EUA prices.”

Finally, it must be noted that the financial security must be adjusted yearly. This means that increases or reductions in the EU-ETS price will impact upon the amount of financial security over time.

⁶⁷ The purpose of the *Guidance Document nr 4* was to guide Member States to “strike the right balance between full coverage of obligations as required under Article 19 while at the same time not overpricing the risks in relation to these obligations for early movers.” The ‘unavoidable uncertainty’ can be dealt with by competent authorities because article 19 requires that the Financial Security should be periodically adjusted. Competent authorities can therefore avoid making long-term estimates of future EUA prices. In fact, the first known official example of such Financial Security (the draft Taqa storage permit), states that “the permit award system is such that the security to be provided for the first five years following the start of injection is determined in the permit. The financial security will be revised and adjusted five years following the permit award and subsequently every five years thereafter.” This however does not create more certainties for project initiators for the entire project.

6.2.2 Financial instrument

With a view to the activities described in the paragraph above, the CCS Directive requires that the operator must provide proof that adequate provisions can be established “....by way of financial security or any other equivalent”.⁶⁸ The CCS Directive, again, gives no clarity on what this security should look like. However, the Guidance Documents provide a (non-limited) summary of financial instruments to cover the financial security and assess these instruments.

In general, the guidance document offers two possible approaches to defining what instruments are acceptable either as financial security or as 'any other equivalent':

1. list specific types of allowable mechanisms. The Guidance Document summarizes three different types of security instruments:
 - a. setting aside funds or other assets - these include funds or deposits, irrevocable trust funds and escrow;
 - b. guarantee that funds will be available if the operator defaults - e.g. bank guarantees, irrevocable standby letters of credit and surety or bank bonds (either payment or performance bonds); and
 - c. insurance - defined here to include both risk transfer products, such as environmental liability insurance (EIL), to cover contingent risks, and other types of products, which do not involve the transfer of risks or the pooling of premiums between policyholders, to cover performance of unavoidable tasks specified in the permit.
2. list the characteristics that an acceptable mechanism must possess.

Regarding the financial instrument, ROAD described in the storage permit application several financial instruments that could be used to provide the financial security. ROAD elaborated one specific instrument that proves that a valid and effective financial security can be given before injection. The balance sheet of the operator is strong and can easily cover the financial security as assessed in the storage permit application. The permit conditions secure that injection can only start if the Competent Authority is satisfied with the financial security in 2014, (according to the draft storage permit):

- operator sets financial security preferably by bank guarantee or escrow;
- minister approves the financial security instrument selected by operator;
- operator sets financial security three months before start of injection.

At this moment the Dutch Government accepts a balance sheet, but prefers a bank or parental guarantee. This is also explicitly noted in the storage permit.

ROAD successfully argued that a bank guarantee (that will impose higher costs than for example a balance sheet or parental guarantee) must not be demanded by the competent authority. ROAD consulted several banks and they stated that under the current conditions (amount

⁶⁸ Article 19 (1) CCS Directive.

financial security, permit conditions, etc.) they all would be prepared to provide a bank guarantee in 2014. After discussions with the EC, ROAD even provided a letter of intent of one Dutch bank. ROAD proved that it most likely would be able to handover a bank guarantee in 2014, if this was demanded by the competent authority.

With a view to a bank guarantee, ROAD argued that invoking the financial security in case the operator does not comply with the permit conditions, the costs always first needs to be paid by the operator itself (a bank guarantee can only be invoked after the company can't pay the bill). This means, given the financial security amount and the strong balance of the operator, that a bank guarantee will give no/minimal additional security for the competent authority. A bank guarantee is accompanied by a parental guarantee. Only in the case where the operator goes bankrupt would a bank guarantee provide extra security for the competent authority.

Therefore, a bank guarantee does not provided the needed extra security above a parental guarantee and only increases the costs of the project; however, if the balance of the operator dramatically weakens in the coming years a bank guarantee could be demanded by the competent authority.

The financial security shall be periodically adjusted to take account of changes to the assessed risk of leakage and the estimated costs of all obligations arising under the permit but also to assess whether the provided instrument is still providing sufficient security to the competent authority.

6.3 Transfer of responsibilities

The CCS Directive states that when a storage site has been closed, the responsibility for all legal obligations can be transferred to the competent authority of the Member State, subject to several conditions:⁶⁹

- all available evidence indicates that the stored CO₂ will be completely and permanently contained;
- a minimum period after closure, to be determined by the competent authority has elapsed. This minimum period shall be no shorter than 20 years, unless the competent authority is convinced that the first condition above is fulfilled;
- the financial obligations under the financial mechanism have been fulfilled;
- the site has been sealed and the injection facilities have been removed.

In ROAD's opinion, clarity on the transfer of these responsibilities to the competent authority is one of the crucial issues, which has yet to be resolved. The main concern of the ROAD project is in which way and under which conditions the minimum period of 20 years can be reduced.

There are no technical or safety arguments as to why a minimum period would have to lapse. The greatest risk of leakage is during injection (although this risk is less than negligible, particularly for a reservoir that is only partly re-pressurised), when the well is open. After the well has been abandoned and the CO₂-proof sealing has been successfully carried out, and during injection no leakages occurred, future leakages are as good as ruled out. The demonstration is of a limited length.

⁶⁹ Article 18 CCS Directive.

A period of 20 years after injection is very costly; costs for monitoring, financial security, insurances for liabilities will continue while there is no additional income. Furthermore, a minimum period creates a great uncertainty for the ROAD project. The transfer could in theory be postponed infinitely.

The CCS Directive created a possibility to reduce the minimum period of 20 years, if all available evidence indicates that the stored CO₂ will be completely and permanently contained, this minimum period can be reduced. The key questions ROAD still has include:

1. Which evidence is taken into account?
2. What if the competent authority is not convinced, although all available evidence indicates that the stored CO₂ will be completely and permanently contained, for example due to leakage in another CCS project (what if for example in Canada stored CO₂ would leak and the Dutch public/politics get worried?)?
3. Who is going to assess this evidence?

The first two questions are to the main concern of ROAD. The CCS Directive and Guidance Documents to support coherent implementation of the CCS Directive across the EU Member States, give clarity to some extent on the first question.⁷⁰ At least the following three items noted must be taken into account as evidence that the stored CO₂ is completely and permanently contained:

1. **The conformity of the actual behaviour of the injected CO₂ with the modelled behaviour.** It is important to recognise that assessing the conformity of models for geological storage for regulatory purposes is an emerging area of practice. Hence, learning by doing is a key part of this process, and it is difficult at this stage to provide detailed standards which will be possible only if there is operating history and experience to use as a benchmark.
2. **The absence of any detectable leakage.** A key aspect of containment is that there are no detectable leaks from the storage complex, including leakage through geological or man-made structure. There should be no observed leakages from any existing or abandoned wells. This may be assessed by the operator demonstrating that there are no leakages for a continuous 10 year period immediately before the time of transfer. If a successful corrective measure has taken place (as result of leakage), the 'clock' for the ten year time period would start over from the point in time when the corrective measure has been proven successful. This would allow the competent authority to have sufficient confidence that the site would not leak again.
3. **That the storage site is evolving towards a situation of long-term stability.** Monitoring instruments that could be suitable to prove the evolvement towards a situation of long-term stability are:

⁷⁰ GD 3 Criteria for Transfer of Responsibility to the Competent Authority, p.3.

- pressure within the storage complex;
- movement of the plume;
- geochemical changes in the storage complex and the wells;
- samples of cap rock for testing integrity should be done using side-core samples, where the characteristics of injected fluids pose unusually high risks for the cap rock integrity;
- integrity of materials used to construct or abandon the wells.

Due to the long term nature of CCS, it is expected that technologies and techniques will have changed by the time the transfer of responsibilities becomes relevant. As of now, the regulation on the transfer of responsibility is not detailed enough. How can project developers be certain that in 20 years from now, the demands have not changed to the extent that it is almost impossible to comply?

The competent authority is to decide upon all of these issues and ROAD is concerned that decisions made today may change over time. The CCS Directive only gives directions on the issues to include in permits and it was anticipated that national legislation would provide details. As Dutch legislation is not more specific where there is a gap, which gives project initiatives the opportunity to use the freedom and come up with their own solutions, but the disadvantage is the uncertainty the project will face in the future. Taking into account good industry practices, careful monitoring and inspection, the transfer condition could be met relatively easily. However, in case of unforeseen circumstances, it could take a lot longer than 20 years before this condition could be met, which would leave an operator (and therefore the entire CCS project) with a large amount of ‘unwanted uncertainty’ on the EUA price.

ROAD tried to reduce these risks in the storage permit, as the storage permit application included a plan for closure and post closure. ROAD described this process, including a timeline, which was accepted by the competent authority and the European Commission adopted a positive opinion on the draft storage permit.

The post closure plan includes a monitoring plan after closure. After the abandonment monitoring possibilities are very limited. If after abandonment no additional evidence comes up, an assessment of the known data and information of the injection process should be sufficient. The well can only be abandoned if the competent authority is confident that the stored CO₂ will be completely and permanently contained. This should lead to the conclusion that after abandonment (and the inspections of the abandonment are positive), all available evidence indicates that the stored CO₂ will be completely and permanently contained and therefore handover can be established. Otherwise, the competent authority would not be able to give approval for abandonment of the well.

However, this still does not provide sufficient certainty; in ROAD’s opinion, the CCS Directive still leaves too much room for Member States to reject permits based on the handover criteria even if all evidence indicates that the stored CO₂ is completely and permanently contained. The competent authority could simply reject the abandonment request in order to keep the well and the monitoring possibilities open. This creates unlimited liabilities and provides no certainty that the transfer of responsibilities will be established overtime. This is unacceptable, certainly for proponents of demonstration projects. This must be taken into account when the CCS Directive is reviewed in 2015.

6.4 Financial mechanism

Member States must ensure that the operator makes a financial contribution available to the competent authority before the transfer of responsibilities to the competent authority takes place.⁷¹ The contribution should cover at least the anticipated cost of monitoring for a period of 30 years, but it also “may be used to cover the costs borne by the competent authority after the transfer of responsibility to ensure that the CO₂ is completely and permanently contained in geological storage sites after the transfer of responsibility”.⁷²

Guidance Document 4 suggests, with regard to this provision, that the intent of this financial mechanism is to ensure that the costs of performing obligations under the Directive are covered at the operator's expense, even if the operator does not carry them out, and that the funds to perform them should be readily available to do so. The guidance observes that the Directive does not define 'financial contribution', leaving it open to Member States to specify as acceptable the same types of instrument as for (pre-transfer) financial security.

It also suggests, however, that, because the Article 20 financial contribution does not necessarily have to cover the full extent of the authority's possible costs, Member States may want to consider using the expected value techniques, which were discouraged under Article 19, discounting the amounts required for the probability of an occurrence.

In theory, this means that the competent authority can demand a financial contribution that is almost unlimited, while the competent authority will be responsible in perpetuity for a site after the handover. ROAD discussed this intensively with the competent authority and concluded that if the Government would demand a high financial contribution, there is actually no handover. While the competent authority is technically responsible, the former operator will pay the bill. In the opinion of ROAD and the Dutch Government, the financial contribution should only include costs that the competent authority will have after handover and not include contingency costs, i.e. monitoring.

There are several strict requirements for the handover, and only if these are fully met, then can the handover can take place. All available evidence must indicate that the stored CO₂ is completely and permanently contained, the abandonment plan was fulfilled according strict regulation. The risk that after handover CO₂ would leak is kept to an absolutely minimum after the applications of all these measures and requirements.

Therefore, the Dutch competent authority also concluded that with regarding to the financial contribution:

- it only includes monitoring after the handover for a period limited to 30 years. Only the monitoring instruments will be used as described in the monitoring plan after the well has been abandoned;
- also the frequency of monitoring is included in the monitoring plan. This means that once every five years a subsea bed inspection will take place. ROAD requested several market orders for this 30 years of monitoring. On basis of these orders, a provisional amount of EUR 2M will be included in the financial security;
- no contribution will be charged for other possible costs after handover (for example in case of leakage).

⁷¹ Article 20 CCS Directive.

⁷² Article 20 CCS Directive.

7. Legal liabilities

Legal liabilities are probably the most discussed issues amongst stakeholders. There is a general opinion among stakeholders that the legal liabilities are unlimited and pose a serious threat on CCS projects. This chapter provides an overview of all legal liabilities CCS projects have to cope with. As will be stressed out in this chapter, there are several different legal liability regimes that regulate capture, transport and storage.

In general, there are three different kind of legal regimes under which liability may arise with a view to CCS:

1. damage to the climate through the release of the greenhouse gas CO₂ (regulated by the EU ETS);
2. environmental damage (regulated by the Environmental Liability Directive);
3. damage to persons or goods: civil liability (regulated by National law).

For all three components of CCS (storage, transport and capture) below discusses the question of who under these three regimes can be held liable.

Please note that the civil liability is not regulated on EU-level but by Member States its selves. Therefore, all statements made about civil liability in this report are only applicable on the Dutch situation.

7.1 Liabilities for storage

The CCS Directive introduced a number of obligations for the storage holder and also amended the EU ETS Directive and the Environmental Liability Directive. The CCS Directive explicitly states that liabilities other than those covered by the EU ETS Directive and the Environmental Liability Directive, in particular concerning the injection phase, the closure of the storage site and the period after transfer of legal obligations to the competent authority, should be dealt with at national level.⁷³

In ROAD's opinion, this statement in the Directive refers to civil liability. Therefore, the civil liability for CO₂ storage must be regulated by the Member State (Netherlands) itself. While this regulation can and probably will differ in every Member State, a brief summary of the Dutch regulation is given below.

7.1.1 Civil liability

Civil liability in general, and not specifically for CCS, is regulated in the Dutch Civil Code ('Het Burgerlijk Wetboek' or BW). The Civil Code applies in principle only on Dutch territory and not in the exclusive economic zone or on the Dutch continental shelf. However, the Civil Code does

⁷³ CCS Directive, preamble recital 34.

apply where the damage occurs. In the event of leakage, damage may occur almost exclusively on Dutch territory, the BW regime is applicable on the CO₂-storage of the ROAD project.

The BW has a general basis for accepting liability in the form of 'tort' (Article 6:162 BW). This article is in principle applicable on any wrongful act or omission that causes damage to a person and/or its goods. The article gives the following five conditions that must be cumulatively met:

1. unlawful conduct (act or omission);
2. imputability (fault, attribution of the act to the perpetrator);
3. there must be damage;
4. causal link between the unlawful conduct and the damage;
5. relativity (the violated norm must be intended to protect the injured person against the damage suffered).

Whether, and to what extent, the operator can be held liable is highly dependent on the specific circumstances of each case. Questions around whether it was foreseeable that harm could occur, whether the operator has failed to take adequate safety measures, and whether sufficient warning against possible risks, all play an important role in the assessment of the operator's liability.

The Dutch Civil Act (BW) also provides several liability provisions specific to mining activities, with provisions for mining infrastructure, hazardous substances, landfill and the gas storage operator.

1. Liability for superficies⁷⁴

Superficies are buildings and works that are placed upon and permanently attached to the ground. According to the definition in the Dutch Civil Act, the well and the well-head are qualified as superficies. The operator can be held liable for damage caused by "defective superficies", which is defined as superficies that "does not meet the requirements that in the given circumstances are required, and therefore cause danger to property or persons health". These circumstances may indicate the design or layout of the premises, or the defectiveness of the structure.

The owner of the superficies is in the event of damage caused by a defective superficies liable. The possessor is presumed to be the same in the public records as the owner of the land on which the superficies are located.

2. Liability for hazardous substances⁷⁵

Liability under this article occurs when a substance, that is known to have such properties that it has a particular risk of a serious nature yields, causes damage. The question is whether CO₂ can be classified as a hazardous substance. There seems to be no clear answer to give. The element of "danger" in this article refers to the inherent aspect of danger of the substance. CO₂ itself is not toxic, explosive or flammable, but in large quantities or concentrations may be dangerous in certain situations. However, there is probably a minimum low probability of CO₂ to be classified as a hazardous chemical (as CO₂ is also not in Annex I of the Dangerous Substances Directive). Furthermore, in order to be held liable for hazardous substances, damage must be caused

⁷⁴ Article 6:174 BW.

⁷⁵ Article 6:175 BW.

(what is very unlikely). Therefore, liability for CO₂-storage arising from this legal article is very unlikely.

3. Liability for damage caused by a landfill⁷⁶

This article states that the operator of a landfill is liable for damage where there is contamination of the air, water or soil. Damage caused by the landfill to goods and/or people's health is not regulated by this article. The operator remains liable after the landfill has been closed and abandoned.

Landfill is in this article defined as: each area that is used or intended by the operator to deposit wastes. CO₂ that is captured and transported for the purposes of geological storage and geologically stored, falls outside the scope of the Waste Directive and Chapter 10 EMA on waste⁷⁷. CO₂ for CCS is therefore not treated as waste. Nevertheless, it is not excluded that a CO₂ storage facility should be qualified as a landfill and therefore the operator could possibly be held liable for damage as a result of contamination of the air, water or soil.

After closure of the site the last operator remains liable, but the liability under this section expires when the damage is done more than twenty years after closure.

Although CO₂ storage can maybe be regarded as landfill, this article for liability is in practice not that relevant. Damage to persons or property cannot be recovered under this article. With a view to damage resulting from pollution of the air, water or soil, only the pollution of air is relevant. Containment of water or soil caused by leaking CO₂ is very unlikely. Damage resulting from the pollution of the air is already covered by the EU ETS.

4. Liability for damage caused by mining works⁷⁸

Art. 6:177 Civil Code regulates the liability of an operator of a mining work for damage caused by outflow of minerals or from soil movement caused by that work.

Subparagraph a of this article concerns the liability for damage caused by the outflow of minerals referred to in art. 1 part MBW. Minerals are present in the subsoil minerals or substances of organic origin, in there by natural resultant concentration or deposition, solid or gaseous state, with the exception of source gas, limestone, soil, sand, clay, shells, and mixtures thereof. CO₂ is according to this definition no mineral. Therefore it will not be possible to hold the operator liable on basis of this liability for damage caused by mining works. However, an amendment provided, see below.

Subparagraph b of this article states that the operator is liable for damage caused by soil movement, if it is caused by the stored CO₂. In order to hold the operator liable, a causal link between the movement and the CO₂ must be demonstrated. The liability under this Article expires 30 years after the event that caused the damage.

⁷⁶ Article 6:176 BW.

⁷⁷ Article 35 CCS Directive respectively Paragraph 10.1 sub a Wm.

⁷⁸ Article 6:177 BW.

7.1.2 Environmental liability

Liability for environmental damage, or the imminent threat thereof, is regulated by the Environmental Liability Directive.⁷⁹ The storage of CO₂ is listed in Annex III of this Directive and therefore, strict liability applies for damage caused:

- to protected species or natural habitats under the Birds and Habitats Directives;
- to water in the sense of the Water Framework Directive;
- to soil.

Strict liability means that the liability by definition applies when the damage occurs, irrespective of any guilt. This means that if there is a significant adverse effect on protected species, natural habitats, water or soil as a result of CO₂ storage, the operator bears the costs of the repair even if he was not responsible for the CO₂ leakage. For activities not listed in Annex III of the Directive, the liability is limited to damage to protected species and natural habitats, and the person who caused the damage is only liable if the damage was caused by his fault or that he acted negligent.

The Environmental Liability Directive is transposed in Title 17.2 of the Environmental Protection Act ("EIA", Wm in Dutch). Title 17.2 Wm is not applicable on the Exclusive Economic Zone (EEZ) and the Dutch Continental Shelf (DCS) in which the storage site of the ROAD project is located. However, Title 17.2 Wm, via its reference to Annex III of the Environmental Liability Directive, applies on the operation of CO₂ storage sites pursuant to the CCS Directive. Title 17.2 Wm is therefore regulating the storage of CO₂ in the EEZ and the DCS.

According to the Wm those performing the activity (or has performed, controls or is controlled) and that may be held liable is:

1. the license holder or the performing the activity with Governmental permission; or
2. the person who has decisive economic power over the technical functioning of the activity.

Every kind of environmental damage has a limit below which there is no more question of environmental damage within the meaning of Title 17.2 Wm, the damage threshold.

Damage to protected species and natural habitats is only recoverable if the damage "has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species". To assess this, a comparison should be made with what is referred to as the 'baseline condition' of the protected species and natural habitats. Regarding CO₂ storage in the EEZ damage to protected species and marine Natura 2000 sites are key (which are located in the EEZ).

Water damage is recoverable only if the damage has a substantial negative impact on the ecological, chemical and quantitative status or ecological potential, as defined in the Water Framework Directive. This Directive is applicable to waters within the territory of a Member State and the territorial sea of Member States which is situated within one nautical mile from the coast.

⁷⁹ Directive 2004/35/EC.

Damage to the soil is only recoverable if the contamination has a substantial negative impact that creates a significant risk of adversely affecting human health.

With a view to the criterion that there has to be significant damage, it is very unlikely that the operator can be held liable in case of damage. It is very unlikely that the damage has significant adverse effects. However, liability may arise from other legislation (that do not have significant damage criterion):

- environmental damage caused by unusual events within an establishment;⁸⁰
- Soil Protection Act (Wbb): duty of care for prevention and remediation of soil damage;
- Water Act, with respect to the discharge into surface water;
- Nature Conservation Act 1998 (Conservation Act) and the Flora and Fauna Act (F & F Act) relating to the protection of certain species and areas;
- Article 38 MBW: duty of care for the holder of a storage permit.

Furthermore, the Environmental Liability Directives obligates the operator, if there is environmental damage or an imminent threat thereof, to immediately take the necessary preventive or remedial measures. The operator shall in principle bear the cost of preventive or remedial measures. The competent authority requires the operator to take the measures. If the operator takes no action, the competent authority shall take measures itself or entrust the implementation thereof to third parties, and recover the costs from the operator.

The cost recovery period is bound. The period for a claim for recovery of costs for environmental damage (or threat of environmental damage) is thirty years after the date on which the damage occurred, this period corresponds to the period of article 3:310 BW (civil liability for environmental damage).

In principle, the operator can only be held liable until the transfer of responsibilities to the competent authority. However, if damage is done after the transfer of responsibilities and this damage is caused by the negligence of the operator; the operator is liable even after the transfer.

Although this environmental liability is pretty strict, this does not result in high additional risks for CCS projects in ROAD's opinion. But even more important, if there even would be environmental damage, the highest costs for an operator will probably be related to the corrective measures (and contingency monitoring). These requirements and relating costs are however already covered by the CCS Directive. For example, if CO₂ would leak through the cement of a well and causes damage to the environment, according to the environmental legislation the leakage must be stopped and a well makeover will probably be needed. In case of leakage the CCS-D is in compliance with the Dutch environmental legislation. ROAD does not assess the environmental liability as an additional liability above the liability under the CCS Directive.

⁸⁰ 1.17 Wm Title.

7.1.3 Climate liability

The storage of CO₂ is covered by the EU ETS Directive and is included in Annex I of the revised EU ETS Directive. Therefore, the operators of the capture plant, transport network and storage facilities all require an emission permit. The storage of CO₂ is regarded as a separate installation for the purposes of the Environmental Management Act and therefore in case of leakage, the operator must include these emissions in its reporting to the Dutch Emission Authority (Nea) and handover EUAs.

An interesting question is when the operator must surrender allowances. According to the CCS Directive,⁸¹ 'leakage' means any release of CO₂ from the storage complex (the storage complex is "the storage site and surrounding geological domain which can have an effect on overall storage integrity and their safety"). In case of leakage corrective measures must be taken.

However, according to the EU ETS Directive, EUAs only have to be surrendered "when leakage of CO₂ from the storage complex pursuant to Directive 2009/31/EC is detected and if this results in emissions or release of CO₂ in the water column" (Section 3 of Annex Decision of 8 June 2010 amending Decision 2007/589/EC as regards the inclusion of guidelines for the monitoring and reporting of greenhouse gas emissions from the capture, transport and geological storage of carbon dioxide). Only when that leakage results in detectable emissions in the atmosphere or in the release of CO₂ in the water column (the vertically continuous mass of water from the surface to the bottom sediments of a water body) this leakage is recorded as a source of emissions from the installation.

The conclusion is that the operator has a major problem if CO₂ leaks from the reservoir / complex and the operator is required to take action, but as long as the CO₂ does not reach the surface, no allowances have to be surrendered.

7.2 Liabilities for transport

7.2.1 Civil liability

Civil liability (in general, not specific for CCS) is regulated in the Dutch Civil Code ('Het Burgerlijk Wetboek' BW). In paragraph 7.1, under civil liability for the transport of CO₂, an extensive assessment of the civil liability regime for CO₂ storage is given. This civil liability regime is also applicable on the transport of CO₂. There is only one difference with the liability arising from the storage of CO₂.

The Dutch Civil Act (BW) includes several liability provisions specific to mining activities, with provisions for mining infrastructure, hazardous substances, landfill, gas storage operator. Only two of these provisions are (possibly) applicable on the capture plant: (1) Liability for superficies⁸² and (2) Liability for hazardous substances.⁸³ Both are described in detail in paragraph 7.1.

⁸¹ Article 3, paragraph 5 jo. paragraph 6 CCS Directive.

⁸² Article 6:174 BW.

⁸³ Article 6:175 BW.

Furthermore, with a view to the liability for superficies, it must be noted that not only the operator of the transport network can be held liable for damage caused by "defective superficies". If the pipeline is located in a building or work or is attached to this building or work, the owner of the building or work is liable. This is relevant with a view to the compressor station, while the owner of the compressor station will be held liable in case CO₂ leaks out of a pipe in the compressor station.

7.2.2 Environmental liability

Environmental liability for the transport of CO₂ is regulated by the Environmental Liability Directive, as implemented in Title 17.2 Environmental Protection Act ("EIA"). Paragraph 7.1 describes this liability in detail because this Act is also applicable on storage.

However, an important difference is that CO₂ transport is not listed in Annex III of the Environmental Liability Directive. For activities not listed in Annex III of the Directive, the liability is limited to damage to protected species and natural habitats, and the person who caused the damage is only liable if the damage was caused by his fault or that he acted negligent.

Furthermore, liability for environmental damage of CO₂ transport is limited to damage to protected species and natural habitats, and therefore not for environmental damage to water or soil.

7.2.3 Climate liability

CCS is included in Annex I of the revised EU ETS Directive. Therefore, the operators of the capture plant, transport network and storage facilities all require an emission permit. The transport of CO₂ is regarded as a separate installation for the purposes of the Environmental Management Act and therefore in case of leakage at the transport network, the operator must include these emissions in its reporting to the Dutch Emission Authority (Nea) and handover EUAs.

7.3 Liabilities for capture

7.3.1 Civil liability

Civil liability (in general, not specific for CCS) is regulated in the Dutch Civil Code ('Het Burgerlijk Wetboek' BW). In paragraph 7.1, under civil liability for CO₂-storage, an extensive assessment of the civil liability regime for CO₂ storage is given. This civil liability regime is also applicable on the capture of CO₂. There is only one difference with the liability arising from storage of CO₂.

The Dutch Civil Act (BW) gives several liability provisions specific for mining activities, with provisions for mining infrastructure, hazardous substances, landfill, gas storage operator, etc. Only two of these provisions are (possibly) applicable on the capture plant: (1) Liability for

superficies⁸⁴ and (2) Liability for hazardous substances⁸⁵. Both are described in detail in paragraph 7.1.

7.3.2 Environmental liability

Liability for environmental damage or the imminent threat thereof is regulated by the Environmental Liability Directive⁸⁶. Strict liability applies on damage caused by the capturing of CO₂:

- to protected species or natural habitats under the Birds and Habitats Directives;
- to water in the sense of the Water Framework Directive;
- to soil.

Strict liability means that the liability by definition applies when the damage occurs, irrespective of any guilt. This means that if there is a significant adverse effect on protected species, natural habitats, water or soil as a result of the capture of CO₂, the operator bears the costs of the repair. Paragraph 7.1 assesses this liability extensively.

With a view to the capture plant, there is only one difference with the liability regime for storage. Strict liability does not apply if the CO₂ capture plant is used for research, development, and testing of new products and processes. In that case there is only a limited liability for environmental damage to protected species and natural habitats.

7.3.3 Climate liability

Captured greenhouse gases from installations are covered by the EU ETS Directive. CCS is included in Annex I of the revised EU ETS Directive. Therefore, the operators of the capture plant, transport network and storage facilities all require an emission permit. The capture of CO₂ is regarded as a separate installation for the purposes of the Environmental Management Act and therefore in case of leakage at the capture plant, the operator must include these emissions in its reporting to the Dutch Emission Authority (Nea) and handover EUAs.

7.4 Overview legal liabilities

All legal liabilities that are discussed in the sections above, are summarized in scheme 7.4 below. As can be concluded from the scheme, the liability for EU ETS regarding the storage (surrender EUAs in the event of leakage) and regarding the capture plant liability in the form of tort, are the two main concerns of the ROAD project.

⁸⁴ (Article 6:174 BW).

⁸⁵ (article 6:175 BW).

⁸⁶ Directive 2004/35/EC.

	Liability regime	Potential grounds for liability	Law	EU law ⁸⁷	Dutch law	Applicable	Risk assessment ⁸⁸
Capture	Civil	Tort	6:162 Civil Code	No	Yes	Yes	+/-
	Civil	Superficies	6:174 Civil Code	No	Yes	Yes	+
	Civil	Hazardous substances	6:175 Civil Code	No	Yes	Probably not	+
	Environmental	Environment damage	Env. Liab. Dir. / Wm	Yes	Yes	Probably yes	+
	Climate	Emissions	EU ETS / Wm	Yes	Yes	Yes	+
Transport	Civil	Tort	6:162 Civil Code	No	Yes	Yes	+
	Civil	Superficies	6:174 Civil Code	No	Yes	Yes	+
	Civil	Hazardous substances	6:175 Civil Code	No	Yes	Probably not	+
	Environmental	Environment damage	Env. Liab. Dir. / Wm	Yes	Yes	Yes, but limited ⁸⁹	+
	Climate	Emissions	EU ETS / Wm	Yes	Yes	Yes	+
Storage	Civil	Tort	6:162 Civil Code	No	Yes	Yes	+
	Civil	Superficies	6:174 Civil Code	No	Yes	Yes	+
	Civil	Hazardous substances	6:175 Civil Code	No	Yes	Probably not	+
	Civil	Landfill	6:176	No	Yes	Maybe	+

⁸⁷ 'Yes' means that this legislation is also applicable in other Member States.

⁸⁸ '+' means that ROAD assess the risk that liability will apply is low or that the costs related to this liability are low.

⁸⁹ Liability is limited to damage to protected species and natural habitats.

			Civil Code				
	Civil	Mining works	6:177 Civil Code	No	Yes	Yes, but limited ⁹⁰	+
	Environmental	Environment damage	Env. Liab. Dir. / Wm	Yes	Yes	Yes, but limited ⁹¹	+
	Climate	Emissions	EU ETS / Wm	Yes	Yes	Yes	-

⁹⁰ Only liabilities arise for damage caused by soil movement, not for damage caused by outflow of CO₂.

⁹¹ Liability is limited to damage to protected species and natural habitats.

Annex I Environmental Impact Assessment

1. Announcement of the Project and Notice of Scope and Level of Detail

The draft Notice of Scope and Level of Detail was drawn up by the proponent, after which the appropriate authority draws up the Notice of Scope and Level of Detail. This document describes which alternatives are possible for the operation, what impacts it could have on the environment and how these impacts will be researched in the EIA

2. Notice

The appropriate authority gives notice that the decision is being prepared, and announces the public consultation for the Notice of Scope and Level of Detail.

3. Consultation and Advice on the Notice of Scope and Detail.

The appropriate authority consults the government agencies and advisors who should be involved in the scope and level of detail of the EIA. The Notice of Scope and Level of Detail was available for inspection on 24 September 2010.

The consultation in this phase was meant to gain insight into the affected parties' ideas of what should be studied in the EIA. The Notice of Scope and Level of Detail and the comments from the consultation were submitted to the Commission for EIAs (Commissie-m.e.r. in Dutch). The Commissie-m.e.r. is composed of independent experts from different disciplines. This commission submitted advice to the Authority on the contents of Advisory Scope and Level of Detail for the composition of the EIA.

4. Advisory Scope and Level of Detail

The appropriate authority, on the basis of the consultation comments and the opinion of the Commissie-m.e.r., established the Advisory Scope and Level of Detail of the proposed EIA. This document states which alternatives and which environmental themes and impacts must be covered in the EIA. The Authority took the advice and incorporated it into the Notice of Scope and Level of Detail. This Notice was given in January 2011.

5. The Environmental Impact Assessment (EIA)

The proponent then draws up the EIA; there is no time limit for this procedure. The point of departure for the EIA is the Advisory Scope and Level of Detail. The EIA is submitted to the appropriate authority.

6. Publication of the EIA and Request for the Draft Decision

The appropriate authority publishes the EIA and the request for the draft decision and opens both for comments.

7. Consultation

The EIA is open for comments for six weeks. Commenters have the possibility to react in writing to the quality and completeness of the EIA.

8. Advice of the Commissie-m.e.r.

The Commissie-m.e.r. assesses the EIA on completeness and quality and submits an opinion to the appropriate authority. In the ROAD project, the Commissie-m.e.r. also submitted a (positive) interim assessment in May 2011. The proponent incorporated remarks from that assessment in the EIA.

9. Decision

When the EIA process is completed successfully, the appropriate authority gives its decision on the project and the conditions under which the project may be completed.

10. Evaluation of the Environmental Impact after Completion

The decision contains an evaluation procedure, which was begun by the proponent in the EIA. It is assessed during and after the completion of the project whether the environmental impacts remain within the limits given in the decision. It is usual to publish the results of these evaluations in an evaluation report.

Annex II Monitoring plan

	Injection process	Measurement equipment / method	Location and rationale	Frequency and rationale
1	Injection rate	Flow meter	<p>1 Flow meter Onshore (Downstream Capture Plant and upstream transport pipeline)</p> <p>1 Flow meter Offshore (on Platform P18-A in dedicated flow line from Injection header on Platform to dedicated injection well (P18-4A2))</p> <p>RATIONALE: To determine volumetric and mass flow rate. Furthermore all sources and sinks will be metered individually to confirm safe transportation of CO₂ and allow for future tie-in of CO₂ sources in the system or use of multiple sinks.</p>	<p>Continuously</p> <p>RATIONALE: Flow rate provides key provide information about pressure-volume behaviour of the CO₂ injection. ETS credits are tied to the amount of CO₂ stored.</p>
2	Injection stream CO ₂ concentration	Gas samples & analysis: online system (Chromatograph)	<p>Onshore (Downstream Capture Plant and upstream transport pipeline)</p> <p>RATIONALE: Trend and level of CO₂ concentration is the first indication of the performance of the capture plant and warning for potential contaminants, or exceeded thresholds.</p>	<p>Hourly</p> <p>RATIONALE: Frequency due to nature of technique and constraints of equipment not continuous but intermittent.</p>
3	Injection stream composition	Gas samples and analysis: Additional samples for calibration	<p>Onshore (Downstream Capture Plant and upstream transport pipeline)</p> <p>RATIONALE: to verify and confirm CO₂ concentration, Calibrate chromatograph, spot undesired contamination and monitor trends in composition.</p>	<p>Quarterly</p> <p>RATIONALE: Requires manual sampling and analysis in laboratory.</p>
4	Water measurement	Moisture analyser	<p>Onshore (Downstream Capture Plant and upstream transport pipeline)</p> <p>RATIONALE: Closest to source, CO₂ stream cannot be contaminated downstream.</p>	<p>Quarterly</p> <p>RATIONALE: Tied to composition analysis</p>
5	<p>Discontinuous emissions through leakage, venting or incidents</p> <p>This does not only involve CO₂ measurements at the platform to capture pipeline/choke/wellhead technical leakage, so description might be misleading: It is the integration of all available monitoring data and the model predictions into an "integrated approach", as such able to describe any leakage</p>	Combination of techniques (Flow meter in vent line, CO ₂ detection devices on platform)	<p>On Offshore Platform</p> <ul style="list-style-type: none"> - Flow meter in vent line - CO₂ detection on platform <p>RATIONALE: CO₂ detection on platform to guarantee safety of personnel visiting the offshore platform and detect leakage. Incidental venting of CO₂ will be metered with a dedicated flow meter in the vent line located on the platform. All emissions require emission reporting.</p>	<p>Continuous</p> <p>RATIONALE: All CO₂ emissions need to be reported</p>

	out of the storage complex (this includes deep subsurface leakage).			
	Well			
6	Annular pressure	Pressure device	Well head P18-4A2, located on Offshore Platform P18-A RATIONALE: Pressure build up can be an indicator for failure of well integrity.	Continuous RATIONALE: Unmanned platform, information on well integrity available continuously and online.
7	Well integrity	Wireline Logging (selection of tool: CBL, PMIT, EMIT, ultrasonic, noise detection, optical)	Well P18-4A2, accessible via wellhead located on Offshore Platform P18-A RATIONALE: To capture information on potential leakage pathways through well cementation and potential degradation of well materials	5-yearly RATIONALE: Industry standard for wells.
8	Well head pressure	Pressure device	Well head P18-4A2, located on Offshore Platform P18-A RATIONALE: To determine CO ₂ phase behaviour and state, and to spot irregularities.	Continuously RATIONALE: Continuously to be able to trend process information, determine behaviour and take action if required to control operation.
9	Well head temperature	Temperature device	Well head P18-4A2, located on Offshore Platform P18-A RATIONALE: To determine CO ₂ phase behaviour and state, and to spot irregularities.	Continuously RATIONALE: Continuously to be able to trend process information, determine behaviour and take action if required to control operation.
10	Plug integrity	Pressure test and inspection, downhole fluid sample.	In well above set plug RATIONALE: Proof integrity of set plug	Once post injection and pre abandonment RATIONALE: Opportunity only available between setting the plug after the injection phase and before abandonment.
	Reservoir integrity			
11	Reservoir pressure (FBHP) (see also line 8)	Pressure device	Bottom hole well P18-4A2, located on Offshore Platform P18-A RATIONALE: To determine CO ₂ phase behaviour and state To provide information about pressure-volume behaviour to refine reservoir simulation to geological models of the storage formation. To capture information on potential migration of CO ₂ in the subsurface	Continuously RATIONALE: Continuously to be able to trend process information, determine behaviour and take action if required to control operation. Furthermore, to make sure CO ₂ behaviour is in line with reservoir model.
12	Reservoir Temperature (FBHT) (see also line 9)	Thermometer	Bottom hole well P18-4A2, located on Offshore Platform P18-A RATIONALE: To determine CO ₂ phase behaviour and state To detect the presence, location and migration paths of	Continuously RATIONALE: Continuously to be able to trend process information, determine behaviour and take action if required to control operation. Furthermore, to make sure CO ₂ behaviour is in

			CO ₂ in the subsurface and at surface. To provide information about pressure-volume behaviour to refine reservoir simulation to geological models of the storage formation. To capture information on potential migration of CO ₂ in the subsurface	line with reservoir model.
13	Stabilised pressure (CIBHP) (gradient) during shut-in period	pressure device (wireline tool or memory gauge) combined with shut-in	Bottom hole well P18-4A2, located on Offshore Platform P18-A RATIONALE: To determine CO ₂ phase behaviour and state To detect the presence, location and migration paths of CO ₂ in the subsurface and at surface. To provide information about pressure-volume behaviour to refine reservoir simulation to geological models of the storage formation. To capture information on potential migration of CO ₂ in the subsurface	Semi annually RATIONALE: Only possible during shut in of injection. To make sure CO ₂ behaviour is in line with reservoir model.
14	Stabilised temperature (CIBHT) (gradient) during shut-in period	thermometer (wireline tool or memory gauge) or DTS combined with shut-in	Bottom hole well P18-4A2, located on Offshore Platform P18-A RATIONALE: To determine CO ₂ phase behaviour and state To detect the presence, location and migration paths of CO ₂ in the subsurface and at surface. To provide information about pressure-volume behaviour to refine reservoir simulation to geological models of the storage formation. To capture information on potential migration of CO ₂ in the subsurface	Semi annually RATIONALE: Only possible during shut in of injection. To make sure CO ₂ behaviour is in line with reservoir model.
15	Suspected leakage	Pressure device adjacent reservoir (and/or pulse test) and/or surface seismic survey	Well P18-4A2 / Well P15-9E1 located on P15 Echo Platform / Survey Vessel RATIONALE: Best available technology	Incidental RATIONALE: As required when leakage is suspected.
	Environmental monitoring			
16	Pockmarks at the sea bottom	Multi-beam echo sounding	Survey vessel RATIONALE: Best available technology	Contingent monitoring RATIONALE: As required when leakage is suspected.
17	Presence of shallow gas or gas chimneys in the subsurface	Baseline seismic data	Survey vessel RATIONALE: Best available technology	Contingent monitoring RATIONALE: As required when leakage is suspected. This is an interpretation of seismic data (either of existing baseline or of new measurement). No additional measurement.
18	Migration pathways for gas in the shallow subsurface	Time-lapse seismic data acquisition (2D or 3D)	Survey vessel RATIONALE: Best available technology	Contingent monitoring RATIONALE: As required when leakage is suspected.

				This is just an interpretation of seismic data (either of existing baseline or of new measurement). No additional measurement.
19	CO ₂ in soil at pockmarks	Gas samples using vibrocore + lab analysis	Seabottom sampling and laboratory RATIONALE: Best available technology	Contingent monitoring RATIONALE: As required when leakage is suspected. Sampling occurs only if (new) pockmarks are found (item 16). So it happens maximum at the same frequency as the pockmark surveys and as suggested in 16, also on a long-term regular basis
20	Bubble detection at wellhead	Acoustic bubble detector	Offshore Platform P18-A RATIONALE: Best available technology	Contingent monitoring RATIONALE: As required when leakage is suspected.

Abbreviations

BW	Burgerlijk Wetboek (Dutch Civil Act)
CCS	Carbon capture and storage
CEN	European Committee for Standardization
EEPR	European Energy Programme for Recovery
EIA	Environmental Impact Assessment
EPC	Engineering, procurement and construction
ETS	Emissions Trading System
EUA	EU Emission Allowance
FC	Financial Contribution
FEED	Front-end engineering design
FID	Final Investment Decision
FS	Financial Security
Global CCS Institute	Global Carbon Capture and Storage Institute
MCP	Maasvlakte CCS Project C.V.
MEA	Monoethanolamine
MER	Milieu Effect Rapportage (Dutch EIA)
MPP3	Maasvlakte Power Plant 3
Nbw	Dutch Nature Protection Act
NER300	New Entrants' Reserve 300
ISO	International Organisation for Standardization
ROAD	Rotterdam Opslag en Afvang Demonstratie
Wabo	Dutch General Environmental Conditions Act