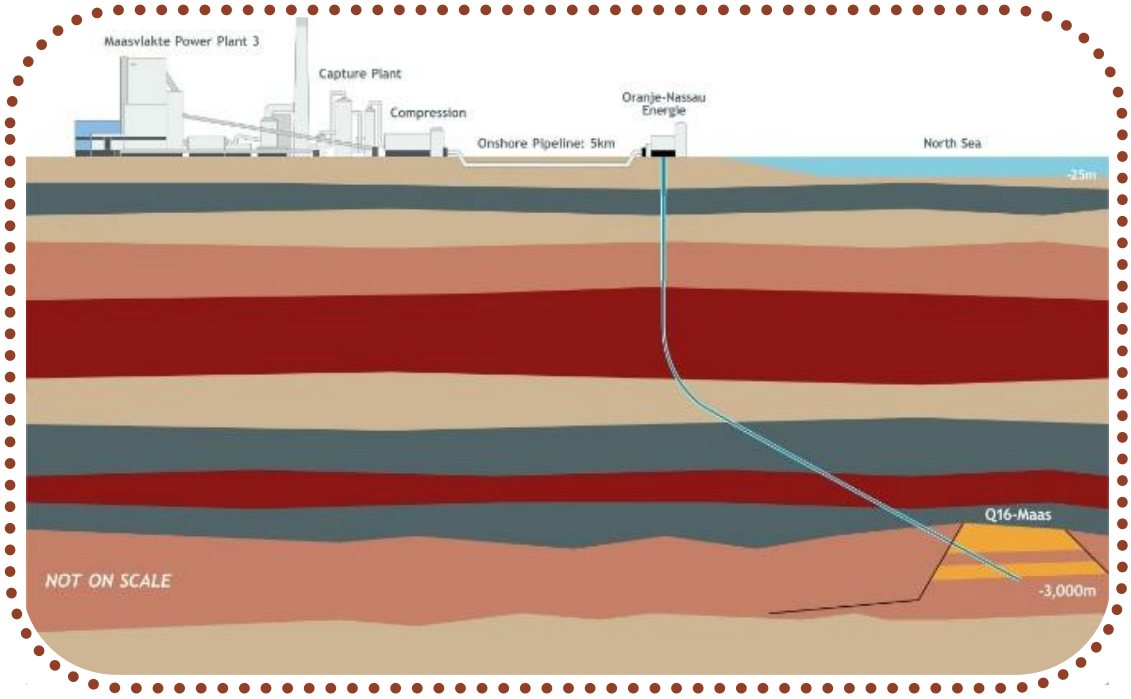
Close-Out Report Permitting & Regulation

Rotterdam Opslag en Afvang Demonstratieproject



Maasvlakte CCS Project C.V.

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Close-Out Report 6 of 11: Permitting & Regulation

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Index of ROAD Public Close-out Reports

No	Title	Scope
1	Overview	Introduce and summarise the public close-out reports.
2	Capture and Compression	Technical report covering capture, compression and power plant integration.
3	Transport	Technical report covering CO_2 pipeline transport.
4	CO_2 Storage	Both technical and commercial aspects of CO_2 storage for ROAD. Subsurface work required to demonstrate permanent storage is described.
5	Risk Management	The risk management approach used by ROAD.
6	***Permitting and Regulation***	***Description of the regulatory and permitting framework and process for the ROAD project, including required changes to regulations.***
7	Governance and Compliance	Company structure and governance for Maasvlakte CCS Project C.V., the joint venture undertaking the ROAD Project
8	Project Costs and Funding	A presentation of the projected economics of the project, with both projected income and costs.
9	Finance and Control	Description of the financial and control systems, including the costs incurred and grants claimed.
10	Knowledge Sharing	Outline of the Knowledge Sharing & Dissemination plan as developed by the ROAD project and completed KS deliverables and actions
11	Public Engagement	Description of how ROAD organized and managed the Public Engagement process.

Table of Contents

Management Summary

Project Summary

This public close-out report describes how the permitting and regulatory affairs of the CCS demonstration project "ROAD" were managed. The ROAD Project (Rotterdam Opslag en Afvang Demonstratieproject) was one of the largest integrated carbon capture and storage (CCS) projects in the world, aiming to install carbon capture on a coal-fired power station in Rotterdam and store the CO_2 in an empty off-shore gas-field.

The project ran from 2009 to 2017. The developer was Maasvlakte CCS Project, a joint venture between Uniper (formerly E.ON) and Engie (formerly Electrabel and GDF Suez), with financial support from the EU EEPR program, the Dutch Government, the Port of Rotterdam and the Global CCS Institute.

In the first phase of the project, 2009-2012, the project was developed to Final Investment Decision (FID) based on using the TAQA P18-4 gas-field as the CO_2 storage location. This required a pipeline of approximately 25km from the capture location (Uniper's coal-fired Maasvlakte Power Plant – MPP3), about 5km onshore and 20km off-shore. This phase of the project had some notable successes in terms of permitting and regulation. The environmental impact assessment for the project as produced and accepted by the regulator. All relevant permits were applied for. The construction permit for the capture plant was granted in 2012. The CO_2 storage licence for P18-4, the first under the EU CCS Directive, was granted in 2013. This included demonstration of permanent storage, and agreement on a high-level monitoring and verification plan. Other permits were approved in draft and only awaiting a positive investment decision before final issue.

Unfortunately, the collapse in the carbon price undermined the original business case, and in 2012 a positive FID was not economically possible. The project then entered a "slow-mode" in which activities focused on reducing the funding gap, either by reducing costs or by securing new funding.

In late 2014, a possible new funding structure was identified, and explored in 2015 and 2016. This included additional grants for operation and cost reductions. The cost reduction that could be successfully applied was to change storage sink to Q16-Maas, operated by Oranje-Nassau Energie (ONE). This smaller field was much closer, with only a 6 km pipeline required. Some light oil (condensate) would be produced during CO_2 injection,, and this required a change of Dutch law to allow a production permit and a CO_2 storage permit to apply for the same reservoir at the same time. This change was approved by parliament in July 2016 and became law on 1st January 2017. This new project set-up resulted in a remobilization of the project late in 2016, and development of the new scheme. However, in mid 2017 work was again halted, and formally stopped in November 2017.

Scope of this report

After an introduction and project description, this report describes the regulatory and permitting framework for the CCS in the Netherlands on how the ROAD Project complied with it, covering both phases of the project. The funding regulations are summarized. Then a description is given of all the permit documentation, followed by a summary of conclusions and lessons learnt.

Summary of Lessons Learnt

A brief summary of lessons learnt is given here by topic. One essential prerequisite for success for a CCS project is that the national government must strongly back the project. Without this, there is no chance to overcome the permitting, regulatory and financial challenges to the project.

Permitting

Timely collaboration with the government has helped ROAD to reduce the timeline between the application and issuing of the permits. Close cooperation with authorities and regulators in an early stage of the project is essential due to the complexity of CCS regulation. There is only limited experience with CCS legislation so each permit needs to be tailor made.

Generally speaking, the provisions of the CCS Directive leave a lot of room for interpretation by Member States (MS), which provides flexibility, but also leaves uncertainties for future CCS projects. The Guidance documents are only helpful to a limited extent. They are not legally binding, and are not written with a demonstration in mind. To make investment decisions, long term certainty is needed. This in particular relates to the freedom of member state governments to impose high barriers for projects by e.g. setting high requirements on monitoring obligations, financial securities and transfer of responsibility.

Regarding the large responsibilities and liabilities resulting from the provisions of the directive, regulators should ask themselves on how to deal with the following questions and how one can provide sufficient certainty for operators to invest in CCS:

- How and when will the reservoir with CO_2 be handed over by an operator to the authorities? And how can certainty be provided well before the actual handover will take place (preferably before FID)?
- What are the conditions for the handover and how does the operator demonstrate all CO_2 is safely stored as expected?
- How can the liabilities for operators be reduced? What can the role for the State be in this regard (socialization)?
- How can liabilities for the long-term be fixed at moment of granting the permit / before first injection of CO_2 (to avoid the project being exposed to changing government policies and legislation)?

As financial security requirements are not described in detail in the directive, this leaves room for Member State governments to set the requirements on operators. This results in potential uncertainty for developers as Member States can require (unnecessary) high financial security, posing a heavy burden on the finance of projects. Every project and regulator should ask itself the following questions:

- What are the exact activities that must be covered by the financial security?
- What is the amount of money that should guarantee these activities and?
- What kind of financial instrument is accepted by the competent authority?

In ROAD's opinion, clarity on the (conditions for) transfer of the responsibilities to the competent authority is one of the crucial issues that remains in the directive and still has not been solved.

Each CCS project has its own characteristics. The Government needs to determine an approach that will enable the projects to proceed, but also ensure proper assessment and regulation. ROAD believes that, until CCS becomes standard, a tailor-made, project specific approach will be needed by regulators for each project.

The current regulatory framework does not take away the risk that over time the requirements set by the authorities on the requirements for transfer of responsibility may change. After all, government policy and regulation can change over time. If one approves a plan for transfer of responbilitilies today, there is still a risk that this will have changed over 20 years.

The Dutch Ministry has been a big help in coordinating the permitting stakeholders and showing them that the project has national relevance.

Funding

CCS projects are yet not commercially viable. A high EUA price itself is unlikely result in the development of projects as the future price will remain uncertain an open to political influence and liabilities on operators are very large (considering the very high investment and uncertainties for projects). Sufficient CAPEX and OPEX subisidies should therefore be in place to fund CCS projects in order to support a further roll-out.

In the absence of a high carbon price, there is also a lack of OPEX-support for CCS projects. It is advised to have more flexible (provisions in) schemes addressing the actual financing need of projects.

Moreover, ROAD has the following recommendations for funding:

- Allow different EU funds to be combined.
- Ensure compatibility across funds.
- Raise the cap for funding in individual schemes above 50%.
- Have a more flexible scope for relevant costs in funding schemes.
- Ensure that there is adequate support for transport & storage activity.
- Requirements regarding entry into operations of projects should be flexible. Too restrictive timelines can hamper projects.
- More flexibility for the operators and timelines in general is desired.

1. Introduction

This chapter gives a brief overview of the ROAD project and defines the scope of the close-out report on permitting and regulation.

1.1 Background

The objective of the ROAD project is to capture CO_2 from the coal fired power plant MPP3, transport the pure CO_2 from the plant to an injection facility and to store the CO_2 in an offshore depleted gas field. The ROAD project is a demonstration project, with a minimum operating period of about 3 years[1] and a minimum volume of about 3 Mton CO_2.

E.ON and Electrabel have formed the Maasvlakte CCS Project CV ("MCP") in 2010 for the purpose of the demonstration project ROAD. Both companies have new names in 2017: Uniper and Engie. In this report the current names will be used, even when referring to earlier activities.

1.1.1 Partners

Engie / GDF SUEZ Energie Nederland (parent company of ROAD)

Engie Nederland is a leading player in the Dutch energy market and part of the Engie Group. With six state-of-the-art production locations and a total capacity of 5,103 MW, it 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 and has 1,250 employees.

Uniper / E.ON Benelux (parend company of ROAD)

Uniper Benelux concentrates on the production and supply of electricity and gas to private customers and business customers in the Netherlands and Belgium. It is primarily an electricity-generating company; the company can trade internationally and has its own professional sales organization. The company was originally established in 1941 and since 2000 has been part of E.ON Energie AG. In 2016, Uniper Benelux's power stations with a total capacity of 1,850 MW were located in the province of South Holland, the economic heart of the Netherlands. The company has approximately 600 employees and 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.

[1] The design life is 20 years for the components and the intent was always to run for longer than just the demonstration period.

Port of Rotterdam

The Port of Rotterdam is Europe's largest sea port. The port owes its leading position to its outstanding accessibility for sea-going vessels. And to its intermodal connections and the 175,000 people working in and for Rotterdam's port and industrial area.

The Port of Rotterdam Authority is committed to combating climate change and wants to play a leading role in the global energy transition. The reduction of CO_2 emissions and efficient use of raw and residual materials are important tasks for the Port Authority.

Oranje Nassau Energy (ONE)

Oranje-Nassau Energie (ONE) is a private Dutch exploration and production company, with a long track record in running a diversified upstream portfolio. Following the acquisition of Dutch operator Cirrus, the acquisition of NAM's operated Q16 field and most recently the Shell UK operated Sean gas field, ONE focuses on expanding its North Sea operated portfolio and will also look at attractive investment opportunities West of Africa. In the past ONE only focused on non-operated North Sea ventures (the Netherlands and the United Kingdom) and was able to successfully grow, diversify and renew its reserve base over the last 30 years.

1.1.2 Two alternatives developed for CCS

ROAD project – P18-4 storage (2011-2012)

The Uniper powerplant MPP3 is located on the Maasvlakte. In 2010 the depleted Taqa P18-4 field was selected for offshore storage of CO_2. This storage site is about 20 km distance from the Maasvlakte shore and requires a pipeline, partly on land and on the sea bed. For this development a number of permit applications, supported by an Environmental Impact Assessment (EIA) were needed. It also required and adjustment of the spatial planning. The required documents were submitted in 2011 and during 2012 the authorities agreed on the EIA (Environment Impact Assessment) and provided most of the permits. Not all permits were completed, when ROAD decided to put the project on hold. One of the main reasons to suspend the project was because of insufficient funding due to low forecast price of CO_2 emission allowances (EUAs).

ROAD project – Q16-Maas storage (2016-2017)

The ROAD project remained on hold (formally, in "slow mode") until an alternative design for the project had been worked out. The new storage site was relocated to a near shore field, Q16-Maas, with onshore facilities for CO_2 injection. This plan was elaborated during 2016 and 2017, resulting in a starting note for the EIA procedure and first draft documents for both the EIA, spatial planning and a number of permit application. No discussions with authorities on the applications for the permits for the new project-set up took place before the project was ended.

For the transport of CO_2, ROAD cooperated with the Port of Rotterdam, in the same construction as during the ROAD project P18-4. The storage site Q16-Maas is operated by Oranje Nassau Energy (ONE), which was included as partner in the consortium for ROAD Q16-Maas.

The ROAD project was formally terminated in September 2017 by the parent companies.

1.2 Scope

In previous reports the progress for the P18-4 set up has been reported. In this close-out report the additional and up to date insigths are listed including the relevant insights for the Q16 Maas setup. This report includes, besides an overview of the most important elements in the regulatory framework for permitting of CCS projects, an update on the current regulations, concerning mainly the all-in-one permit for physical aspects (wabo), the Dutch Mining Act (Mijnbouwwet) and the CCS Directive.

The scope of this document is to describe the findings of the ROAD-project, with emphasis on the current situation. This contains three main elements:

- Giving an comprehensive overview of the situation for permitting a CCS project in The Netherlands, based on the existing regulatory framework applicable to CCS projects;

- Giving an overview of the available financial instruments during the project development (funding schemes and financial instruments and incentives);
- Giving an overview of activities to acquire the necessary permits and an overview of the most important lessons learned.

2. Overview of Regulatory and Permitting Framework

2.1 Introduction

This chapter provides a general overview of the regulatory and permitting framework for CCS activitity in the Netherlands. In chapters 4 and 5 the practical experiences of ROAD in working with the framework are shared.

As one of the first CCS projects in the EU, ROAD has been pionieering in dealing with legislation applicable to CCS projects. Through the years, ROAD has dealt with a variety of regulatory and permitting issues. The work of the ROAD team required close collaboration of the project team with the legislators (in particular with the EC and Dutch government) and competent authorities.

The work carried out by the regulatory team of ROAD involved a wide range of activities. The work e.g. involved close monitoring and involvement in the implementation of the CCS Directive into the Dutch Mining Act. The Regulatory and Permitting work was concentrated on taking practical barriers in the application of legislation (e.g. the numerous requirements in the CCS Directive) as well as in advising the Dutch government with amending legislation and policy in order to establish a framework that is workeable for CCS projects.

ROAD has been the first project in applying the CCS Directive. ROAD is the first, and yet only, project to obtain a storage-license under the directive. ROAD (with storage partner TAQA) obtained the storage license for the P18-field in 2012. For the Q16-Maas (developed during 2016 and 2017), ROAD made significant progress in the preparations towards the permits for storage, but an application for a storage permit was not submitted before the project ended.

In the first part of this chapter a general description of the regulatory and permitting framework for CO_2 storage is given. The framework is mainly based on EU regulation (CCS Directive and Guidance documents) and implementation of these into the Dutch Mining Act. Some deeper insight is given on the most important elements of the directive for storage permits.

Secondly, the broader framework of legislation relevant for CCS projects is discussed. These e.g. include rules from the ETS-directive, cross-sectoral issues such as (environmental liability) and energy-efficiency requirements.

In the third part, the environmental regulatory framework applicable to CCS projects, with a focus on the framework in the Netherlands is displayed. An overview of the relevant legislation for the permitting of CCS - projects in the Netherlands is given.

The fourth part of this chapter provides an overview of the permitting authorities that have been relevant for the regulatory and permitting process of ROAD.

2.2 Regulatory Framework Offshore CO_2 Storage

ROAD was the first project ever to deal with the provisions of the CCS Directive. The CCS Directive was implemented in the Dutch Mining Act. The Netherlands decided to do a one-on-one implementation of the provisions in the directive and did not deviate from the provisions in the directive.

With regards to offshore CO_2 storage, the applicable legal regimes are to be found on three levels:

- International agreements (OSPAR-decision, London propocol).
- EU legislation (CCS Directive, ETS Directive, environmental liability, etc.).
- National legislation (implementation of EU CCS Directive), mining legislation, civil and environmental legislation.

With regards to the parts of the activity concerning the actual storage of CO_2, most important is the national legislation in which the rules and procedures for storage according to the CCS Directive are implemented. The provisions are found in the Mining Act, Mining Decree and Mining Regulation.

2.2.1 International Agreements

London protocol

The London protocol is a protocol under the London Convention aiming to regulate the disposal of wastes and other matter at sea. As CO_2 is considered by the protocol to be a waste, it fell under the scope of the protocol. Before 2006, the protocol prohibited some CCS project configurations. To resolve the issue, the protocol was amended in 2009 allowing the disposal of CO_2 in geological formations. However, the protocol has yet not entered into force, as too few countries have ratified the protocol. Hence, the entry into force of the protocol is still pending and did not affect the ROAD project, but might become relevant for future CCS projects.

OSPAR Decision

In 2007 the OSPAR Commission adopted the 2007/2 decision on Carbon Capture and Storage. The purpose of the decision was that authorities of OSPAR member countries will ensure that carbon dioxide streams, stored in geological formations, are intended to be retained in these formations permanently and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area. The decision required regulatory action, such as the granting of permits or approvals by the competent authorities concerning the storage of carbon dioxide streams in geological formations.[2] Following the adoption of the OSPAR-decision the EU adopted the CCS Directive, which implements the general principles of the OSPAR decision in EU legislation.

2.2.2 EU Legislation

EU CCS Directive

The EU CCS Directive gives the general regulatory framework to ensure permanent containment of CO_2. The CCS Directive sets several elements for CO_2 storage with the aim to harmonize regulation of CCS activity throughout the EU. The directive introduces key elements for CO_2 storage permitting such as rules on financial security, monitoring plans and provisions on the handover of responsibilities regarding the stored CO_2 from operator to the authorities. It should be noted that the interpretation of these elements is to a large extent left for the Member States in the implemation of the directive in national legislation, as well as by interpretation by the authorities. The EC published the CCS Directive on the 25th of June 2009, with a deadline for implementation by member states set on the 25th of June 2011.

In the review of the CCS Directive in 2015, the European Commission found that the directive is fit for purpose. In its review-report the European Commission concluded that due to a lack of experience with application of the directive, a revision of the directive was not feasible at that moment. Stakeholders, including ROAD, concluded that the provisions of the directive in general expose operators to significant liabilities. The EC was advised to address this issue if the Directive was to be revised. However, as no revision took place[3], the issue was still at stake[4]. Alternatively stakeholders suggested to the EC to revise the Guidance Documents to address the main concerns. The Guidance Document have not been revised yet.

During the course of the project, ROAD has, in close collaboration with the legislator, authorities and other parties, found practical solutions to comply with the legal provisions in the EU CCS Directive. The most relevant findings will be discussed in this chapter and chapter 5.

[2] OSPAR decision 2007/2

[3] The EC did consult in 2015 on whether the CCS Directive should be revised. However, ROAD, in common with most other CCS stakeholders, advised against revision. ROAD felt that political support for CCS was not secure at the time, and that a revision to the CCS Directive may result in the introduction of further conditions and barriers to CCS and thus be counter productive. The EC chose not to reopen the Directive.

[4] In 2015, the EC did consult on whether the EU CCS Directive should be revised. However, ROAD, like most other CCS stakeholders, advised against revision. ROAD felt that political support for CCS was not secure at the time, and that a revision to the EU CCS Directive could result in the introduction of further conditions and barriers to CCS and thus be counter productive. The EC chose not to reopen the Directive.

Guidance Documents

In order to guide the implementation of provisions in the CCS Directive, the European Commission has drafted several Guidance Documents.

- CO_2 Storage Life Cycle Risk Management Framework (Guidance document 1).
- Characterisation of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures (Guidance document 2).
- Criteria for Transfer of Responsibility to the Competent Authority (Guidance document 3).
- Financial Security (Art. 19) and Financial Mechanism (Art. 20) (Guidance document 4).

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 for amending the Minig Act was drafted and discussed in Parliament in 2010. As stated before, the EU guidance documents are to a limited extend helpful and are not legally binding. Hence, Member States are allowed to deviate from them. This creates uncertainty for industries, but also creates the possibility to describe the provisions to be applied in detail in the storage permit. Especially the key elements of the CCS Directive must be addressed in the storage permit.

2.2.3 Dutch Legislation

At the time of the implementation of the CCS Directive in Dutch legislation (in 2010), ROAD was already established. ROAD got actively involved with the Dutch government with the implementation of the directive. An important question was whether the Directive would be implemented 'as-it-is' in Dutch leglation (hence, in its original format and without amendments compared to the directive) or whether the Dutch Governemnt would add additional national provisions on top of the provisions of the CCS Directive.

The Dutch Minister of Economic Affairs, responsible for mining activity in the Netherlands, decided to implement the CCS Directive in its entirety with no additional national provisions or any further interpretation of the key elements in the CCS Directive. The result was that the legislative proposal for implementation in the Mining Act was almost a literal translation of the CCS Directive. The entire directive was implemented in the Dutch Mining act, Decree and Regulation.The CCS Directive is rather flexible in its provisions and leaves room for interpretation. Most stakeholders in the Netherlands agreed with this open and flexible way of implementation.

Considering that ROAD would be the first, and currently only, party to apply the provisions on CO_2-storage in the Mining Act, ROAD fully endorsed the open approach. Morever, since each CCS project has its own specific characteristics, and in order to have a proper assessment of the project proposal, a tailor-made approach is essential. The requirements for CO_2-storage, set by the government, should be based upon the specific characteristics of each storage site. The latter allows for the needed level of flexibility that projects need.

In 2016 the Dutch Mining Act has been subject to some important changes for CCS. The ROAD team has been closely involved in this revision of the Mining Act. The changes were of particular importance for the ROAD Q16-Maas project, as these allowed for a production and storage permit for the same well at the same time. This was an important element to close the financials of the Q16-Mas project. With the assistance of ROAD, the Minister of Economic Affairs proposed the necessary amendments to the Mining Act. The provisions were successfully adopted in the revised Mining Act which entered into force on the 1st of January 2017.

The above was in particular relevant as in 2016 as under the provisions of the Mining Act it was not possible to have a production permit and storage permit at the same time for the same reservoir. For the Q16-Maas scenario, a consequence of this would have been that the injected CO_2 under the production license would not

be eligible for EUAs because it was not injected under the storage permit (as the field was expected to be producing at the scheduled time for the start of injecting CO_2). Holding a production licence and a storage licence at the same time took this issue away. This opened up the possibility to apply for a CO_2 storage permit under the Dutch transposition of the CCS Directive at which point Q16-Maas would become eligible as a carbon storage under the ETS. This would bring a saving of EUAs (ETS-allowances) to the power station.

In order to facilitate the above and to avoid that the production operator would ignore the storage-operator resulting in potential risky practices, another new provision was introduced in the Mining Act.5 This provision requires that the production operator is obliged to cooperate with the conclusion of an agreement between the storage operator and production operator for the permanent storage of CO_2. This agreement is to ensure that production and permanent storage over CO_2, will happen in collaboration. The Minsitry is allowed to set requirements for this agreement by implementing legislation.

2.3 EU CCS Directive

As the EU CCS Directive has been 'as-it-is' implemented in the Dutch Mining Act, in the below we follow the numbering and provisions of the Directive. The EU CCS Directive contains several key elements for operators in CCS projects which all have to be addressed in obtaining storage permits:

- Plans (Monitoring, Corrective measures, Abandonment, etc.).
- Financial security.
- Transfer of responsibility.
- Financial mechanism.

2.3.1 Plans

Several plans need to be submitted at the time of application of the storage permit.The CCS Directive follows a risk-based approach in mitigating the risks on CO_2 leakage. 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 CO_2 leakage, significant irregularities, risk of leakage and risk to health or the environment, and the proposed course of action for the post- closure period. In summary, the following plans have to be developed and accepted by the competent authority:

1. Risk management plan (not mandatory).
2. Monitoring plan.
3. Corrective measure plan.
4. Abandonment plan.

There is a great consistency between all these plans. For example, if the monitoring results show that CO_2 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 CO_2 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.

[5] Article 42.2. Mining Act

Risk Management Plan

The risk management plan contains at least a description of measures to minimize the risk of a significant irregularity and the possible consequences thereof.

The suitability of the 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. This characterisation and assessment must be carried out in the following three steps:

a) Step 1: Data collection

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

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

This characterisation and assessment should not only lead to the conclusion that the CO_2 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 reservoir pressure).

ROAD combined the requirements related to the characterization of the storage 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, 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.

As the risk management plan is location-specific, the ROAD plan is therefore not really helpful for other projects. 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. On basis of this QRA, the competent authority determines whether the risks are acceptable or whether additional measures are necessary. However, for underground storage of CO_2 it is not (yet) possible to carry out a QRA. There is 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 yet.

Monitoring Plan

The CCS Directive requires a monitoring plan from the operator. The monitoring plan is the key instrument to ensure the safe storage of CO_2. 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. More specifically, the purpose of the monitoring is e.g. to:

- Detect significant irregularities.
- Detect migration of CO_2.
- Detect leakage of CO_2;
- 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 CO_2 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 CO_2 plume), and where appropriate the surrounding environment.

Finally, the monitoring plan must comply with the guidelines established pursuant to the EU ETS Directive and with all the requirements set in the CCS Directive.

Note that the monitoring plan will have an effect on the required financial security. As in the financial security, the costs for monitoring activities are covered, so the monitoring plan is a determining factor for the amount of financial security (and financial mechanism).

For ROAD P18-4, ROAD drafted an extensive plan and found practical solutions in dealing with the requirements of the plan (see chapter 5). ROAD submitted at the time of application for the storage-permit a provisional plan which would have to be updated and finalized six months prior to start of injection for the authorities.

Abandonment Plan

Once the storage site is filled with CO_2, the site can be closed. A storage site shall be closed if at least one of the following three conditions are met:

1. The relevant conditions stated in the storage-permit have been met.
2. At the substantiated request of the operator, after authorisation of the competent authority.
3. If the competent authority so decides after the withdrawal of a storage permit.

In the period preceding the closure, a closure plan must been developed based on the best knowledge at that time on closure operations. Already 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 CO_2 remains contained) is possible on basis of the current state of technology and experience.

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 from the operator to the competent authority. Because abandonment procedures and techniques do not differ significantly from gas- and oil activities, no problems were expected to be foreseen yet regarding the closure of the sites in the ROAD project.

Corrective Measures Plan

In the event of leakages or significant irregularities on the storage complex, the operator must immediately notify the competent authority and take all necessary corrective measures. Therefore, prior to injection, the corrective measures must be ready to deploy and are elaborated in the corrective measure plan. A corrective measures 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 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. The competent authority may also at any 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.

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:

1) 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;

2) 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).

ROAD developed for P18-4 a sufficient and well thought corrective measures plan including sufficient measures to stop a potential leakage.

2.3.2 Financial Security

Article 19 of the CCS Directive requires that the operator applying for a storage permit presents proof that adequate Financial Security will be valid and effective before commencement of the injection. In essence, it obliges Member States to only award permits if the operator proves that it is able to finance the storage operation and in the future will be able to maintain it, pay for closure and will be able to finance corrective measures. The main issue for the financial security is that the amount is not determined and it is up for the competent authority of each member state to decide on this amount. This results in large uncertainties on the financial resources needed to cover the financial security demanded by authorities.

If there is an incident during operation, the competent authority might use the financial security to fulfil the necessary obligations and it will use the security in case of corrective measures and premature closure. Member States are held to ensure that in the application for a storage permit the operator proves that he is able to fulfil all financial obligations, which actually have to be in place before injection starts.

The main issue for the Financial Security is the amount and calculation of the security asked by the Member States Authorities. It is to a large extent to the discretion of Member State authorities to decide on the amount of security needed. In practise this results in the fact that very large financial security can be demanded from the authorities.

2.3.3 Transfer of Responsibility

Article 18 of the CCS Directive states that when CO_2-storage has been completed and a storage site has been closed, the responsibility for all legal obligations can be transferred from the operator to the competent authority of the Member State, subject to several conditions:

a) All available evidence indicates that the stored CO_2 will be completely and permanently contained;

b) 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;

c) The financial obligations under the financial mechanism have been fulfilled; and

d) The site has been sealed and the injection facilities have been removed.

In ROAD's opinion, clarity on the transfer of the responsibilities to the competent authority is one of the crucial issues that remains in the directive and still has not been solved. The main concern of the ROAD project has been in which way and under which conditions the minimum period of 20 years can be reduced and whether an actual handover of responsibilities could be guaranteed after 20 years.

There are no technical or safety arguments why a minimum period would have to lapse. The greatest risk of leakage is during injection, particularly for a reservoir that is only partly repressurised), when the well is

open. After a well has been abandoned and the CO_2-proof sealing has been successfully carried out, and during injection no leakages occurred, future leakages are as good as ruled out. The minimum period was a political compromise, not based on any scientific substantiation.

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 created a great uncertainty for the ROAD project and other new CCS projects. The transfer could be postponed in theory infinitely (due to changing politics and government policy).

The CCS Directive creates a possibility to reduce the minimum period of 20 years, if all available evidence indicates that the stored CO_2 will be completely and permanently contained, this minimum period can be reduced. However, several questions are to be considered on this issue:

- Which evidence is taken into account?
- What if the competent authority is not convinced, although all available evidence indicates that the stored CO_2 will be completely and permanently contained, for example due to leakage in another CCS project (what if for example in Canada stored CO_2 would leak and the Dutch public/politics get worried?)?
- Who is going to assess this evidence?

The first two questions have been main concerns of ROAD. The CCS Directive and Guidance Documents support coherent implementation of the CCS Directive across the EU Member States, and give clarity to some extent on the first question.[6] However, more clarity will be needed before commercial operators will be able to agree on such conditions.

2.3.4 Financial Mechanism

According to Article 20 of the CCS Directive, Member States shall ensure that operators make a financial contribution available to the competent authority before the transfer of responsibilities to the competent authority takes place. 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 CO_2 is completely and permanently contained in geological storage sites after the transfer of responsibility".

In theory, this means that the competent authority can demand a financial contribution that is almost unlimited, while the competent authority will be forever responsible after the handover. ROAD discussed this many times 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, the financial contribution should only include costs that the competent authority will certainly have after handover (so no contingency costs), i.e. monitoring.

There are several strict requirements for the handover, and only if these are fully met, then can the handover take place. All available evidence must indicate that the stored CO_2 will be completely and permanently contained, the abandonment plan was fulfilled according to strict regulation. The risk that after handover CO_2 would leak is by all these measures and requirement kept to an absolute minimum.

Therefore, the Dutch competent authority (NEA) also concluded that with regards to the financial contribution:

- It only includes (costs for) 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.

[6] GD 3 Criteria for Transfer of Responsibility to the Competent Authority, p.3.

- Also the frequency of monitoring should be included in the monitoring plan. This means that once in the five years a subsea bed inspection (for transport to an offshore platform) will take place. ROAD P18-4 requested several market orders for this 30 years of monitoring. On basis of these orders, a provisional amount of € 2 million would have been be included in the financial security for P18-4.
- No contribution will be charged for other possible costs after handover (for example in case of leakage).

2.3.5 Other CO_2-Storage Permit Issues

Access for Third Parties

Although the CCS Directive gives some general factors that should be taken into account by Member States when regulating the third-party access to storage locations, many stakeholders in the EU believe that the CCS Directive leaves too 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 Netherlands, no additional regulation for third-party access has been under development; this is primarily because no potential problems were foreseen initially. However, due to the plans of the Dutch government to significantly increase CCS activity in the upcoming decade, there will be more demand for (access to) storage than before. 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).

ROAD considers that, generally speaking, before CCS will become commercially feasible, industries will need more guidance from the legislator. Legislation must explain under which specific conditions third-party access can be denied. In the review of the CCS Directive, given the limited experience with application of the directive, no attention was given to the issue. Hence, as the EU does not step up to provide further guidelines on third party acces, 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. Also in Dutch legislation this should be better facilitated.

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:[7]

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

The ROAD project intended to store CO_2 in a gas reservoir (Q16-Maas) that would be in production at least till the end of 2019. 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. This means that no further exploration activities and therefore no permits were needed.

[7] Article 6 (3) CCS Directive.

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 CO_2 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 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. At the stage the project stopped, no other parties than Maasvlakte CCS Project C.V. were interested to submit a competing storage permit application for the Q16 Maas field. However, the relation between the exploration permit and the storage permit should be considered in the review of the CCS Directive or the Dutch Mining Act.

Technical Requirements Operator

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.[8] 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 partners TAQA Energy (ROAD 2011-2012) and ONE (ROAD 2016-2017) have already been active for many years in the Netherlands and the competent authority endorsed its competence and reliability. Furthermore, probably no operators 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.

Financial Requirements Operator

Operators are required to show that they are financially sound. Eventually, the storage permit holder must provide financial security prior to the injection of CO_2, 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.

Following the liabilities imposed on storage operators, ROAD has considered itself to apply for the storage permit, in particular for the Q16-Maas set up. As ROAD is not an operator and does not possess similar financial resources as most elegible operators would have, ROAD looked for solutions. It was found that technical expertise could be hired from third parties and that with that expertise the technical requirements could be fulfilled. Moreover, there was an option to fulfil the financial requirements with bank-guarantees from the parent companies (although it was doubtful that the parent companies would accept this given their desire to cap their contribution to the project). However, no practical experience was gained, as no application was submitted before the project ended.

2.4 Liabilities in CO_2 Storage

The EU 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. With the liabilities from the CCS Directive in mind, there are in fact in total four different legal regimes under which liability may arise for storing CO_2:

[8] Article 8(1) CCS Directive.

1. CCS Directive; liabilities resulting from the requirements on operators in CCS Directive.
2. Climate liability: EU-ETS; operator is liable for damage to the climate in case of the release of CO_2.
3. Environmental Liability Directive; operator is liable for damage to the environment.
4. Civil liability; operator is liable for damage to third parties (damage to persons and/or goods).

The last three regimes are applicable on capture and transport as well as storage. ROAD concluded that besides the vast liabilities resulting from the provisions in the CCS Directive, also the liabilities arising from the EU ETS Directive are of the main concern and have caused difficulties in finding practical and acceptable terms for the operator.

Overall ROAD finds that all the storage liabilities resulting from the CCS Directive cause a major regulatory barrier for CCS projects to succeed. This is particularly caused by the fact that the costs of long term storage liabilities are largely controlled by the regulating authorities (such as requirements on post-closure monitoring, etc.) and are therefore largely out of the control of operators. For the development of CCS projects it is therefore desirable that the liabilities (for storage) are carried by the government rather than private parties.

Liabilities Under EU CCS Directive

As discussed above, the CCS Directive contains several obligations for the storage operators. Operators have under the CCS Directives large responsibilities (monitoring, corrective measures, etc.). The Directive states for example that if the operator fails to undertake sufficient monitoring or, for example, does not take the required corrective measures in case of a leakage, then the competent authority must make sure that additional requirements or measures are taken. Costs are in any case incurred on the operators. The CCS Directive requires the competent authority in such cases to recover all of the costs from these actions from the storage operator, with the possibility of using the financial security. Therefore, the operator can be held liable by the competent authority or non-fulfillment of the obligations under the storage permit.

Moreover, an important liability emerges as there is a risk that a transfer of responsibilities from operator to the state authorities will never take place. Operators are not guaranteed upfront (at time of injection) that a transfer of responsibilities will actually take place in the future. That will depend on whether the competent authorities agree on transfer of responbisibilities This results in the risk that the operator remains for an indefinite time responsible for monitoring, corrective measures, etc. Hence, the responsibilities result in actual liabilities for operators.

Climate Liability

The storage, capture and transport of CO_2 is covered by the EU ETS Directive and is included in Annex I of the EU ETS Directive. Therefore, the operators of the capture plant, transport network and storage facilities are all required to have an emission permit. The storage of CO_2 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.

The climate liability consists of the facts that all operations (capture, transport, storage) are held to surrender EUAs in case of leakge of CO_2 during projects. The liability of surrendering EUAs can be rather big, as the price of EUAs might (and is expected to) increase over time.

An interesting question is when the operator must surrender allowances in the event of leakage. According to the CCS Directive, 'leakage' means any release of CO_2 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 CO_2 from the storage complex pursuant to Directive 2009/31/EC is detected and if this results in emissions or release of CO_2 in the water column*". Only when that leakage results in detectable emissions in the atmosphere or in the release of CO_2 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 CO_2 leaks from the reservoir / complex and the operator is required to take action, but as long as the CO_2 does not reach the surface, no allowances have to be surrendered.

Environmental liability

Liability for environmental damage, or the imminent threat thereof, is regulated by the Environmental Liability Directive. The storage of CO_2 is listed in Annex III of this Directive and therefore, strict liability applies for damage caused:

a) To protected species or natural habitats under the Birds and Habitats Directives;

b) To water in the sense of the Water Framework Directive;

c) 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 CO_2 storage, the operator bears the costs of the repair even if he was not responsible for the CO_2 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 de damage was caused by his fault or that he acted negligently.

The Environmental Liability Directive is in the Netherlands transposed in the Environmental Protection Act ("EIA", Wm in Dutch). The concerned 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 2011-2012 is located. However, Title 17.2 Wm, via its reference to Annex III of the Environmental Liability Directive, applies on the operation of CO_2 storage sites pursuant to the CCS Directive. Title 17.2 Wm is therefore regulating the storage of CO_2 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
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 Wet Miliebeheer (Wet WM), the damage threshold. Important to note is that, in principle, the operator can only be held liable until the transfer of responsibilities to the competent authority. However, if damage occures 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 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 already covered by the CCS Directive. For example, if CO_2 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 Directive is in compliance with the Dutch environmental legislation.

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 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 CO_2-storage of the ROAD project.

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.

2.5 Emission Trading Scheme (Wet Milieubeheer)

Emission Permit

The ETS-directive is of particular relevance for CCS projects. In the Netherlands the ETS-directive is implemented in the Wet Milieubeheer. The Dutch part of the ETS is governed by the Dutch Emission Authority (NEA).

The ETS-directive is considered as an important driver for CCS projects as for the equivalent of stored CO_2 no EUAs have to be surrendered, resulting in an economic benefit for the emitting installation(s) involved in the project[9]. Nevertheless, due the low EUA price, the ETS has not been a strong driver to develop CCS projects, yet.

The ETS states the obligation to surrender EUAs in case of emissions (including in the event of leakages). Each of the installations involved in projects (capture plant, transport network and storage locations) must have an ETS emission permit from the moment it becomes operational. For each tonne of leaked CO_2 an equivalent amount of EUAs must be surrendered.

In particular, the question when and how many EUAs have to be surrendered in case of leakage from the storage-site result in an important issue to be addressed. The variation in prices of EUAs has a potential impact on the finance of projects. As operators can be required to set aside an certain amount of EUAs during storage (as security for the event of leakage) a higher EUA price can have impact on the finance of CCS projects.

2.6 Energy Efficiency Directive (Wet Milieubeheer)

The Energy Efficiency Directive[10] (EED) sets binding energy-efficiency targets for Member States. On average the reduction-target for energy efficiency is set at 1,5% annually. Member States have implemented the EED and have set energy-efficiency requirements for industrial installations. In the Netherlands energy-efficiency requirements have been incorporated in the Wet Milieubeheer and in (non-binding) convenants with the industry. Industries have, according to these convenants, to ensure sufficient efficiency-measures to achieve this 1,5%.

These energy efficiency requirements may also apply to installations in CCS projects such as capture installations. Due to the high energy-intensity of some of the (capture) installations (potentially) involved in CCS projects, these requirements can cause difficulties for CCS projects. In particular, as industries have to ensure that energy-consumption over time is reduced including the energy consumption of capture plants. However, the possibilities for owners of installations to reduce energy consumption from capture installations seem limited.

Energy-efficiency requirements and CCS project therefore potentially conflict with eachother. Both are aimed at the reduction of CO_2-emissions. It can be argued that capture installations should not be subject to energy-efficiency requirements in order to allow for development of CCS.

As powerplants are not subject to the efficiency-requirements, and the capture of ROAD took place at the MPP3 powerplant, ROAD was not subject to these rules. However, it should be highlighted that it is desirable that capture-installations (and installations involved in transport and storage) are excluded from the generally

[9] Article 12, Directive 2003/87/EC
[10] Directive 2012/27/EU

applicable energy-efficiency requirements. In order to avoid potential lock-ins by energy-efficiency requirements, CCS projects should be excempted from energy-efficiency requirements.

2.7 Environment, Water, Nature for ROAD

2.7.1 Overview Regulatory Framework

The ROAD project required environmental permits, mining act permits and adjustment of the spatial zoning plan. For the application of these permits and adjustments, separate procedures could be followed, or one coordinated procedure, like the combination of the Amendment of the State zoning plan (Rijksinpassingsplan, RIP) and the National Coordination Scheme (Rijkscoordinatie Regeling, RCR)

The regulations are described based on the most recent design, with storage in the Q16-Maas reservoir. Capture will take place at the MPP3 power plant, including an updated design. Transport from the capture plant will take place in the existing utilities access corridor (leidingenstrook) to the current ONE Q16-Maas location. The ONE location is currently in use to produce gas from the Q16-Maas reservoir and to transport the gas to a nearby Gasunie location. On the ONE location a compressor will be placed and a new well will be drilled. One well will be used to inject CO_2 and the other well to continue producing. Because CO_2 will spread in the reservoir to the production well, it is expected that some CO_2 will be retrieved with the gas after a period of time. This requires a CO_2 separator at the production well. The produced CO_2 will be re-injected with the main stream CO_2 from MPP3.

The all-in-one permit for physical aspects is based on the Wabo (Wet algemene bepalingen omgevingswet) and contains separate permits for building, spatial,environmental and – optional – nature impacts. The permit is digitally submitted to the Dutch competent authorities through the Omgevingsloket online (OLO).

The water permit is a combination of eight previously separate permits, including the permit for crossing a weir, groundwater extraction and discharge on surface level.

Next to the wabo-permit and water permit there are specific permits required, based on the local situation. This includes permits on soil protection, shipping interference, rail and road crossings and clearance of ground.

Implementation of the ROAD project requires an adjustment of the current spatial zoning plan. This includes the route of the pipeline outside the existing utilities access corridor and the adjustment of the ONE location into a gas production and CO_2 injection location.

2.7.2 Spatial Planning Act and National Coordination Scheme

In contrast to the permits needed for the capture facility, the permits and approvals needed for the CO_2 pipeline and the storage facilities are governed by the National Coordination Scheme. 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:

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 CO_2 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 and the water permit.

- The Ministry of Economic Affairs uses the RCR to coordinate large scale developments with multiple stakeholders and national interest. CCS is also part of the RCR, both for the transport and the storage part. Capture falls outside the RCR. When the RCR is applicable there is a central coordination on the submission of permits, which should take place simultaneously. There is a limited procedure for protests.
- The RCR is applicable, but a request can be made to have the permits procedures separated, in case it is not convenient to combine them. Especially the injection and storage permit under the mining act might be submitted in a later stage. There is also a sensitivety towards the other authorities, who might feel overruled by the RCR procedure.

For the ROAD project there are some arguments to use the RCR procedure and some to submit the permit applications separately. The ROAD 18-4 alternative followed the RCR procedure. In the starting note for ROAD Q16-Maas it is suggested to follow the procedure outside the RCR, however this still needed to be discussed with the Ministry of Economic Affairs.

Procedure permits through the National Coordination Scheme

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 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 from one year to one and a half years.

State Zoning Plan

As described above, the (infrastructure for) transport of CO_2 falls within the scope of the Mining Act. This means that planning permission for the laying and use of the CO_2 pipeline becomes possible, in principle, through a State Zoning Plan.

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 CO_2 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 CO_2 pipeline.

For the ROAD Q16-Maas project there is still discussion with the Port of Rotterdam whether adjustment of the current zoning plan for the pipeline is required. This focusses on the status of the area outside the the existing utilities access corridor (leidingenstrook) near the ONE Q16-Maas location where the pipeline crosses industrial areas.

Procedure State Zoning Plan

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

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 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.

2.7.3 Environmental Impact Assessment

The Dutch legalistion discerns two types of procedures for the Environmental Impact Assessment (EIA): the Strategic Environmental Impact Assessment (SEA; in Dutch called "plan-m.e.r.") and the Environmental Impact Assessment (IEA; in Dutch called "project-m.e.r.").

Strategic Environmental Impact Assessment

The Strategic Environmental Impact Assessment (SEA) is required as part of the procedure to adjust the spatial Zoning Plan. The possible impacts of the adjustment have to be described in the SEA, including the possible alternatives. The Ministry of Infrastructure & Environment is responsible for the zoning plan, and they are responsible for the SEA procedure. The Netherlands commission for environmental assessment (NCEA) gives advice on scope and content and reviews the Report.

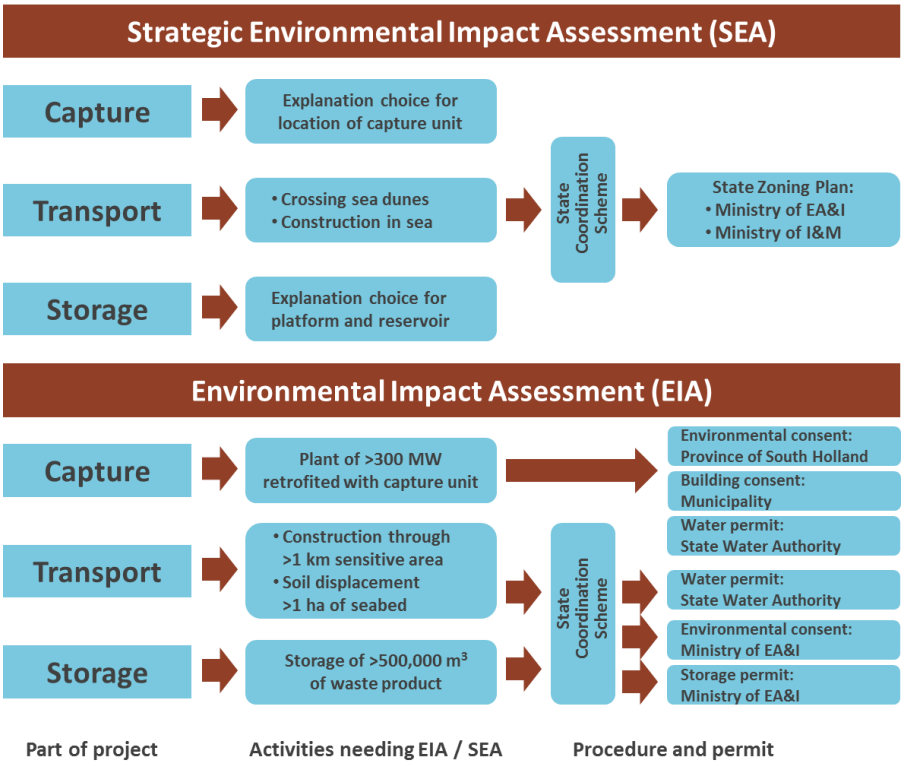

Figure. Overview of procedural choices for ROAD P18-4

In case the SEA procedure is related to a specific project which is obliged to have an Environmental Impact Assessment, both procedures are generally combined and there is a integrated SEA/EIA report.

Environmental Impact Assessment (IEA)

Before 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.

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.

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 8.2	The creation of a storage location according to Guideline 2009/31/EG of the European Parliament and the Counsel of 23 april 2009 concerning geological storage of CO2 (PbEG L 140)	Onshore storage site for CO_2 injection	All-in-one permit for physical aspects Water Permit

The are three differences between the above table for ROAD Q16-Maas and the previous table for ROAD P18-4:

- Category C5.3 is not applicable because it is related to offshore facilities;
- Since the ROAD P18-4 procedure category C18.5 has been withdrawn;
- Category C8.2 has been added for the onshore storage site Q16-Maas.

ROAD Q16-Maas EIA / SEA procedure

In 2011 the EIA was submitted. It was with limited comments accepted in 2012. For the new design in 2017 there are two options, (1) add an alternative to the existing EIA or (2) draft a complete new EIA. Although an addition to the existing EIA is more or less the practical situation, there is a period of 6 years since the previous EIA. As a result the findings of 2011 needs to be regarded in de light of current knowledge. Therefore all of the EIA needs to be revised. To avoid complications and misunderstandings, it has been proposed to write a complete new EIA, including a new EIA procedure. This has been proposed to the Ministry of Economic Affairs, but no decision has been made. It also requires an advise from the Committee of the EIA.

EIA Mandatory Activities

As part of the EIA, the following studies have been identified:

- Soil, water, archaeology.
- Nature, check if there is any impact on nature or in nature reserve area (in Dutch, “voortoets”).
- External safety, calculations on QRA.
- Noise calculations.
- Calculations of air emissions, and deposition.
- Traffic movements, use of energy, waste.

Storage in the subsurface will be outside the top 500 meter (biosphere) concerning the environmental impact. However, there could be risks involved that might impact the biosphere. In the EIA the storage reservoir is extensively described, including concealment, fractures, caprock, rock quality, possible leakage from the reservoir or from the well. In addition possible earth termors are described including mitigation measures.

2.7.4 Legal and Regulatory Framework for Capture

An irrevocable permit has been issued for the capture unit op the MPP3 location, based on the design for the capture unit as presented in 2011. In 2017 an improved design for the capture unit has been developed, which requires an environmentally neutral update of the permit conditions.

In this section a current overview is given of the different permits that are required for the capture unit. The operator of the power plant is Uniper, and Uniper should submit the permit requests.

There are three different authorities for permits:

- The province of South Holland for the wabo permit, including building and environmental permits and the previously separate permits for nature.
- The Ministery of Infrastructure and Environment (I&M) for the Water permit, which regulates the discharge of water on surface water (Watervergunning (onherroepelijk) Waterwet).
- For the NEa (Nederlandse Emissie Autoriteit) an emission permit is required.

All-in-one Permit for Physical Aspects (wabo-permit)

For the wabo permit the extended procedure is required, because the activity itself (CO_2 capture) requires an EIA (category C8.3 en C22.1 from Besluit m.e.r.).

The wabo permit contains an overview of regulations. This require specific reports on:

Building part

- Construction design maps.
- Building consent.
- Masterplan fire safety.

Environmental part

- Situation maps.
- Quantitative Risk Analysis (QRA).
- Acoustic report.
- Baseline soil research.
- Soil risk report.
- IPPC Check – with BAT, BREF.
- Air quality / emissions report.
- Environmental impact report.

Nature part

- Quickscan flora and fauna, nature protection areas
- Waiver for flora and fauna, nature protection areas

Water Permit

The water permit is an extension of the existing water permit for MPP3. There are additional water flows and discharge of cooling water. For the permit application the following information is reported:

- Cooling water modelling.
- Environmental risk analysis including risks of unexpected discharge.
- ABM-check on the use of auxiliary materials.
- IPPC-check of BAT compliance.

2.7.5 Legal and regulatory framework for transport

For the ROAD Q16-Maas project the transport is on land, generally directly below the surface and crossing the Yantzekanaal. There is no offshore track on the seabed, comparable to the route of ROAD P18-4 to the offshore platform. The pipeline is scheduled in the existing utilities access corridor (Leidingenstrook). There is a part of the pipeline track that is outside this corridor and there is discussion whether that requires an adjustment of

the spatial zoning plan. The Municipality of Rotterdam is the permit authority. In its role as developer, the Port of Rotterdam was expected to submit the permit applications.

The pipeline connects the capture unit at the MPP3 location with the compressor at the Q16-Maas location. Part of the pipeline track will be situated on the industrial sites of Uniper and ONE.

There will be a pigging station, and a facility to launch and receive the pig (Pipeline Inspection Gauge) as part of the regular maintenance of the pipeline. The following permits were foreseen for the ROAD Q16-Maas project, section transport:

- Ministery of Infrastructure and Envrionment (Soil protection regulation, water permit for crossing weir, message shipping law).
- Department of Public Works (Rijkswaterstaat) (Message discharge of extracted groundwater).
- Province of South Holland (waiver clearance as part of soil protection).
- Municipality Rotterdam (wabo permit for building and use pipeline strip, waiver for road crossings).
- Prorail (Waiver rail crossings).
- Waterboard Delfland (Permit groundwater extraction).
- NEa (monitroingplan for emission permit).
- Tennet (waiver for working near high voltage area).

2.7.6 Legal and regulatory framework for injection location

Wabo-permit (all-in-one permit for physical aspects)

The ROAD Q16-Maas project has planned to use the current ONE production location Q16-Maas for combined CO_2 injection and gas production. The operator at this location is ONE, and the wabo-permit applications were planned to be submitted by ONE.

The wabo permit application is an update of the existing wabo-permit of ONE, including the newly planned installations. This includes the specific CO_2-injection facilities such as the compressor and the pipelines, but also adjustment of the existing production well with a CO_2 separator. The authority is the Ministry of Economic Affairs.

The CO_2 storage could lead to enhanced production of oil condensate. A second well has to be operational before the storage starts. The application for the wabo permits contain the technical data of the pipelines and installation, and for the possible impact and risk the following detailed studies:

- Description and explication of spatial components, including maps.
- Process flow diagram.
- Quantitative Risk Analyse (QRA).
- Nature protection report.
- NRB Soil risk analysis.
- Study on air quality / emissions.
- Study on nitrogen deposition.
- Acoustic report.
- Product safety sheets.
- Environmental report.

Additional Permits

The storage of CO_2 in P18-4 or in Q16-Maas requires in addition the following permits:

- Storage permit.
- Emission permit.

The storage permit is described in the previous chapter.

The Dutch emissions authority (NEa) is responsible for the emission permit. The application will contain a monitoring program, that will be reviewed by the NEa.

2.8 Permitting Authorities

The permitting process of the ROAD project comprised a wide range of relevant permitting authorities. The following table summarizes the involved permitting authorities, their competences and the relevant advisors.

Permitting authority	Name in English	Competence (Dutch)	Competence (English)	SCS
DCMR Milieudienst Rijnmond (DCMR)	DCMR Rijnmond Environmental Agency	Milieutoestemming	Environmental consent	No
Dienst Stedenbouw en Verkeer, Gemeente Rotterdam (dS+V)	Department of Construction and Transport, Municipality of Rotterdam	Bouwtoestemming	Building consent	No
Provincie Zuid-Holland (PZH)	Province of South Holland	• Natuurbeschermings-wetvergunning • MER Afvang	• Nature Protection Act Permit • Capture EIA**	No
Rijkswaterstaat Dienst Zuid-Holland (RWS DZH)	State Water Authority of South Holland	• Watervergunning Afvang • MER Afvang	• Water Permit Capture • Capture EIA	No
Rijkswaterstaat Dienst Noordzee (RWS DNZ)	State Water Authority of the North Sea	• Watervergunning Transport • MER Transport	• Water Permit Transport • Transport EIA**	Yes
Ministerie van Economische Zaken, Landbouw en Innovatie (EL&I)	Ministry of Economic Affairs, Agriculture and Innovation (Ministry of EA&I)	• Ontheffing Flora- en faunawet Transport • Ontheffing Flora- en faunawet Platform • Milieutoestemming Platform • Rijksinpassingsplan • Rijkscoördinatie-regeling (RCR) • Opslagplan • Opslagvergunningen - Platform MER - Opslag MER - Integraal MER - Plan MER	• Endangered Species Permit Transport • Endangered Species Permit Platform • Environmental consent Platform • State Zoning Plan **** • State Coordination Scheme (SCS) - Storage plan - Storage permits - Platform EIA** - Storage EIA** - Integral EIA** - SEA***	Yes

** SCS = State Coordination Scheme; ** EIA = Environmental Impact Assessment; *** SEA = Strategic Environmental Impact Assessment; **** Together with the Ministry of Infrastructure and Environment as second competent authority*

In addition to the permitting authorities, also several advisors of the permitting authorities were involved in the permitting process. The most important are shown in the following table.

Advisor	Name in English	Advisor to	Competence
Bureau Energieprojecten	Energy Projects Agency	Ministry of EA&I	Permitting procedures
Brandpreventiecommissie	Fire prevention committee	Department of Construction and Transport, Municipality of Rotterdam	Fire prevention
Staatstoezicht op de Mijnen (SodM)	State Supervision of Mines	Ministry of EA&I	Integrity of subsoil and wells
TNO Bouw en Ondergrond (TNO)	TNO Building Construction Division	Ministry of EA&I	Integrity of subsoil and wells
Dienst Landelijk Gebied (DLG)	Government Service for Land and Water Management	Ministry of EA&I	Endangered species

3. Funding

3.1 Introduction

This chapter describes the funding-structure of the ROAD-project. This chapter aims to display the funding structure of the project and which resources have been used. As funding has been an important reason for the delay of the project, solutions were actively explored in the past few years on how to close the funding gap. Funding will remain a key issue for the development of CCS projects as the technique is currently still commercially not viable.

The ROAD project was co-financed by the European Commission ("EC") within the framework of the European Energy Programme for Recovery ("EEPR"). Moreover, the project was funded with a subsidy granded by the Government of the Netherlands. The grants amounted to €180 million from the EC and €150 million from the Government of the Netherlands. In addition, the Global CCS Institute is global knowledge sharing partner of ROAD and has given a financial support of €4.3 million to the project. The parent companies were willing to contribute €50 million each to the project.

Due to low prices of EUAs a funding gap emerged in late 2011, which resulted in the delay to the initial FID. The low price of EUAs was in particular an issue as the financial incentive to store CO_2 had dropped and less income was generated throughout the EUA benefits. The latter made in particular the operational phase uneconomical.

Due to the funding gap for the P18-4 secenario, the ROAD directors decided in 2012 to continue the project on "slow-mode". In this period, ROAD reviewed alternative funding sources, cost saving measures and a phased project approach in order to close the funding gap. The project team explored a number of opportunities for additional funding. Representatives from both the government of the Netherlands and the EC discussed with several direct and indirect stakeholders (e.g. a number of European Member States and the City of Rotterdam) finding alternative ways for additional funding.

The main objective of the review during the slow mode was to close the funding gap by improving the economics of the ROAD project. Following extensive efforts by all parties, a number of developments allowed the funding gap to be considered closed. The main changes to the ROAD project were a so-called 'phased' project approach and a new offshore storage location. These changes included the following measures:

- Reallocation of the Dutch grant to support only the construction period;
- Additional funding from ERA-NET Cofunds to support early operation as discussed in several roundtables on the initiative of the EC;
- Use of the Q16-Maas reservoir as the CO_2 storage location for the first demonstration period, located near shore resulting in cuts on CAPEX costs for transport;
- An understanding between the ROAD parent companies (Engie and Uniper) and Dutch stakeholders (the Government of the Netherlands and the City of Rotterdam) over long term project funding allowed the parent companies to firmly commit a maximum of € 50 million each to the project.

Moreover, ROAD explored other options including a change of supplier for the capture unit and the possible availability of alternative storage facilities, that could have positive impact on the project economics.

After a thorough assessment of different options, ROAD decided in 2016 to change the project set-up. The new project set-up comprises a so-called 'phased approach; with a reallocation of (additional) funding sources and a new offshore storage location Q16-Maas gas field operated by Oranje-Nassau Energie. The shorter distance (nearer to the shore) to this new storage location allowed ROAD to substantially reduce investment and operating costs. By the end of 2016, the EC and ROAD agreed to extend and amend the EU EEPR Grant Agreement by adjusting the work plan and timing of the Action based on the new project set-up.

3.2 Funding Framework

In general, the EEPR and the NER300 have been offering funding opportunities for CCS projects in the past years. However, both funding schemes have now expired and did not result in successful development CCS projects. All CCS projects that have used the schemes failed.

There are different causes for the failure of CCS projects in the last decade. The low price of EUAs has also had its impact on the economic viability of CCS projects. The ETS is supposed to be an important driver for CCS, as with a high ETS-price CCS projects are assumed to become economically feasible (due to the EUA benefit). However, the low price for EUAs has not given a sufficient incentive to result in the development of CCS projects.

EEPR

ROAD made use of the funding scheme of the European Energy Programme for Recovery (EEPR). In 2009, ROAD applied for the fundering under the EEPR-scheme. In May 2010 the EEPR Grant Agreement was signed by representatives of the European Commission and Maasvlakte CCS Project C.V. Following the delay to the FID, grant agreement for the EEPR-funding was extended in 2016 in order to allow ROAD to ultimately start operations in 2020. Iniatilly the EEPR required projects to be operational ultimately in 2015. The EEPR had been a temporary scheme, and has now ended.

Subsidy by Dutch Government

The Dutch government provided a CCS subsidy dedicated for the ROAD-project. The Ministerial Order granting the funding for the ROAD Project was signed by the former Minister of Economic Affairs in May 2010, after the text of the order had been finalized in co-operation with the ROAD project team. This State Aid by the Dutch Government was formally approved by the European Commission in October 2010. The Dutch grant was not been revised following the new project set-up with ONE in Q16-Maas.

For ROAD in 2016-2017, it turned out that the provisions of the Dutch grant were a major issue. In particular, as the OPEX support of the grant was made conditional on the amount of CO2 stored. As there remained uncertainty on how much CO2 would be stored in Q16-Maas, ROAD would be potentially only be eligible for part of the Dutch subsidy. The latter would have automatically resulted in an additional funding gap. Negotiations with the Dutch Ministry on the terms for the revision of the grant (extension of the grant was needed) never took off before ROAD was stopped, despite the efforts of the ROAD team. ROAD understands that this was due to uncertainty within Government over policy on the future of coal plants.

Additional Funding

ROAD agreed on a coperation with the Global CCS Institute (GCSI) in 2010. Through the corporation with the GCCSI, a limited amount of funding was provided by the GCCSI and knowledge generated by ROAD, amongst which the results of one of the FEED studies (as far as acceptable to the technology supplier), were shared with the GCCSI. The amount of funding from GCCSI was € 4.3 million.

Co-funding Schemes

In the slow-mode funding was sought from the EU Horizon 2020 fund via a so called “ERA-NET” co-funding scheme. ERA-NET co-funding under Horizon 2020 is designed to support public-public partnerships, including joint research programme initiatives between Member States. This covers the preparation and establishment of networking structures, and the design, implementation and coordination of research activities. Multiple Member States are needed to establish an ERA-NET co-funding scheme. However, no applications were submitted nor ERA-NET proposals were set up before the project was ended.

3.3 CAPEX

The largest part of the capital costs of the ROAD-project was covered by funding from the EEPR-scheme and contributions by the parental companies. As long as CCS is not commercially viable, strong CAPEX incentives will be needed for CCS development.

In the revision of the ETS-scheme, it is important that a strong NER400 ('*Innovationfund'*) is established that provides sufficient CAPEX investment supporting the development of CCS projects. Moreover, member states should establish strong national CAPEX support schemes to (co-) fund CCS projects.

Moreover, to support the broad development of CCS projects and CO_2-transport and storage infrastructure, it is desirable that the government invests in CAPEX related to storage and infrastructure.

Having a storage and transport infrastructure network in place would reduce the CAPEX for individual projects and results therein that emitters focus on investments in capture installations. If the costs of the transport and storage infrastructure can be socialised (for example by funding via carbon emission revenues or other levy mechanism), this gives the important advantage that the risks and liabilities regarding the storage part will not fall on the capture installations. This would be very beneficial to the development of CCS.

3.4 OPEX

As elaborated above, OPEX funding has for the ROAD project been an issue. Due to the low price of EUAs, the funding of the operational phase of projects became from the beginning of the project uneconomic.

As there was under the EEPR grant an obligation to store at least a minimum amount of CO_2, there was additional OPEX funding needed for the project to close this gap. Several sources of operational funding where sought during the slow-mode of the project. However, ROAD found a lack of funding-support schemes for OPEX.

The majority of existing funding schemes is not sufficiently flexible to support (only) OPEX. Often funding is linked to a minimum amount of CO_2 storage or becomes only available once CAPEX investments have been made. For Q16-Maas, it for example has been an issue that the funding under the Dutch grant was related to the amout of CO_2 stored, which resulted in financial uncertainties for the project.These have been issues for ROAD as it was upfront not certain what the exact amount of stored CO_2 would be. ROAD finds that in particular for demonstration projects, there is a need for sufficiently flexible OPEX support.

For the development of CCS it is essential that there are stronger and more flexible financial support mechanisms for the operational phases of projects.

3.5 Funding and Support

CCS projects are yet commercially not attractive. Funding and government support will therefore still be needed in the upcoming decade.

In establishing funding mechanisms to support future CCS projects, it should be considered that no CCS project set-up will be similar. As set-ups for CCS projects will potentially differ much from each-other, it is very difficult to deal with pre-set rules for funding. This is particularly true as the focus for CCS switches to industry, as each individual industry has its own unique combination of technical and economic challenges. Due to these changing demand and business cases, sufficient flexibility in the rules is required. Hence, a flexible approach in criteria for funding is needed.

The issue of a low EUA price is likely to remain and is unlikely to achieve a level that makes CCS projects commercially viable any time soon. As CCS is not yet commercially viable, the development of projects will remain dependent on government support and subsidies. Even if the EUA price would become an important driver, ROAD believes that it still will not provide the certainty projects need.

Support of the government for the first CCS projects (in the demonstration) phase remains crucial. Without sufficient backing, at both political and policy level, there is little chance that CCS projects will be developed.

For CCS to be successful it is important that govnerments start funding the necessary infrastructure for transport and storage for CO_2. That means that strong backing from the government is essential for any CCS project. To succeed the projects support must be designed in a way that operators can rely on long term certainty provided by governments.

Regarding the establishment of new funding schemes the issues should be addressed in their design aiming to support CCS:

- Allow different EU funds to be combined;
- Ensure compatibility across funds;
- Raise the cap for funding in individual schemes;
- Have a more flexible scope for relevant costs in funding schemes;
- Ensure that there is adequate support for transport & storage activity – ideally this activity should be socialised;
- Requirements regarding entry into operation of projects should be flexible. Too restrictive timelines can hamper projects;
- More flexibility for the operators and timelines in general is desired.

4. Overview of Permitting Documents

4.1 Introduction

This chapter gives an overview of the documents that have been submitted by the ROAD project, concerning permit applictions, spatial planning procedures and the supporting environmental impact assessments. All these documents are related to the ROAD P18-4 project and have been reported more extensively in the previous progress reports.

In addition, a description is given of the practical application of the procedures, like the RCR procedure, the RIP procedure, e.i.a. procedure and the EU procedures, including the effectiveness of these procedures.

For the ROAD Q16-Maas project, the team has made an overview of the required applications as mentioned in chapter 3. The team was preparing the draft documents for different procedures at the moment the project was stopped. As a result, only the draft starting note was finished and submitted to the Ministry of Economic Affairs. No discussion had taken place on this document. In this chapter the draft starting note is mentioned as the only formal document for ROAD Q16-Maas that was delivered.

4.2 Permits – Environment – ROAD P18-4

4.2.1 Capture unit

All-in-one Permit for Physical Aspects

ROAD will capture CO_2 from the flue gases of the new build coal fired power plant MPP3 on the Maasvlakte, Rotterdam. MPP3 is an ultramodern power plant with a total electrical capacity of about 1,100 MWe. It burns coal and secondary fuel sources (biomass).

The capture activities were not covered by the previous 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 falls 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. 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 needed to be resolved.

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

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 did 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 Act Permit

There are a number of water related activities, for the onshore pipeline during the construction phase, for crossing the protection zone and for digging the pipeline offshore. This required permits from the waterboard and Rijkswaterstaat.

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 Unipers' 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. 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.

Nature Act Permit

Extensive research has been done on possible impact on the nature area's (voortoets). The studies concluded that the impact was limited except for the possible impact from deposition from the capture unit. This has been used for additional research (passende beoordeling), concluding under which conditions deposition was within the limits.

Two European Directives, the Birds Directive and the Habitats Directive, help to protect Europe's most important natural assets. 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 CO_2 will be removed from the gases uses materials that include nitrogen compounds (e.g., amines, 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 nitrogen compounds, 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.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.

4.2.2 Transport

Specific discussions with the Ministry of Environment about the risk analyses for transport have been organised. The calculations have been done with SafetiNL, using an probit-relation specifically calculated for the ROAD project but has not yet been formally acknowledged.

This paragraph covers the legal framework that applies to the onshore and offshore transport aspect of the ROAD-P18-4 project and the permits that are required. First, a brief description of the CO_2 transport is given.

The pipeline will be connected to the capture installation on the Uniper site. A compressor will be used to compress the captured CO_2 to the desired pressure for transport. From the capture facility, the CO_2 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.

National Coordination Scheme

In contrast to the permits needed for the capture facility, the permits and approvals needed for the CO_2 pipeline and the storage facilities are governed by the National Coordination Scheme. 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. More detail on this is given in Section 3.7.2 of this report.

With a view to the transport of CO_2 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.

State Zoning Plan

As described above, the transport of CO_2 falls within the scope of the Mining Act. This means that planning permission for the laying and use of the CO_2 pipeline becomes possible, in principle, through a State Zoning Plan.

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 CO_2 pipeline is actually contrary to the provisions of the current zoning plans 'Maasvlakte '1' and 'Maasvlakte 2'. This means that a State Zoning Plan needs to be approved to grant planning permission for the CO_2 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.

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.

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.

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.

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.

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 CO_2 emission permit from the moment that it is operational. No permits where obtained before the project ended.

4.3 Permit – Storage – ROAD P18-4

4.3.1 General Developments Storage Permitting Process

In close collaboration with TAQA, ROAD started the application process for the storage permit already in 2010. In the course of 2011 ROAD and TAQA started writing the storage permit. It was the first application for a CO_2-storage permit (offshore) in the Netherlands under the CCS Directive. Therefore ROAD, TAQA and the Ministry were in frequent contact to discuss the interpretation of the Directive and Guidance Documents, to align expectations regarding the permit application. The storage permit appliation was submitted on June 30, 2011.

The storage permitting process took almost two years. The permit was finally issued in July 2013. There were several causes for this delay. The permitting process had one year delay due to the fact that the original (draft) permit application was filed in June 2010. At that time, the CCS Directive was already published by the EC but the directive needed to be implemented in Dutch legislation.

The competent authority understandably wanted to assess the application with a view to the Directive framework and therefore demanded an application that was complying with all requirements of the CCS Directive (although the transposition of the CCS Directive into the Dutch Mining Act was not completed yet). The CCS Directive was implemented in the Mining Act by the end of 2010.

It was not until June 2011 (initial application-date was June 2010) an update of the application with all necessary information regarding the CCS Directive was submitted by TAQA. Almost immediately after the application was submitted, the competent authority granted the draft storage permit.

The EC drafted its opinion on the permit in 6 months, although the CCS Directive stated that the EC has a maximum term of 4 months to do so. According to the EC, the 4 month term only actually starts once any additional documents have been submitted, and the EC has all the required information. If you exclude the communication period from the process, the EC acutally drafted its opinion within the 4 months period. It was the first storage permit of this kind that was sent to the EC, and is a good precedent for the timeliness in of the process.

There are a number of (general) other lessons learnt regarding the permitting process, where time was gained due to the fact that:

1. TAQA and ROAD have had several informative meetings with the civil servants and their advisors that were preparing the draft permit. This had been very helpful as TAQA/ROAD could already explain the approach or adjustment of the application. This resulted in a very short period between the application being submitted and the date on which the draft permit was granted. The civil servants and their advisors knew the content of the application and their questions were answered before the application was submitted.

2. As soon as the permit application was filed by TAQA, the competent authority published the application. In the Netherlands the CCS Directive requirement of 'Member States shall ensure

that the procedures for the granting of storage permits are open to all entities posessing'[11] is elaborated in the requirement that the government must publish the permit application in order to enable possible other interested parties to apply for the same storage permit. Competitors have a 91-day term in which they can file an application. The compentent authority immediately published the permit application of TAQA and did not wait before the draft permit was ready. This led to a time advantage.

3. The public consultation period and the EC opinion period started at the same time. This ensured an efficient approach as actions could be held simultaneously.

Elements Storage Permit

As discussed in chapter 3, 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 the requirements that are incorporated in the Mining Act. This means that the key elements of the CCS Directive were directly interpreted in the storage permit by the Dutch autorities. In particular ROAD has worked actively on finding practical solutions for the following elements in the storage permit:

- Plans (Monitoring; Risk management; Corrective measures, Abandonment).
- Financial Security.
- Transfer of responsibilities.
- Financial Mechanism.

In ROADs opinion there is a large gap between the requirements of the CCS Directive and the feasibility for a concrete project such as ROAD to comply with all these elements. 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 done after an 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 injection. The (draft) plans in the permit application would provide sufficient information to prove that CO_2 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. ROAD managed to agree with the EC that these final plans would be submitted to the competent authority and the EC a year before the injection of CO_2 starts.

The competent authorities must give (at that point) their approval on the final plans and before adjusting the permit SodM (Mining Authority) and TNO (state advisors) will give their expert advice. ROAD agreed with the EC that they would be enabled in 2014 to give another non-legally binding opinion on the update of the storage permit, when all of the plans would have been elaborated. With that agreement, the draft storage permit was been granted to ROAD (which gave at the time sufficient comfort to take the final investment decision for the ROAD project) and the competent authorities and the European Commission were enabled to approve the final plans before injection starts (which complies with the CCS Directive). This was a pragmatic solution which can be taken into account when the CCS Directive will be revised in the future.

4.3.2 Plans

The CCS directive requires the following plans that have to be developed and accepted by the competent authority: Risk management plan, Monitoring plan, Corrective measures plan and Closure plan. There is a great

[11] Article 6 sub 2 Directive 2009/31/EC

consistency between all these plans. 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.

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, is advised. 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 abandonment plan. And all these plans together provide the input for the monitoring plan. Although the risk management plan is location-specific, the ROAD plan is therefore not really helpful for other projects, one some important topics of the ROAD plans are outlined more specifically below.

In the risk management-plan a substantial risk analysis and scenarios that would apply in the event of leakage were described. Successively the following leakage scenarios are adressed in the plan that was submitted by ROAD:

- Leakage through the cap rock.
- Leakage via the reservoir spill-point.
- Leakage through fractures.
- Leakage through wells.

The leakage scenarios are described according to the following six steps:

1. A description of the relevant scenario.
2. A description of the threats and the possible consequences of the leakage or migration.
3. A description of the probability that a leak or migration occurs.
4. A first estimate of the risk that the leakage or migration occurs (the risk is based on the probability and the consequences).
5. An overview of available control measures, including monitoring.
6. Description of the remaining risk (after management measures have been taken).

Monitoring plan

The monitoring plan is the key instrument to ensure the safe storage of CO_2. The monitoring plan must not only target the storage site, but also the injection facilities, the storage complex (including, if possible, the CO_2 plume), and where appropriate the surrounding environment. Please note that the storage site is not the same as the storage complex. The monitoring plan consists of a variety of measures. It e.g. includes the detection of significant irregularities, detection of CO_2-migration and leakage, detection of significant effects for the surrounding environment, evaluation of the corrective measures and actualisation of the safety- and integrity-control of the storage-complex.

The 'storage site' is a defined volume area within a geological formation used for the geological storage of CO_2 and associated surface and injection facilities. 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. The figure below illustrates the different monitoring areas. 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 the figure below.

- Corrective measures
- Scale up monitoring
- Standard monitoring

In the stoplight model, a green zone is given for each operational parameter, indicating the measurement values are 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 CO_2 injection is temporarily halted until the reasons for the anomalous observations are explained.

The monitoring plan for the ROAD project, and the storage permit in particular, serves to provide substantiated statements about:

- Safety and integrity, with regard to possible damage to the environment or subsoil. Monitoring will have to underpin that the CO_2 remains stored in the reservoir and does not end up in the biosphere. It must also show that the structure of the reservoir and the sealing layer remain intact.
- Monitoring offers the opportunity to intervene if deviations occur,
- Demonstration character of the project, learning from findings, some situations can be better understood by measurements,
- Commercially, with regard to the ETS and the quantities CO_2 stored. The monitoring must show that the captured CO_2 has actually been permanently removed from circulation and no emission allowances have to be surrendered for this CO_2,
- Legally, with regard to the demarcation of the storage location. The monitoring must show that the CO_2 does not end up in other reservoirs, for which no storage permit has been granted,
- Provide a basis to support the transfer of responsibility after completion of the injection.

ROADs monitoring plan contained a detailed overview of the above. Divided into the categories of; injection process, well, reservoir integrity and environment; details are given on what kind of measurements and equipment would be used for monitoring. Also the location, frequency and rationale of the monitoring activities is described in the document.

Corrective Measures Plan

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.

With regard to the measures, it is obvious that in case of an undesirable event, a combination of the proposed measures is applied. Of course, this combination must be effective to correct significant irregularities or to close leaks in order to prevent the leakage of CO_2 from the storage complex or to stop it. An important aspect of the corrective measure plan is 'early warning' and 'early intervention', with the aim to prevent worsening of the situation and to minimize 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.

Five types of corrective actions have been identified and were proposed in the plan that was submitted with the application for the storage permit. The following measures can be applied as soon as an undesirable event occurs with the storage complex:

- Report to competent authority and communication with stakeholders.
- Additional monitoring (intensify or expand).
- Adjusting operational parameters.
- Technical adaptation to the system.
- Large-scale intervention.

Moreover, the plan provides for an overview of the 'unwanted' events, describing at what event what measure would be taken.

Abandonment Plan

The abandonment plan is an important document as it sets the actions and conditions which have to be fulfilled before a transfer of responsibilities from the operator to the the state authority will be allowed. The following aspects are considered at the conclusion and transfer:

1. Proven complete and permanent storage of CO_2 where:
    - Actual behavior of the injected CO_2 is in accordance with the modeled behaviour.
    - No detectable leaks.
    - Storage location is evolving to a state of long-term stability.
2. Closure of the well and removal of the injection facilities.
3. Period of monitoring after closure.
4. Transfer of data.

ROAD submitted a provisional plan for the abandonment of the well. After the reservoir is filled with CO_2, or as soon as it is decided to stop injecting CO_2, the reservoir will be shut down. Based on the insights, this was expected to take place approximately 7 years after the start of the injection, ie around 2022. Prior to the closure of the reservoir, a final closure plan will be submitted to the competent authorities for approval. The ROAD closure plan would be based on the then existing techniques and experience.

An additional preliminary plan aimed to clarify how closure could take place with the current state of technology and experience. In this way it is demonstrated that even with the current state of technology the reservoir can be closed in a way that keeps the CO_2 in the long term.

Moreover, for the procedure for the closing and transfer procedure, the following steps were provided:

1. Termination of the injection, as yet assumed in 2022.
2. Period monitoring behavior CO_2 in reservoir, expected to be about 1 year.
3. Establish that the conditions for closure are met.
4. Closing the well.

5. Period monitoring closing operation plug in well, expected to be about 1 year.
6. Establish that transfer conditions have been met.
7. Transfer to competent authority.
8. Monitoring by competent authority, period of 30 years.

4.3.3 Financial Security

The ROAD project faced three specific important questions regarding the financial security. The amount of financial security is stated in the storage permit. The financial security needs to be available to the compent authorities prior to the start of injection. There are no binding provisions on the amount of financial security. An estimate of the appriopriate amount of financial security can be made by answering the following questions:

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?

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 measures to be taken into account for the financial mechanism are:

1. Monitoring.
2. Contingency monitoring.
3. Abandonment.
4. Financial contribution.
5. EUAs surrendering in case of leakage.

For the ROAD project, the contingency monitoring imposed 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. Overview of financial security ROAD-project

With a total amount of CO_2 stored (planned) in the period 2015-2020 it was expected to overall store 4 Mton CO_2. All the risks for potential leakage had been identified and all possible measures would be taken to prevent leakage. The injection of CO_2 would be constantly monitored and also after the abandonment of the well, monitoring would continue. A corrective measures plan was therefore being developed to ensure that in case of a leakage sufficient measures can be taken to prevent further leakage. However, if CO_2 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 CO_2 that has leaked.

With a view to the storage permit application, ROAD needed to prove that the reservoir is sealed and, if CO_2 did nevertheless happen to leak, what the most likely leakage pathways are. ROAD also needed to calculate the amount of CO_2 that could leak to the atmosphere in case of a leakage. Furthermore under the provisions 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 CO_2 that could leak. ROAD had already taken the financial risks into account that ROAD is would to suffer in case of a leakage, and the risk(calculation) is set out below:

Risk = (1) amount of CO_2 x (2) allowance price

With a view to the first factor (amount of CO_2), 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 CO_2:

- A conservative estimate of the maximum percentage of CO_2 that can be released (which, it says, “in most situations, will be much less than 100%”).
- A calculation based upon a probability distribution of the amount of leakage.

The uncertainty for ROAD mainly was to be found in the EUA price, while ROAD had a solid estimation of the maximum amount of CO_2 that could leak to the atmosphere in case of a leakage. A sufficient and well thought corrective measures plan was developed giving ROAD confidence that in case of a leakage (see above) , ROAD would be able to take sufficient corrective measures to stop the leakage. The maximum amount of CO2 that could potentially leak, and EUAs would have to be surrendered, was calculated by considering the injection-speed of CO_2 for a maximum period of 3 months.

During the project, ROAD considered one of the most serious risks to be the price of EUAs. 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 of EUAs). For example, if a leakage would have occured in 2022, ROAD would be obligated to pay the price in that year. At the time of application for the storage permit, almost everybody agreed that the price would increase, but there remains uncertainty as to

how high the price will rise. During the course of the ROAD project it has been extremely difficult to estimate the EUA-prices: estimates in 2010 differed from €15 in 2020 to €140 in 2020. It turned out that the price remained very low.

Another issue was that ROAD remained liable for leakage after the well and platform would 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 would 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 was that an accurate estimation of the development of the EU-ETS price is not possible, but the amount of CO_2 that could leak will remain the same over time.

ROAD argues 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. Hence, this decreases the financial risks for projects over time.

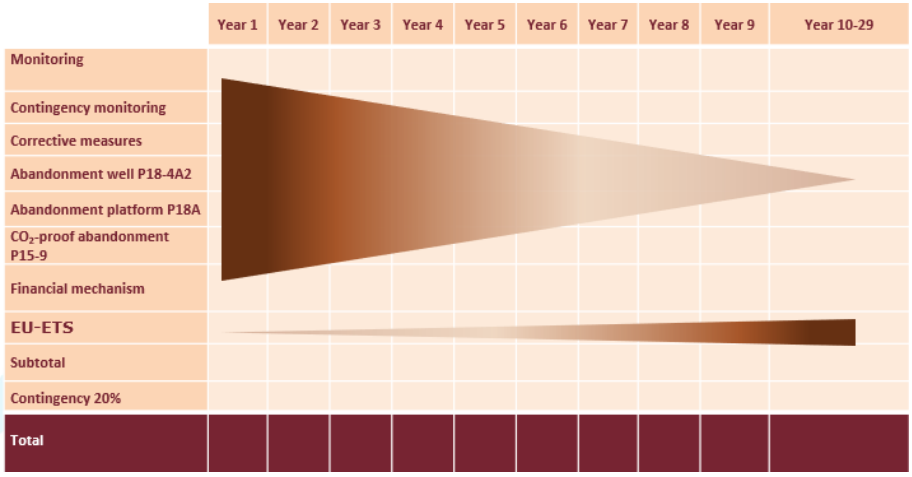

Figure. Total amount for FS decreases over time as risks decrease

ROAD found that over the years the amount of financial security decreases as activities would be carried out and (potential) costs for contingency monitoring would drop (see above).

ROAD managed to agree with the government on acceptable terms for the financial security. However, for other new CCS projects, there is a risk that no acceptable terms will be agreed. In practice, authorities can demand very large amounts of security.

Financial Instruments

The Guidance Documents provide a (non-limited) summary of financial instruments to cover the financial security. In general, the Guidance Documents offered two possible approaches to defining what instruments are acceptable either as financial security or as 'any other equivalent':

1. The Guidance Document summarizes three different types of security instruments:
    a. Setting aside funds or other assets.
    b. Guarantee that funds will be available if the operator defaults - e.g. bank guarantees.
    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 instruments, 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 secured that injection could only start if the Competent Authority is satisfied with the financial security (according to the draft storage permit) in case:

- 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.

In 2013 the Dutch Government accepted a balance sheet, but prefered a bank or parental guarantee. This is also explicitly noted in the storage permit. ROAD consulted several banks and they stated that under the current conditions (amount 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.

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.

4.3.4 Transfer of Responsibilities

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

- All available evidence indicates that the stored CO_2 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 (still) to be resolved. The main concern of the ROAD project has been in which way and under which conditions the minimum period of 20 years can be reduced. Or alternatively, what assurance could be provided to operators than an actual transfer of responsibilities would facilitated after 20 years.

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 CO_2-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. 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 indefinitely.

The CCS Directive created a possibility to reduce the minimum period of 20 years, if all available evidence indicates that the stored CO_2 will be completely and permanently contained, this minimum period can be reduced. The key questions ROAD has considered are:

- Which evidence is taken into account?
- What if the competent authority is not convinced, although all available evidence indicates that the stored CO_2 will be completely and permanently contained, for example due to leakage in another CCS project (what if for example in Canada stored CO_2 would leak and the Dutch public/politics get worried?)?
- Who is going to assess this evidence?

The first two questions were to the main concern of ROAD. The CCS Directive and Guidance Documents give clarity to some extent on the first question.

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 has to decide upon all of these issues and ROAD is concerned that decisions made today by governments 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 the competent authority agrees to the transfer, 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.

A post closure plan including a monitoring plan after closure was submitted at the time of the permit application. After the abandonment, monitoring possibilities are however 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 CO_2 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 CO_2 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 did 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 CO_2 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 revised.

4.3.5 Financial Mechanism

Based on the provisions of the CCS Directive 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.

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 CO_2 is completely and permanently contained in geological storage sites after the transfer of responsibility".

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. The outcome of the talks was that in the opinion of ROAD and the Dutch Government, that the financial contribution should only include costs that the competent authority will have after handover (i.e. monitoring) and should not include contingency costs.

There are several strict requirements for the handover, and only if these are fully met, then the handover can take place. All available evidence must indicate that the stored CO_2 is completely and permanently contained, the abandonment plan was fulfilled according strict regulation. The risk that after handover CO_2 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 was be included in the financial security.
- No contribution will be charged for other possible costs after handover (for example in case of leakage).

4.3.6 Technical specifications operator

With regards to the technical specifications of operators, it should be noted that 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. P18 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.

4.4 Emission Permits – ROAD P18-4

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 CO_2 emission permit from the moment that they become operational. In order to receive a CO_2 emission permit, a CO_2 monitoring plan needs to be submitted to the appropriate authority. In summary, a CO_2 monitoring plan must include the following:

- Determination of the yearly CO_2 emissions.

- Compilation of a yearly emission report (measurement, recording and reporting).
- Validation activities (e.g., calibrating the instruments).
- (internal) quality assurance.

ROAD had not yet applied for the capture plant's emission permit. The application will be submitted after the capture plant has been built (2014), as a result no plan for the permit has been drafted.

The capture and storage of CO_2 would result in the fact that the emitting party has to purchase fewer emission rights. If CO_2 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.

4.5 Expiring Irrevocable Permits

The irrevocable permits from the ROAD P18-4 are still available for future use. During ROAD Q16-Maas a review was held to clearify how long these permits will remain available and under what kind of conditions they could expire. The review has focussed on four specific permits:

1. Storage permit for CO_2 storage in the P18-4 reservoir.
2. Nature protection Act 1998-permit for the capture unit.
3. All-in-one permit for physical aspects for the capture unit.
4. Water Act permit for the capture unit.

The review concluded that the permits will not automatically expire. However the authorities could decide to withdraw a permit, using one of the available legal conditions. Only the last two permits could be withdrawn on grounds of discretionary competence by the authorities after a period of three years without use. The authority needs to provide a motivation in any case.

If an authority decides to withdraw a permit, this does not take into affect immediately. The authority is required to inform the permit holder and offer the opportunity to explain their views. Also after the decision of the authority the permit owner could protest in a court case, to maintain the permit.

The permits themselves could hold limiting conditions, like article 5 of the storage permit which mentions that the period of storage will start at latest at 1 January 2018.

4.6 EIA and SEA – ROAD P18-4

Starting Note

The draft starting note (NRD, Notitie Reikwijdte en Detailniveau) has been submitted to the Ministry of Economic Affairs. The Minister has requested The Netherlands Commission for Environmental Assessment (NCEA) for advice on the approach (request on September 16, 2010). In this starting note the approach is explained, including the proposal to combine the Strategic Environmental Assessment (SEA) and the Einvironmetal Impact Assessment (EIA) into one document. During the period from September 24, 2010 until November 4, 2010 the document was available for public consultation. The committee e.i.a. has described the guidelines (December 2, 2010 / reportnumber 2479-33). (Category Decree EIA: C5.3, D8.1, C18.5, C22.1)

Interim Review

Given the innovative nature of the ROAD project, both technical and procedure wise, the NCEA has been asked to provide an interim review of the research and reporting (May 19, 2011 / reportnumber 2479–55). The committee was asked to review the available documents (April 20, 2011), which exclude the required documents for Nature.This review provided assurance that the project could continue with some adjustment and authorities could start drafting their permits (ontwerpbesluiten).

Advice on EIA including SEA

The Ministry has asked the NCEA to advise on the EIA on November 4, 2011. A public announcement of the EIA was on October 26, 2011, after which the public could comment dureing the period from October 27 until December 7, 2011. The committee has given her advice on the EIA in the report on March 13, 2012 (e.i.a.-reportnumber 2479–107).

4.7 Spatial Planning – ROAD P18-4

The "Inpassingsplan ROAD" (9 juli 2012, BügelHajema) describes the adjustment of the spatial planning in the Maasvlakte area, both onshore and offshore.

For the spatial planning special attention was given to the planned wind turbines and an extension for the firebrigade.

The concept-(rijks)inpassingplan has been brought into procedure but this procedure was not finalized.

4.8 Progress ROAD Q16-Maas project

The ROAD project has started with submitting the starting note (April 26, 2017) to the Ministry of Economic Affairs. In addition the preparations of the EIA has started. An overview has been made for the required permits, updates of existing permits and adjustment of the spatial plan. For the storage part, extensive modelling has taken place, but was not finalized when the project stopped.

4.9 Storage Permit – ROAD Q16-Maas

For Q16-Maas a permitting plan was developed, in collaboration with the field operator, Oranje-Nassau Energie. Applications for a modification of the production permit and the storage permit for Q16-Maas should be submitted, in the first half 2017. Final approval of the permits by the authorities was expected, in the second half of 2017.

- Agreement with the Government on the permitting approach of permanent CO_2 storage in an active reservoir.
- Agreement with the Government on the new and to be modified permits and best trajectory.
- Modification of the Q16-Maas production plan ('winningsplan') and submitting the application for the second well to realize a new production plan.

Storage permit

Preperations were made for the application of a new storage permit for the Q16-Maas field. However, due to the fact the project ended, no application for a storage permit was submitted for ROAD Q16-Maas.

Explanation of different set-up and issue with combining

In 2016 difficulties were discovered by the fact that the Q-16 Maas field would still be in production at the time that ROAD would start with CO_2-injections and storage and production would take place at the same time. Under the Dutch Mining Act, in 2016, it was not possible to hold a production licence and a CO_2 storage licence at the same time. That caused issues for the Q16-Maas project set-up. Because the predicted value of the enhanced condensate (and possibly gas) production exceeded the forecasted value of EUAs for the stored CO_2, in the Q16-Maas Project set-up, and because additional condensate recovery increased the available spae for CO_2 storage, it was planned to carry out the Q16-Maas CO_2 injection under the existing hydrocarbon production licence (owned by ONE), modified to include CO_2-injection for enhanced recovery.

However, to ensure permanent geological storage of the injected CO_2 (and therefore have the EUA benefit), MCP CV and ONE were planning to apply for a storage permit for Q16-Maas. This would have meant that once the production would have stopped, the production permit also would have ended and the storage permit would enter into force. That would be the same approach that was foreseen for P18-4 (TAQA), which was accepted by the Competent Authorities by granting the storage permit for P18-4 and taking in a provision that stated that the production permit needs to be turned in when the storage permit enters into force.

A consequence of that approach would have been, that the injected CO_2 under the production license would not be eligible for EUAs because it was not injected under the storage permit. However timely start of the injection activities was key as the project was ought to start by the end of 2020.

Changes and efforts in amending Mining Act and new legal framework

In close collaboration with the Dutch government, it was considered amendments of the Dutch Mining Act were feasible to make it possible to hold a production licence and a CO2 storage licence at the same time for the same well. This would open up the possibility to apply for a CO2 storage permit under the Dutch transposition of the CCS Directive at which point Q16-Maas would become eligible as a carbon store under the ETS. This would deliver a saving of EUAs for the project. In close collaboration with the ministry it was found that an amendment to the Mining Act was feasible to facilitate the possibility to hold a production license and storage license at the same time. ROAD has backed the ministry with its experience and assisted in drafting the needed amendment. At the time a revision of the Mining Act was (already) pending. In July of 2016 the proposed changes where accepted by Parliament and the amended Mining Act entered into force, on 1 January 2017.

Process on negotations with ONE

Parallel to the revision of the Mining Act, ROAD and ONE worked in close collaboration in order to achieve an MOU for the collaboration on the CO_2 injection in Q16-Maas. A detailed commercial agreement to be developed with ONE, based on the principles agreed in the MOU was agreed in December of 2016. This is described in more detail in the storage report, which includes a section on the commercial arrangements.

Preparations for the application of a storage permit for Q16-Maas were on their way but ceased before the project ended in 2017.

4.10 Stakeholder Management

The authorities were involved already in an early stage in the developing process, asking them about the requirements for a CCS project, since this was the first of its kind. The interaction included discusions on the implementation and application of legislation, often not specifically intended for a CCS project.

This section contains only a brief summary of the stakeholder management. This topic is address more fully in the dedicated Stakeholder management Close-out report.

Key stakeholders

The following stakeholders have been identified, interacted and informed:

- Parent companies. Both Uniper and Engie take part in de ROAD organization and are part of the decision taking, leading up to a FID for both companies.
- Consortium (PoR - operator, ONE, TAQA). For the ROAD 2011-2012 project there was cooperation with the Port of Rotterdam and Taqa, operating the P18-4 field. For ROAD 2016-2017 cooperation was with the Port of Rotterdam for transport and ONE for storage in Q16-Maas. Both organisations have been part of the design team, determining the technical elements, which impact permits, environmental impacts and spatial planning. Specific attention has been given to the Q16-Maas reservoir and the update of the modelling. This has been done by ONE with support from TNO. There have been a number of meetings with all parties and numerous separate meetings and calls. For preparing the documents and research ROAD has used technical support (RHDHV, Tebodin, Genesis, TNO).

- EC – Dutch competition authority. The EC has been sponsor of the demonstration project, involved in the contract procedure and receiving regular progress reports. In addition the storage permit for ROAD P18-4 has been reviewed by the EC. There have been visits to Brussel, a visit by the EC to the ROAD sites (March 8, 2011) and other communication have been through reporting. The Dutch authority has been likewise informed.
- EZ, I&M, EBN, SodM. The involvement of the national authorities for ROAD Q16-Maas has been limited, as the discussisions on the permitting procedures had not started before the end of the project. In ROAD 2011-2012 the authorities have supported on procedural and technical level, resulting in nearly completing the required permits even before submission of applications. The same approach was envisaged for ROAD 2016-2017, however the authorities have postponed starting the procedure and discussions with ROAD for about nine months until the moment ROAD announced to terminate the project.
- Province of South Holland, DCMR, City of Rotterdam, PoR (as authority), other municipalities (bestuur en gemeenteraad), NEA. There has been discussion with DCMR on adjustment of the existing permit for the MPP3 plant, including the capture unit. There are permanent permits available, but both for the MPP3 power plant and for the capture unit adjustments are required. With DCMR it has been discussed to have the update for the capture unit in an early stage. With the PoR discussions have been held on the Tennet-connection, specifically offshore (Net op zee - Hollandse Kust (zuid)). This group of stakeholders have been involved intensively in the ROAD P18-4 period, making sure they have a good view of the project and there are no misunderstandings about the required procedures. For the ROAD Q16-Maas they were expected to getinvolved after the central government would have started the procedure.
- NEA (Dutch Emission Authority). The NEA has reviewed the ROAD P18-4 documents on issues related to the emission-permits for the capture, transport and storage parts.
- ProRail, Waterboard, Euromaxx terminal Rotterdam, Tennet-neighbours. In the ROAD P18-4 project the neighbours have been informed and the possible consequences for their operations have been discussed. In the permit applications there interest have been taken into account, resulting in no complaints during the permit procedure.
- Committee on EIA. The committee has been involved in the ROAD P18-4 project, giving advice and guidance on the setup of the EIA and the results. For the ROAD Q16-Maas the central government did not yet involve the committee.

Stakeholder Engagement

As previous CCS projects have shown there might be considerable interest from the general public for these kind of projects, and local inhabitants might feel uncomfortable. It is therefore important to address these concerns and generate public acceptance. Without public acceptance the local politicians and even on a national level the support might be withdrawn.

In an early stage the ROAD project defined the key stakeholder groups and their perceptions of CCS and related issues. The project could tap into stakeholder insights which the parent companies acquired during the construction of the new coal-fired power plants in the same port and industrial area of Rotterdam. One of the key insights was that local communities have worries about effects of industrial activities that impact the liveability of their direct environment (e.g. noise, air pollution, dust, traffic), beside external safety issues.

ROAD used these insights to map the force field of stakeholders. A force field map is instrumental in plotting the relative positions of stakeholders on relevant issues concerning the project. ROAD identified an extensive list of stakeholders and makes a periodic analysis of the force field in order to keep updated to new initiatives or developments. It focuses on the following categories of stakeholders:

- Local communities and civic groups.
- Regional NGO's (e.g. environmental).
- Local and regional governments and authorities.

- Regional business platforms (port and industrial area).
- National government and parliament.
- Local and national media.
- National NGO's.
- Knowledge institutes.

In addition to the force field map, ROAD also uses the CCS Issue Map (Argumentenkaart) presenting an overview of the pros and cons on CCS used the public debate in the Netherlands. The CCS Issue Map is produced by CATO-2 (the Dutch national R&D programme for CCS) and can be found on their website of (www.co2-cato.org).

In its stakeholder management strategy ROAD primarily focused on local and regional stakeholders (this was particularly important following the projects in Barendrecht and the Northern provinces). The alignment of local and regional stakeholders was seen as a primary condition for the implementation of the ROAD-project. Furthermore, being an active partner of the envisaged Rotterdam CCS network would create a strong local value proposition for the ROAD project: contributing to the sustainable economic development of the Rotterdam port and industrial area.

The stakeholder management strategy was focused on building regular and close relationships with relevant (local) stakeholders. This would gradually create a dialogue with local communities. In the long term the outreach strategy was aimed at building a structural platform via a so-called Community Advisory Panel (CAP) and building and securing mutual understanding and trust. The development of a CAP should also offer an on-going platform for an open, constructive dialogue between ROAD and its (local) stakeholders and to monitor developments in public perceptions.

ROAD developed various basic communication materials to support its outreach strategy such as: project brochure with background information, website, exhibition materials and animations of how the CCS chain (capture, transport and storage) works. For public events like town hall meetings the technical specialists also used core samples in order to show what stones from the gas reservoirs look and feel like.

During the permitting procedure for ROAD P18-4 two evenings were organized by ROAD and the authorities to inform the local communities. Both events were broadly announced, but less then 20 persons actually showed up At the time is was believed that this was caused by the fact that CO_2 storage would take place offshore. Earlier concern in Barendrecht had focused on the possibilities of CO_2 escaping from the subsurface in a living area and forming a cloud.

Special interest groups and the representatives of the local community / counsels, the local politicians and the NGO. Separate discussion have been held with them. There were little concerns on the capture, transport and storage of CO_2. Discussion focused on the coal fired power plant and the idea that CCS made this plant possible.

Imperative for effective stakeholder management of CCS projects is to fully integrate the stakeholder management and communication function in the project organisation. The demonstration of large-scale CCS faces many technological challenges, but at this stage its success is for a large part dependent on many issues that are non-technical and depend on stakeholder perceptions and interests.

Support and involvement of local, regional and national governments throughout all project phases was a prerequisite for creating the right circumstances for the successful implementation of a CCS project. The stakeholder engagement and communication strategy of ROAD was aimed at gradually involving local communities in the project. In the initial phase (e.g. design and permitting phase) of the project communication activities have been generally aimed at informing stakeholders about the project (i.a. brochure, website).

From negative publicity concerning onshore storage in The Netherlands, ROAD learned right at the start of the project that public outreach and pro-active stakeholder management is critical for a successful CCS project. At

the same time however, ROAD was working in uncertain conditions - most of the CCS related legislation was not in place yet and related permits had never been awarded before. Moreover, in the demonstration-phase, CCS projects need public funding and in order to reach the goal of commercialising CCS, so knowledge sharing is essential.

5. Lessons Learnt and Recommendations

5.1 Lessons Learnt and Recommendations

These paragraphs summarize the most important lessons learned and give recommendations by the ROAD Project regarding permitting and regulatory for future CCS projects.

5.1.1 Permitting

Planning and Time Schedule

- Establish a common target to meet time schedule with the regulatory authorities. Keep the project under time pressure to keep the authorities focused and meet regularly to be able to address issues as they evolve. Build up mutual commitment and accessibility of the authorities to enable tackling issues in between meetings over the phone or by e-mail.
- Early involvement of the competent authorities is important and preparatory work before application for storage permits is highly recommended. Timely collaboration with the government has helped ROAD to reduce the timeline between the application and issuing of the permits.
- Show that the project does everything within its power to reach the deadlines. It is hence important to take the initiative in all meetings, while keeping everybody involved, but also support authorities with technical help to fulfill their obligations. Finally, accept that the authorities take the safe route as accuracy is more important than speed.
- A prerequisite for success of the project is that the national government backs the project, in particular to help industry develop (demonstration) projects establishing a basis infrastructure for CCS.

Technical Understanding Limited

- Some technical information is missing early in the project. Although the capture plant FEED study was completed at an early stage, not all technical (detailed) information (on emissions) was available. Because this is the first time a large scale CCS project is designed, there are few standards available (pilots give some information but are not always trustworthy for scaleup). This means that it is difficult to fill in permit applications early in the procedure. It would be more pragmatic to get permits and being allowed to adjust later on, within established limits.

Understanding Legal Issues

- Close cooperation with authorities and regulators in an early stage of the project is essential due to the complexity of CCS regulation. There is only limited experience with CCS legislation so each permit needs to be tailor made.
- For a CCS project, it is important that the authorities and regulators are proactive and take on their responsibilities regarding CO_2 storage. Issues should be addressed in a coordinated way, in order to avoid a significant delay of the legislative and regulatory process.
- Without an open and flexible regulatory approach it is very unlikely that CCS demonstration projects will be developed. Project developers need certainty and clarity on what the government expects from them.

Making Interpretations, Getting Confirmation of Interpretation on Procedures

- Often a specific legal and regulatory framework on capture, transport and storage technologies is missing or in development: this demands pro-activity, flexibility and close interaction with regulators and authorities. Managing expectations of stakeholders and developing a clear project vision are a prerequisite in that regard.

CO_2 Storage

- Generally speaking, the provisions of the CCS Directive leave room for interpretation by Member States (MS), which on the one hand provides flexibility, but also leaves uncertainties for future CCS projects. The Guidance documents are only helpful to a limited extent. They are not legally binding, and are not written with a demonstration in mind. Uncertainties can negatively impact the case for storage operators and provide too little certainty for operators upfront. To make investment decisions, long term certainty is needed. This in particular relates to the strong position of member state governments that can impose high barriers for projects by e.g. setting high requirements on financial securities and transfer of responsibility.
- The directive contains four main elements (monitoring plans, financial security, transfer of responsibilities, financial mechanism) for CO2-storage. These impose vast responsibilities and liabilities on operators. The liabilities are large, uncertain and unlikely to be accepted by commercial parties. In order to bridge this issue, governments should consider facilitating CCS projects by for example facilitate parts of the CO2 storage and take over responsibilities/liabilities from operators.
- Regarding the large responsibilities and liabilities resulting from the provisions of the directive, regulators should ask themselves on how to deal with the following questions and how one can provide sufficient certainty for operators to invest in CCS:
    - How and when will the reservoir with CO2 be handed over by an operator to the authorities? And how can certainty be provided well before the actual handover will take place?
    - What are the conditions for the handover and how does the operator demonstrate all CO2 is safely stored as expected?
    - How can the liabilities for operators be reduced? What can the role for the State be in this regard (socialization)?
    - How can liabilities for the long-term be fixed at moment of granting the permit / before first injection of CO2 (to avoid the project being exposed to changing government policies and legislation)?
- All plans for risk management for CO2-storage (Monitoring, Corrective measures, abandonment, etc.) have to be submitted at the time of the storage permit application. However, at the time of the storage permit application, not all details of the plans will be known yet. It was therefore agreed with the competent authorities to update the plans at least 6 months prior to injection.
- Drafting the monitoring plans at the time of the permit application is difficult, as not all elements can be overseen at the time of the application. The (draft) plans submitted by ROAD in the storage permit application would provide information and prove that CO2 can be stored safely, complying with the CCS Directive requirements. These do not include operational parameters, choices for specific monitoring instruments, all of which will be elaborated in the final plans. Doing so, ROAD managed to agree with the EC and Dutch competent authorities that these final plans would be submitted to the competent authority and the EC at least six month before the injection of CO2 starts. This flexibility is essential as details will lack at the time CCS projects apply for permits, whilst a storage permit is required to achieve a positive FID.
- Although it is not mandatory to submit a Risk Management Plan, ROAD drafted an integral risk management plan consisting of a risk analysis and risk management (throughout the monitoring plans). It provided a good overview of the risk analysis and control of the storage activity.

- As financial security requirements are not described in detail in the directive, this leaves room for Member State governments to set the requirements on operators. This results in potential uncertainty for developers as Member States can require (unnecessary) high financial security, posing a heavy burden on the finance of projects. Every project and regulator should ask itself the following questions:
    - What are the exact activities that must be covered by the financial security?
    - What is the amount of money that should guarantee these activities and?
    - What kind of financial instrument is accepted by the competent authority?
- ROAD found that the financial security could be adjusted yearly as (potential) costs for monitoring, corrective measures, well abandonment decrease over time.
- ROAD found that the financial security could be adjusted yearly as (potential) costs for monitoring, corrective measures, well abandonment decrease over time.
- The risk in EUA's price that needs to be covered in financial security, results in pressure on the financials of projects. In mutual agreement with the competent authorities one should agree on the max. amount of financial security needed in case of leakage (handover of a sufficient amount of EUAs).
- In ROADs opinion, clarity on the (conditions for) transfer of the responsibilities to the competent authority is one of the crucial issues that remains in the directive and still has not been solved (also not in the Netherlands). The main concern of the ROAD project has been in which way and under which conditions the minimum period of 20 years before hand-over can be reduced. More clarity upfront is desired.
- The current regulatory framework does not take away the risk that over time the requirements set by the authorities on the requirements for transfer of responsibility may change. After all, government policy and regulation can change over time. If one approves a plan for transfer of repsonbilitilies today, there is still a risk that this will have changed over 20 years. As long as there is no certainty on the requirements for transfer (e.g. in the storage permit) upfront, this poses uncertainties for operators (as stricter requirements might be imposed over time). Questions which should be addressed are:
    - What kind of monitoring is actually needed before handover?
    - What kind of assurances can prove that CO2 is contained permanently at the time of handover?
    - What is a reasonable period for a transfer of responsibilities?
    - How to determine the funds (financial mechanism) for handing over?

Regarding the responsibilities and liabilities resulting from the EU CCS Directive, it is essential that there is more certainty and long-term outlook for operators regarding the requirements governments will ask for the hand-over of responsibilities. In order for operators to be able to accept responsibilities liabilities, these should 1) be mitigated as much as possible and 2) clarified in legislation.

5.1.2 Funding

Effective and Sufficiently Flexible Funding Schemes

- Time conditions and restraints of the existing funding-schemes available to CCS are limiting the development of projects. In general, funding schemes are giving a necessary pressure to progress, but also causing administrative work when there is a good reason why deadlines need to be shifted.
- CCS projects are yet not commercially viable. A high EUA price itself is unlikely result in the develompent of projects as liaiblities on operators are very large (considering the very high investment and uncertainties for projects). Sufficient CAPEX and OPEX subisidies should therefore be in place to fund CCS projects in order to support a further roll-out.
- There is in particular a lack of OPEX-support for CCS projects. It is advised to have more flexible (provisions in) schemes addressing the actual financing need of projects.

- Moreover, ROAD has the following recommendations for funding:
  - Allow different EU funds to be combined.
  - Ensure compatibility across funds.
  - Raise the cap for funding in individual schemes above 50%.
  - Have a more flexible scope for relevant costs in funding schemes.
  - Ensure that there is adequate support for transport & storage activity.
  - Requirements regarding entry into operations of projects should be flexible. Too restrictive timelines can hamper projects.
  - More flexibility for the operators and timelines in general is desired.

5.1.3 Interaction with the authorities

Communication with Authorities

- An open process between the applicant and relevant authorities, in which the first findings are shared and discussed, is important to maintain momentum in the (permitting) process.
- A prerequisite for the success of the project is that the authorities feel involved in the project.
- The Dutch Ministry has been a big help in coordinating the permitting stakeholders and showing them that the project has national relevance. Wherever a National Coordination Scheme ('Rijkscoordinatieregeling') for permitting is present, make use of it for this kind of projects involving multiple permitting stakeholders. Nevertheless, as initiator it is important to stay involved in coordinating the permitting authorities. Local authorities are sensitive to be overruled.
- Permitting authorities not only want to be informed on procedures, but also on contents, as early as possible. Convene early with the permitting authorities to discuss matters as a) how many commentary rounds should be included in the permitting process; b) what points are relevant for them; c) who will be contact person and d) how information exchange will take place. This builds up mutual commitment and trust.
- Make sure your contact persons at the permitting authorities are committed and accountable. Some of the delay in this project was caused by contact persons who did not have enough time or knowledge to assess the permitting documents. Make sure the project has the support at their manager's level so you could lobby for more dedicated contact persons if necessary. Demand that the coordinating permitting authorities use their power and responsibility to address lagging permitting authorities so the process is not held up by them.

5.1.4 Stakeholder Management

- Often a specific legal and regulatory framework on capture, transport and storage technologies is missing or in development: this demands pro-activity, flexibility and close interaction with regulators and authorities. Managing expectations of stakeholders and developing a clear project vision are a prerequisite in that regard.
- CCS projects can be driven by technology and easily become caught up in technological tunnel vision. One of the biggest threats is losing track of stakeholders' views and interests. Instead CCS projects should develop an outside in perspective, taking into account stakeholder expectations. By developing a stakeholder dialogue they create two-way communication with stakeholders that are relevant to the implementation of the project.
- As a consequence of diverse technologies in the CCS chain spread over different areas, multiple governments and authorities are involved in the projects. This demands an integrated Stakeholder

Management approach comprising functions such as regulatory affairs, permitting and public outreach. Ultimately Stakeholder Management is instrumental in creating necessary conditions for other project functions (e.g. capture, transport & storage).

5.1.5 Consortium

- CCS requires cooperation of different companies and organisations. The roles of the parties during development, construction and operation need to be clear from the start. There are a number of boundaries between the CCS components that need to be defined. It has to be clear who is submitting the permit application. It needs to be clear who will be owner of the permits (current operator, future user or government?)