

ZEPP - Introducing CO₂ capture and storage in the Netherlands

Background Zero Emission Power Plant (ZEPP)

In Drachten, a town in the North of the Netherlands, a Zero Emission Power Plant (ZEPP) is planned that is able to produce emission-free electricity for hundred thousand households (68 MW_e) by capturing the CO₂ and storing it underground. The climate neutral power plant has a go/no-go decision point in 2007/2008 and should be operational in 2010. To realise the project several innovative technologies are combined.

The ZEPP will be equipped with an innovative gas generator in which gas is combusted with pure oxygen (oxyfuel). The generator produces electricity, water (steam) and CO₂. The CO₂ is stored in an unused natural gas field that still contains a considerable amount of natural gas. The injection of CO₂ increases field pressure which enables the extraction of the remaining gas (Enhanced Gas Recovery). The gas is then combusted in the power plant (see Figure 1). The residual heat of the plant will be supplied to nearby industries.

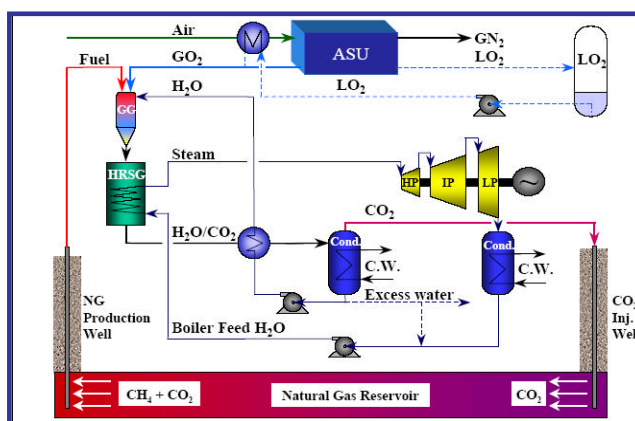


Figure 1: schematic overview of the technology of the ZEPP

Consequently the plant produces electricity without any substantial emission and result in a CO₂ reduction of one megaton in six years. In the Netherlands, several gas fields are suitable for ZEPP technology. After the plant in Drachten has become operational, possibly other locations will follow. This project will be the first project in the Netherlands with inland underground storage of CO₂.

The ZEPP in Drachten is initiated by the Dutch company SEQ Nederland B.V. Managing director of SEQ is Mr. Wouter van de Waal. Financial support is provided by energy companies, local and national governments and financial institutes. The project is also supported by Energy Valley, a public-private foundation with local, national and European members, which stimulates the economy of the North of the Netherlands through the financing of energy activities.

Applying ESTEEM

The Energy research Centre of the Netherlands (ECN) has applied and tested the ESTEEM tool in the ZEPP project. ECN executed the six steps of the tool together with the project manager, Wouter van de Waal during 2007.

Step 1: Project past & present

Based on two interviews with Mr Van de Waal, ECN wrote the narrative of the project. A story-like text on the past and current situation of the ZEPP starting with the first ideas of Van de Waal to store CO₂ under ground in 1999 until the concrete plans of the ZEPP as they are in 2007. Based

on the narrative, the table with defining moments of the project was compiled: a chronological overview of moments in the past that have influenced the project in a major way, for example the introduction of project partners, the concession to use the gas field, financial support decisions, etc. ECN also analysed the context of the project in the barriers and opportunities tables in which potential opportunities and barriers of the project are shortly described. Together with Van de Waal ECN finally compiled an overview of all the stakeholders and their past, current and possible future role in the actors table. This table was visualised in a social network map (Figure 2)

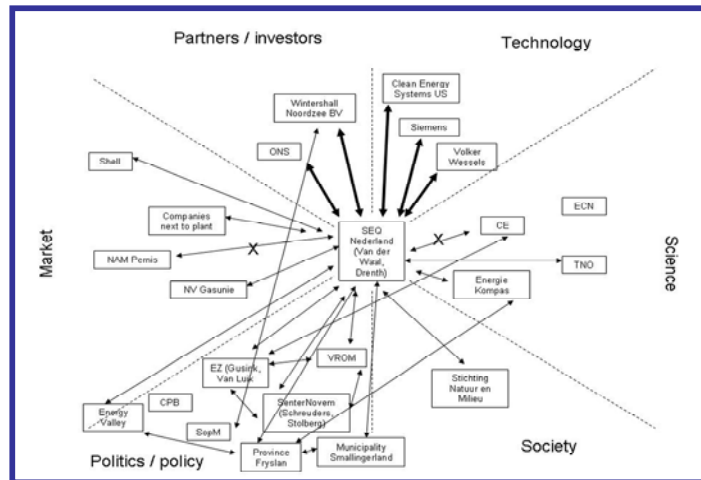


Figure 2: present situation: stakeholder map ZEPP

Step 2: Vision building

In the second step of the ESTEEM process ECN investigated the future visions for the project in 2020 of project manager Van de Waal and seven stakeholders. These stakeholders were selected using the criteria in the ESTEEM manual and included stakeholders such as local and national government (municipality, province, ministry of Economic Affairs and Ministry of Environmental affairs), technology developers (Siemens), NGOs (Friesche Milieufederatie) and an interest group for local industries. Based on face-to-face interviews ECN wrote the visions in the format of a future newspaper article (20th September 2020) with a title summarising the vision. Also a network map was designed for each vision, visualising the relations between stakeholders in the future. For each network map ECN took the future vision of Mr Van de Waal as a starting point and differences with this vision were indicated with colours (see Figure 3).

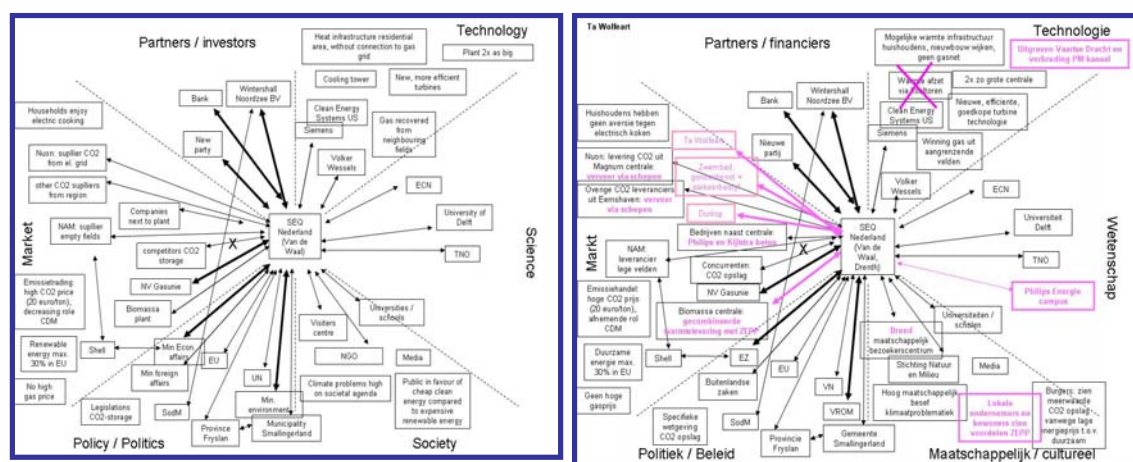


Figure 3: social network map of the future vision project manager versus one of a stakeholder

Step 3: Vision confrontation

In the third step ECN analysed and compared the visions drafted in the previous step and derived potential controversies and opportunities from the comparison. In total thirteen controversies between the visions were identified (for example whether or not to have a cooling tower, role of local versus national government, etc) as well as seven opportunities (for example joined heat supply with a local biomass plant and making use of locally available services and industries) which had not been mentioned by the project manager before. These controversies and opportunities were rated by their urgency, importance and solvability and visualised in a diagram (Figure 4).

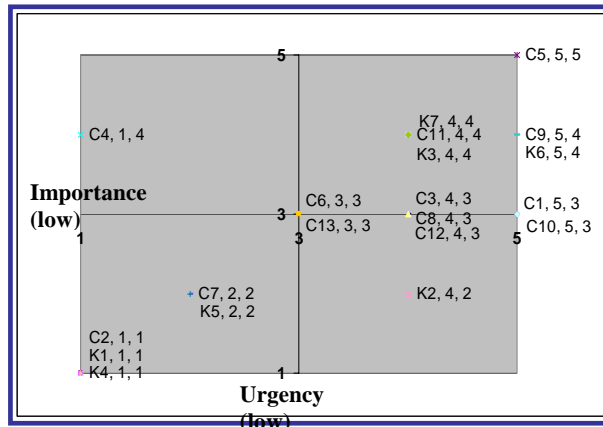


Figure 4: Visualisation of urgency and importance of controversies (C1-C13) and opportunities (K1 – K7)

Step 4: Identifying solutions

For each controversy and opportunity identified in the previous step Mr Van de Waal and ECN discussed one or more strategies to overcome the controversies and make use of the opportunities. These strategies were divided into four categories: adjustments of the installation design or (change of) location, gaining extra knowledge through articulating new research questions, financial incentives and others. In total Mr Van de Waal and ECN identified 29 new strategies for the project.

Step 5: Stakeholder workshop

ECN grouped the controversies and opportunities identified in step 3 of the ESTEEM process in five themes which were discussed at a stakeholder workshop. ECN organised this workshop in November 2007. The location was provided by one of the neighbouring companies at the industrial area where the ZEPP is planned. The goal of this workshop was twofold:

1. Identifying and debating strategies, that are desirable from a societal point of view, in interaction with SEQ and relevant stakeholders.
2. Testing the fifth step of ESTEEM to gain experience and refine it.

Eighteen ZEPP stakeholders participated in the workshop. Some were already involved in the project (for example Siemens and the municipality), others were not yet involved or only from the sideline and did know much about the project yet (for example people living close to the gas field and local media). After a plenary session in which ECN presented ESTEEM and the project manager some facts about the ZEPP project, the participants were divided into three groups. Within these groups they discussed five themes concerning the ZEPP (Figure 5):



Figure 5: Stakeholders discussing the ZEPP in workshop

- Local benefits of the plant - for example constructing a visitors centre next to the plant that is also exploited as a local cultural centre.
- Local negative impact of the ZEPP - for example the visual impact of the plant.
- Technological and legal aspects - for example gaps in current legislation regarding CO₂ storage.
- Economic aspects - for example the economic impulse and employment possibilities in Drachten.
- The relation with sustainable energy - for example including renewable energy sources like green gas in SEQ's company strategy.

During the group work the participants were asked to formulate strategies to deal with the five issues. In total the participants defined more than 100 strategies during the workshop. The workshop ended with an excursion to the future location of the ZEPP. Here the participants could sense the direct environment of the future plant and imagine the size and design of the plant next to the existing industries.

Step 6: Planning for action

In the last step of ESTEEM, ECN has categorized all strategies formulated in the stakeholder workshop into activities and actions to be taken on the short time and do not require extensive cooperation activities, activities that do require extensive collaboration with third parties and actions focusing on the long time and/or monitoring. These actions are further elaborated into sub-actions and concrete recommendations for the project manager by ECN in three different plans for action:

- A short term action plan, including for example adaptations to plant design proposed by stakeholders or specific information supply to local residents.
- Collaboration plan, including for example collaboration with the city council for improving the green image of Drachten by advertising the ZEPP and also advertising residual heat to potential users.
- Long term action plan, including for example strategies for taking part in national and international debate on the relation between Carbon Capture & Storage technologies and renewable energy.



Figure 6: location of the planned ZEPP

In these plans the project manager was provided with details about what steps the project manager needs to take from a societal perspective with the aim of increasing societal acceptance of the ZEPP in Drachten.

Benefits gained from ESTEEM

The ESTEEM tool has been very helpful for the ZEPP project manager Wouter van de Waal. ESTEEM enabled him to broaden his views on the project and it made him realize the importance of communication aspects of such a project. He has been able to make new contacts during the stakeholder workshop such as local citizens and local media. The ESTEEM process has resulted in a large number of recommendations and will be used to improve the ZEPP project's communication strategy.