Ministry of Economic Affairs and Climate Policy

Pre-publication Chapter 4

Natural resources and geothermal energy in the Netherlands

Annual review 2022

4.
Subsurface storage

4.1 Introduction

Subsurface storage is an exceptionally space-effective method for storing very large quantities of substances. Various forms of storage are possible in the Dutch subsurface. For example, storage in porous layers (such as the space between sand grains in depleted gas fields or in aquifers, or in constructed cavities, such as caverns in rock salt or mining galleries in former coal seams).

These storage systems can be used as a temporary stock or buffer (such as for natural gas, nitrogen gas and potentially hydrogen and energy), but they can also be used for the permanent storage of substances (such as CO_2 and saline water).

According to the Mining Act, the storage of substances in the subsurface (at depths of more than 100 m) requires a storage licence and the licence holder must have an approved storage plan. The storage plans provide information about the geological setting and the process of storage. In certain cases, the injection of substances does not legally fall under the storage of substances as referred to in the Mining Act: for example, the injection of nitrogen to prevent subsidence (De Wijk gas field) is part of the production plan and re-injection of formation/process water as undesirable co-produced substances falls under environmental legislation.

In order to obtain a licence for the permanent storage of CO_2, a storage plan consisting of a risk management, corrective measures, monitoring and closure plan must be submitted with the licence application. The plans should be finalised shortly before the start of injection. For this reason, these storage licences are awarded, but do not take effect until all related plans have been approved.

In addition to the existing storage sites, the Dutch subsurface provides the potential for the storage of various new forms of sustainable energy carriers. Future energy scenarios foresee an increasing demand for large-scale subsurface storage to buffer energy in order to match supply and demand. The most concrete developments are in: hydrogen storage, compressed air storage (CAES) and high temperature heat storage (HT-ATES). Studies on the storage of hydrogen in salt caverns in the Zuidwending storage licence area are ongoing.

4.2 Overview licences

In 2022 no new storage licences were applied for on land. At sea, two exploration licences for CO_2 storage and one CO_2 storage licence have been applied for. Whilst one CO_2 storage licence has been amended one CO_2 storage licence has been granted.
As of 1 January 2023 nine storage licences were in force. The CO_2 storage licences P18-2 and P18-4 have been granted but are not yet in force.
An overview of all storage licences can be found in Table 4.1 and Annexes I and Q. Figure 4.1 shows their locations on the map.

Table 4.1 Storage licences, onshore and offshore the Netherlands.

Licence	Awarded	Operator	Product	Status
Alkmaar	01-04-2003	TAQA	Gas	Effective
Bergermeer	08-01-2007	TAQA	Gas	Effective
Grijpskerk	01-04-2003	NAM	Gas	Effective
Norg	01-04-2003	NAM	Gas	Effective
Zuidwending	11-04-2006	EnergyStock	Gas	Effective
Twenthe-Rijn de Marssteden	02-10-2010	Nobian Salt B.V.	Oil	Effective
Winschoten II	15-11-2010	Gasunie (GTS)	Nitrogen	Effective
Winschoten III	15-11-2010	Nobian Salt B.V.	Nitrogen	Effective
Andijk	12-12-2019	PWN	Saline water	Effective
P18-4	20-07-2013	TAQA	Carbon dioxide	Awarded
P18-2	13-07-2022	TAQA	Carbon dioxide	Awarded

Figure 4.1 Storage licences as of 1 January 2023.

Temporary storage

Gas storage

The seasonal variation in natural gas demand (winter/summer) has long been balanced with the Groningen field. An important reason for this was that in doing so the small fields could be produced without being disturbed (as part of the small fields policy). As production from the Groningen field progressed, the pressure and thus the flexibility in the production rate of the Groningen field declined accordingly. In order to maintain sufficient flexibility to meet fluctuations in gas demand to guarantee the security of gas supply, four underground gas storage facilities have been put into operation since 1997.

Gas storage facilities at Norg (low-calorific gas/Groningen gas) and Grijpskerk (high-calorific gas until 2022, after that low-calorific gas) have served as a buffer to cope with seasonal fluctuations in gas demand. When demand increases, particularly in winter, extra natural gas is supplied from Norg and Grijpskerk. The storage facilities in Alkmaar and in Zuidwending are primarily used to accommodate peak demands of one or more days. Together with the Bergermeer storage facility, which is primarily aimed at gas trading and operates on the gas market on its own initiative, five natural gas storage facilities (Underground Gas Storage - UGS) are currently operational in the Netherlands. Except for the Zuidwending facilities, where storage takes place in salt caverns, all storages are (former) gas fields.

Figure 4.2 and Figure 4.3 respectively show the volume of natural gas stored and withdrawn from the five natural gas storage facilities from 2003 to and including 2022. From 2015 onwards, the capacity used by the storage facility in Norg has risen sharply, by increasing the maximum operational pressure. The working volume in the storage plan was increased that way from 3 to 7 billion Nm^3 (adjusted to 6 billion Nm^3 in 2019) coinciding with the reduction in production from the Groningen field. Also, the Bergermeer storage facility discharged more gas from 2016 onwards after years of predominantly filling.
The transition of the Grijpskerk storage facility from high calorific gas to a low calorific gas buffer in 2021 coincided with the start of the events in Ukraine and resulted in a low level of filling combined with a relatively high extraction of natural gas as can be seen in figures 1.2 and 1.3. The events in Ukraine and volatile gas prices had the effect in 2022 that a lot of gas was stored in Norg, Alkmaar and Bergermeer in particular, because filling rates needed to be up to par, but eventually less was discharged, due to the warm winter.

Increased gas demand on for instance very cold winter days, can to a certain extent also be solved via international pipelines and LNG terminals. On the Maasvlakte, there is a terminal where liquefied natural gas (LNG) is stored in tanks at surface (with a total capacity of approximately 310 million Nm^3 gas this is considerably smaller than underground storage). In Delfzijl there is a temporary floating LNG terminal.

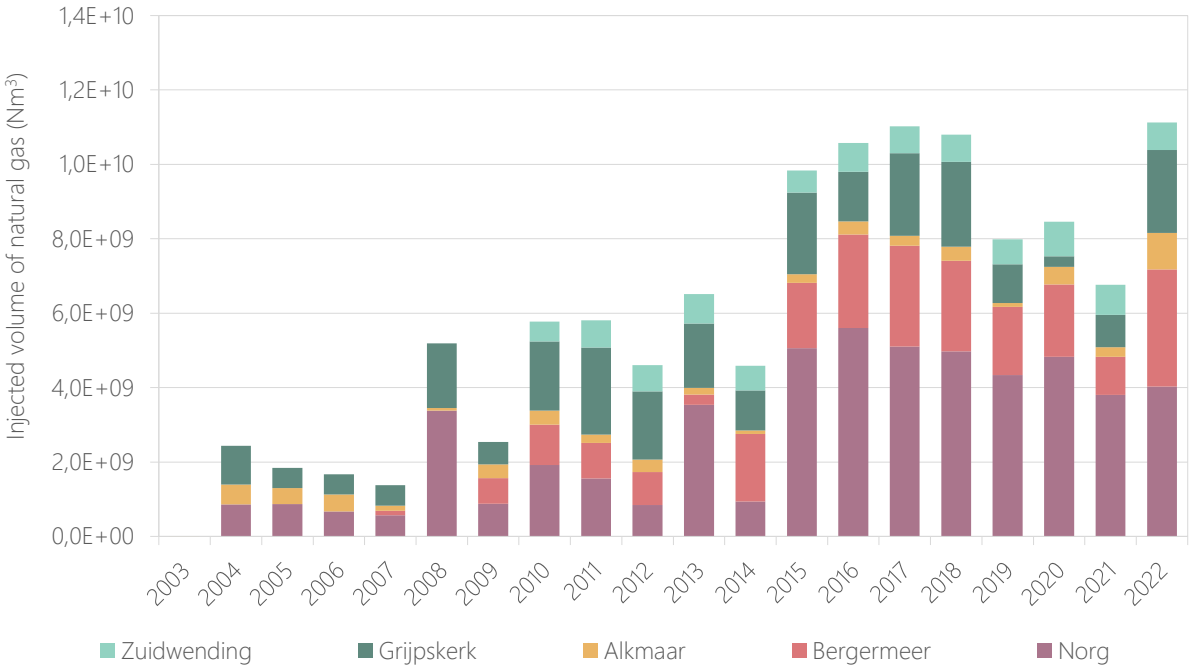

Figure 4.2 Injected volume of natural gas per UGS from 2003 to 2022.

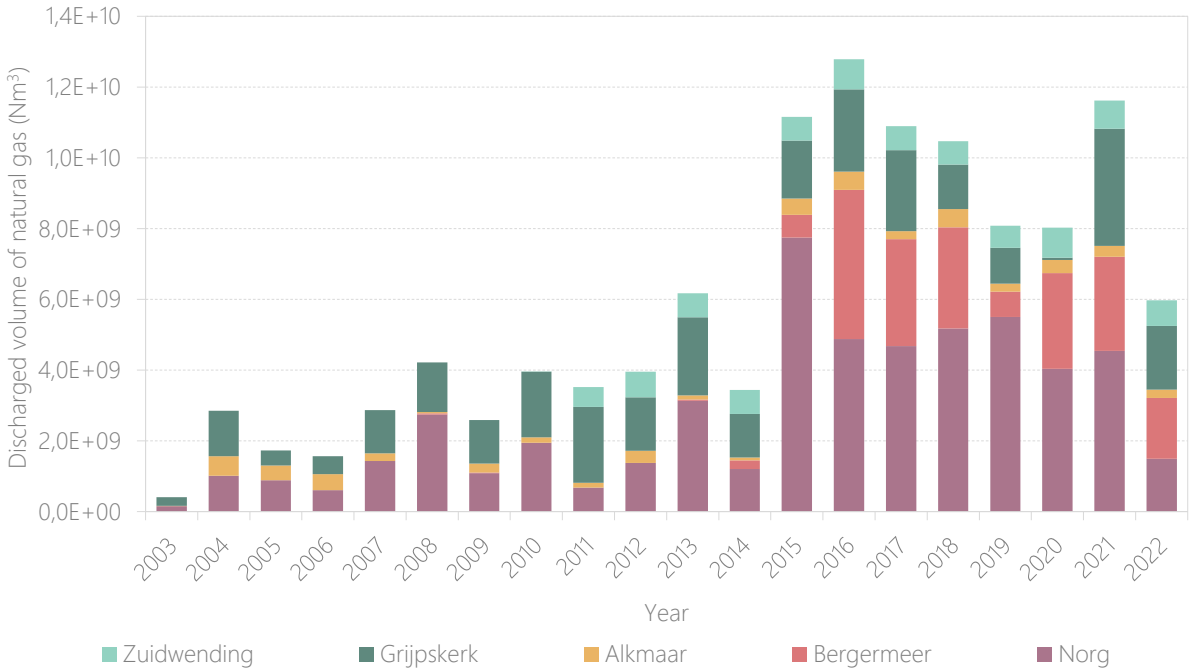

Figure 4.3 Discharged volume of natural gas per UGS from 2003 to 2022.

Storage of nitrogen and oil

In the Netherlands, the subsurface is used for the temporary storage of other substances as well. This concerns, for example, salt caverns that are used for the storage of nitrogen and oil. In Twente (Twenthe-Rijn de Marssteden storage licence) a strategic oil supply is stored in one of the salt caverns, while in Winschoten (Heiligerlee) a salt cavern is used to store nitrogen for the conversion of high-calorific gas into low-calorific quality gas to replace the decreased Groningen gas production.

Permanent storage

CO_2 storage

There are advanced plans to use depleted offshore natural gas fields to provide significant capacity for the permanent storage of CO_2 in the coming years. A storage licence for this purpose was granted back in 2013 for the depleted P18-4 gas field, part of the Porthos project, located just off the coast of South Holland, but it is not yet in force. On 13 July 2022, the licence was amended for an integral approach with the storage at P18-2. The plan is to store up to 8 Mton of CO_2 in the depleted gas field P18-4 and 32 Mton in the adjacent gas field P18-2 from 2024 to 2041 at the latest. Another licence application has been submitted in 2022 to store CO_2 in the K14-FA gas field, as a part of the Aramis project.
Two exploration licences have been applied for the storage of CO_2, one in the P&O blocks and one in the K blocks. In both applications, exploration will focus on storing CO_2 in deep saline aquifers.

To encourage the development of CCUS projects, these projects are also eligible for the "Stimulation of sustainable energy production and climate transition" (SDE++). This programme provides subsidies to companies and non-profit organisations that generate renewable energy or reduce CO_2 emissions on a large scale. A total budget of 13 billion euros was available in 2022, most of which was applied for by CCUS projects.

Storage of saline water

The Andijk storage licence is intended for the permanent storage of the filter residue formed during the purification of saline groundwater to produce drinking water. This concentrated salt water is injected into a groundwater package at a depth of 100 to 500 metres. Because this aquifer is deeper than 100 meters, this activity requires a storage licence under the Mining Act.

4.3 Subsurface storage in 2022

The monthly quantities of natural gas and nitrogen that were stored and discharged in the subsurface in 2022, are listed per licence in Table 4.2 to Table 4.5. The information has been provided by the licence holders.

Table 4.2 Stored natural gas (in million Nm^3).

Licence	Operator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Alkmaar	TAQA	0	0	0	0	0	57	77	117	732	0	0	0	982
Bergermeer	TAQA	33	5	128	208	498	486	569	579	68	458	101	16	3,149
Grijpskerk	NAM	0	1	0	341	428	396	379	352	332	0	0	0	2,228
Norg	NAM	0	0	0	410	748	804	735	339	620	369	0	0	4,026
Zuidwending	EnergyStock	38	35	33	98	74	92	54	57	43	98	48	72	742
	Total	71	41	161	1,057	1,747	1,835	1,815	1,444	1,794	925	149	89	11,127

Table 4.3 Discharged natural gas (in million Nm^3).

Licence	Operator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Alkmaar	TAQA	101	87	34	0	0	0	0	0	0	0	11	0	232
Bergermeer	TAQA	373	222	115	43	0	0	0	0	0	0	284	683	1,718
Grijpskerk	NAM	186	152	15	0	0	0	0	0	0	955	183	314	1,804
Norg	NAM	562	276	66	112	0	0	0	0	0	0	4	473	1,493
Zuidwending	EnergyStock	135	43	83	22	50	41	61	47	50	38	71	86	728
	Total	1,357	779	312	177	50	41	61	47	50	993	552	1,556	5,975

Table 4.4 Stored nitrogen (in million Nm^3).

Licence	Operator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Winschoten II	Gasunie	9.1	5.6	6.5	4.5	4.1	3.5	7.4	5.3	1.6	3.5	1.0	4.3	56.5

Table 4.5 Discharged nitrogen (in million Nm^3).

Licence	Operator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Winschoten II	Gasunie	1.6	6.6	5.6	8.9	9.5	3.1	0.0	1.3	4.6	0.7	2.3	5.6	49.6

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For more information:
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