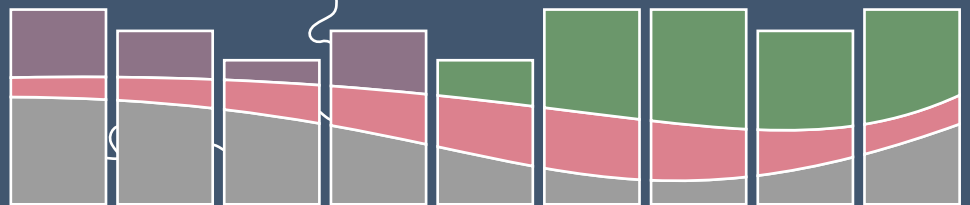


Pre-publication Chapter 5



Natural resources and geothermal energy in the Netherlands

5. Geothermal Energy

5.1 Preface geothermal energy

In 2020 18 new applications for exploration licences for geothermal energy were filed. As at 1st of January 2021 a total of 31 geothermal energy exploration licences were in the process of application. In 2020 10 geothermal exploration licences were awarded and one application for an exploration licence was rejected. One exploration licence was split and one was spatially restricted. Two exploration licences were merged into one exploration licence. Further, for 11 geothermal exploration licences the licence period was extended and 5 licences were expired, withdrawn or relinquished. Three exploration licences have lapsed due to the granting of a production licence for geothermal energy. As at 1 January 2021 60 geothermal energy exploration licences were in force (see Figure 5.1).

In 2020 3 new applications for a production licence for geothermal energy were submitted. One of the four pre-2020 applications was withdrawn in 2020 and three production licences were awarded, resulting in a total of 3 standing applications. On the first of January 2021 25 geothermal production licences were in force (see Figure 5.1).

Changes in the licence position in 2020 of geothermal energy exploration and production licences are listed in the tables of Chapter 8. Figure 5.1 shows the evolution of the Dutch geothermal licence position. In the histogram of year 2020 the number of licence applications is presented as well.

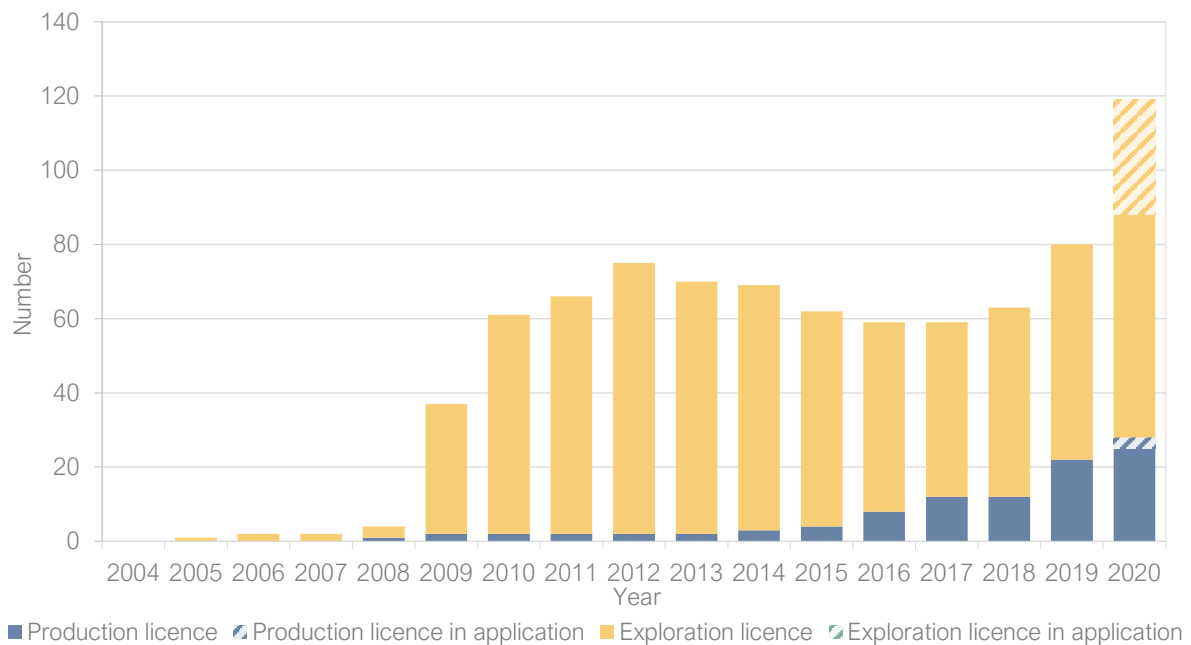


Figure 5.1 Number of licences for geothermal energy in force per year. For the year 2020 the number of applications is presented as well.

5.2 Geothermal wells and production installations as at 1 January 2021

In 2020 7 geothermal wells were completed (see Table 5.1 and Figure 5.2). These concern wells within the licences Oostvoorne, Naaldwijk II and Luttelgeest II. Realising these wells increased the number of geothermal production installations in the Netherlands by three.

As at 1 January 2021 there were a total of 28 geothermal production installations, of which the Mijwater Energiecentrale Heerlen installation is actually a heat/cold storage facility and as such will not be included in the following overview. The other 27 geothermal installations (will) produce heat from the deep subsurface. In general, these installations are named doublets as they consist of two wells. One well produces warm water from the aquifer and after extracting the heat, the second well injects the cooled water back down into the same aquifer. Twenty of these 27 geothermal production installations were operational with reference to the fact that they provide (energy) production figures according to art. 111 and 119 of the Mining Decree. All of the operational installations operate under a formal production licence (as at 1 January 2021). At the end of 2020 all not yet producing operators owned a formal production licence or had applied for one.

Table 5.1 Geothermal wells completed in 2020.

	Name of well	Geothermal energy licence	Operator
1	LTG-GT-04	Luttelgeest II	Aardwarmte Combinatie Luttelgeest B.V.
2	LTG-GT-05	Luttelgeest II	Aardwarmte Combinatie Luttelgeest B.V.
3	LTG-GT-06	Luttelgeest II	Aardwarmte Combinatie Luttelgeest B.V.
4	TNT-GT-01	Oostvoorne	Hydreco Geomec B.V.
5	TNT-GT-02	Oostvoorne	Hydreco Geomec B.V.
6	NLW-GT-03	Naaldwijk II	Trias Westland B.V.
7	NLW-GT-04	Naaldwijk II	Trias Westland B.V.

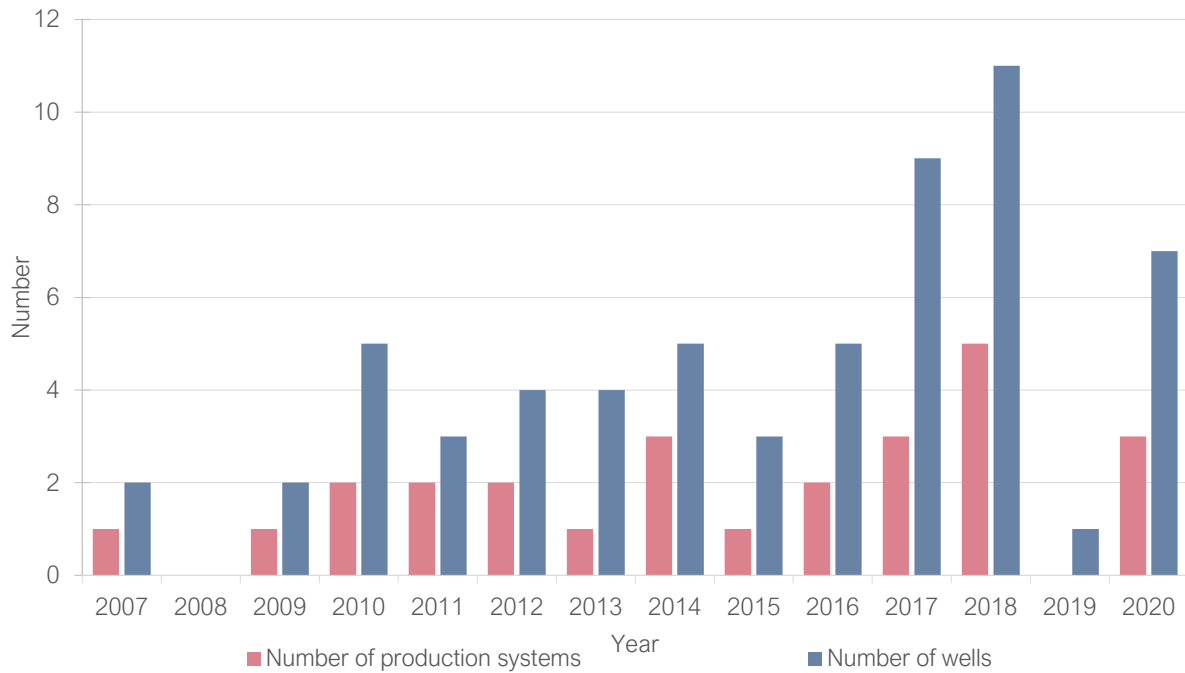
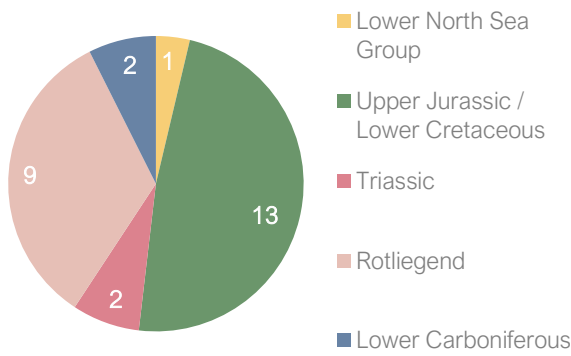


Figure 5.2 Number of geothermal wells completed (side-tracks excluded) per calendar year and number of installations completed since 2007.

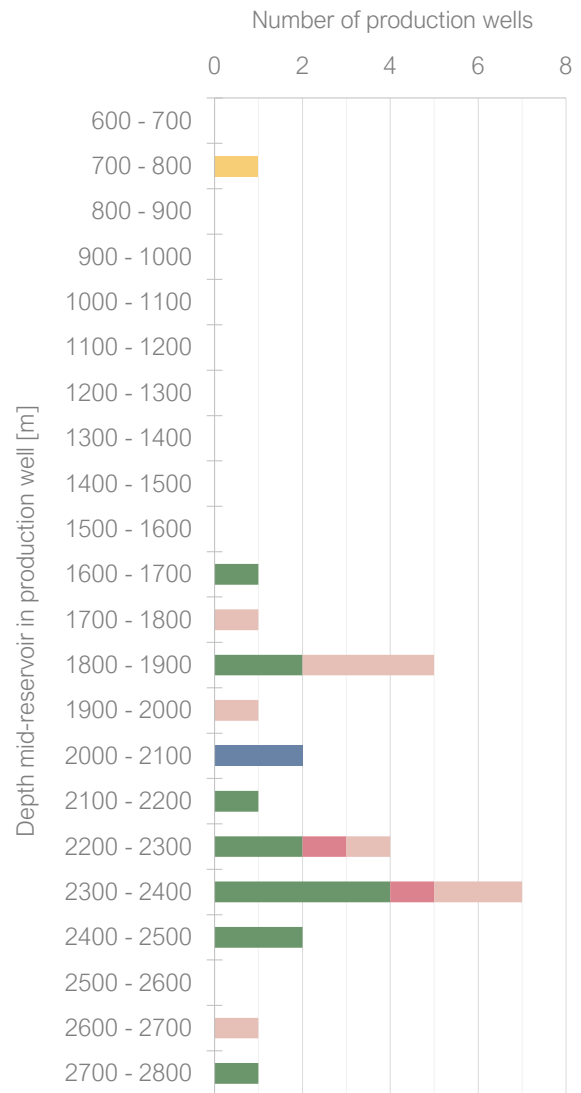
The heat is produced from depth intervals between 700 and 2800 meter and from various geological units (Figure 5.3a and b). The depth of the mid of the producing zone is displayed in Figure 5.3 b. Most of the geothermal energy is produced from rocks from the Upper-Jurassic and Lower-Cretaceous strata in the southwest of the Netherlands. Two installations in the southwest of the Netherlands produce from strata of Triassic age. The eight production installations in Noord-Holland, Overijssel and Flevoland produce from Rotliegend strata, whereas two installations in North-Limburg produced heat from Lower Carboniferous to Devonian strata. One geothermal energy production installation in Noord-Brabant produces water from an aquifer pertaining to the Lower North Sea Group.

The heat produced is predominantly used to heat commercial greenhouses. One project also supplies heat to a public utility facility and several buildings. Another project will supply heat to a district heating network in an urban area (Figure 5.3 c).

a) Stratigraphy of the productive interval



b) Depth to mid of aquifer



c) Uses of the heat produced

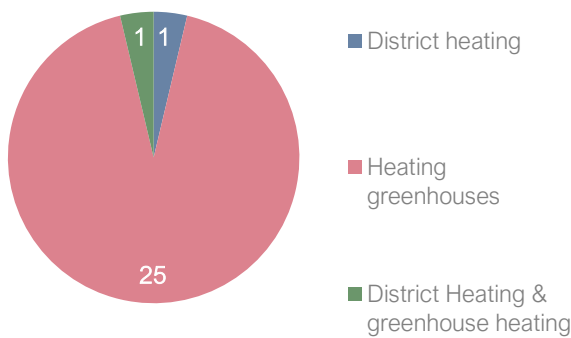


Figure 5.3. a) Stratigraphy of the productive interval, b) Depth to mid of aquifer, c) Uses of the heat produced.

5.3 Production of geothermal energy in 2020

Of the 27 geothermal installations (Mijnwater Energiecentrale Heerlen excluded) 20 were operational in 2020 (Table 5.2). This is one less than in 2019 because one system is temporarily closed in the course of 2019 and did not re-start in 2020. The operational installations have submitted the obligatory monthly production figures. Of the 7 remaining non-operational installations 2 were temporarily closed in and 3 were in the start-up phase. The other 2 non-operational geothermal energy production installations were shut down in 2018 as a consequence of agreements and safety policy in force. Further research into induced seismicity has to show whether future production of these two geothermal installations can continue or can be utilised for other purposes within the set safety standards.

Table 5.2 Geothermal installations.

	Name geothermal energy installation	Wells	Geothermal energy licence	Operational in 2020
1	Californië Geothermie	CAL-GT-1,2&3	Californië IV	No, shut down in May-18
2	De Lier Geothermie	LIR-GT-1&2	De Lier	Yes
3	Honselersdijk Geothermie	HON-GT-1&2	Honselersdijk	Yes
4	Installation Berkel en Rodenrijs	VDB-GT-3&4	Bleiswijk-1b	No
5	Installation Bleiswijk	VDB-GT-1&2	Bleiswijk	Yes
6	Koekoekspolder Geothermie	KKP-GT-1&2	Kampen	Yes
7	Mijnwater Energiecentrale Heerlen	HLH-G-1&2	Heerlen	Yes, WKO
8	Pijnacker-Nootdorp Geothermie	PNA-GT-5&6	Pijnacker-Nootdorp-4	yes
9	Pijnacker-Nootdorp Zuid Geothermie	PNA-GT-3&4	Pijnacker-Nootdorp-5	Yes
10	-	HAG-GT-1&2	Den Haag	No
11	Heemskerk Geothermie	HEK-GT-1&2	Heemskerk	Yes
12	MDM-GT-02 /MDM-GT-05	MDM-GT-2&5	Middenmeer I	Yes
13	MDM-GT-04 / MDM-GT-03	MDM-GT-3&4	Middenmeer II	Yes
14	Vierpolders Geothermie	BRI-GT-1&2	Vierpolders	Yes
15	Californië Lipzig Gielen	CAL-GT-4&5	Californië-V	No, shut down in aug-18
16	Poeldijk Geothermie	PLD-GT-1&2	Poeldijk	Yes
17	Kwintsheul Geothermie	KHL-GT-1&2	Kwintsheul II	Yes
18	Lansingerland Geothermie	LSL-GT-1&2	Lansingerland	Yes
19	MDM-GT-06 / MDM-GT-01	MDM-GT-6&1	Middenmeer I	Yes
20	Maasland Geothermie	MLD-GT-1&2	Maasland	Yes
21	Naaldwijk Geothermie	NLW-GT-1&2	Naaldwijk	Yes
22	Zevenbergen Geothermie	ZVB-GT-1&2	Zevenbergen	Yes
23	Andijk-GT-01/02	ADK-GT-1&2	Andijk	Yes
24	Andijk-GT-03/04	ADK-GT-3&4	Andijk	Yes
25	Luttelgeest Geothermie 1	LTG-GT-1,2&3	Luttelgeest	Yes
26	-	LTG-GT-4,5&6	Luttelgeest II	No
27	-	TNT-GT-1&2	Oostvoorne	No
28	-	NLW-GT-3&4	Naaldwijk II	No

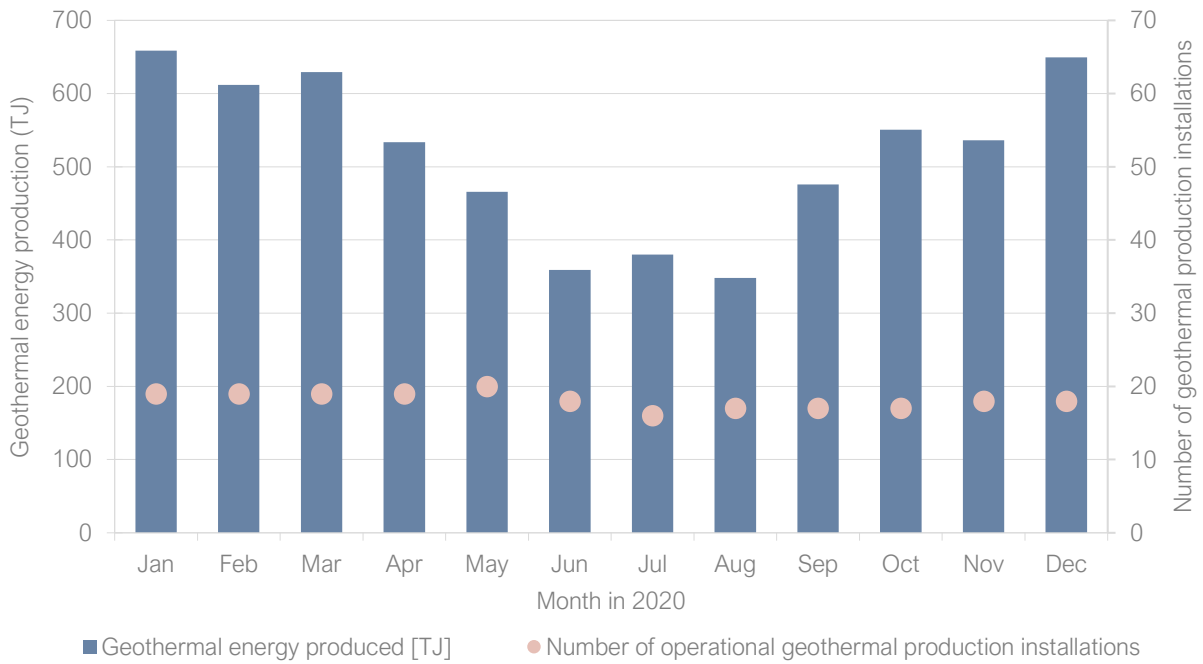


Figure 5.4 Monthly production of geothermal energy in terajoules and the number of geothermal energy production installations contributing to the reported production (Mijnwater Energiecentrale Heerlen excluded).

Figure 5.4 shows the aggregated production figures of geothermal energy per month in TJ ($\times 10^{12}$ Joule) and the number of installations contributing to the monthly total. Not all installations were operational throughout the year. The cumulative reported annual production is 6.20 PJ (1 PJ = 10^{15} J) in 2020 (Figure 5.5).

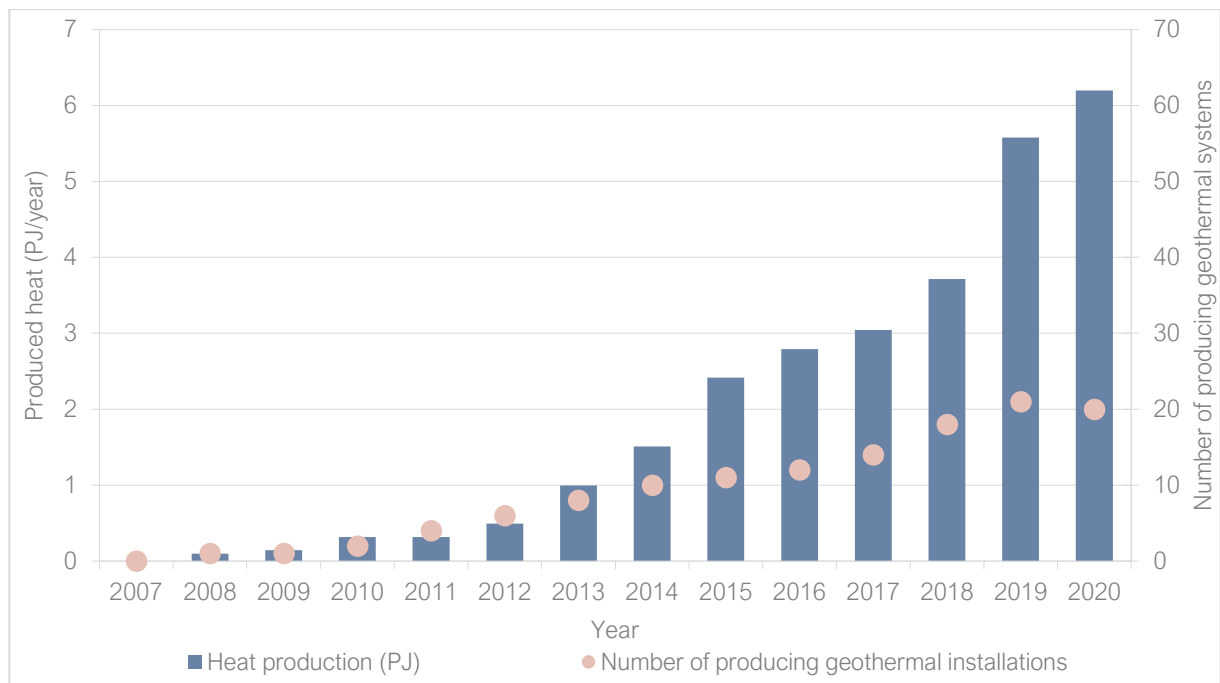


Figure 5.5 Annual production of geothermal energy (PJ/year) and number of operating geothermal systems.

Small amounts of natural gas are co-produced with the geothermal energy (Figure 5.6). Under subsurface reservoir conditions (elevated pressure and temperature) the gas is dissolved in the formation water and released when the pressure of the production water in the production installation falls below the 'bubble point'. Table 5.3 gives an overview of the produced geothermal energy, co-produced gas and co-produced oil per year since 2008. Only in one installation oil was co-produced until March 2017.

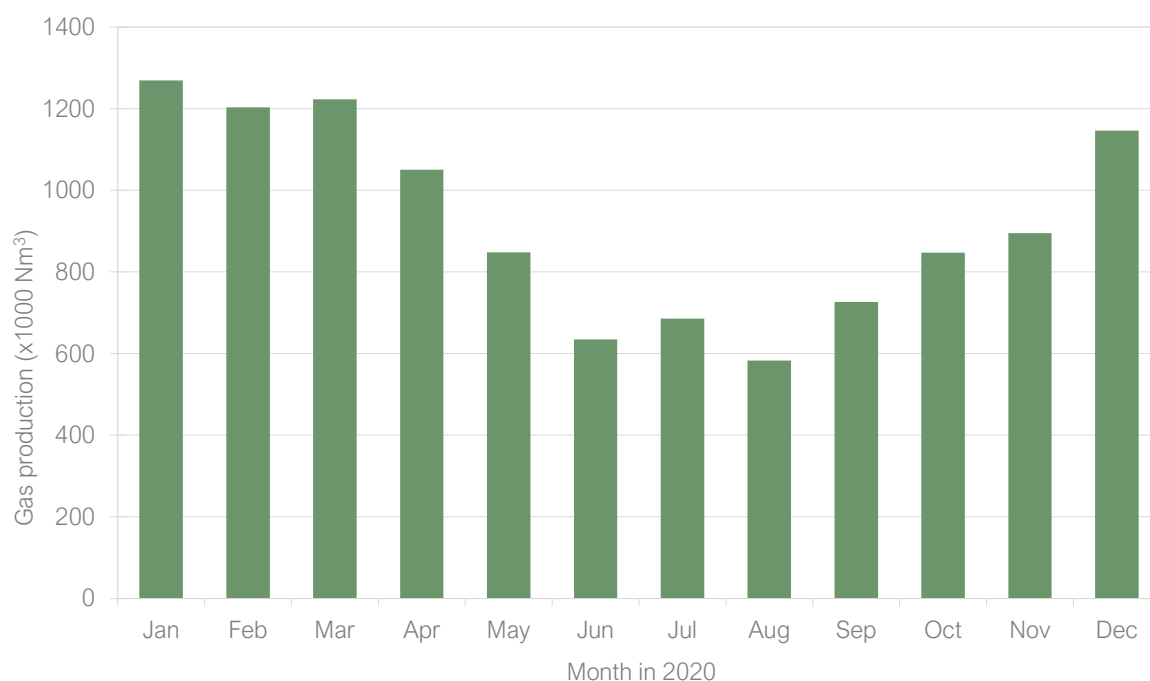


Figure 5.6 Volumes of hydrocarbons co-produced with geothermal energy. Gas in 1000 Nm³.

Table 5.3 Overview of produced geothermal energy, co-produced gas and co-produced oil.

Year	Produced geothermal energy (TJ)	Co-produced gas (x1000 Nm ³)	Co-produced oil (Sm ³)
2008	* 96	-	-
2009	* 142	-	-
2010	* 318	-	-
2011	* 316	-	-
2012	* 495	-	-
2013	* 993	-	-
2014	1,509	3,267	429
2015	2,417	4,378	186
2016	** 2,792	7,670	130
2017	3,042	8,100	31
2018	3,714	10,676	0
2019	5,578	12,772	0
2020	6,199	11,115	0

* Figure derived from: *Hernieuwbare energie in Nederland 2013*. Statistics Netherlands, The Hague/Heerlen, 2014. ISBN: 978-90-357-1857-9.

- No value reported

** Adjustment of reported figure in Natural resources and geothermal energy in the Netherlands, Annual review 2016.



Ministry of Economic Affairs and Climate Policy
Directorate-General Climate and Energy
2021

