Security of Supply Monitoring Report 2010-2026

TenneT TSO B.V.

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Contents

1. Introduction

Every year, TenneT monitors the long-term security of supply as part of its statutory task of ‘market facilitation’. The monitoring activities and the required data collection are carried out pursuant to Section 16, subsection 2 f, of the Electricity Act, which assigns to TenneT the task of monitoring the security of delivery and supply.

The purpose of this Monitoring Report is to provide insight into the expected development of the domestic supply of electricity in relation to domestic demand over a 7-year period going forward. EU Directive 2005/89/EC prescribes an extension of the surveyed period to 15 years. In section 3.7 of this report, therefore, we look ahead to the possible situation in 2026.

This report examines the extent to which domestic capacity is sufficient to cover domestic demand. Security of supply is not confined to the national borders, however. Therefore, as in previous years, we have examined the extent to which the foreign supply and the required international transmission capacity are available for electricity supplies to the Netherlands.
This Monitoring Report shows that the capacity surplus of the Dutch electricity system will increase from 2010 onward, despite the amount of production capacity that producers have reported as scheduled for decommissioning. Consequently, we have also analysed whether the international transmission capacity will be sufficient to export this potential capacity.
In the final analysis, the market determines the extent to which this potential will actually be used for electricity exports through deployment of the available international transmission capacity, or the extent to which producers decide to decommission obsolete installed capacity.

In late May 2011, the German government decided to phase out nuclear energy in Germany. This means that all 17 German nuclear power plants, with a total capacity of over 20 GW, will be closed at some point during the period until 2022. Eight nuclear plants with a total capacity of 8 GW have already been taken out of operation. The electricity production of these nuclear power plants will be compensated by the production of other plants in Germany and by imports from neighbouring countries. As a result of the growing capacity surplus, the production of Dutch power plants may also be used for this purpose. The fact that the German nuclear power plants are being decommissioned may result in price increases in the coupled European electricity markets.
The German TSOs are currently investigating whether additional measures in the high-voltage grid are needed to continue assuring the security of supply in Germany.

The number of requests to connect new production capacity to the grid did not show a further increase in the past year. Plans to construct new large-scale power plants and small-scale production capacity are under development and currently entering the final decision-making stage. Almost all plans announced in the 2007-2009 period are still relevant, with just a few projects having been cancelled. Several projects to build new capacity were deferred until a future completion date or even cancelled.
For the time being, most of this new production capacity will have to be transmitted via the existing grid. In some locations, however, the grid does not have sufficient capacity to transmit the (new) supply of

electricity at all times. We are therefore working to expand the grid's capacity, based on the principle that every user should be provided with sufficient transmission capacity where possible. In addition, TenneT has developed a national congestion management system to deal with transmission capacity shortages on the grid. Under this system, the deployment of capacity is restricted when the actual congestion occurs. It should be noted that a congestion management system does not affect the security of supply.
In the previous Monitoring Report, the effects of the economic crisis were clearly visible in the declining level of electricity consumption. Demand for electricity has shown a slight recovery over the past year. This Report addresses the link between Gross Domestic Product (GDP) and demand for electricity.
It appears that the unfavourable economic outlook and the recent crisis have had little effect so far on the amount of planned new production capacity. Although there are many plans to construct new large-scale production capacity, at the same time we cannot be certain if and when all these plans will actually be realised. Consequently, it is difficult to produce long-term forecasts with a high degree of certainty. We have therefore performed several additional 'sensitivity calculations' in order to determine the effects that the respective supply and demand developments could have on the security of supply.

If most of the reported plans for new capacity are realised, the analyses show that the available export capacity will not be sufficient under all circumstances to transmit the full export potential from reference year 2013 onward. However, it is unlikely that such extreme situations will occur very frequently. In view of these uncertain circumstances, TenneT is conducting further analyses to determine the desirability of a further increase in interconnection capacity. We have also carried out studies into the large-scale integration of wind power which clearly reveal that sufficient export opportunities are essential. Given these developments, TenneT is currently investigating a possible electricity connection between the Netherlands and Denmark (COBRA Cable) and other ways of expanding the interconnection capacity.

In this Monitoring Report, we have applied the so-called LOLE (Loss Of Load Expectation) method as a standard for assessing the adequacy of the electricity production system. A key reason for using LOLE-based assessments is that this methodology is in line with the models and analysis methods used in other countries.

TenneT collaborates closely with the Transmission System Operators (TSOs) of Germany, France, Belgium and Luxembourg in the Pentalateral Energy Forum. The first result of this collaboration was the development of a joint assessment framework, which was completed towards the end of 2008. The parties involved will use this framework as a basis for conducting joint analyses of the security of supply in the region. The new assessment framework uses integrated, probabilistic, chronological simulation models of the electricity systems of the five countries involved (the Netherlands, Germany, France, Belgium and Luxembourg). This represents a significant improvement compared to the previous deterministic analysis method, which considered the supply-and-demand situation separately in each country at a few times during the year. Simultaneous events occurring throughout the region will be a key consideration in these analyses. This includes, for instance, periods of extreme cold in Europe (high electricity demand throughout the continent), periods of extreme heat (cooling water restrictions combined with high electricity demand due to widespread use of air conditioning), and storm fronts resulting in the simultaneous switch-off of wind turbines.

The joint analyses will be continued over the coming years and extended to cover a larger region. In this context, TenneT is collaborating in the ENTSO-E North Sea Regional Group with TSOs from the aforementioned countries (Germany, France, Belgium and Luxembourg) as well as Denmark, Ireland, Norway and the United Kingdom. Analyses for the North Sea Region are currently mainly focused on the integration of offshore wind energy. Among other things, the participating TSOs use the results from these regional analyses as a basis for ENTSO-E's Ten-Year Network Development Plan (TYNDP).

Chapter 2 of this Monitoring Report presents conclusions and recommendations based on the results of the monitoring exercise. The results of the security-of-supply analyses are described in Chapter 3, while Chapter 4 provides explanatory notes on the data used.

2. Conclusions and recommendations

2.1 Conclusions

The results of this Monitoring Report indicate that in principle there will be a sufficient supply of electricity during the surveyed period (i.e. up to and including 2018) to meet domestic demand in the Netherlands.

The general picture presented in this report is largely in line with the results of last year's Monitoring Report: the security of supply will continue to improve in the surveyed period. In addition, the Netherlands' structural dependence on imported electricity for its security of supply appears to have come to an end as of 2009. This conclusion is reconfirmed in this year's Monitoring Report, as all the examined variants show an export potential beginning in 2009, which then increases further during the remainder of the surveyed period. The projected growth of the capacity surplus is largely caused by the firm plans for new large-scale production capacity. The capacity surplus trend is also reinforced because demand for electricity is currently down due to the global economic crisis. Although the demand for electricity is currently developing at a lower level than was previously forecast by market parties, this has not yet had any significant effect on plans to develop new capacity. So far only a few plans for the construction of new capacity after 2014 have been cancelled compared to the previous Monitoring Report. In addition, a number of projects have been postponed for one year and the decommissioning dates of several old power plants have been rescheduled.

Demand side

As expected, the effects of the economic crisis have become apparent in the development of the domestic demand for electricity. After an initial sharp drop, demand is now gradually recovering. In this Monitoring Report, the development of the demand over the next few years is based on an assumed direct link between increased electricity consumption and the economic growth forecasts published by the Netherlands Bureau for Economic Policy Analysis (CPB). Two years ago the Monitoring Report stated that this assumption would result in a drop in demand of 4.75% in 2009 and 0.50% in 2010, based on the CPB figures. The actual decrease in electricity consumption amounted to 4.84% in 2009 and 0.30% in 2010. CPB is currently expecting the economy to grow by 1.75% in 2011. Economic growth is assumed to take place during the years after that, with a year-on-year growth of 1.5% and a corresponding rise in electricity consumption. The developments outlined above result in a total electricity demand of 115.8 TWh in 2011, a level almost equal to that of 2006.

Supply side

Approx. 1.4 GW of new thermal production capacity was completed in the course of 2010, which corresponds to the forecasts in the previous Monitoring Report. In 2011 there will be an increase in new large-scale thermal production capacity of 1.5 GW (start-up phase[1]). This increase will be included in the analysis as of 1 January 2012 after the actual start-up of the relevant installations. Subsequently approx. 7.0 GW of capacity will be realised in the period from 2012 until 2014 (realisation or construction phase[2]). Plans for the construction of approx. 5.7 GW of new capacity have been reported for start-up in the period from 2013 until 2018 (application phase[3]). TenneT is currently planning for a total of 14.3 GW of new large-scale thermal production capacity in the period from 2012 to 2018. Construction plans for new small-scale thermal capacity are limited to 0.3 GW.

On the other hand, producers with large-scale capacity intend to 'mothball' nearly 1.6 GW, and decommission approx. 0.7 GW[4] in the surveyed period until 2018.

Compared to the previous Monitoring Report, there is a slight downward trend in the construction of new large-scale production capacity.

The total installed wind energy capacity amounted to approx. 2.2 GW in 2010, which means that there has been hardly any growth. In the 2011-2020 period we have taken into account an increase of nearly 2.0 GW in onshore installed wind capacity and 1.8 GW in offshore installed capacity, bringing the total installed wind energy capacity in the Netherlands to 6 GW in 2020.

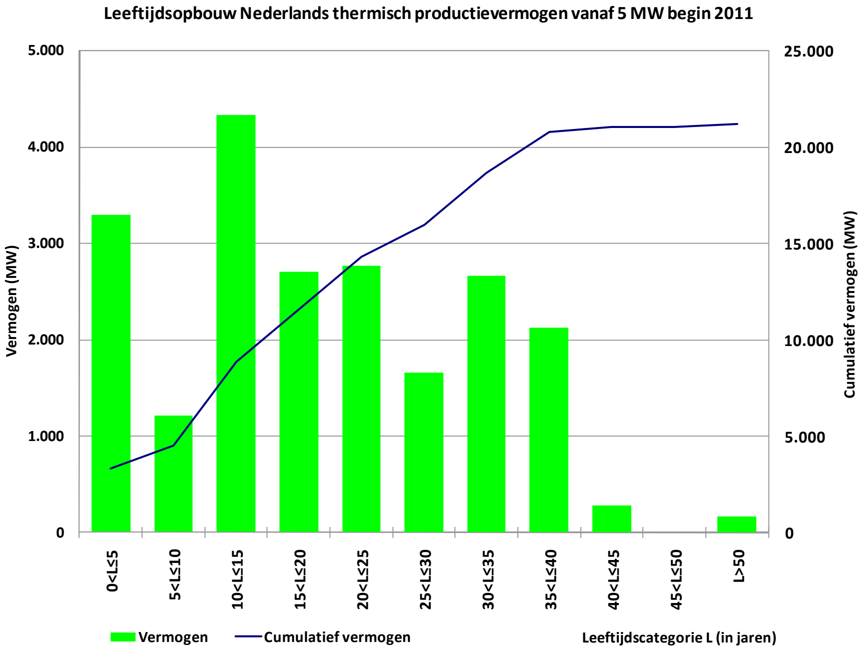

Figure 1: Age breakdown of production capacity in the Netherlands (reference date: 1 January 2011)

Figure 1 presents the age breakdown of all thermal production units with a capacity of more than 5 MW.

[1] Start-up phase: phase in which the installation becomes operational.
[2] Realisation or construction phase: phase in which the installation is built or a final investment decision is taken.
[3] Application phase: phase in which an application for a connection is submitted or the intention to do so is communicated.
[4] Decommissioning: demolition.

The weighted average age of the installed production capacity was approximately 20 years at year-end 2010.
The size of the thermal production park with a capacity of more than 5 MW and an age of at least 30 years at year-end 2010 is 5.2 GW. Of this total, 1.0 GW has been reported as scheduled for decommissioning, while 1.2 GW has been nominated for 'mothballing'.

It is attractive for international market parties to invest in the Netherlands, as the country offers a relatively favourable climate for the establishment of enterprises thanks to excellent supply routes for coal and other fuels, a high-quality gas and electricity grid, relatively efficient permit procedures, relatively large quantities of cooling water, substantial gas reserves, and a relatively large amount of interconnection capacity. This is a favourable situation for the security of supply in the Dutch electricity system.

There are uncertainties on both the supply and demand side when it comes to developments in the period until 2018. On the supply side, there is no certainty that all the reported projects will actually be realised. The amount of capacity to be taken out of operation is also uncertain, as there is no clarity regarding market parties' willingness and ability to report this information. For instance, producers may announce their intention to decommission obsolete capacity shortly before that decision is actually implemented.

On the demand side, there is some uncertainty about the extent to which the economic crisis will affect the demand for electricity, although the economy is beginning to recover and electricity consumption figures for the past few quarters show that the lowest point was reached in 2009. We have performed so-called 'sensitivity calculations' in order to determine the effects that anomalous supply developments may have on the security of supply. These analyses show that a very high degree of security of supply will be achieved in 2018, with the Netherlands enjoying a capacity surplus of nearly 7.0 GW. This applies even in the most 'extreme' sensitivity variant, which assumes that only the reported new construction projects in the start-up or realisation phase (approx. 8.5 GW) will actually be realised.

As stated above, the results of this Monitoring Report indicate that we need not expect any structural problems with regard to the security of supply. Nevertheless, extreme situations may occur which our assessment method does not cover. These include 'Phase 2' cooling water restrictions in the summer and gas supply problems during very cold winters. This Monitoring Report indicates that the electricity system will be less vulnerable to such situations in the future because most of the reported large-scale new production capacity will be developed at coastal locations and near open water, where there are few cooling water restrictions. In addition, most of the new capacity reported for the period until 2015 will be gas-fired (6.6 GW) while another part will be coal-fired (4.4 GW). This diversity of fuels has a favourable effect on the security of delivery.
In this context, it should be noted that this Monitoring Report does not factor in the quality and availability of sufficient primary fuels (coal and natural gas).

EU Directive 2005/89/EC stipulates that the period surveyed in national monitoring reports must be extended to 15 years. The expected supply-and-demand situation in 2026 is therefore discussed briefly in this Monitoring Report. The analysis shows that electricity supplies in 2026 should in principle be sufficient to meet the domestic demand for electricity, although it should be noted that this reference year is associated with a great deal of uncertainty regarding producers' plans to construct new production capacity and take obsolete capacity out of operation. For the period after 2018, for instance, producers report plans to construct 3.7 GW of new large-scale thermal capacity and mothball or decommission 4.8 GW of large-scale production capacity. The growth trend in the construction of new capacity appears to stabilise after 2018.

In addition, there is a high degree of uncertainty associated with any projections of the demand for electricity at the end of a surveyed period of this length. It is not possible to predict all the relevant developments accurately, although they may have a major impact on the level of electricity demand. Such developments may include a substantial increase in the use of electric cars or heat pumps. Consequently, the results of the security-of-supply analysis for the 2026 reference year are merely indicative.

In order to enhance the monitoring of the security of supply, TenneT is currently conducting joint cross-border analyses together with the TSOs of the North Sea region. The first result of this collaboration was the production of a joint assessment framework, which was completed toward the end of 2008. The parties involved will use this framework to conduct additional joint analyses in the coming years. The simultaneity of events throughout the region will be a key consideration in these analyses. The participating TSOs will use the results from these regional analyses as a basis for the ENTSO-E Ten-Year Network Development Plan (TYNDP).

2.2 Recommendations

The results of this Monitoring Report do not give us cause to advise the government to take any new measures in order to guarantee the future security of supply in the Netherlands.

3. Results of security-of-supply analysis

3.1 Introduction

This chapter presents the results of the security-of-supply analyses performed using the LOLE methodology. The results of the assessment method indicate the extent to which domestic supply can meet domestic demand.
The LOLE method is used widely in other countries to determine the adequacy of electricity systems. The method produces an expected value for the annual number of hours during which the available production capacity will not be able to meet the demand (‘Loss of Load Expectation’ or LOLE). The maximum LOLE value is used as a criterion for the adequacy of a particular electricity system, and refers to the acceptable risk that the demand cannot be met during a specific number of hours in the year. This value is easily translatable into the minimum required production capacity.

In the Netherlands, the criteria used to assess the reliability of limited-capacity electricity production systems are usually based on macro-economic considerations involving the impact on society in the event of an interruption in the supply of electricity. By comparing these costs with the costs of investments in additional production capacity, the desired level of reliability can be determined. In calculations relating to the Dutch electricity system, an acceptable LOLE value of four hours is used.

This chapter presents the model results of several calculation variants on an annual basis and in several formats. In each variant, the calculated LOLE value (in hours per year) is presented first. The existence of a shortage (LOLE value exceeds applicable standard) or surplus (LOLE value falls below applicable standard) can be deduced from this value. In addition, capacity values indicating the extent of the shortage or surplus are presented for each variant. If there is a shortage, these values tell us exactly how much capacity must be added to the system (or purchased from surrounding systems) in order to meet the reliability criterion. In the event of a surplus, the values tell us exactly how much capacity can be removed from the system (or sold to surrounding systems) until the criterion is no longer fulfilled.

As in the previous Monitoring Report, we examined two variants with regard to the assumed unavailability of production assets (basic variant and sensitivity variant A). The basic variant is presented in section 3.2. The unavailability figures assumed in section 3.2 are those indicated by the producers who supplied information for this Monitoring Report. Section 3.3 indicates the extent to which the outcomes are influenced by (i.e. sensitive to) alternative assumptions about the unavailability of production assets. As in the previous three Monitoring Reports, this edition again points to a considerable increase in the planned construction of new large-scale thermal production capacity, to a total of over 14 GW in the 2012-2018 period. We cannot be certain, however, that all these plans will actually be realised. A separate sensitivity calculation has therefore been performed in order to determine the consequences for the security of supply if some of these plans for the realisation of new capacity are cancelled (sensitivity variant B). In other words, variant B only includes new construction projects.The results of this analysis are presented in section 3.4.

Electricity consumption

From late 2008 onward, the global economic crisis has started to affect the demand for electricity. Figure 2 shows the monthly consumption levels as measured by TenneT based on rolling annual totals. It should be noted that the observed consumption is less than the total system load. The figure shows an increase in electricity consumption after 2009 that appears to level off somewhat in early 2011.

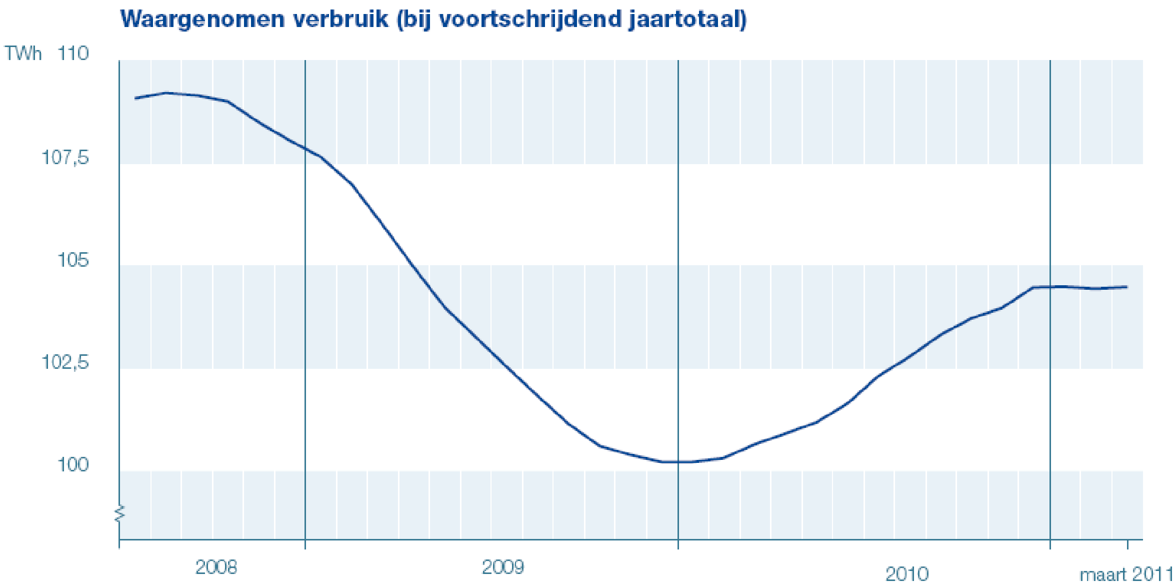

Figure 2: Monthly consumption levels as measured by TenneT based on rolling annual totals

This Monitoring Report assumes a direct link in the basic variant for 2011 and 2012 between the expected increase in electricity consumption and the economic growth forecasts published by the Netherlands Bureau for Economic Policy Analysis (CPB). This assumption results in an increase in electricity consumption of 1.75% in 2011 and 1.50% in 2012, based on the most recent figures for GDP growth in 2011 (1.75%) and 2012 (1.5%) as published in the Central Economic Plan (*CPB, March 2011*). Recovery is assumed to take place over the next few years, with a year-on-year rise in electricity consumption of 1.5%. In the previous Monitoring Reports, the annual increase in electricity consumption had traditionally been estimated at 2.0 percent in the medium term. This new 1.5% rate of increase is primarily the result of CPB's assumption of a relatively low GDP growth rate of 1.25% per year in the 2013-2015 period (*Updated Economic Outlook 2011-2015, November 2010*). The above assumption results in a total electricity demand of 115.8 TWh in 2011, a level almost equal to that of 2006. The previous Monitoring Report estimated that demand in 2011 would amount to 116.9 TWh, partly due to a projected recovery of 0.5% in 2010. However, consumption decreased by 0.3% in 2010 (initial CBS estimate); see Table 7 in Chapter 4.

The assumption that electricity consumption grows or decreases in step with the overall economy also holds true in a period of recession, as the data show. The 1.5% annual increase in electricity consumption from 2012 onwards does not give us cause to carry out a sensitivity analysis with a demand variant. No substantial developments in overall electricity demand are currently expected in the surveyed period, partly because of the expectation that potential savings through greater energy efficiency will be cancelled out by a possible increase in demand due to greater prosperity and further electrification. This phenomenon is assumed to exist for energy savings in general.

The direct link between these key figures can be explained on the basis of historical GDP growth data and the electricity consumption figures published by CBS. The graph below also shows the IMF's estimates regarding the growth of Dutch GDP. From 2006 onward, the annual actual growth in electricity consumption has been just below the forecasts and actual GDP growth figures published by the CPB. This was the other way around for several years prior to 2006. The direct link between future demand and the estimated growth of GDP is a defensible assumption, as shown in the graph below, and helps us to avoid underestimating the level of electricity demand for the benefit of the security-of-supply analysis.

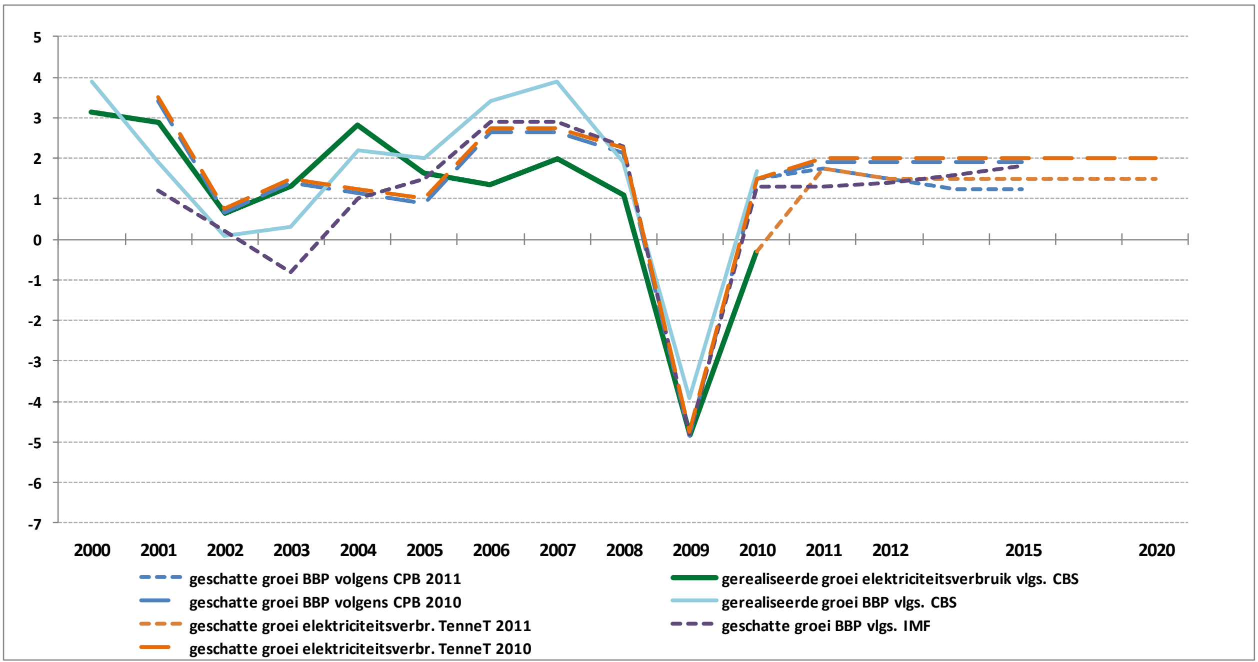

Figure 3: Relationship between Gross Domestic Product (GDP), growth of domestic net electricity consumption, and the most recent annual estimates (in %)

Section 3.5 compares the results of the investigated variants with the transmission capacity that is available for imports and exports. By way of supplement, section 3.6 presents an overview of the reserve factors that can be derived from the data used. Section 3.7, finally, concludes with a discussion of the possible situation in 2026 based on conservative assumptions and information provided by producers.

3.2 Main results of the 2010-2018 Monitoring Report (basic variant)

Figure 4 summarises the results of the basic variant employed in the 2010-2018 Monitoring Report. The line shown in this figure represents the calculated LOLE values. The black portion of the line represents the calculated actual values for the 2007-2009 period. In the first few years the line is below the LOLE standard of four hours per year, but the standard is complied with from 2009 onward.

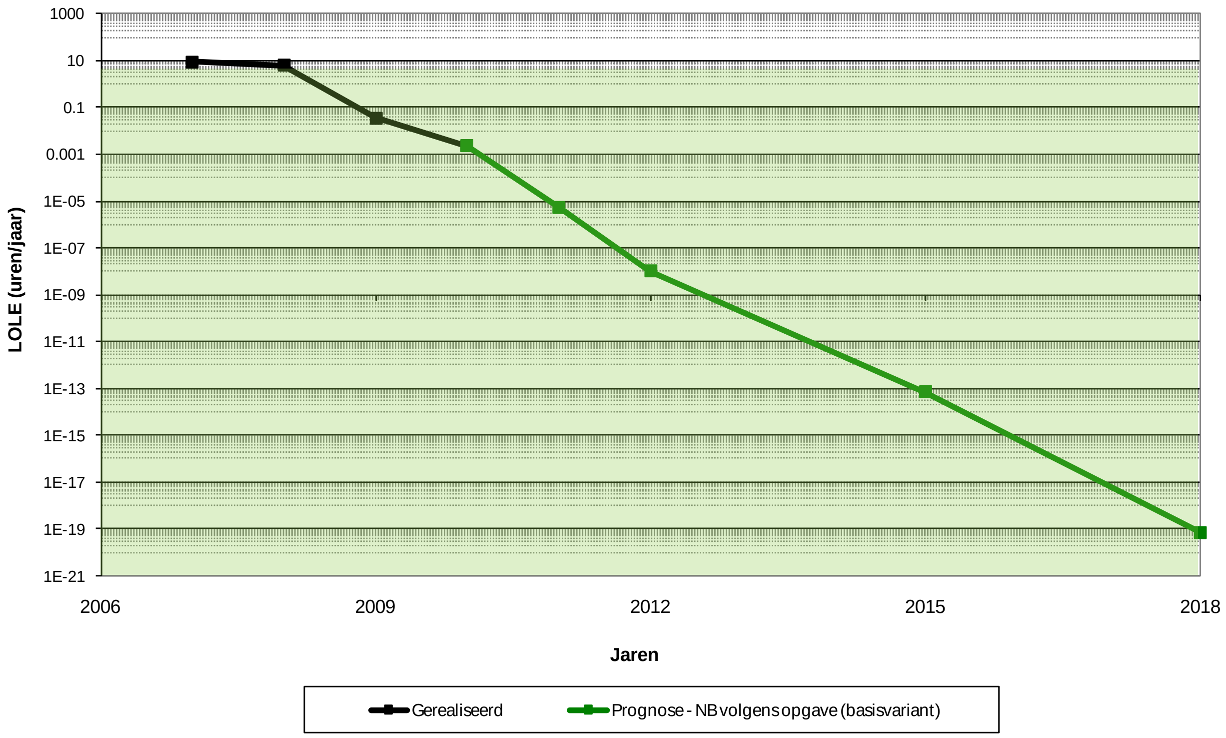

Figure 4: Main results of the 2010-2018 Monitoring Report (basic variant)

Figure 4 shows that the Netherlands was (to a limited extent) dependent on electricity imports in the period up to and including 2008. The four-hour LOLE standard is indicated by the colour green in the graph. What is striking is that the security of supply has increased steadily over the years compared to the actual levels realised prior to 2009. After 2008, the line moves into the green area and a capacity surplus exists.

Table 1: Main results of 2010-2018 Monitoring Report, actual figures for 2007-2010 and forecasts for 2011-2018, taking account of the unavailability of production assets (according to information provided by producers) (basic variant)

Note: *NA = Unavailability of production assets*

By way of amplification of the calculation results presented in the graph, Table 1 provides further information on the development of domestic demand and supply. The domestic supply has been subdivided into operational and non-operational capacity. Non-operational capacity refers to conserved or 'mothballed' capacity. The operational capacity has been subdivided into thermal capacity, capacity from generation sources (almost exclusively wind power), and other capacity (mainly waste and biomass). Chapter 4 provides further information on the development of supply and demand.

In addition to the results in terms of LOLE, the table presents two different capacity values which indicate the extent of the shortage or surplus: a so-called 'firm' capacity value and an equivalent production capacity value. The firm value represents a surplus or shortage in terms of capacity with 100% availability. In practice more capacity will always be required, as capacity with 100% availability does not exist. This 'equivalent production capacity' depends to a large extent on factors such as the risk of disruption or failure, average overhaul duration, and the unit size of the production facility concerned. In these results, the equivalent production capacity has been determined on the basis of a representative mix of large-scale production capacity.

The table clearly shows the effects of a drop in demand (due to the economic crisis) in 2009, the first year surveyed. Despite a decrease in thermal production capacity by approx. 0.2 GW compared to 2008, the security of supply in 2009 increased compared to 2008. The firm capacity shortage of 0.3 GW in 2008 will become a surplus of 2.3 GW in 2010 due to a reduction in consumption and an increase in the amount of available production capacity. The table also reveals a capacity surplus (in terms of firm production capacity) during the entire surveyed period after 2010, rising from approx. 3.8 GW in 2011 to 12.9 GW in 2018. This surplus could mean that there is scope to decommission older production capacity in order to assure the national security of supply, or that this capacity may be used for export purposes without jeopardising the security of supply (also see section 3.5). Decommissioning results in reduced pressure on the available export capacity. Particularly in the 2015 and 2018 reference years, there will be a significant export surplus due to a major increase in the expected production capacity reported by producers.

3.3 Sensitivity to unavailability of production units (sensitivity variant A)

The assumptions made in respect of the likely unavailability of production assets supply important input for the calculations. These assumptions greatly influence the findings, as a higher level of unavailability results in less capacity being available to meet the demand. As was the case in the previous Monitoring Reports, we again noted a difference between the actual past unavailability levels and those forecast by producers. The producers' forecasts were significantly lower than the unavailability levels actually realised. This can be seen in Figure 5, which depicts the actual unavailability levels from 2003 up to and including 2010 as well as the compiled forecasts submitted by producers. The black line represents the historical average unavailability level (14.6%). It is notable that an excellent average unavailability level of 11.4% was achieved in 2008, after which the actual unavailability of production capacity increased to 13.6% in 2010. This should be compared to the 10.1% unavailability level forecast in 2010.

These discrepancies between reported and actual realised capacity unavailability have prompted us to perform several analyses for this Monitoring Report where we based the unavailability figures for all surveyed years on the historical average. These analyses are an addition to the basic variant, in which the unavailability figures are based on the information provided by producers.

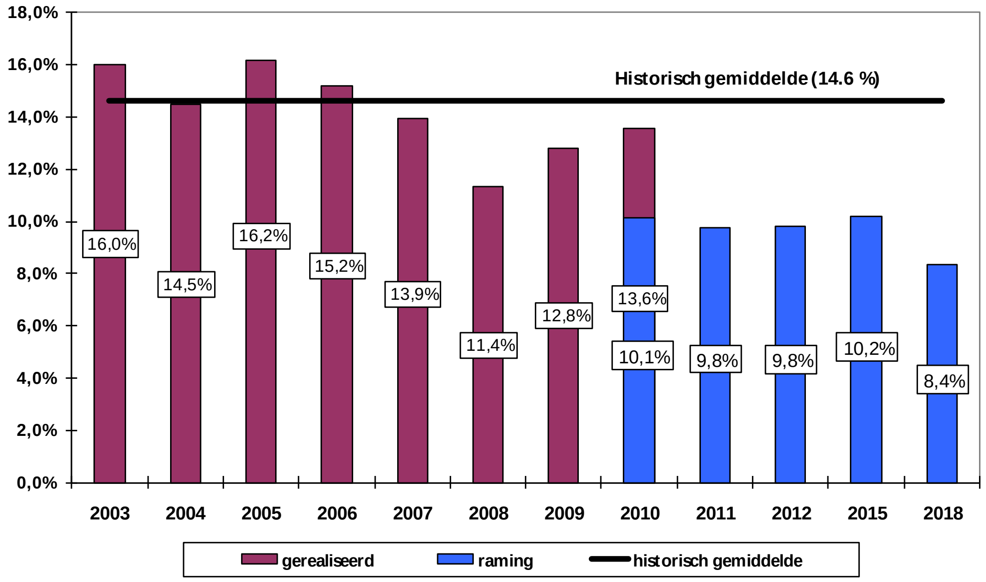

Figure 5: Actual and estimated unavailability of production assets as percentages

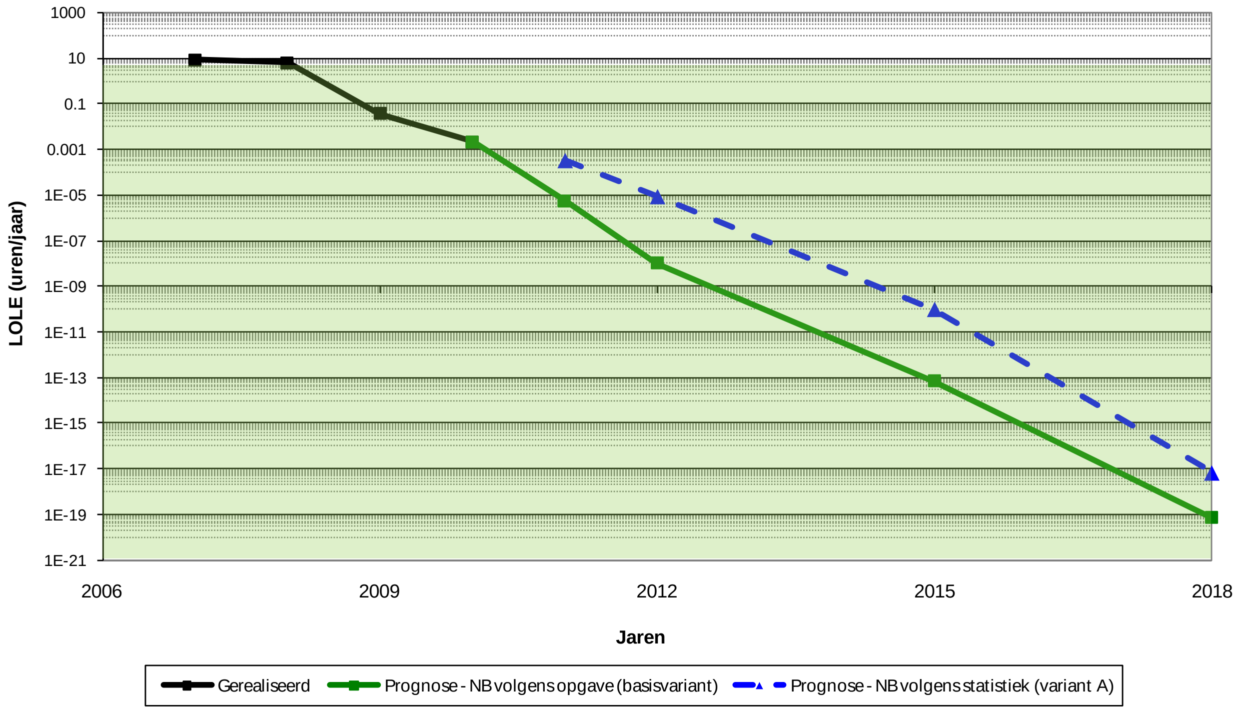

Figure 6: Monitoring results for 2010-2018 (basic variant and sensitivity variant A)

To supplement the main results presented earlier, the dotted line in Figure 6 represents the results of the variant with availability data based on actual historical values. Table 2 presents the results of this sensitivity variant in figures.

Table 2: Monitoring results for 2010-2018, actual results for 2007-2010 and forecasts for 2011-2018 with standardised unavailability of production assets based on historical statistical data (sensitivity variant A)

	vraag	niet operationeel vermogen	operationeel vermogen				LOLE	vermogenstekort	
							NB	firm	equivalente
jaar	totaal		totaal	stromings-bronnen	thermisch	overige (oa. waste)	obv hist. statistiek		productie-capaciteit
	TWh	GW	GW	GW	GW	GW	h	GW	GW
2007	118,7	0,0	23,5	1,6	21,2	0,7	**8,7**	**1,3**	**1,6**
2008	119,9	0,0	23,9	1,8	21,3	0,8	**6,4**	**0,3**	**0,4**
2009	114,1	0,1	24,2	2,3	21,1	0,8	**0,1**	**0,2**	**0,3**
2010	113,8	0,0	25,1	2,3	22,0	0,8	**0,0**	**-2,3**	**-2,7**
2011	115,8	0,0	26,6	2,3	23,4	0,9	**0,0**	**-3,1**	**-4,0**
2012	117,5	0,1	28,2	2,5	24,8	0,9	**0,0**	**-4,0**	**-5,2**
2015	122,9	0,9	37,2	3,7	32,5	1,0	**0,0**	**-9,6**	**-12,5**
2018	128,5	0,6	41,1	4,7	35,4	1,0	**0,0**	**-11,3**	**-14,7**

As was to be expected, smaller surpluses are found in this sensitivity variant compared to the basic variant, due to the higher assumed unavailability of production assets. For instance, the firm capacity surplus amounts to 2.1 GW in the first surveyed year (2010), while the basic variant produced a surplus of 2.3 GW. This picture also applies to the years after 2011.

3.4 Sensitivity to reduced realisation of new production capacity (sensitivity variant B)

For this Monitoring Report we have assumed a total of approx. 14.6 GW of planned new thermal production capacity over the 2011-2018 reporting period. Almost all of this capacity (approx. 14.3 GW) is large-scale capacity. In the previous Monitoring Report, the planned new large-scale capacity in the surveyed period amounted to approx. 17 GW. Large-scale projects have shown a slight decrease (approx. 3.9 GW) compared to the previous Monitoring Report. This is offset by the reporting of new nuclear generating capacity. The volume of capacity in new, small-scale thermal projects fluctuates around 0.3 GW and is approximately the same as forecast in the previous Monitoring Report. Because we cannot be certain that all these plans will actually be realised, a sensitivity calculation has been performed to determine the consequences for the security of supply if most of these plans are not realised. This sensitivity variant is based on the assumption that current projects (representing 8.5 GW in total) will actually be realised. These projects are described in Chapter 2. The calculations are based on standardised unavailability levels of production assets, derived from historical statistics.
Figure 7 shows the results of this sensitivity calculation in combination with the results presented previously. Table 3 shows the results in figures.

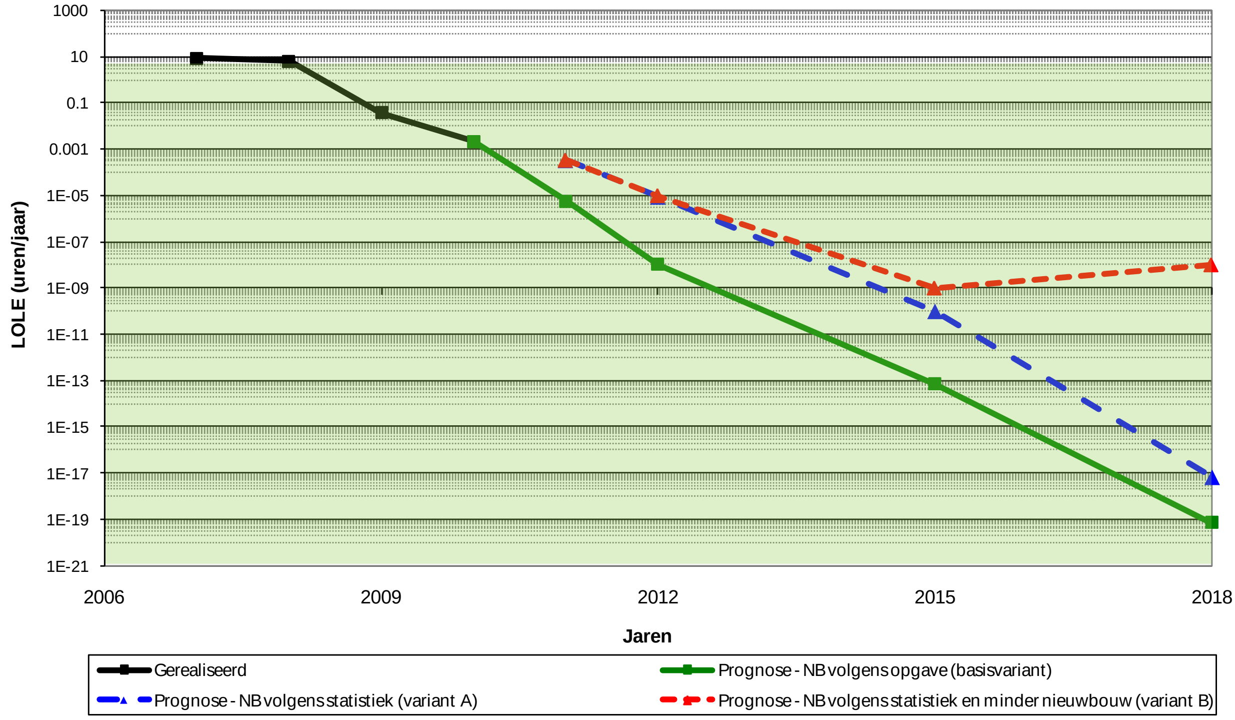

Figure 7: Monitoring results for 2010-2018 (basic variant and sensitivity variants A and B)

Table 3: Monitoring results for 2010-2018, actual results for 2007-2010 and forecasts for 2011-2017 with standardised unavailability levels of production assets based on historical statistical data (sensitivity variant B)

jaar	vraag totaal	niet operationeel vermogen	operationeel vermogen totaal	operationeel vermogen stromings-bronnen	operationeel vermogen thermisch	operationeel vermogen overige (oa. waste)	LOLE NB obv hist. statistiek	vermogenstekort firm	vermogenstekort equivalente productie-capaciteit
	TWh	GW	GW	GW	GW	GW	h	GW	GW
2007	118,7	0,0	23,5	1,6	21,2	0,7	**8,7**	**1,3**	**1,6**
2008	119,9	0,0	23,9	1,8	21,3	0,8	**6,4**	**0,3**	**0,4**
2009	114,1	0,1	24,2	2,3	21,1	0,8	**0,1**	**0,2**	**0,3**
2010	113,8	0,0	25,1	2,3	22,0	0,8	**0,0**	**-2,3**	**-2,7**
2011	115,8	0,0	26,6	2,3	23,4	0,9	**0,0**	**-3,0**	**-3,9**
2012	117,5	0,1	27,7	2,3	24,6	0,9	**0,0**	**-3,9**	**-5,1**
2015	122,9	0,9	34,7	2,3	31,5	0,9	**0,0**	**-8,0**	**-10,4**
2018	128,5	0,6	34,7	2,3	31,5	0,9	**0,0**	**-7,0**	**-9,0**

These results show that there is still a firm capacity surplus in all the years analysed. Even if just over half of the plans for new production capacity are realised, there is more than enough installed production capacity to meet Dutch domestic electricity demand up to the end of the surveyed period.

3.5 Comparative analysis of shortages and surpluses and available import and export capacity

The previous sections presented an overview of the shortages and surpluses that result from a comparison of the various supply forecasts. This section offers a comparative analysis of the shortages and surpluses and the available import and export capacity.

Previous Monitoring Reports factored in 0.3 GW of additional import / export capacity as a result of the completion of phase shifters in the Belgian grid. It now appears that this additional capacity cannot yet be counted as extra transmission capacity. The Belgian grid operator will be able to add this capacity to the grid once several other upgrade projects in the Belgian grid have been completed. Furthermore, neighbouring TSOs need to improve the coordination of their operations with respect to available cross-border capacity and regional grid security. Introduction of flow-based capacity assessment is part of this process. The import/export capacity at the German/Belgian border therefore remains constant at 3.9 GW.

The completion of the Doetinchem-Wesel connection with a capacity of 1.5 GW (completion scheduled for 2014 at the latest, in conservative estimates) means that the import/export capacity at the German/Belgian border amounts to 5.4 GW from 2015 onward.

Together with the NorNed cable (0.7 GW from 2008 onward) and the BritNed cable (1.0 GW from 2011 onward), the total cross-border transmission capacity for imports and exports comes to 7.1 GW in reference year 2015.

TenneT and its Danish counterpart Energinet.dk are currently investigating the possibilities for the construction of a subsea cable link between the two countries. Known under the working name COBRA Cable, this connection will contribute to the integration of sustainable energy in the Dutch and Danish electricity systems while improving the security of supply. Furthermore, the connection will enhance competition in the North-West European electricity markets. If a positive business case can be prepared, the cable can be taken into operation in late 2016 at the earliest. The COBRA Cable (capacity: 0.7 GW) is therefore included in the analysis from 2017 onward.

The table below provides an overview of the assumptions with regard to the available capacity levels. Besides the sum of the nominally available transmission capacity for imports and exports, the table also provides an estimate of the average available capacity when taking account of reductions resulting from failures, overhauls and loop flows due to production surpluses (wind energy capacity).

Table 4: Available import/export capacity and maximum utilisation in the calculation variants

jaar	Bel/Duit GW	NorNed GW	BritNed [1)] GW	Cobra cable GW	Totaal nominaal [2)] GW	Totaal na reducties [3)] GW	maximaa basis var.	var. A	var. B
2010	3,9	0,7	0,0	0,0	4,6	4,2	-53%	-53%	-53%
2011	3,9	0,7	0,0	0,0	4,6	4,2	-89%	-72%	-72%
2012	3,9	0,7	1,0	0,0	5,6	5,2	-100%	-77%	-75%
2015	5,4	0,7	1,0	0,0	7,1	6,6	-165%	-146%	-122%
2018	5,4	0,7	1,0	0,7	7,8	7,2	-179%	-156%	-96%

[)] The BritNed cable has been in operation since April 2011
[2)] Excluding reductions
[3)] Including reductions resulting from failures, overhauls and loop flows due to production surpluses (wind energy capacity)

In both Table 4 and Figure 8, the available import and export capacity including reductions is compared to the firm production shortages and firm production surpluses occurring in the three calculation variants (basic variant, variant A, variant B).

In the table, this comparison is expressed in terms of the utilisation of import and export capacity (as a percentage), whereby a positive value indicates utilisation of import capacity and a negative value indicates utilisation of export capacity.

The red lines in the graph below represent the maximum import and export capacity. The graph also shows the production capacity surpluses and shortages occurring in the three calculation variants (in terms of firm capacity).

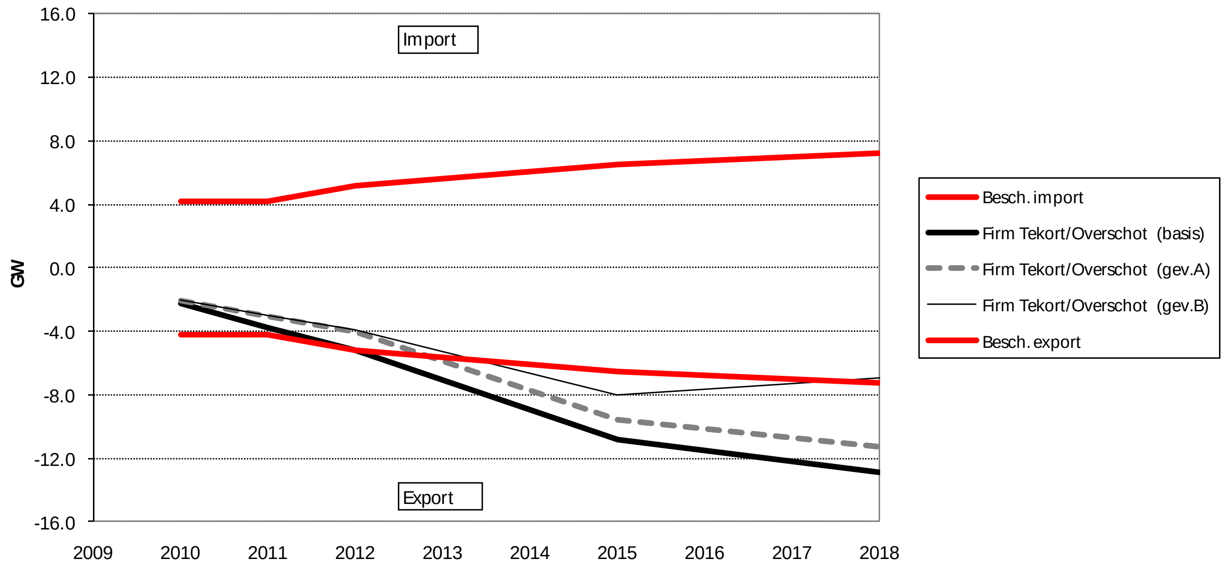

Figure 8: Comparison of surpluses/shortages and available import and export capacity in the basic variant and in sensitivity variants A and B

Figure 8 shows that the available export potential cannot be fully utilised in all variants from 2013 onward. For instance, the basic scenario indicates a firm capacity surplus of 10.9 GW in 2015, while the available export capacity will amount to approx. 6.5 GW. This means that around 4.5 GW of the export potential cannot be utilised under all circumstances. In 2018, the unutilised export potential is set to increase to 5.7 GW, a level comparable to the analysis in the previous Monitoring Report.
In the (more realistic) sensitivity variant with standard availability levels (variant A), the unutilised export potential is lower: 3.1 GW in 2015, increasing to 4.1 GW in 2018.
In sensitivity variant B, the unutilised export potential amounts to 1.5 GW in 2015. In 2018, the available export capacity will be fully sufficient to be able to utilise the capacity surplus calculated for that year.

3.6 Reserve factors

As in previous Monitoring Reports, we have again estimated the so-called ‘reserve factors’. The ‘reserve factor’ is the ratio of installed production capacity and maximum demand. Table 5 provides an overview of the reserve factors that can be derived from the data used.

The reserve factors show a similar trend as the results based on the LOLE calculations, i.e. a continuous increase in reserve capacity during the surveyed period.

Table 5: Reserve factors 2010-2018

jaar	niet operationeel vermogen	totaal operationeel vermogen	vermogen uit stromings-bronnen	beschikbare import-capaciteit	piekvraag	reservefactor		
	GW	GW	GW	GW	GW	1)	2)	3)
2010	0.0	25.1	2.3	4.2	17.6	1.43	1.32	1.56
2011	0.0	26.6	2.3	4.2	17.9	1.48	1.38	1.62
2012	0.1	28.2	2.5	5.2	18.2	1.55	1.44	1.72
2015	0.9	37.2	3.7	6.6	19.0	1.95	1.80	2.14
2018	0.6	41.1	4.7	7.2	19.9	2.06	1.88	2.24

1) zonder import, stromingsbronnen tellen voor 100% mee, niet operationeel voor 0%

2) zonder import, stromingsbronnen tellen voor 20% mee, niet operationeel voor 0%

3) importcapaciteit telt voor 100% mee, stromingsbronnen tellen voor 20% mee, niet operationeel voor 0%

3.7 Prospects for 2026

EU Directive 2005/89/EC stipulates that the period surveyed in national monitoring reports must be extended to 15 years. Consequently, the expected supply-and-demand situation in 2026 is discussed briefly below.

As in the previous Monitoring Report, the information supplied by producers for 2026 does not produce a clear picture of the development of their portfolios. In most cases, therefore, no changes compared to 2018 have been indicated. This applies to the construction of new production units as well as the decommissioning of existing production assets. The information supplied by producers who did report changes shows that approximately 5.6 GW of thermal capacity will be taken into operation in the 2018-2026 period, while approximately 1.4 GW will be decommissioned. Table 6 in Chapter 4 of this report summarises the development of the electricity supply according to data supplied by producers.

In order to determine how the electricity demand will develop in the eight years added to the surveyed period (i.e. the 2018-2026 period), we have extrapolated the annual growth rate assumed to apply to the period after 2011 (1.5%). This scenario would result in an annual electricity demand of approx. 145 TWh in 2026 in the basic variant and in sensitivity variants A and B (also see Table 7 in Chapter 4). In assessing these forecasts, it should be kept in mind that there is a high degree of uncertainty concerning the level of the electricity demand at the end of a surveyed period of this length. It is not possible to predict all the relevant developments accurately, although they may have a major impact on the level of electricity demand. Such developments may include large-scale market penetration of electric cars or heat pumps. A market penetration level of 1 million electric cars in 2026 is often cited as the highest feasible level. Research has show that this number of electric cars will result in an annual rise in electricity demand of approx. 3 TWh, equivalent to an increase of approx. 2% in 2026. It is still uncertain what impact these developments will have on the national demand curve, as this depends to a large extent on the times when the electric vehicles are charged. For the time being the expected increase in peak demand is not sufficiently large to warrant further analysis in the context of monitoring the security of supply (e.g. because of the scope for managing the additional demand).

An indicative calculation has been carried out to determine the security of supply if supply and demand levels develop as outlined above. This calculation yields a substantial capacity surplus in 2026 in the basic variant and in sensitivity variants A and B. In the introduction to this Monitoring Report, we already indicated that it was difficult to produce long-term forecasts of supply and demand in 2018. Obviously, an even higher level of uncertainty applies to any forecasts for 2026. When we combine this fact with the level of uncertainty regarding the demand trend, it is clear that the results of the security-of-supply analysis for the 2026 reference year must be regarded as indicative.

4. Notes on the data used

This monitoring exercise and the resulting report are based on data from the following sources:

- Producers that are known to TenneT and that have units of 2 MW or more are asked every year to submit data and forecasts regarding the domestic production assets they currently operate or expect to operate in future. The latter plans are generally provisional in nature.
- Data on domestic production assets collected for inclusion in the Quality and Capacity Plan 2012-2021, as well as data on the growth of the domestic market in the period after 2011, and data on the transmission capacity of cross-border interconnections. Please refer to TenneT's Quality & Capacity Plan and the sources of producers for original data on new production capacity.
- Data provided by Netherlands Statistics (CBS) on the actual domestic demand in the period up to and including 2010, on electricity production assets and the electricity balance between supply and demand, as well as figures on actual economic growth.
- Data provided by the Netherlands Bureau for Economic Policy Analysis (CPB) and the International Monetary Fund (IMF) regarding expected economic growth in the period after 2010.
- Data provided by CertiQ B.V. regarding the installed sustainable production capacity.

Table 6 summarises the development of the installed capacity. The information yields a similar picture to last year's Monitoring Report, with the exception of a slight drop (1.0 GW) in operational thermal capacity towards the end of the surveyed period.

Table 6: Development of installed capacity

	niet oper. vermogen	operationeel vermogen			evolutie operationeel vermogen					
					grootschalig thermisch			kleins.th.	stroming	totaal
jaar	totaal	totaal	stromings bronnen	tot. excl. str. bron.	nieuw	mothball en uitbedrijf	saldo	saldo	saldo	saldo
	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
2009	0.1	24.2	2.3	21.9						
2010	0.0	25.1	2.3	22.8	0.9	0.1	0.8	0.0	0.0	0.8
2011	0.0	26.6	2.3	24.3	1.4	0.0	1.4	0.1	0.0	1.5
2012	0.1	28.2	2.5	25.7	1.5	0.1	1.5	-0.1	0.2	1.6
2015	0.9	37.2	3.7	33.5	9.3	1.6	7.7	0.1	1.2	9.0
2018	0.6	41.1	4.7	36.4	3.5	0.6	2.9	0.0	1.0	3.9
2026	3.3	41.5	9.0	32.5	3.7	4.4	-0.7	-0.3	1.4	0.4

The development of installed capacity gives rise to the following points for attention:

- After 2012 we observe a massive increase in the planned realisation of new large-scale production capacity. For example, more than 14.3 GW of new large-scale thermal production capacity has been reported for the period up to and including 2018. Approx. 10.8 GW of the reported total of 14.3 GW will be realised in the period up to and including 2015. Although we cannot be certain that all these projects will in fact be realised, more than 8.5 GW is currently in the realisation phase.

- In the 2011-2018 period, 2.3 GW of large-scale thermal production capacity will be ‘mothballed’ or decommissioned. A further 4.4 GW will be added in 2026.
- The expected growth of small-scale thermal production capacity from 2011 onward has been revised slightly downward from the level indicated in the previous Monitoring Report. This is mainly due to the fact that there seems to be no further growth in the use of gas engines in the glasshouse horticulture sector. Reported large-scale projects in the glasshouse horticulture sector have been included in the analysis.

Table 7 summarises the key assumptions with regard to the size of the domestic market.

Table 7: Assumptions concerning market size

Ontwikkeling van de elektriciteitsvraag (monitoring 2010-2026)

Jaar	monitoring 2004-2012		monitoring 2005-2013		monitoring 2006-2014		monitoring 2007-2023		monitoring 2008-2024		monitoring 2009-2025		monitoring 2010-2026	
	groei verbruik %	vraag TWh	groei verbruik %	vraag TWh	groei verbruik %	vraag TWh	groei verbruik %	vraag TWh	groei verbruik %	vraag TWh	groei verbruik %	vraag TWh	groei verbruik %	vraag TWh
2003	1.32%	109.8	1.32%	109.8	1.32%	109.8	1.32%	109.8	1.32%	109.8	1.32%	109.8	1.32%	109.8
2004	0.92%	110.8	2.83%	112.9	2.83%	112.9	2.83%	112.9	2.83%	112.9	2.83%	112.9	2.83%	112.9
2005	1.00%	111.9	1.53%	114.7	1.64%	114.8	1.64%	114.8	1.64%	114.8	1.64%	114.8	1.64%	114.8
2006	2.25%	114.5	2.75%	117.8	1.27%	116.2	1.36%	116.3	1.36%	116.3	1.36%	116.3	1.36%	116.3
2007	2.00%	116.7	3.00%	121.3	2.75%	119.4	0.53%	117.0	1.99%	118.7	1.99%	118.7	1.99%	118.7
2008	2.00%	119.1	2.00%	123.8	2.75%	122.7	2.25%	119.6	0.68%	119.5	1.09%	119.9	1.09%	119.9
2009	2.00%	121.5	2.00%	126.2	2.00%	125.2	1.75%	121.7	-4.75%	113.8	-5.87%	112.9	-4.84%	114.1
2010	2.00%	123.9	2.00%	128.8	2.00%	127.7	2.00%	124.1	-0.50%	113.2	1.50%	114.6	-0.30%	113.8
2011	2.00%	126.4	2.00%	131.3	2.00%	130.2	2.00%	126.6	2.00%	115.5	2.00%	116.9	1.75%	115.8
2012	2.00%	128.9	2.00%	134.0	2.00%	132.8	2.00%	129.1	2.00%	117.8	2.00%	119.2	1.50%	117.5
2013	*2.00%*	*131.5*	2.00%	136.7	2.00%	135.5	2.00%	131.7	2.00%	120.1	2.00%	121.6	1.50%	119.3
2014	*2.00%*	*134.1*	*2.00%*	*139.4*	2.00%	138.2	2.00%	134.3	2.00%	122.5	2.00%	124.0	1.50%	121.1
2015	*2.00%*	*136.8*	*2.00%*	*142.2*	*2.00%*	*141.0*	2.00%	137.0	2.00%	125.0	2.00%	126.5	1.50%	122.9
2016	*2.00%*	*139.5*	*2.00%*	*145.0*	*2.00%*	*143.8*	*2.00%*	*139.8*	2.00%	127.5	2.00%	129.1	1.50%	124.7
2017	*2.00%*	*142.3*	*2.00%*	*147.9*	*2.00%*	*146.7*	*2.00%*	*142.6*	*2.00%*	*130.1*	2.00%	131.6	1.50%	126.6
2018	*2.00%*	*145.2*	*2.00%*	*150.9*	*2.00%*	*149.6*	*2.00%*	*145.4*	*2.00%*	*132.7*	*2.00%*	*134.3*	1.50%	128.5
2023	*2.00%*	*160.3*	*2.00%*	*166.6*	*2.00%*	*165.2*	2.00%	160.6	*2.00%*	*146.5*	*2.00%*	*148.2*	*1.50%*	*138.4*
2024	*2.00%*	*163.5*	*2.00%*	*169.9*	*2.00%*	*168.5*	*2.00%*	*163.8*	2.00%	149.4	*2.00%*	*151.2*	*1.50%*	*140.5*
2025	*2.00%*	*166.7*	*2.00%*	*173.3*	*2.00%*	*171.8*	*2.00%*	*167.0*	*2.00%*	*152.4*	2.00%	154.2	*1.50%*	*142.6*
2026	*2.00%*	*170.1*	*2.00%*	*176.8*	*2.00%*	*175.3*	*2.00%*	*170.4*	*2.00%*	*155.4*	*2.00%*	*157.3*	1.50%	144.8

legenda

140.0	gerealiseerd (definitief CBS)
140.0	gerealiseerd (schatting CBS)
140.0	prognose (op basis meest recente CPB-prognoses)
140.0	*prognose-extrapolatie vroegere monitoring*

The following conclusions can be drawn from Table 7:

- The definitive figure for domestic electricity demand in 2009 is approx. 1.2 TWh higher than the preliminary estimate used in the previous Monitoring Report. It was estimated at the time that the decline in total consumption (-5.8%) would be more substantial than it was in reality (-4.8%). The expectation that electricity consumption levels would increase in step with the overall economy in 2010 was not fulfilled. Statistics Netherlands estimates that the Dutch economy grew by 1.7% in

2010, while total electricity consumption decreased by 0.3%. As a result, the estimate of total electricity consumption in 2010 is 0.8 TWh less than was assumed in the previous Monitoring Report.

- The size of the domestic market in 2011 and 2012 has been based on the most recent CPB forecasts of GDP growth in 2011 (1.75%) and 2012 (1.5%) (*Central Economic Plan, CPB, March 2011*). The growth of electricity consumption in subsequent years is based in part on these forecasts, taking account of the GDP growth rate of 1.25% as published in the Updated Economic Outlook 2011-2015 (*CPB, November 2010*).
- Together, the above factors result in a domestic market size of 128.5 TWh in 2018 (including grid losses). This is approximately 5.8 TWh less than was assumed in the previous Monitoring Report. Extrapolation of the electricity consumption levels based on current long-term growth forecasts would result in a domestic market size of nearly 145 TWh in 2026.