

Report on Monitoring of Reliability of Supply, 2004-2012

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1. Introduction

TenneT annually monitors the long-term reliability of supply, at the request of the Dutch Ministry of Economic Affairs. In 2005 monitoring and the required data collection were performed for the first time on the strength of the law, viz. Section 16(2) sub f, which charges TenneT with the monitoring of the reliability of supply and provision (Section 41(1) of the Netherlands Electricity Act 1998).

Monitoring is performed with the aim of providing an insight into the projected development of domestic supply relative to the domestic demand for electricity by investigating the degree to which the domestic capacity is capable of catering for the domestic demand. As reliability of supply does not stop at the national borders, attention has also been devoted this year to the extent to which cross-border supply and the required international transmission capacity are available to be tapped into by the Dutch electricity supply system. This is of particular significance in view of the increasing pressure having been brought to bear in recent years on the available export capacity from Germany to the Netherlands.

New to this monitoring method is the introduction of a second set of assessment parameters based on a “Loss of Load Expectation” (LOLE) method, it having been decided in view of the key significance of monitoring that a second method should be introduced to enable verification of the results obtained using the existing method, in addition to which the second method is in line with similar appraisal systems applied in other countries including Belgium and France, thus potentially producing a basis for international comparison.

2. Conclusion and Recommendations

2.1 Conclusion

The results of this year's monitoring exercise have borne out that the Netherlands will continue in principle to have sufficient supply at its disposal until the end of 2012 to enable the domestic demand electricity being duly catered for. Until the end of 2009 the Netherlands will continue to rely for adequate supply on being supplied from abroad to a degree which compared with 2004 does not point to worsened susceptibility for the reliability of supply, whereas our country's import dependence and the degree to which this affects the reliability of supply will have increased to such levels by 2012 that the reliability of supply could by then become a point for attention, primarily owing to internationally reduced reserve margins.

2.2 Recommendations

- It is important that measures to ensure the long-term reliability of supply should be implemented at the appropriate time, i.e. neither too soon (as this would result in unnecessary public charges being incurred while discouraging market players from taking the initiative) nor too late (as this would give market players insufficient time to respond, resulting in risk exposure over a period of time). We consider a four-year term to be reasonable for anticipating the moment at which problems would first crop up.
- The results of the present monitoring exercise do not in our view warrant our advising the government at this point in time to implement measures regarding the future reliability of supply in the Netherlands.
- Given the interwovenness and decisiveness of the reliability of supply in neighbouring countries *vis-à-vis* that in the Netherlands owing to the cross-border interconnection between the (national) electricity grids, TenneT is a keen sponsor of the Minister's initiative of having our country conclude Memorandums of Understanding with its neighbours, collective assessment of the reliability of supply, optimisation of the available international transmission capacity and non-discriminatory export cancellation representing key factors in the further development of a liberalised, stable European market and thus, that of the international reliability of supply.

3. Results

The appraisal method applied denotes the degree to which domestic supply is capable of satisfying domestic demand, showing the result as a shortfall in domestic supply to be supplemented by means of imports. Other options for making good the shortfall are: greater investment in new capacity by the supply side of the market, deferral of decommissioning of existing capacity, and more efficient unavailability planning. As for the demand side, energy saving could help reduce the shortfall. Figure 1 shows the monitoring results for the years 2005, 2006, 2009 and 2012.

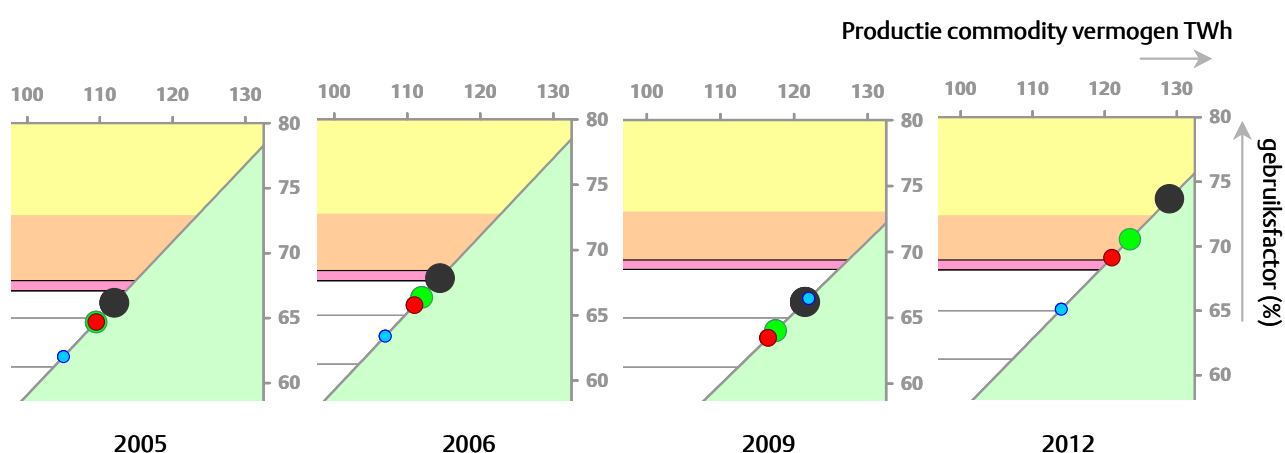


Figure 1: Monitoring results for 2005, 2006, 2009 and 2012

Generation of commodity power (TWh)
 User factor (%)

Legends to Figure 1:

- resultant user factor for commodity power (CP) where this is used exclusively to cover the market
- ditto, on deduction of the contribution from renewable energy forces
- ditto, on deduction of the contribution from renewable energy forces and reserve power
- maximum CP user factor still allowing the permanent satisfaction of all aspects of domestic demand, with the remainder being sourced from other countries where appropriate
- CP taken up due to no-load
- CP taken up due to unavailability
- CP taken up due to UCTE commitments

(Reference is made to the Glossary for an explanation of the terminology and to Chapter 3 for the data used.)

Where the shortfall in supply from domestic capacity is supplemented using imports, this results in Table 1. A negative value implies that rather than there being a shortfall, there is room for exports. Reference is made to the Glossary for an explanation of the terminology. Figure 2 shows the development of the shortfall in domestic supply relative to the scope for import. The results on the basis of the reports received point to a limited, stable shortfall which has dwindled to nil by 2009, only to start going up again in subsequent years.

It should be pointed out in this context that the outcome is influenced to a considerable degree by the development as reported of the Unavailability of Commodity Power, viz. the reported decline in Unavailability by approx. 5 percentage points by 2012 compared with 2004 corresponds with more than 1GW in additional capacity based on 20GW in operational capacity. (This is addressed in more detail below.)

Table 1: Monitoring results, 2004-2012

jaar	markt TWh	commodity- vermogen		reserve			niet operationeel	vermogen uit stromingsbronnen		tekort
		op- gesteld	NB	op- gesteld	vollast- uren	bijdrage	opgesteld	op- gesteld	bijdrage	(import)
		GW	%	GW	h	TWh	GW	GW	TWh	TWh
2004	111.0	19.3	14.5	0.6	560	0.3	0.4	1.1	1.6	5.5
2005	112.0	19.3	13.4	0.6	300	0.2	0.4	1.4	2.3	4.5
2006	114.5	19.3	11.6	0.7	800	0.6	0.4	1.6	2.7	4.0
2009	121.5	21.0	9.8	0.6	1000	0.5	0.6	2.2	3.8	-5.5
2012	129.0	20.0	9.2	1.4	800	0.9	0.7	3.2	5.5	7.0

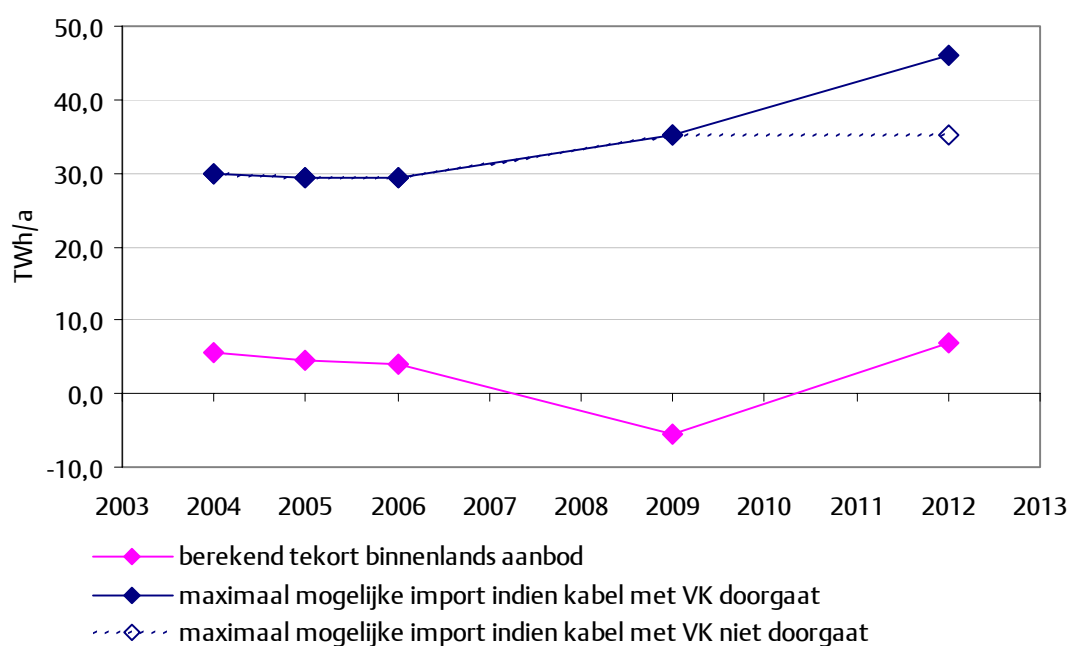


Figure 2 : Calculated shortfall and upper limit on imports, 2004-2012

Table 2 places the results in their historical context. The data pertaining to 2002 and 2003 have been copied across from the monitoring reports for the relevant years.

Table 2: Realised values, 2002-2004

jaar	markt TWh	commodity- vermogen		reserve			niet operationeel	vermogen uit stromingsbronnen		tekort
		op- gesteld	NB	op- gesteld	vollast- uren	bijdrage	opgesteld	op- gesteld	bijdrage	(import)
		GW	%	GW	h	TWh	GW	GW	TWh	TWh
2002	109.2	18.6	12.5	0.4	738	0.3	0.8	0.6	1.0	7.5
2003	109.6	18.6	16.0	0.6	1300	0.8	0.5	1.0	1.2	14.0
2004	111.0	19.3	14.5	0.6	560	0.3	0.4	1.1	1.6	5.5

Table 3 shows the implications in terms of available import capacity being taken up.

Figure 3 shows the available import capacity in nominal conditions (also see Appendix 1). Figure 4 illustrates how much of this would be taken up in the event of the Anglo-Dutch interconnection going ahead.

Table 3: Available import capacity and take-up due to potential shortfall in domestic supply

jaar	beschikbare importcapaciteit											Tekort TWh	Beslag %	
	België/Duitsland					Noorwegen			Verenigd Koninkrijk					Totaal
	GW ¹⁾	NB ²⁾	ER ³⁾	GW ⁴⁾	TWh	GW ¹⁾	NB ²⁾	TWh	GW ¹⁾	NB ²⁾	TWh			TWh
2004	3,6	0,5%	4,5%	3,4	30,0							30,0	5,5	18
2005	3,6	0,5%	6,5%	3,3	29,3							29,3	4,5	15
2006	3,6	0,5%	6,5%	3,3	29,3							29,3	4,0	14
2009	3,6	0,5%	6,5%	3,3	29,3	0,7	4,1%	5,9				35,2	-5,5	-16
2012	3,6	0,5%	6,5%	3,3	29,3	0,7	4,1%	5,9	1,3	5%	10,8	46,0	7,0	15

¹⁾ nominaal

²⁾ niet-beschikbaarheid vanwege revisies en uitval

³⁾ reductie vanwege onzekere exportcapaciteit uit België/Duitsland

⁴⁾ gemiddeld

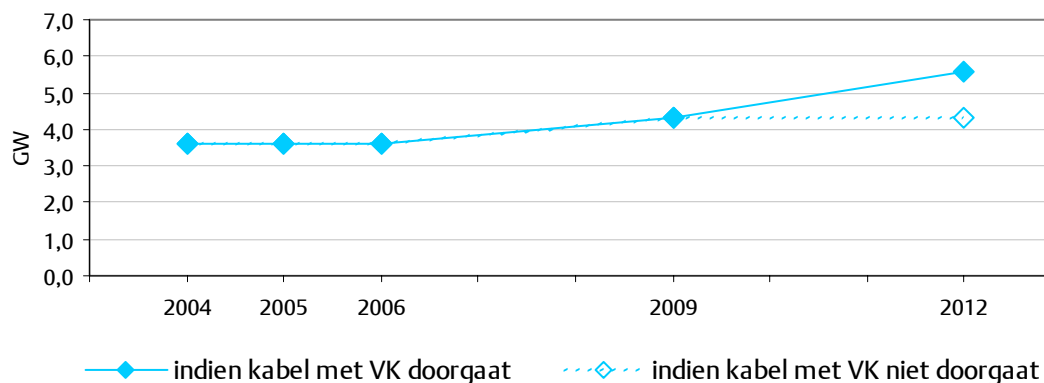


Figure 3: Available import capacity

3.1 Unavailability Forecast

A comparison has been made between the unavailability forecasts for the generating units as reported and values having been historically realised in the Netherlands. Table 4 contains an overview of realised availabilities and the estimates. Interestingly enough, the gap between the values as reported by the generating companies and the historically realised values widens as the years progress.

Table 4: Unavailability of generating units as %, realised vs. estimated values

Gerealiseerd		Raming				
Historisch	Monitoring 2003 - 2011	Monitoring 2004 - 2012				
	2003	2004	2005	2006	2009	2012
14.9%	16.0%	14.5%	13.4%	11.6%	9.8%	9.2%

For this reason calculations have been made for a “standard” scenario in which the unavailability figures for all years under scrutiny have been standardised at the historical level of 14.9%, in addition to which the full-load hours for reserve power and recurring energy forces have been standardised at 1,000 and 1,700 hours, respectively, resulting in the following pattern: a gradually deepening shortfall, which is reduced by 2009 and which in the years beyond goes back up again. Table 5 presents an overview of the results for this standard scenario. Figure 4 presents the outcomes for a variety of scenarios in terms of minimum import capacity take-up required. The available import capacity is adequate for each of the scenarios throughout the period under scrutiny.

Table 5: Results of 2004-2012 monitoring, standard unavailability of commodity power and standard full-load hours for reserve power and recurring energy forces

jaar	markt TWh	commodity- vermogen		reserve			niet operationeel	vermogen uit stromingsbronnen		tekort
		op- gesteld	NB	op- gesteld	vollast- uren	bijdrage	opgesteld	op- gesteld	bijdrage	(import)
		GW	%	GW	h	TWh	GW	GW	TWh	TWh
2004	111.0	19.3	14.5	0.6	560	0.3	0.4	1.1	1.6	5.5
2005	112.0	19.3	14.9	0.6	1000	0.6	0.4	1.4	2.3	6.5
2006	114.5	19.3	14.9	0.7	1000	0.7	0.4	1.6	2.7	10.0
2009	121.5	21.0	14.9	0.6	1000	0.6	0.6	2.2	3.8	4.5
2012	129.0	20.0	14.9	1.4	1000	1.4	0.7	3.2	5.5	18.0

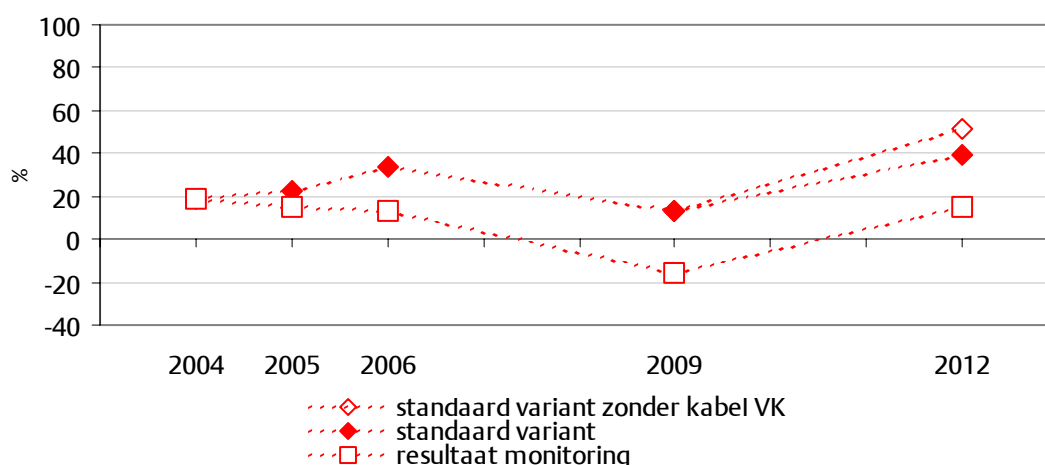


Figure 4: Import capacity take-up for various scenarios

Table 6 shows the latitude for additional commodity power in order to ensure that reliance on domestic supply is maintained at a constant level of 5.5TWh/a (as realised in 2004) subject to standard unavailability of commodity power and standard full-load hours for reserve power and recurring energy forces.

Table 6: Shortfall as per standard scenario shown as additional commodity power required in order to ensure a domestic shortfall in the amount of 5.5 TWh (as realised in 2004)

Year	2005	2006	2009	2012
MW	115	580	-170	1675

Table 7 contains an overview of the reserve factors to be derived from the statistics used.

Table 7: Reserve factors

jaar	commodity-vermogen [GW]	reserve-vermogen [GW]	stromings-bronnen [GW]	Sep-contracten import (OEPS) [GW]	nominale import capaciteit [GW]	piekvraag [GW]	reservefactor				
							1)	2)	3)	4)	5)
2004	19.3	0.6	1.1	0.9	3.6	16.5	1.27	1.22	1.33	1.27	1.44
2005	19.3	0.6	1.4	0.8	3.6	16.7	1.27	1.21	1.32	1.25	1.42
2006	19.3	0.7	1.6	0.8	3.6	17.1	1.26	1.19	1.31	1.23	1.40
2009	21.0	0.6	2.2	0.0	4.3	18.1	1.31	1.21	1.31	1.21	1.45
2012	20.0	1.4	3.2	0.0	5.6	19.2	1.28	1.15	1.28	1.15	1.44

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

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

3) incl. Sep-contracten import, stromingsbronnen tellen voor 100% mee, niet operationeel vermogen voor 0%

4) incl. Sep-contracten import, stromingsbronnen tellen voor 20% mee, niet operationeel vermogen voor 0%

5) incl. 100% importcapaciteit, stromingsbronnen tellen voor 20% mee, niet operationeel vermogen voor 0%

4. Explanatory Notes to Data Used

The present monitoring and reporting has taken place on the basis of data on:

- The members of EnergieNed's Generation Section where it concerns such domestic generating resources as come under their administration (in general this concerns plans subject to reservation)
- Generators that are known to EnerQ and CertiQ. This year's monitoring exercise has for the first time involved data being requested from all generating companies with units of 5MW and over in so far as they are known to TenneT. This has been done with the aim of expanding the survey's cover and reducing reliance on estimates produced in-house, thus enhancing the survey's quality and robustness. Use has been made inter alia of EnerQ/CertiQ address files in approaching this new category of generating companies.
- The draft basic scenario for the Capacity Plan for 2006-2012 where it concerns other domestic generating resources, size of domestic market and transmission capacity on cross-border interconnections (also see Appendix 1).

Compared with the previous monitoring exercise, the following aspects are worthy of note where it concerns the data having been reported:

- Reports of increased planned new-build commodity power;
- The conservation reported in the previous monitoring has been cancelled or deferred beyond the period under scrutiny;
- By requesting information from a larger group of generating companies (see above), the degree of cover for generating units for which the generating company has reported data direct to TenneT has increased by just over 1.8GW to turn out at approximately 17.0GW overall, representing an increase in the degree of cover to 82% in 2004. A concerted effort will be made to approach even more generating companies in future, albeit that the identification of future new entrants will continue to complicate matters.

The following changes are relevant compared with the previous monitoring exercise where it concerns data from the draft basic scenario for the Capacity Plan for 2006-2012:

- The size of the domestic market has turned out slightly lower (basic scenario = CPB scenario) owing to:
 - lower growth rate for 2005 (originally 1.5%, since revised to 1%)
 - a slightly lower initial value (110.8TWh rather than 110.9TWh realised in 2004)
- Maximum available capacity until the end of the period under scrutiny in the average amount of 3,350MW has been assumed for the Belgian and German interconnections. Appendix 1 elaborates on these available import capacities, which are lower compared with the previous monitoring exercise. The expected increase in import capacity owing to the Anglo-Dutch interconnection remains conditional as the formal decision making is still being awaited; if the project is given the go-ahead, the interconnection is not expected to be available to be taken into use until beyond 2011.

5. Explanation of Result and Comparison with Previous Monitoring

An aspect that is worthy of note in the comparison with last year's monitoring exercise is that the actual unavailability of commodity power for the past year (2004) has turned out greater than had been projected (14.5% rather than 9.8%), which for 2004 has resulted in a greater domestic shortfall than had been forecast in the monitoring exercise for 2003-2011 (5.5TWh rather than 0TWh). This shortfall has been made good using imports without this having caused problems. Compared with the previous monitoring exercise, the increase in available commodity power from 2009 onwards will significantly cut back reliance on imports as well as reducing the import capacity take-up.

Taken as a whole, the statistics point to a scenario in which the supply from domestic generating resources will fall somewhat short of satisfying the expected domestic demand in all its aspects. This slightly less rosy picture compared with the previous monitoring exercise has primarily been caused by the greater unavailability of commodity power having been reported (at 13.4% rather than 8.5% for 2005). If this pattern is extrapolated in line with the reports, a potential for exports could in fact arise by 2009, only to revert to a rapidly rising domestic shortfall in subsequent years if the market refrains from making additional investments. The same pattern would prevail if use was made of statistics based on historical unavailability (see table 5 and figure 4), albeit that in this scenario the potential for exports by 2009 would revert to a shortfall similar to that for 2004, whereas the shortfall in 2006 would be about twice that realised in 2004 but less than that realised in 2003.

These are the options for covering shortfalls which the market has at its disposal against the background of the development in demand as shown:

- Reconsideration of conservation of existing commodity power;
- New development of commodity power;
- Improvement of unavailability;
- Imports (as these would be required in such a scenario), to result in import reliance worsening.

If it is decided only to focus on imports, the reliably available interconnection capacity having been assumed would in principle be capable of transmitting the required imports.

6. Susceptibility of Reliability of Supply due to Reliance on Imports

Reliance on domestic supply is set significantly to increase in the longer term if the market refrains from making additional investments. In principle reliance on imports would be acceptable provided the neighbouring countries could be trusted always to have sufficient reserve power available to enable the Dutch domestic demand to be satisfied in combination with the Dutch-based generating power, in addition to which the various transmission grids and the links between them should have sufficient capacity to facilitate the transmission requirement.

An analysis was carried out in the previous monitoring report into the susceptibility to import reliance of the Dutch reliability of supply. Certain parameters warrant ongoing tracking in this context, most notably the reliably available import capacity and the reserve generating power in neighbouring countries.

Owing to the increase in wind power in the German grid, a trend can be discerned in the reliably available import capacity of progressively less of the nominally available capacity on the German and Belgian interconnectors qualifying as reliable. This has been taken into account in the calculation of the interconnector capacity take-up requirement. We would add that sufficient amounts of reliable import capacity will continue to be available throughout the period under scrutiny to supplement the domestic shortfall using imports.

As the reliably available import capacity continues to be adequate throughout the period under scrutiny and the reserve power for 2006 and 2010 in neighbouring countries has not declined¹, we do not consider a revision of the conclusions concerning susceptibility to import reliance as per the previous monitoring to be warranted. This conclusion was as follows:

On assumption of a temperature dependence of peak demand amounting to 1%/°C for UCTE as a whole, the possibility exists in the short term that the operational reserve exclusive of contractually offswitchable demand in the Netherlands, Germany, France and Belgium combined could at any time during the winter drop back to nil in up to one in every seven winters in 2005 and up to one in every four winters in 2008. This would render the Netherlands, Germany, France and Belgium combined dependent on imports from other countries in the event of above-average unavailability of generation due to failure, revision, lack of wind and hydropower. In such scenario internal pressure points within the German and Belgian grids would pose a genuine threat to the imports needed by the Netherlands from countries outside the area concerned.

¹ See references [1] and [2]

The above conclusion has been based on statistics from the UCTE Adequacy Forecast 2004-2010 [1] and historical observations of the average 24-hour cycle temperatures in Maastricht since 1906 (source: Royal Dutch Meteorological Institute, KNMI). The outcome appears to be highly susceptible to the value of the peak demand's temperature dependence and thus, to a demand response (if any) or to other dynamic market effects. No reliable value could be found for the peak demand's temperature dependence, with estimates ranging between 0.4% and 2%. No significance risk of occurrence could be determined for the event referred to in the conclusion for values of less than 0.7%.

7. LOLE

It has been decided for the sake of assessment of the adequacy of the Dutch electricity generating system that a set of alternative parameters, the LOLE method, should be used in future in support of the current method. LOLE methods are probabilistic, the principle being anchored in the determination of the likelihood of the available generating capacity being insufficient for satisfying the aggregate demand. By carrying out this calculation for a large number of moments within a calculation horizon, LOLE models can generate expected values for the amount of time within the set horizon during which the generating capacity will not be enough to match demand. This is referred to as the "Loss of Load Expectation", or LOLE for short. If for example a 12-month calculation horizon were applied, a one-day LOLE could be expressed in terms of one day a year, 24 hours a year or 0.27% of the time.

These have been the main reasons for introducing the LOLE method :

- The ability to verify the results of the current method. The overwhelming importance of monitoring long-term reliability of supply makes it necessary that this option should be available.
- Having an international basis for comparison available. LOLE methods are used worldwide as an indicator of system adequacy. The application of similar methods moreover makes it easier together with other countries to carry out system adequacy analyses in the combined system.

7.1 Comparison of model outcome

Calculations have been made using the LOLE method on the basis of the same points of departure, the outcome of the existing appraisal method (degree of import reliance) having been vetted against the outcome of the LOLE model (expected value of number of hours per year during which the Dutch demand will exceed the Dutch supply) for the calculation scenario without imports and with availabilities in accordance with the generating companies' reports. Figure 5 shows the results of this comparison.

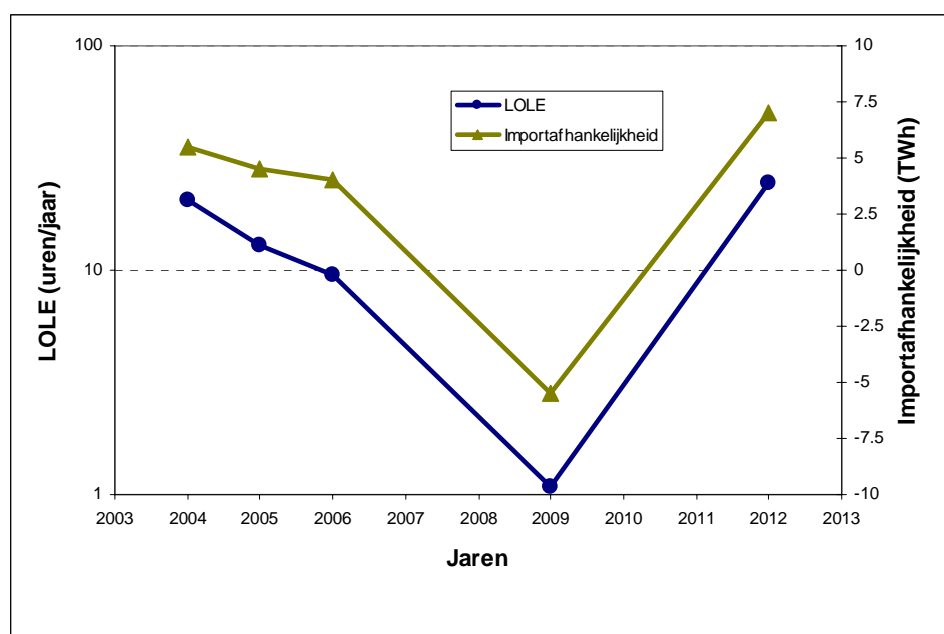


Figure 5

Comparison of outcomes of current appraisal method and LOLE model, scenario without imports and with availabilities as reported by generating companies.

The conclusion is that the two models produce similar outcomes. The results have moreover been compared for other calculation scenarios as well, and here too the outcomes were consistently similar.

Glossary

Contribution

Generating power contribution to market demand.

Commodity power (CP)

Domestically installed controllable generating power reported as having 2,000 running hours or over, “controllable” meaning that it can be switched on as and when needed.

Running hours

The number of hours per year during which a unit is in operation.

CP user factor

Generation projected on the basis of the outcome of the appraisal method as a share in generation for 8,760 full-load hours.

Market

Level of domestic electricity use inclusive of grid losses.

Modelled imports

- necessary

shortfall in supply from commodity power to enable permanent cover of the market demand prior to gate closure (leads to balanced E Programmes)

- sufficient

shortfall in supply from commodity power to enable permanent cover of the market demand after gate closure (leads to the ability to live up to E Programmes/balance preservation)

NA

Not available: the sum total of anticipated and unanticipated unavailability, expressed as a percentage.

Non-operational power

Domestically installed controllable generating power that is out of order and/or subject to conservation.

No-load

Complement of the capacity demand relative to the 95 percentile value of the capacity demand, per annum.

Reserve power

Domestically installed controllable generating power reported as having (or being expected to have) fewer than 2,000 running hours.

Recurring energy forces

Domestically installed generating power on the basis of recurring energy forces (e.g. wind, sun).

UCTE commitments

Required running reserve to be maintained by the Netherlands at all times pursuant to UCTE agreements (required primary and secondary reserve).

Full-load hours

The quotient of generation per annum and a unit's capacity.

Leeway

Average potential generation, per annum, of the commodity power not being taken up due to unavailability, no-load, market and UCTE commitments.

References

- 1] “UCTE System Adequacy Forecast 2004-2010” (December 2003), see http://www.ucte.org/pdf/Publications/2003/SAF_Report_2004-2010_web.zip
- [2] “UCTE System Adequacy Forecast 2005-2015” (January 2005), see <http://www.ucte.org/pdf/Publications/2005/UCTE-SAF-2005-2015.zip>