

Onderwerp Explanatory notes to the import and export of electricity

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Facts, **TenneT**'s view and answers to key questions:

- How do imports and exports work within the international power grid?
- How much transmission capacity is available?
- How is the available capacity distributed?
- What is the transmission capacity requirement and when is a sufficient quantity available?
- What are the plans for expanding the import/export capacity?
- What is the influence of imports and exports on the reliability of supply?

1. How do imports and exports work within the international power grid?

Rather than taking the shortest route to get from A to B, electrons find the path of least resistance, in accordance with the laws of physics, in their journey through the European power grid, so that the route they end up taking depends on the location and numbers of electrons injected into the grid by power plants and the quantity extracted from the grid by power users. This is what dictates the flow patterns or load flows, as they are called in the trade. While generators, traders and suppliers all over Europe merrily conclude generation and supply contracts, close tabs need to be kept on the ensuing physical flows, as transmission runs have a way of never turning out as the underlying contracts would have suggested. This is why the administrators of the European transmission grids, the Transmission System Operators or TSOs, regulate the international transmission runs as well as monitoring the load flows. **TenneT** as the Dutch TSO continuously works closely with its fellow TSOs in neighbouring countries, as all regions continuously affect one another. Information is exchanged and potential joint transmission hot spots are sorted while the market players go about their daily business, blissfully unaware of all of this.

A second important rule applies to the power grid, which is that demand and supply need to be balanced at all times, as it is impossible to store power in large(r) quantities. It is crucial that the power used at any given moment is generated at that very moment in power plants somewhere in Europe's extensive synchronously linked grid. It is each TSO's responsibility to preserve the balance between supply and demand in its own control area. Together the TSOs oversee the integrity of the system.

Whereas cross-border interconnections were used for lending assistance in emergencies in the past, nowadays they are used for commercial trade. The upshot is that the demand for capacity on the cross-border interconnections has grown. It is for this reason that the European Commission is advocating adequate interconnection between countries in promotion of the European energy market as set out in the internal power market directives. The Netherlands easily meets the relevant EC target.

In addition to enabling trade, an extensive interlinked transmission grid offers a high degree of resilience, as the impact of a power generation failure is effectively dispersed all over Europe owing to

this on-line system: if a power plant somewhere in this extensive grid collapses, this has no more of an impact than would a small pebble being tossed into a large pond.

2. How much transmission capacity is available?

The Dutch transmission grid of 50,000V (= 50kV) and upwards currently comprises five cross-border interconnections at top voltage (380kV) level: two between our country and Belgium, and three with our German neighbours. These five interconnections have 3,600MW in market capacity available for imports and the same amount for exports virtually all the time, as per the arrangements with the Belgian and German TSOs. This compares favourably with other European countries, about one fifth of aggregate power consumption in the Netherlands in 2003 having been imported from elsewhere. More than 3,600MW can be made available to the market provided the grid's load flow permits – in fact, the market is given access to as much as 3,850MW on occasion. Demand for capacity varies with market prices. Owing to international cost discrepancies there is currently keen demand in the Netherlands for import capacity, particularly during the day.

The existing Dutch interconnection is effectively up to importing a total of 5,000MW, of which the TSO requires 300MW to cope with exceptional operating scenarios, so that in theory 4,700MW could be made available to the market. However, this level is not yet practically feasible due to grid restrictions applying in other countries sparked by strong load flow fluctuations in the northwest of Europe and by erratic conduct on the part of market players. Moreover the plant deployment pattern in the Netherlands and elsewhere tends to be fairly changeable. For example, power injection into the grid in northern Germany has been quite erratic due to the large number of wind turbines, whose contribution to power generation depends on the weather. All of this is brought to bear on the load flow in all transmission grids and thus, on the transit flows that enter the Netherlands on one interconnection and exit on another, and has the effect of narrowing the securely available capacity margin. Upgrading of the internal grids in Germany and Belgium will also benefit the available cross-border transmission capacity.

3. How is the available capacity distributed?

The decision as to what quantity can be made safely available to the market is made by **TenneT** in consultation with other TSOs. This is a firm offer, which will only be departed from in emergencies. To this end the TSOs apply international grid security standards. Since 2001 the distribution to the market of the reconciled available cross-border capacity has been provided for through an auction, which **TenneT**, also acting on behalf of the relevant German and Belgian TSOs, organises. According to the Dutch Electricity Act and the various Technical Codes based on legislation, the auction constitutes a regulated activity. The **TenneT** subsidiary, TSO-Auction Office, auctions off the capacity in the following categories: "annual", "monthly" and "daily". (Reference is made to www.tso-auction.org for further information.)

The capacity is free of charge until the point where demand exceeds such capacity as is available. **TenneT** is limited in its use of the proceeds of the auction: these may only be put towards for expansion of the interconnection capacity or be used for other DTe-approved purposes (DTe, the Dutch Office for Energy Regulation, being the national watchdog).

TenneT assesses on the basis of the actual international transmission programmes whether transmission bottlenecks could occur in the grid. Market players are under the obligation to submit these exchange programmes on a daily basis. It is thus fair to state that those countries that are hooked up to one another have considerable mutual impact. The European TSOs have established a compensatory fund to make up for the adverse effects of transit flows. **TenneT** also needs the programmes so as to be able to preserve the balance throughout the Dutch grid. Although everything is always neatly balanced in advance, fluctuations occur as soon as implementation kicks off. These departures from the planned programmes spark off inadvertent exchanges with other countries, which **TenneT** has to make up for in accordance with international agreements.

4. What is the transmission capacity requirement and when is a sufficient quantity available?

The demand for interconnection capacity will persist as long as cost discrepancies continue to exist between the various countries. One of the reasons why prices are different is that there is no level playing field for generators in the various constituent parts of the European energy market in terms of tax regimes, environmental directives, grant schemes, legislation and regulations, and so on. It is expected that these differences between countries will eventually be phased out, which would open the door to exports from efficient, clean power plant in the Netherlands.

In view of this, **TenneT** carries out in-depth analyses prior to proceeding with sizeable investments in interconnective capacity. It primarily looks for enhanced utilisation of the capacity on the existing interconnections by working more closely together with the relevant TSOs both operationally and in terms of grid development. The planned cable connections with the United Kingdom and Norway will be realised once feasibility studies have confirmed that there is sufficient interest in the market. These planned cables are in line with the **TenneT** policy of linking markets together, as a way of enhancing market liquidity so as to render power pricing more stable, in support of the reliability of supply, inter alia, and are in accordance with the European Commission's push for the further strengthening of the European energy infrastructure so as to boost the European energy market.

5. What are the plans for expanding the import/export capacity?

TenneT is keen to make better use of the existing direct – synchronous – interconnections with the European UCTE grid via Belgium and Germany as well as being in the process of sounding out the scope for new direct-current connections with the Norwegian and British markets, neither of which is currently linked to Europe's synchronous grid. Direct-current (DC) cables are impervious to the aforementioned load flows in the European grid and operate independently of balance preservation and frequency.

Belgium

There are currently two 380kV interconnections between the Netherlands and Belgium: one at Maasbracht and the other at Geertruidenberg/Borssele. The Netherlands imports considerable amounts of French-generated power, which implies sizeable transit flows through the Belgian grid. Moreover, as no interconnection is in place between the Belgian and German high voltage grids, part of the Belgian-German as well as the French-German trade brings about considerable transit flows through the Dutch grid. Elia, the Belgian TSO, is currently working on upgrading the Belgian interconnections with France and the Netherlands.

Germany

Three 380kV cross-border interconnections are currently in place between the Netherlands and Germany. These are located near Meeden, Hengelo and Maasbracht, respectively. Two phase shifters were installed in Meeden in 2003 which have enabled better control of the transmission flows. A similar phase shifter is located at Gronau, in Germany. If these phase shifters were not available, the available transmission capacity would currently be several hundreds of megawatts lower. The original plan was for these phase shifters to provide the market with an additional 1,000MW in import capacity. So far this has not been achieved due to the strong fluctuations in load flows internationally, the erratic wind power supply being one of the contributing factors. As soon as grid restrictions ease off in Germany or Belgium owing for example to grid investments being made, this would be expected to enable the further upgrading of the available transmission capacity. **TenneT** is discussing this with the relevant TSOs while the Dutch Ministry of Economic Affairs is working on arrangements being agreed with the German authorities providing for the strengthening of the energy infrastructure.

United Kingdom

The BritNed project, in which **TenneT** collaborates with its British counterpart, National Grid Transco, is aimed at paving the way for a 800-1,320MW transmission cable to be laid across the sea bed between the Netherlands and the United Kingdom. The final decision is expected to be made by mid-2005. Linking up the two markets is a lucrative option owing to the British market having a different demand and supply pattern. The cable to be laid would provide for a DC rather than an AC connection, as DC connections are impervious to the aforementioned load flows in the European grid.

Norway

TenneT and its Norwegian counterpart, Statnett, are currently investigating the feasibility of a 600MW (envisaged capacity) DC cable across the sea bed between the Netherlands and Norway. The feasibility study is scheduled to be completed before the current year is out, so that the transmission cable could be taken into operation by 2008 at the latest. In Norway 99% of electricity is generated using renewable hydropower whereas Dutch power plant by contrast mainly run on gas and coal. The cable would open up attractive opportunities for market players. For example, Dutch power plant could supply Norwegian users at night, when Dutch demand drops off, enabling the Norwegian water basins to fill back up and subsequently supply power to Dutch users during the expensive daytime peaks.

6. What is the influence of imports and exports on the reliability of supply?

The rule of thumb is that the more closely markets are linked together, the better this works out in terms of market performance owing to greater market liquidity and thus, superior pricing, which in turn helps boost reliability of supply. Stable pricing, after all, serves as a key yardstick for investors in new generating assets. A robust grid is the cornerstone of healthy competition between major European power generators, with competitive market prices ultimately benefiting the users.

TenneT during the first half of 2003 investigated the reliability of supply in the electricity market, at the request of the Ministry of Economic Affairs, with a particular focus on whether sufficient supply would be achieved in the market in the longer run. The development of demand and supply in the electricity market has been projected until the year 2010, due allowance having been made for the scope for imports and exports. The initial conclusion has been that although sufficient supply is basically in place until 2010 to meet the domestic demand, it has been established that the reliance upon other countries in terms of power supply is set to increase in years to come if no new power plant come on stream. This need not be a problem provided the European market performs as it should. **TenneT** analyses European market trends and long-term availability of foreign supply on an annual basis; its monitoring is to be embedded in national legislation.