Conclusion of the GDP 2014, first draft

This Grid Development Plan 2014 (GDP) is already the third GDP to be presented for public consultation by the four German transmission system operators (TSOs) 50Hertz, Amprion, TenneT and TransnetBW. The Grid Development Plan deals with the expansion requirements of the German onshore energy transportation network and is based on the legal requirements as stipulated by the Energy Industry Act (*EnWG*) (Section 12a-d). The transmission system operators are planning, developing and building the grid of the future. The GDP is used to show how power generation in Germany can successfully be restructured and renewable energy can be integrated within ten and twenty years.

Process and methodology
By presenting the assumptions regarding the generation and consumption structure, the calculation method used and the resulting requirements for grid expansion on a public stage, the whole process of grid development planning is made very transparent. The GDP 2014 uses the same methodology as the GDP for 2012 and 2013 and as approved by the German Federal Network Agency *(Bundesnetzagentur*). In terms of assumed energy generation capacity and the consumption situation in the future, the scenario framework, as approved by the Federal Network Agency on 30 August 2013, is used as a starting point for creating both the Grid Development Plan and the Offshore Grid Development Plan 2014 (in accordance with Section 12b and Section 17b of the Energy Industry Act).

The transmission system operators are constantly working to further develop the methods and simulation tools used for network planning. Improvements have been made to the market simulation methodology for the Grid Development Plan 2014 compared to the Grid Development Plan 2013.

For this GDP consultation, the TSOs also present a more advanced methodological approach for evaluating grid expansion measures; this method is exemplary in more comprehensively demonstrating the necessity and effectiveness of certain extension measures described in Scenario B 2024.

As with the last two Grid Development Plans, grid optimisation and enhancement measures were given priority over pure grid expansion measures. The “NOVA principle” (NOVA is a German acronym for the optimisation, enhancement and expansion of the grid [*Netzoptimierung, -verstärkung und -ausbau*]. According to this principle, grid optimisation and enhancement have priority over the expansion of the grid.) That forms the basis of the Grid Development Plan is already guided by the optimal usage of existing power line routes.

Just like its predecessors, the GDP 2014 highlights the transmission requirements between start and end points. As a rule, starting points are located in regions with surplus energy generation whilst end points are in regions with high levels of consumption or at nuclear power stations, which are to be closed by 2022. Like its two predecessors, the present Grid Development Plan 2014 does not detail any spe-

cific routes for new transmission lines, but rather documents the levels of transmission demand required between grid nodes. Future line connections from one substation to another substation are calculated. Specifically named locations to denote start and end points are purely technical statements that serve to identify existing grid connection points. Exact line corridors or routes are not determined until later stages in the approval procedure (e.g. federal sectoral planning, planning permission). The GDP does not define locations for future power stations, renewable energy facilities or a market design for the future, nor does it give recommendations or suggestions for optimisation.

Alongside the expansion of the 380 kV alternating current systems, high voltage direct current (HVDC) connections are also planned to handle the long-range transmission requirements from north to south. These enable low-loss transmission over long distances and, thanks to the use of modern technology, help to stabilise the alternating current network. The otherwise necessary, far more large-scale AC grid expansion is thus avoided. Converter facilities are required for injection and withdrawal, which significantly limit the number of potential tension points along the route.

The additional optimisation and expansion of the 380 kV alternating current system is also required along with the utilisation of direct current technology. So as to minimise the demand on new transmission routes, it is planned that this expansion will use the routes of the current 220 kV network insofar as is possible. The combined use of direct current and alternating current technology as proposed in the GDP enables the collective optimisation of the transmission network to match with the development of supply tasks over time as well as future transmission requirements with regard to network stability, economic efficiency and spatial demands.

Network analysis results

Due to the scope of three different scenarios, the network measures investigated cover a wide range of possible future developments. For example, Scenario A 2024 comes very close to the new, aggregated goals for generation of energy from renewable sources as proposed by the German federal government. In light of the planned modifications of the goals for energy policy as laid out in the coalition agreement of the current German government, as well as the key points of the German Renewable Energy Act reform (*EEG Reform*), it would appear that, in contrast to the GDP 2013, it is no longer appropriate to label one Scenario (e.g. Scenario B 2024 or A 2024) as a “lead scenario” and designate its network as the result of the Grid Development Plan.

The measures reported in previous Grid Development Plans have still proved to be consistent even when parameters in the relevant scenario framework are changed. Thus, all four direct current corridors are still required to handle long-distance north-south transmission demands in all three scenarios. It is also clear that in all scenarios a starting grid that is simply expanded according to the measures included in the Federal Requirement Plan (*Bundesbedarfsplan*) will not suffice to cover the levels of transmission demand. This confirms the necessity of all the measures stipulated in the Federal Requirement Plan. The stability evaluation clearly shows that the levels of network load that occur in the GDP 2014 are com-

parable with those in the GDPs for 2012 and 2013. In general, no changes can be seen in the indication of problems regarding transient stability and voltage stability.

In Scenario A 2024, the volume of grid enhancement along existing routes (recabling or circuit requirements, construction of a more efficient power line along existing routes) amounts to 5,300 km. By way of comparison – the entire volume of the today's extra-high voltage network is around 35,000 km. In Scenario A 2024, the required level of expansion is calculated at 3,500 km, 2,000 km of which are HVDC corridors. This also includes the German share in the three direct current interconnectors between Germany and Belgium, Denmark and Norway with an onshore length of approximately 200 km. The transmission capacity of the HVDC corridors totals ten gigawatts.

In comparison with Scenario B 2024, Scenario A 2024 presents the development of renewable energy sources spread out over a longer period of time. The AC grid expansion measures outlined in Scenario A 2023 of the GDP 2013 are also largely necessary in Scenario A 2024. In comparison with the resultant networks of the other scenarios, it is clear that here the need for expansion measures in the long-term does not diminish in any way, but is simply stretched out over a longer period of time.

The investment costs for the network measures are calculated in the Grid Development Plan on the basis of specific cost estimations and are of a provisional nature. Depending on the scenario, the total volume of investments over the next ten years totals between 21 and 26 billion euro. No conclusive statements can be made in the Grid Development Plan regarding cabling and partial-cabling as these are subject to later approval procedures.

Additional findings in light of current political discussion
In a digression in Chapter 1, the transmission system operators interpret the results of the GDP 2014 against the backdrop of the German government's new key issues for a reform to the German Renewable Energy Act.

In all scenarios, the expansion of wind power has the strongest influence on nationwide transmission requirements in a north-south direction, as, in some cases, the level of wind energy output far exceeds regional demand. Wind energy therefore continues to be decisive for the expansion of the grid. According to the preliminary estimations of the transmission system operators, if the outline data from the current EEG key issues paper is adhered to, no significant reduction in demand for onshore grid expansion is to be expected compared to those presented in Scenarios A and B. The qualitative analysis carried out in the digression looking at the impact of the key issues currently being discussed for a reform to the German Renewable Energy Act on the necessity of expanding the transmission network reveals that the current Federal Requirement Plan continues to form a solid core of the grid expansion required in the future and that, with regard to Scenarios A and B, the long-term necessity of expansion measures is not greatly reduced, but simply spread over a longer period of time.

In addition to the GDP 2014, the transmission system operators give political value to the new basic conditions by presenting the GDP alongside their report on factors influencing grid development, which provides the first detailed review of the impact of individual parameters from the planned Renewable Energy Act policy reform on grid expansion. Here, the specific consequences of extending the timeline of offshore grid expansion and of the peak capping of new renewable energy facilities for the expansion of the grid. Thus, the transmission system operators also make a significant contribution to the current political debate. However, these factors that influence grid development cannot be seen as anything more than additional indicators and do not allow for the investigation of a new, to-be-confirmed target grid. Further points in the Renewable Energy Act reform that have yet to be specified in sufficiently concrete terms will likewise have a decisive effect on grid expansion. However, these still have to be defined politically and then modelled to create a complete framework for the precise, detailed evaluation of the impact upon the demand for network development.

Recommendations for the Grid Development Plan 2014
In this GDP 2014, in view of the changes currently being discussed to the Renewable Energy Act, the transmission system operators do not recommend the approval of a target grid whose structure is free from congestion. In addition to the measures of the Federal Requirement Plan and the approved measures from the GDP 2013, they simply propose the approval of three projects that are directly related to essential, already-approved measures. Further measures, which are investigated in the network analysis, are to be assessed and then prioritised in terms of their economic and ecological efficiency and their effectiveness in stabilising the network in a later GDP 2015, which will be based on new scenarios.

As long as progress in implementing the turnaround in German energy policy continues along the same path that has already been started, i.e. phasing-out nuclear power and the dynamic expansion of renewable energy sources for energy supply, the GDP measures approved from 2012 and 2013 are still just as urgently needed as before. The adjustments to the Renewable Energy Act that are currently being discussed do not mean a fundamental reversal in policy, but rather a simple extension of the time given to develop individual generation methods, such as wind power. This means that certain network development measures will also be postponed, without becoming obsolete.

The transmission system operators are merely building an energy network that is needed in order to facilitate the turnaround in energy policy efficiently and securely on the part of the transmission network. The Federal Requirement Plan has proven itself to be a solid foundation for network development over the coming years. This forms the basis of the target grid reported in Scenarios A 2024 and B 2024, also in light of the current Renewable Energy Act reform proposals.

Grid expansion is a fundamental requirement for the success of the turnaround in German energy policy. The speed of grid expansion determines the speed that the turnaround in energy policy can be implemented. If this continues to remain behind the speed at which renewable energy generation facilities are expanding, the aims of the turnaround in energy policy and the security of power supply will both be

placed in jeopardy. Furthermore, high costs would be incurred in other places if the optimisation, development and expansion of the transmission network were to be neglected.

The current draft of the Grid Development Plan 2014 will be made available by the transmission system operators for public consultation until 28 May 2014. Responses from the consultation process will be taken into consideration when drawing up the second draft of the GDP 2014. The transmission system operators hope to see as high a level of interest and participation in the consultation process for this draft as in 2013.