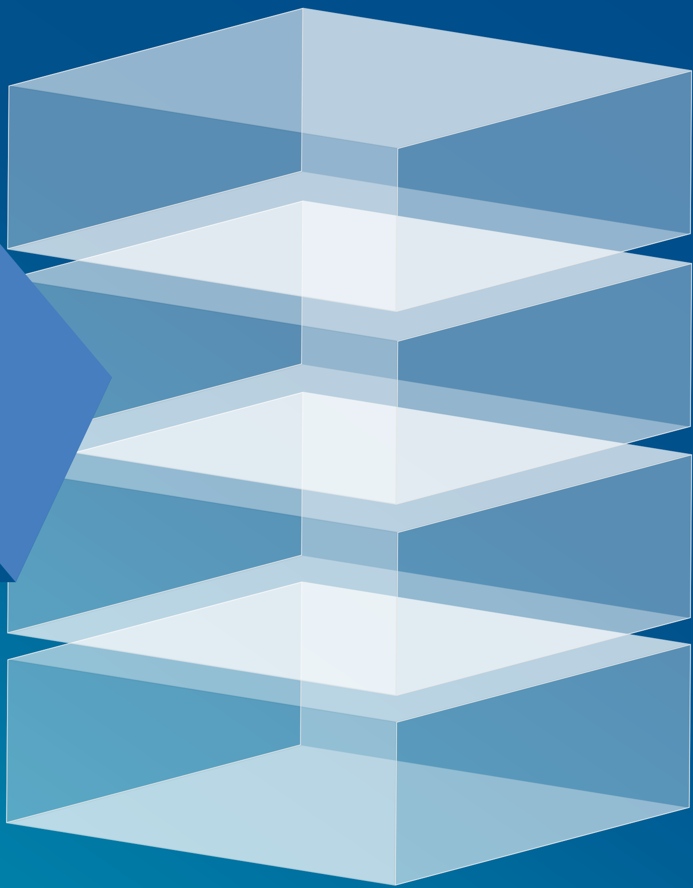

SUMMARY

dena Grid Study III

Stakeholder dialogue on the development of planning procedures for energy infrastructures for a climate-neutral energy system

Summary of Results

Over the past three years, dena, together with a broad range of partners from the energy industry, politics and civil society, investigated how our energy infrastructure planning needs to be developed to meet the requirements of a climate-neutral energy system in its dena Grid Study III.

The central results of the dena Grid Study III are presented here. This summary was discussed thoroughly with the committees advising the development of the study. In the main study, these results are explained in detail from dena's point of view and supplemented by expert opinions.

Integrated planning of energy infrastructures is necessary to meet the requirements of a climate-neutral energy system.

The development of the different energy networks should be better coordinated during the transformation of the energy system. This applies both to the transmission grids for electricity, gas and, prospectively, hydrogen, as well as the distribution grids, where it will be necessary to coordinate the planning of an appropriate infrastructure for the heat transition, for instance.

Integrated planning of energy infrastructures complements measures to efficiently develop energy infrastructures, such as the acceleration of approval procedures or the higher utilisation of capacities in the electricity grid. The advantages of integrated planning cannot be used today because the infrastructure planning processes are not sufficiently coordinated, both in terms of time and essential input variables. This is partly due to the lack of a common target.

Integrated planning means better coordinating existing planning processes by defining new interfaces and using common input variables, as well as synchronising the timelines. Due to the high level of complexity, it is not feasible to merge the different processes into a single process; doing so would not meet the specific requirements of the respective planning processes. Evaluating potentials for systemic optimisation across sector boundaries requires considering the system as a whole, which would overload the existing infrastructure planning processes. Consequently, a solution should be found in an upstream process: the System Development Plan.

An upstream System Development Plan complements existing energy infrastructure planning processes by providing a consistent, coordinated framework.

The System Development Plan (SDP) is a strategic planning instrument at the system level. It is a process upstream of the previous infrastructure planning, which creates room for a broad discussion on the development of the energy system, makes optimisation potentials of the integrated energy system available, supports political decisions and, as a result, provides a consistent basis for the subsequent infrastructure planning processes.

The central task of the SDP is to depict a future for which energy infrastructures should be prepared. The SDP takes into account overarching European and national targets and develops a consistent framework for cross-sectoral infrastructure planning. Within this consistent framework, the various energy infrastructure planning processes can devote themselves to identifying network development measures. In addition, they have planning certainty with regard to their assumptions and would no longer have to fulfil policy advisory tasks.

The SDP can increase acceptance for the transformation of the energy system and infrastructure development by enabling participation and a transparent debate at a point in time when there are still opportunities to influence the design of the future energy system. Therefore, the SDP should be developed in a participatory process involving stakeholders and civil society, legitimising the results and placing them on a broad societal basis.

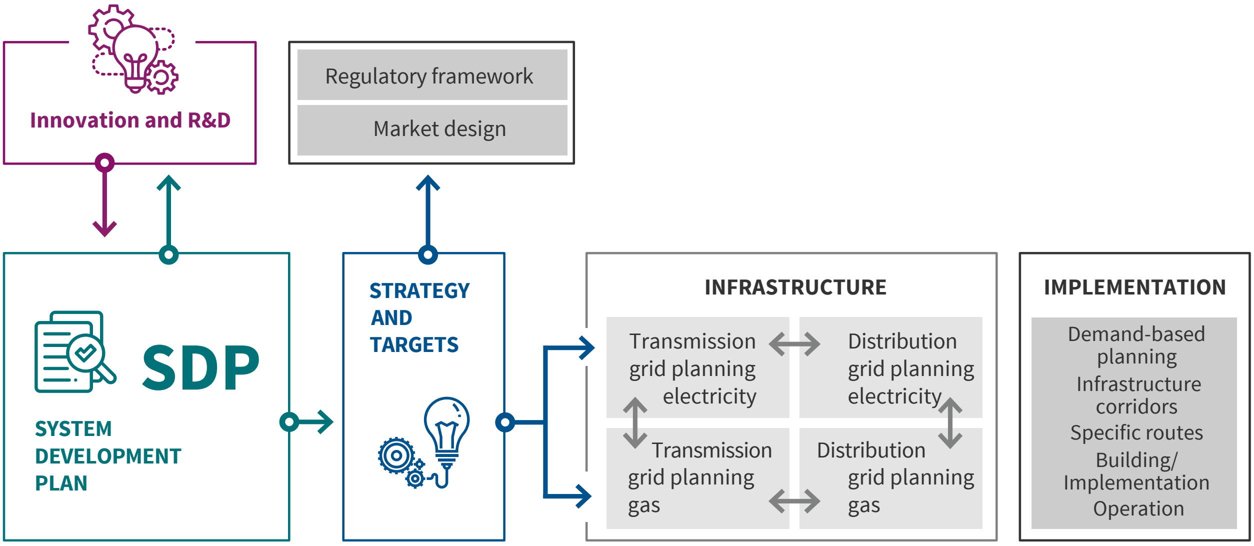

Figure 1: The SDP and its role in infrastructure planning

The results of the SDP are a recommendation to policymakers and an orientation for companies.

The SDP process has three outcomes: a vision, a set of anchor points and a strategy. The vision describes developments relevant to energy infrastructure in a climate-neutral energy system. It identifies developments that can be assumed as certain but also describes uncertainties where different development paths, technology options or energy sources are possible. Anchor points are the quantitative SDP recommendations. They contain, for example, final energy consumption by energy source or certain target values such as renewable energy expansion, import quantities etc. These anchor points can also be given in bandwidths to account for uncertainties. The strategy describes how the vision can be successfully implemented. It contains a well-founded catalogue of recommendations for policymakers.

The anchor points become the binding basis for the scenario frameworks of the following Network Development Plan processes through a political decision. Once confirmed by the government, anchor points set the scope for the scenarios of the subsequent infrastructure planning processes. However, they do not replace the scenario frameworks of the Network Development Plans, which are significantly more detailed.

The results of the SDP are developed in a two-phase process with 14 steps. In the first phase, a broad solution space is set up. It enables dialogue on possible transformation paths and an assessment of their consequences on infrastructure needs. The result of this phase is an initial vision, which is the basis for a public consultation. In the second phase, the solution space is condensed based on the feedback from the consultation and a further analysis. This results in a validated vision and the recommendation for a strategy as well as the anchor points.

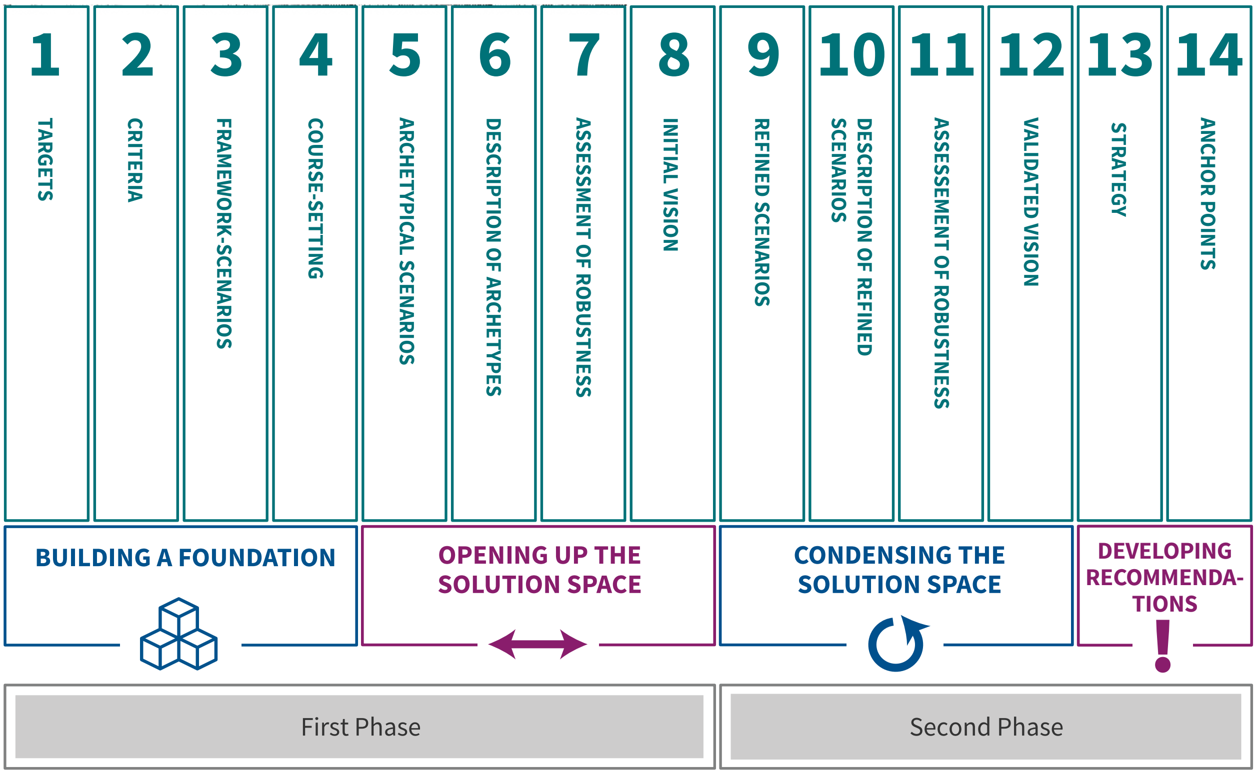

Figure 2: Phases and steps of the SDP methodology

An SDP process should be carried out every four years to ensure that the basis for infrastructure planning is developed consistently and adapted to current targets and developments. As the Network Development Plan (NDP) processes take place every two years, individual anchor points should be updated two years after implementing a full SDP. The extent of this additional SDP process must be assessed based on the necessary changes. Through a political decision, the anchor points become the binding basis for the scenario frameworks of the subsequent NDP processes. An initial SDP should be launched as soon as possible to make the results available to the NDP processes starting in 2024.

Figure 3 shows the chronological sequence of an SDP process starting in mid-2022 as it fits with the upcoming NDP processes. In order for the results of an SDP to serve as a basis for both scenario frameworks of the NDP, the NDP processes for electricity and gas should be synchronised from 2024/2025 onwards.

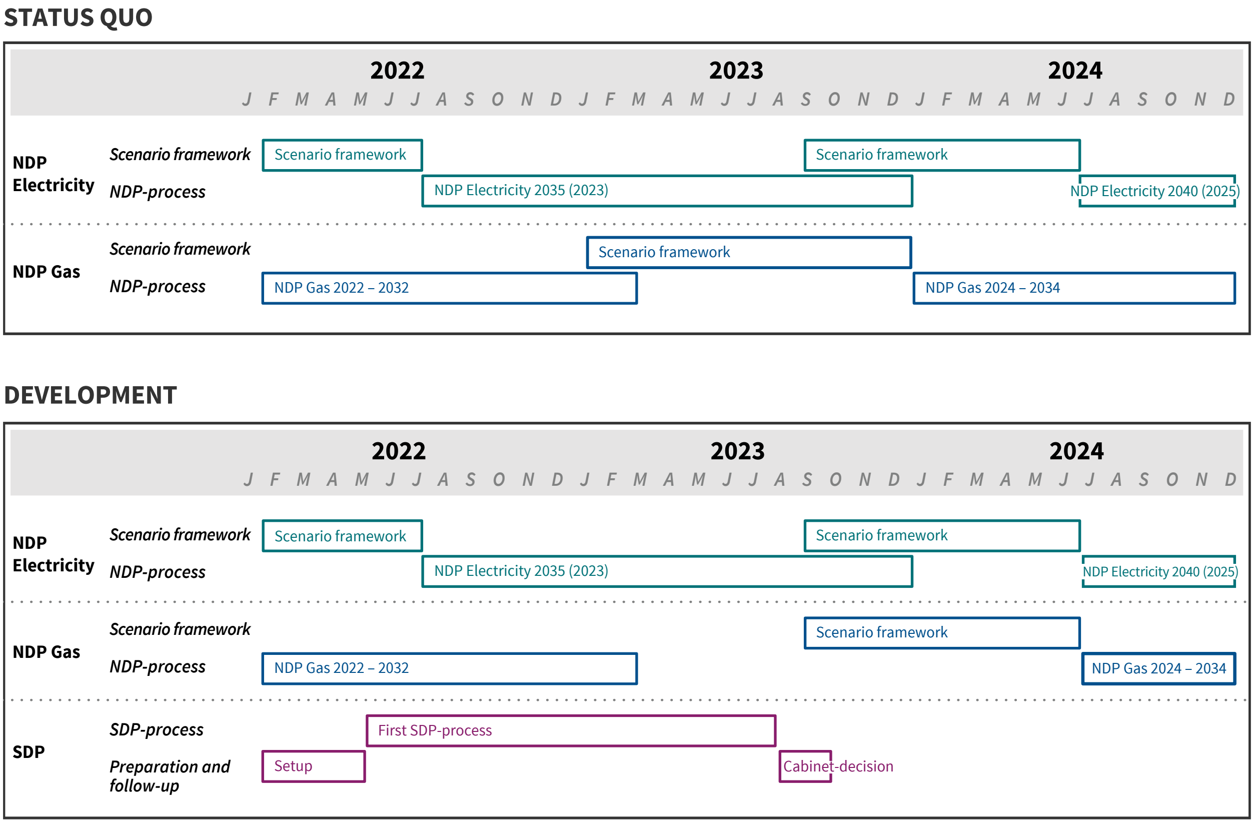

Figure 3: Example of the possible timeline of an SDP process as it fits with the NDP processes

The results of the SDP must be sufficiently politically legitimised to guide the subsequent infrastructure planning processes.

The SDP should be anchored in the Energy Industry Act (EnWG). The SDP and its role for the subsequent processes should be defined, and the SDP process described there: SDP as an upstream planning process to the NDPs; rerun at least every four years; time horizon of the SDP, for example, the target year 2045; government's obligation to take the results of the SDP into account and derive binding anchor points for the subsequent infrastructure planning processes.

The SDP can become the basis for the scenario frameworks of the NDPs through an adjustment in § 12a EnWG and § 15 EnWG by making it mandatory to consider the confirmed anchor points of the SDP for the scenario frameworks.

There should be a cabinet resolution to give the recommendations of the SDP political legitimacy. This resolution would be the basis for considering the results in the downstream processes. The ministry in charge of energy infrastructure planning steers the SDP process and feeds the results into the political process with the aim of bringing about such a cabinet decision.

The SDP is socially legitimised through broad public participation, which is implemented through a stakeholder platform accompanying the process, a citizens' dialogue and a public consultation on the initial vision.

The stakeholder platform is a plenum consisting of 40 to 50 high-ranking representatives from business, politics and society. Moderated and chaired by the ministry responsible for energy infrastructure planning, the plenum continuously accompanies the SDP process and is involved in key decisions.

Working groups (WGs) can be established to introduce the plenum's expertise on specific issues into the process. Important working groups are:

- WG System Operators, in which system operators contribute their knowledge and experience in grid and system modelling
- WG Society, which ensures that the SDP addresses important socially relevant issues with regard to infrastructure planning
- WG Federal States, in which, among other things, allocation issues and their effects on the federal structure in Germany are discussed
- WG Innovation, which promotes the consideration of innovations in infrastructure planning

A broad social debate on the initial vision should be implemented, modelled on the citizens' dialogue on the Climate Protection Plan 2050 and the Citizens' Council on Climate. In this SDP citizens' dialogue, randomly selected citizens discuss the content and implications of the vision, develop their own recommendations and present them for debate in a plenary session. The ministry responsible for energy infrastructure is responsible for moderating and chairing the plenary.

In discussing the vision, possibilities for further opening up the process can be considered. The following instruments can, for example, be used in addition to the citizens' dialogue:

- A public consultation
- Separate discussions with the Federal States and regional stakeholders
- A debate in the Bundestag on the results of the initial vision
- Consultation of associations

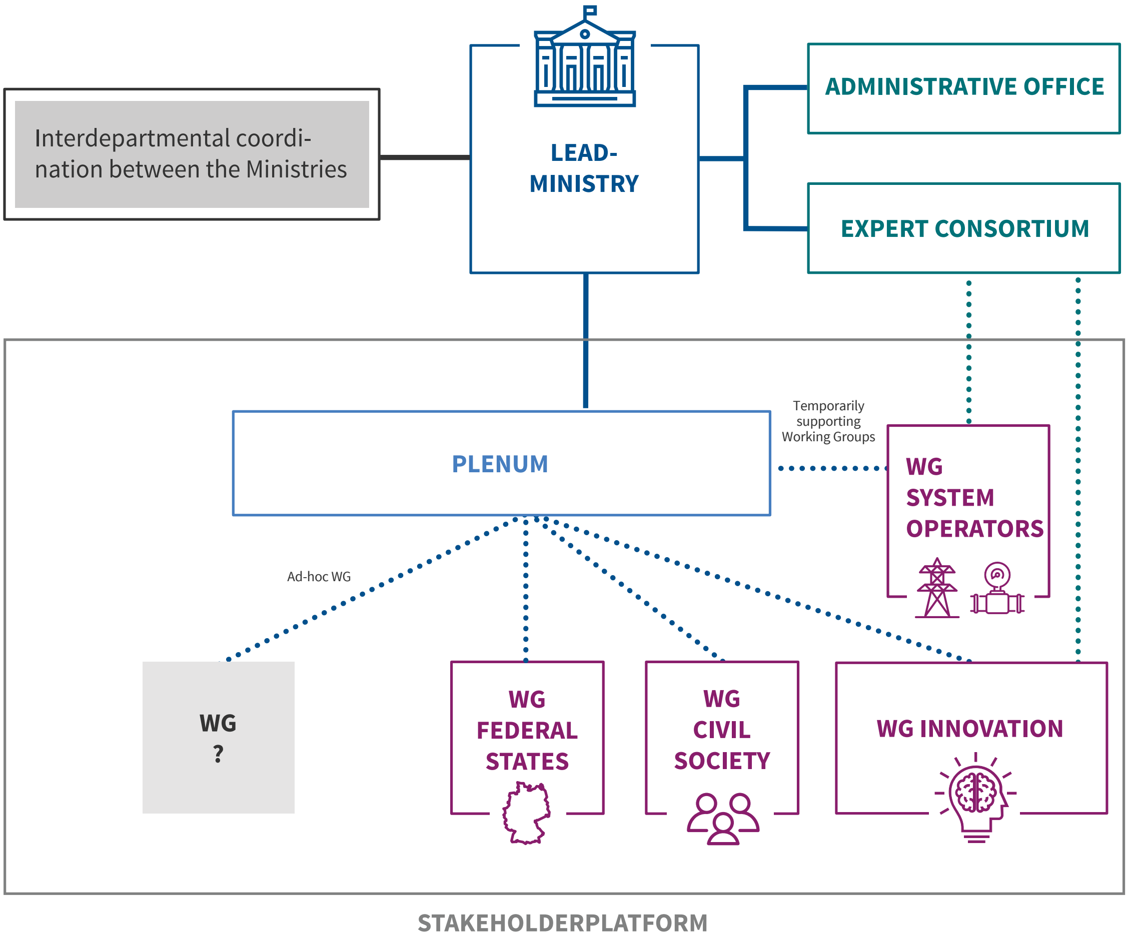

Figure 4: Organisational structure of the SDP bodies

An expert consortium and an administrative office should be appointed to support the government in implementing the SDP.

The expert consortium's main task is to carry out the analyses necessary for the SDP. It should be positioned to conduct research and analyses on issues and tasks arising in the SDP process and to use this knowledge to support the ministry, the plenum and the working groups.

A high degree of transparency by the expert consortium is necessary to strengthen the confidence of the stakeholders involved in the SDP. All plenum participants should receive the necessary information to understand the modelling of the expert consortium. The model used for the SDP analyses must be well documented, and assumptions, data and results must be comprehensible and verifiable for all participants in the stakeholder platform.

The administrative office organises and structures the process. Its tasks include organising and moderating the meetings of the stakeholder groups, coordinating between the committees and documenting the status of the process.

In addition to introducing the SDP, integrated infrastructure planning requires changes in the existing Network Development Plans (NDP).

Transmission system operators (TSOs) for electricity and gas should work closely, exchanging information as the NDP is prepared to ensure that assumptions and results (e.g. allocation of electrolysers) are consistent. To this end, it would be helpful to synchronise the NDP Electricity and NDP Gas processes, which are currently conducted one year apart from each other. The NDP Gas should be expanded to include a t+15 scenario and reflect the same time horizon as the NDP Electricity. If the target year 2045 is considered in the planning, for example, when modelling the climate neutrality network demanded by the coalition agreement, it is also necessary to coordinate electricity and gas network operators.

For the t+15 scenario of the NDP Gas, planning should be scenario-based and take into account current climate targets. The scenarios with shorter horizons (t+5, t+10) should continue to be based on a demand survey. However, it must be ensured that a plausible transformation path can be defined for all scenarios.

To build a hydrogen infrastructure, an initial H_2 transport network should be established, primarily by converting available gas network capacities. A planning process for hydrogen infrastructure is necessary to further develop the initial network in line with demand. The NDP Gas and the planning process for hydrogen infrastructure must be very closely coordinated, as the options of converting existing gas pipelines or building new hydrogen pipelines must constantly be weighed up.

Integrated infrastructure planning should also be implemented in distribution networks. The results of the SDP provide guidance for a consistent overall strategy for developing the transport and distribution networks.

The planning of regional and local energy infrastructures should be consistent with the overarching vision of the SDP. Due to the rough regional resolution of the vision of the SDP, no direct provisions for distribution network planning (comparable to the anchor points for the transmission networks) can be derived from the SDP. Distribution system operators (DSOs) of gas and electricity grids, operators of heating grids with overlapping grid areas and neighbouring DSOs should develop a uniform energy strategy and work together to develop an energy master plan informed by the anchor points of the SDP. Integrated planning requires the formation of regional clusters exchanging information and experiences and identifying solutions in cases of conflicts of interest between the various infrastructure operators.

At the distribution grid level, integrated planning is very diverse, as heating grids must also be taken into account. Therefore, solutions and approaches can be specific to the local situation and must be designed to suit local requirements. At the distribution grid level and for heating grids, the landscape of stakeholders is very heterogeneous, which leads to different constellations of actors and affected grid areas depending on the region. Therefore, integrated planning at the local level must create structures specific to the local stakeholder constellations. In the case of competing business models, they must be able to ensure a balance of interests and resolve questions as to how the provision of basic services can be assured, for example, if gas distribution networks are decommissioned.

Local actors should be supported in identifying solutions by creating exchange formats and disseminating best practice approaches, for instance.

The SDP needs an additional innovation dialogue to proactively account for future developments to support efficient infrastructure planning.

An innovation dialogue should not be limited to individual technologies but should define various fields of development (so-called functionalities) to develop the infrastructures without prejudging outcomes and to systematically identify research gaps.

From today's perspective, important functionalities include:

- Network state estimations and the ability of control (knowledge of the actual network condition with the aim of evaluating the network state under thermal as well as dynamic (stability) aspects)
- Optimisation of the existing network (higher capacity utilisation) and increasing electricity transport capacity
- Grid-forming or grid-supporting capabilities (inherent safeguarding of grid frequency and voltage or safeguarding through fast regulation)
- Quality monitoring for gas and hydrogen as part of network operation to ensure gas quality/purity
- Efficient and secure communication in the network and between actors for fast data exchange via appropriate communication channels
- H_2 readiness for the gas system (infrastructure, end users) for a timely and cost-effective conversion from gas to hydrogen when hydrogen networks are expanded

A Working Group Innovation should also evaluate the associated regulatory framework with regard to innovation friendliness, identify solutions and contribute to removing existing and emerging barriers. In addition, the maturity and potential of known innovations should be assessed as to their applicability and potential for optimising infrastructure needs.

For the innovation dialogue, a separate working group (see above: WG Innovation) should be created within the framework of the SDP governance structure. The expert consortium works with this working group by providing it with the necessary results. The results of the WG Innovation are part of the strategy developed as an outcome of the SDP.

Planning sovereignty of network operators as well as the examination by the regulatory and licensing authorities should remain untouched. An innovation dialogue supports the planning process by increasing the visibility of (novel) innovations and by providing recommendations.

Aspects of the market design can have a high impact on infrastructure needs. Therefore, grid- and system-serving aspects should also be examined and taken into account in the design of markets.

The significant increase in fluctuating renewable electricity generation poses considerable challenges for the system as a whole. Therefore, the expansion of the electricity grid must be accelerated. In addition, existing and new flexibilities within and outside the electricity sector should be used in a way that serves the system. An efficient allocation of loads and generation capacity can also contribute to easing the strain on the electricity grids. The current market design does not encourage this sufficiently. The following approaches to improve this situation were discussed in the dena Grid Study III:

In the electricity sector:

- Bidding zone configuration
- Grid fees
- Expansion of the energy-only market to ensure the security of supply (for example, capacity mechanisms)

In the energy sector as a whole:

- Taxes/levies/surcharges

An initial assessment of the different options has shown the following: Splitting the German electricity market area into several zones is currently considered by the European Commission and some market participants if the massive congestion in the German transmission grid does not disappear. However, doing so would involve considerable effort for grid operators and market players and would lead to distortions in the market. In addition, it is not certain that a market zone division would lead to the elimination of the grid bottlenecks. Therefore, accelerated grid expansion and the activation of flexibilities to relieve bottlenecks should be prioritised. Reforming electricity grid charges can improve the grid-serving use of flexibilities and contribute to an efficient spatial allocation of loads and generators. Time-of-use tariffs, smart connection agreements and deep charging are concepts that should be examined more closely.

At present, the grid and capacity reserve, as well as the security reserve, ensure an uninterrupted supply of electricity. However, they will not be able to continue in their current form due to the phase-out of coal-fired power generation and limited contract terms. An updated regulation of the current reserve mechanisms is required to maintain the security of supply. This also serves to safeguard grid operation. The Federal Government should examine possible alternatives as soon as possible. Promising options could be a strategic reserve or a focused/selective capacity market, both of which must be designed with a view to future climate neutrality. Also due to EU regulations, demand-side management (DSM) and storage must be included alongside hydrogen-ready gas-fired power plants in both cases.

A comprehensive reform of taxes, levies and charges on energy sources is needed. This reform should focus on the pricing of greenhouse gases (GHG) and infrastructure charges to ensure a level playing field for climate-neutral energy sources in the long term. For the transition period, the reformed system should focus on reducing the GHG content of energy carriers, financing the respective infrastructure and strengthening sector coupling. In doing so, EU legal and budgetary framework conditions must be taken into account.

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