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Grid planning at Swissgrid

How Swissgrid is developing the Swiss transmission grid

Date 30 April 2025

Swissgrid is shaping Switzerland's transmission grid for future generations. Swissgrid ensures a stable, high-performance and efficient supply of electricity thanks to forward-looking grid planning that is enshrined in law. The coordinated expansion of the grid is based on transparent considerations, sustainable principles and the involvement of all relevant stakeholders.

This document provides an insight into the methodology and the main principles of long-term grid planning at Swissgrid.

Contents

1 Executive summary

The continuous further development of the Swiss transmission grid and coordination with other grid operators are key statutory tasks for Swissgrid.[1] They will allow Swissgrid to continue to help implement the energy strategy and to ensure a secure, high-performance and efficient supply of electricity in the coming decades.

As part of the Strategic Grid project, Swissgrid regularly updates and publishes its long-term grid planning. The legal basis was set out in the new Federal Act on the Renovation and Expansion of the Grids (Electricity Grid Strategy) and established in Art. 9a–d of the Electricity Supply Act (ESA; SR 734.7).

It is intended that the Federal Council will approve the Scenario Framework Switzerland (SZR CH) prepared by the Swiss Federal Office of Energy (SFOE) following a public consultation.

Swissgrid and the distribution system operators on the transmission system (extra-high-voltage distribution grid, grid level 3) regionalise the national requirements set out in the SZR CH on the grid nodes of their grids. Following the approval of the SZR CH by the Federal Council, Swissgrid has nine months, in accordance with Art. 9d, para. 1 ESA, to determine the grid expansion requirements for the transmission grid, i.e. the Strategic Grid, and to submit these to the Federal Electricity Commission (ElCom) for review. ElCom must notify Swissgrid in writing of the result of the review within nine months of submission (Art. 22, para. 2bis ESA). Swissgrid then publishes its Strategic Grid.

This process is repeated every four years.

This document defines how Swissgrid approaches long-term grid planning. It sets out the objectives of grid planning, the framework conditions and the main principles of grid planning. These form the guardrails for the planning process, both now and in the future.

Sustainable, resource-saving, environmentally friendly and economically efficient grid planning is important to Swissgrid. The grid of the future should be stable and secure to operate. Grid expansion is not carried out to create advance capacity, but on the basis of comprehensible and transparent considerations. Swissgrid involves all affected stakeholders in its grid planning and communicates transparently and comprehensibly. This ensures coordinated expansion planning whilst avoiding parallel investments and blind spots.

This document («Grid planning at Swissgrid») is published on the Swissgrid website and adapted as necessary.

[1] Cf. Art. 8, para. 1 and Art. 9a–d ESA.

2 Structure of the document

This document is divided into the following sections:

1. **Section 3** serves as an **introduction.** It outlines the objectives of this document, summarises the history of long-term grid planning and describes the regulatory framework in Switzerland and Europe.
2. **Section 4** provides an overview of the **grid planning process**.
3. **Section 5** contains the **objectives for the grid planning process**, the relevant **framework conditions** and the **planning principles**.
4. **Section 6** provides an overview of the **process for establishing the Strategic Grid**. The individual steps are described in the following sections.
5. **Section 7** describes the **scenarios** that form the basis for long-term grid planning and the regionalisation process used to distribute the values set for Switzerland to the individual grid nodes of the transmission grid.
6. **Section 8** describes the **start grid**, which forms the starting point for Swissgrid's grid planning.
7. **Section 9** describes the process for forming the **reference grid**, in which future grid congestion is avoided by adding grid projects to the start grid. Potential congestion is identified by applying scenarios or carrying out stress tests.
8. **Section 10** describes the process of **target grid formation.** A multi-criteria cost-benefit analysis is used to examine whether each additional grid project is really necessary. The target grid may therefore not include all additional grid projects from the reference grid. Swissgrid refers to the sum of the additional grid projects of the target grid as the **Strategic Grid**.

3 Introduction

3.1 History of strategic grid planning in Switzerland

The Strategic Grid 2040 is the third coordinated process for the further development of the Swiss transmission grid. For the first time, it takes into account the legal basis established in the «Electricity Grid Strategy», according to which the planning process must be repeated in a comparable manner every four years.

The first two projects to determine the Strategic Grids 2015 and 2025 differed significantly from the current solution.

- In 2008, the planning process for the Strategic Grid 2015 was carried out separately by the former eight owners of the transmission grid[2].
- 2015 was the first year that Swissgrid planned the Strategic Grid 2025 on its own. At the time, Swissgrid created the scenarios itself (with the exception of the SUN scenario, which was created jointly by the Umweltallianz / Alliance-Environnement and Swissgrid)[3].
- The planning of the Strategic Grid 2040 was completed in 2025. The scenario framework was prepared by the SFOE for the first time.

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[2] Report by the Transmission Lines and Security of Supply working group of 28 February 2007:

[3] Swissgrid report on the Strategic Grid 2025:

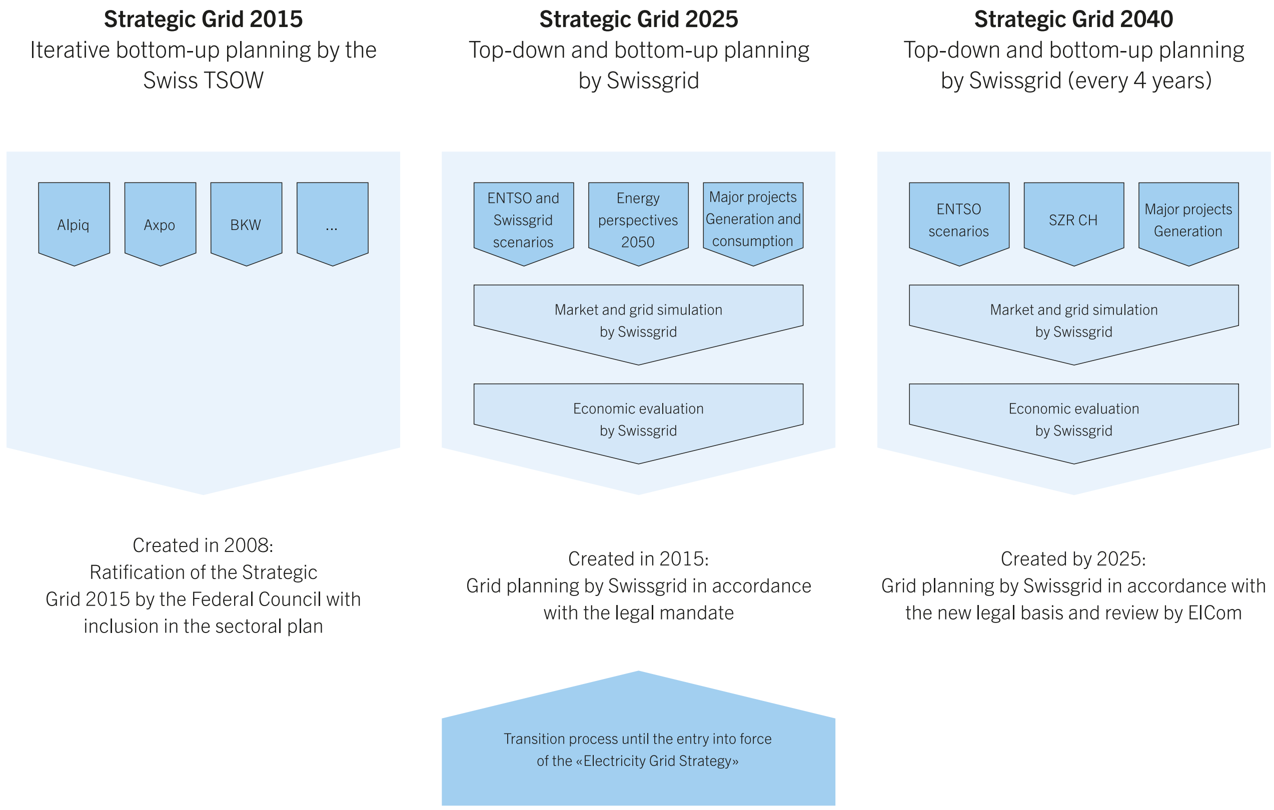

Figure 1: The transmission grid development process in transition

3.2 Regulatory framework

3.2.1 Regulatory requirements in Switzerland

According to Art. 8, para. 1 ESA, the grid operators are responsible for ensuring a secure, high-performance and efficient grid.

With the gradual entry into force (2019–2021) of the provisions of the Federal Act on the Renovation and Expansion of the Grids («Electricity Grid Strategy»), the grid planning process is now additionally regulated by law (Art. 9a–d ESA).

Grid planning is based on scenarios that envisage different possible developments in terms of electricity generation per technology and consumption per consumer group for the target year. The SZR CH is approved by the Federal Council and represents a binding basis for Swissgrid (NE1) and the supra-regional distribution system operators (NE3) as far as grid planning is concerned. In this document, selected ENTSO-E scenarios are also declared as forming a binding basis for developments abroad. ENTSO-E and ENTSOG jointly develop the ENTSO scenarios for electricity and gas for all European countries every two years.

Swissgrid and the distribution system operators on the transmission system (DSOs on the TS) make numerous assumptions for the regional implementation of the requirements of the SZR CH as part of the regionalisation process. Swissgrid makes further assumptions when modelling the use of power plants/storage systems and flexibility (demand-side management, demand-side response). For the purpose of grid planning, Swissgrid relies on the assumption that the future regulatory framework conditions will ensure that generation and consumption develop within the framework established by the SZR CH.

As part of regionalisation, grid operators have to record and exchange large amounts of data with each other. The following provisions of the Electricity Supply Act (ESA) and the Electricity Supply Ordinance (ESO) provide the framework for making this possible and for ensuring that no costs are billed on either side. Each company bears its own costs, which in turn are passed on as grid utilisation costs, given that the associated tasks come under the scope of grid planning.

The legal basis for the coordination of grid planning by the grid operators is established by the provisions of Art. 9c, para. 1 ESA, which are substantiated in Art. 5c ESO.

In accordance with Art. 9c ESA, the grid operators coordinate their grid planning and provide each other with the necessary information free of charge. Swissgrid must take into account the development of electricity consumption and generation at the grid nodes of NE1 when planning its grid and include the major power plant operators and foreign TSOs in accordance with Art. 20, para. 2e ESA. The Strategic Grid must be coordinated internationally. This coordination is ensured by Swissgrid's membership of the European Network of Transmission System Operators for Electricity (ENTSO-E) and via bilateral coordination and joint grid studies with directly neighbouring TSOs.

According to Art. 5c ESO, the required information includes, in particular, information about the existing grid, forecasts regarding production and consumption and planned grid projects. The provision of information relates to information about current or predicted congestion situations and data on planned power plant projects. Details must be given regarding the predicted increase in consumption and the current and future decentralised installed production for each generation technology (for each grid node, if possible).

3.2.2 Regulatory requirements in Europe

The EU Regulation 943/2019 on the internal market for electricity[4] mandates ENTSO-E in Art. 30, para. 1b to «adopt and publish a non-binding Union-wide ten-year network development plan biennially»; this is the TYNDP (ten-year network development plan).

The TYNDP process is divided into eight steps. These are shown in figure 2.

[4] This regulation from the Clean Energy Package is a further development of the EU Regulation 2009/714.

Figure 2: Overview of the TYNDP process

4 Overview of the grid development process

Figure 3 shows the grid development process all the way from the planning to the realisation of grid expansion projects. In the planning phase, the Strategic Grid project determines the grid expansion requirements on the basis of the SZR CH approved by the Federal Council and the data on the local development of generation and consumption regionalised by the distribution system operators on the transmission system.

Figure 3: Differences between the grid planning and grid development process

The «project planning» and «realisation» phases, in which grid projects are specifically planned, approved and built, are not part of the Strategic Grid project and are therefore not described in this document.

Figure 4 illustrates the process for creating the Strategic Grid, which is repeated every four years.

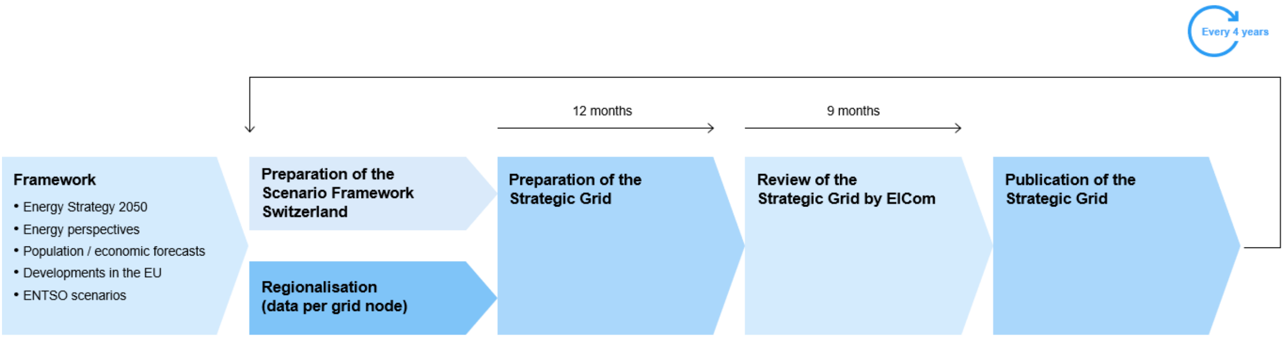

Figure 4: Periodic preparation of the Strategic Grid

The SFOE prepares an SZR CH as the basis for grid planning of the transmission grid and of the extra-high-voltage distribution grids (NE1–3). The SZR CH is based on the energy policy objectives of the Federal Government and macroeconomic framework data, and it takes into account the international environment (in particular the ENTSO scenarios). The SZR CH is approved by the Federal Council and represents a binding basis for the authorities (incl. ElCom) and Swissgrid as far as grid planning is concerned (cf. section 8).

The national targets set out in the SZR CH for the development of generation and consumption, separated according to technologies or consumer groups, are then regionalised by means of a regionalisation process developed by an industry working group.

The regionalisation process describes how the national key figures per parameter are distributed to the grid areas (supply regions) of the grid operators of grid level 3 (NE3) and subsequently to the grid nodes (NE1 and NE3), thus creating a usable (i.e. node-specific) data base for grid planning.

The grid operators at all grid levels coordinate their grid planning and make the necessary information available to each other free of charge. This includes, in particular, information on the existing grid, planned grid projects and forecasts regarding production and consumption. Swissgrid must above all take grid development at NE3 into account when planning the Strategic Grid.

Based on the SZR CH and on the regionalised data derived from it, Swissgrid draws up the Strategic Grid. The Strategic Grid describes and provides the rationale for the planned grid projects for the target year under review. The multi-year plan or the report on the Strategic Grid must be submitted to ElCom within nine months of approval of the SZR CH by the Federal Council.

ElCom reviews the Strategic Grid within the next nine months to determine whether the grid projects contained in it are effective and appropriate from a technical and economic perspective. If ElCom has any objections, adjustments are made to the Strategic Grid.

The reviewed Strategic Grid is subsequently published by Swissgrid by means of appropriate communication measures.

Every four years, this process begins again with an update of the SZR CH.

The roles of the players involved are clearly defined. The process is made sustainable by documenting procedures, assumptions and results in detail. This improves the quality cyclically.

5 Objectives, framework conditions and planning principles for the Strategic Grid

The following table provides an overview of the main objectives, the framework conditions to be observed and the planning principles for the Strategic Grid project.

Every four years

Goals of long-term grid planning

A robust, economically optimised grid ensures security of supply for different scenarios and forms the basis for the transformation of the energy system. During planning, attention is paid to resource conservation and minimal environmental impact.

Framework conditions for grid planning

Developments in generation and consumption in Europe and Switzerland are specified (SZR CH).	The unclear relationship with the EU is leading to uncertainty regarding Switzerland's cross-border capacity and import possibilities.	The further development of grid operation and of operating facilities for load control increases the robustness of the future transmission grid.

Planning principles for the Strategic Grid 2040

Environmental impacts are minimised by the NOVA principle, infrastructure bundling and the reduction of the number of substations.		
Future grid congestion and voltage violations must be avoided.	The flexibility of storage systems, generators and consumers will only be considered if it can be utilised.	Relevant stakeholders are involved in the grid planning process.
Dynamic grid stability must be ensured.	Grid projects will be implemented if they have a positive cost-benefit ratio.	The results are communicated in a transparent and comprehensible manner.

In order to achieve the objectives, knowledge of and compliance with the framework conditions are just as important as clearly defined planning principles, which form the guardrails for the grid planning process at Swissgrid.

5.1 Objectives of strategic grid planning

A robust, economically optimised grid ensures security of supply for different scenarios and forms the basis for the transformation of the energy system. This means that the Strategic Grid will be planned so robustly that it can cope with the challenges of the transformation of the energy system and so that a Swiss transmission grid that can guarantee security of supply will still be available in the future. This objective is achieved with a solution that is optimised as much as possible from an economic perspective. To this end, Swissgrid takes a holistic view of the electricity system (market and grid) and finds sustainable, optimised solutions at reasonable costs.

Grid planning considers resource conservation and minimal environmental impact. This means that the existing grid is used as efficiently as possible before grid enhancement or grid expansion takes place (NOVA principle). When implementing grid projects, Swissgrid endeavours to keep the impact on the population and the environment to a minimum. An assessment of how effectively this is achieved is carried out in the cost-benefit analysis (cf. benefit Z4 in section 11).

5.2 Framework conditions for grid planning

Developments in generation and consumption in Europe and Switzerland are specified in the SZR CH. In order to be able to successfully address future developments and challenges, an efficient transmission grid is needed that is adapted to these requirements. The following points should be noted:

- With its Energy Strategy 2050, Switzerland is aiming to decarbonise the economy and society as part of its climate goals (net-zero greenhouse gas emissions by 2050). Electricity consumption will continue to increase despite efficiency measures. Grid expansion planning is based on the SZR CH, which is subject to public consultation and has been approved by the Federal Council, and from which the future requirements for the transmission grid can be derived.
- The three scenarios set out in the SZR CH contain different possible developments in terms of generation and consumption in Switzerland and Europe. The national target values are allocated appropriately to the grid nodes.

The unclear relationship with the EU is leading to uncertainty regarding Switzerland's cross-border capacity and import possibilities. The following points should be noted:

- Looking ahead to the future, there is hope that Switzerland and the EU will find a way to work together for mutual benefit. The EU can benefit from Switzerland, which lies in the middle of Europe, as a transit country. No other country in Europe has a comparable number of cross-border lines and transit flows. Europe is important for Switzerland, both for the marketing of Swiss hydropower and for ensuring security of supply in winter.
- Swissgrid is an ENTSO-E member[5] and, as such, is integrated into the European grid development process. Switzerland uses the ENTSO scenarios for modelling development in other European countries.
- The implementation of the EU's «Clean Energy Package», which provides for the 70% minRAM criterion and Flow-Based Market Coupling (FBMC), could have a negative impact on the usable cross-border capacity at the Swiss borders. It is therefore important for Switzerland to be fully reintegrated into the European processes as soon as possible[6]. During the transition period, Swissgrid and the neighbouring TSOs must find a way to involve Switzerland properly in the capacity determination process (e.g. by means of private-law agreements such as SAFA).
- It is uncertain what decisions the Federal Council will make in the next few years as a result of the unclear relationship with the EU, particularly in the event of the failure to reach an electricity agreement. The consequences of these decisions for grid planning must be analysed, and appropriate measures taken if necessary.

The further development of grid operation and of operating facilities for load control increases the robustness of the future transmission grid. Grid operation is becoming even more efficient and secure, but also more complex and demanding, as a result of further developments in terms of forecasting, coordination, sensor technology, analysis technology, the use of new flexibility products and the controllability of electricity flows. The following points should be noted:

- Forecasts of supply-dependent electricity generation (PV, wind) and consumption are needed in order to be able to recognise electricity flows and possible grid congestion at an early stage. For this purpose, weather forecasts, which are already available today in very good resolution, must be linked with information on existing systems (output, location, orientation, etc.).
- Shutdowns and switching operations are coordinated with foreign TSOs and Swiss DSOs on the TS for the operating facilities in the observability area, and real-time measured values are exchanged.
- Electricity flows, temperatures, line sag etc. will be measured in the future for heavily loaded lines. This will allow line capacity and any redispatching costs to be optimised.
- Flexibility products for consumers, generators and storage systems (integrated market, Equigy, etc.) are being created and used in a targeted manner.
- Operating facilities for load control and voltage maintenance (e.g. FACTS, PST and four-quadrant transformers) enable optimised use of the existing grid, e.g. by loading parallel lines as evenly as possible. This can also reduce active power loss. Large volumes of electricity can be transported over long distances in a targeted manner with HVDC lines. This technology would be suitable, for example, to connect large PV/wind farms in Switzerland and abroad with domestic pumped storage power plants.

In principle, it should be noted that the market configuration and regulatory framework conditions cannot be assumed to be constant. For example, there are currently no market-based incentives for seeking to ensure system security with an economically optimal solution (e.g. flexibility products, dynamic grid utilisation costs and/or electricity prices). This may change in the next few years, which in turn may reduce the need for grid expansion.

[5] Swissgrid's exclusion from ENTSO-E cannot be ruled out. In such an eventuality, comparable contractual solutions need to be found in the interest of both parties to enable planning of the interconnected grid. This eventuality is therefore not considered in further detail here.

[6] Full integration requires an electricity agreement with the EU.

Paradigm shifts due to a sharp rise in electromobility or the sudden phase-out of nuclear energy etc. are conceivable. They must be addressed immediately. The approval of grid expansion projects takes at least 10 to 15 years. These different time factors must be taken into account when planning a robust grid.

5.3 Planning principles for the Strategic Grid

Environmental impacts are minimised by the NOVA principle, infrastructure bundling and the reduction of the number of substations.

- Swissgrid does not expand the grid preventively. Swissgrid first uses the existing grid as efficiently as possible (through remedial actions), enhances it as required and only builds new lines if absolutely necessary. Lines that are permanently unnecessary are dismantled wherever possible (NOVA principle[7]).
- In principle, Swissgrid does not expand the grid for the purpose of allowing arbitrary decommissioning for maintenance and grid expansion work at any time. This principle may only be deviated from in justified cases, e.g. if secure grid operations cannot be guaranteed by means of temporary grid elements or re-dispatching measures.
- The bundling of transmission lines with each other or with distribution system lines and SBB lines, trunk roads and railway lines[8] is intended to reduce the number of parallel routes in the long term. Swissgrid takes into account the results of the Federal Spatial Planning Conference and coordinates with the responsible federal offices (ARE, FEDRO, FOT), DSOs, SBB and affected project partners (e.g. second Gotthard tunnel, Grimsel tunnel).
- Swissgrid takes into account the impact on space and the environment, technical aspects and economic viability when looking for the best line corridor and when selecting the transmission technology to be used[9]. Swissgrid examines the overhead line and underground cable options for every grid project[10]. Both technologies have their advantages and disadvantages with regard to project planning, construction, operation and maintenance. For technical and economic reasons, underground cabling should only be installed over short distances if an overhead line is not feasible. The line corridor and transmission technology are not determined until later within the framework of spatial coordination in the National Sectoral Plan Procedure. Swissgrid suggests alternatives as part of this process, but does not make the decision itself.
- Compared to other countries, Switzerland has a large number of substations and parallel routes in a small area. One reason for this is that several large hydropower plants are located close together. As far as replacement investments are concerned, checks are carried out in coordination with the local DSOs to determine which substations and routes can be merged or dismantled if necessary. This can lead to cost savings in the long term and reduce the impact on the surrounding area and the environment.

Future grid congestion and voltage violations must be avoided.

- With the help of the grid simulation, Swissgrid can see which grid elements will repeatedly cause congestion or voltage violations in the future.

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[7] The dispatch on the «Electricity Grid Strategy» states the following:

«The distinct measures that make up a grid project must be considered in their entirety. In specific grid projects, the NOVA principle has to be applied across the many distinct measures in such a way that it results in a sustainable and efficient solution. The grid planning principles based on the NOVA principle do not necessarily lead first to optimisation, then to enhancement and finally to expansion. In particular, environmental protection legislation may restrict the optimisation or enhancement of a grid by means of mandatory limit values, for example relating to non-ionising radiation or noise.»

[8] Cf. Bundling of transmission lines with trunk roads and railway lines (admin.ch)

[9] Swissgrid participates in discussions on the potential variants; the technology is chosen by the Federal Government as part of the Transmission Lines sectoral plan.

[10] The choice of technology is based on the Evaluation System and Transmission Lines Manual issued by the Federal Office for the Environment.

- It also examines whether there is congestion in current grid operations that was not shown by the grid simulation. These cases will also be taken into account if necessary.
- Existing and future congestion will be resolved by grid expansion measures if remedial actions are not possible, sufficient or more expensive than grid expansion.
- Grid expansion is driven by demand and serves to eliminate grid congestion, regardless of where it is located. This ensures a reliable supply of electricity in all parts of Switzerland.
- The Strategic Grid is designed to eliminate congestion in the Swiss transmission grid. Multinational TSO studies are prepared on the expansion of the European transit grid. These studies, which alternate with the Strategic Grid project, recognise and eliminate congestion on cross-border lines. National grid studies are also carried out with DSOs connected to the transmission system for the purpose of developing NE1–3 in a coordinated manner. This is particularly important in the case of parallel lines.

Dynamic grid stability must be ensured.

- As a result of the dismantling of large thermal power plants in Europe, the rotating mass on the transmission grid is reduced, which makes ensuring dynamic grid stability more important.
- Therefore, the reference grid is tested for its dynamic stability by means of stress tests.

Grid projects are generally implemented if they have a positive cost-benefit ratio.

- For each grid project costing more than CHF 1.0 million, Swissgrid carries out and documents a uniform cost-benefit comparison.
- Benefit categories include economic added value, improved integration of renewable resources, reduction of electric system loss and redispatching costs, increase in grid security/security of supply, resilience[11].
- Depending on the criterion, the benefit is shown in monetary, quantitative or qualitative terms.
- The costs taken into account are the average prices for the construction of an overhead line or the average costs of overhead or gas-insulated switchgears.

The flexibility of storage systems, generators and consumers will only be considered if it can be utilised.

- Thanks to artificial intelligence, decentralised consumption control and smart peak shaving for PV/wind production, it is possible to reduce the load on both the local grids and the transmission grid.
- In grid planning, this potential is only taken into account if Swissgrid can actually use it at all times and on a permanent basis. To do so, regulatory framework conditions must be created and contracts concluded, which is not yet sufficiently the case today. From the current perspective, these options primarily serve to increase operational security, but rarely to reduce the need for grid expansion.
- Grid planning shows what flexibility would be required from consumers, power plants or storage systems in order to avoid a specific line project. On this basis, it can be examined whether the necessary flexibility can be reliably obtained and at what cost, and whether grid expansion can be avoided as a result.

Relevant stakeholders are involved in the grid planning process and the results are communicated transparently and comprehensibly.

- Swissgrid coordinates the planning of the transmission grid with the planning of the transmission grids of neighbouring countries, the planning of the distribution grids and power plants on the Swiss transmission grid and the planning of the SBB high-voltage grid.
- Swissgrid works closely with partners from the industry and the authorities in defining the necessary data requirements, in regionalising the national requirements and in completing the implementation process.
- Swissgrid communicates information about the Strategic Grid and about the process for its establishment in a transparent and comprehensible manner.

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[11] A grid project has a higher resilience if several scenarios prove its necessity.

6 Process for determining the Strategic Grid

Figure 5 shows the steps that make up the grid planning process at Swissgrid.

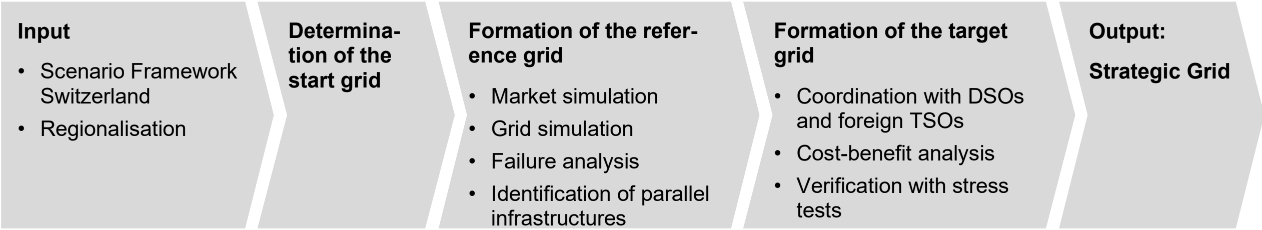

Figure 5: Steps in the grid planning process

The SZR CH and the ENTSO scenarios assigned in it are essential input values for the grid planning process. In addition, Swissgrid receives information on the development of generation and consumption within Switzerland from the regionalisation process from the distribution system operators (DSOs) and power plant operators (PPOs) that are directly connected to the transmission system (TS), as well as from SBB.

The start grid represents the starting point for the grid planning process. This European grid model includes all grid elements that are in operation today and that will still be in operation or will be put into operation by the target year[12].

Subsequently, with the help of market and grid simulations, the reference grid is formed by adding new grid projects to the start grid.

After the finalisation of the reference grid, the target grid is formed. The projects from the reference grid that affect other parties (foreign TSOs, DSOs on the Swiss TS) are coordinated with these parties[13]. With the help of a cost-benefit analysis, all additional grid projects in the reference grid are evaluated. In principle, only the projects where the benefits prevail will become part of the target grid.

Stress tests are used to check whether the target grid is sufficiently robust, for example to cope with multiple failures. Selective changes can be made to the target grid based on the results of the stress tests.

The totality of the additional grid projects in the target grid compared to the start grid forms the **Strategic Grid**.

7 Scenarios and regionalisation

Swissgrid's grid planning is based on scenarios. A grid that is sufficiently robust for an uncertain future can be planned by assuming various possible developments in terms of electricity generation and consumption.

This section describes the structure of the SZR CH and the methodology for regionalisation.

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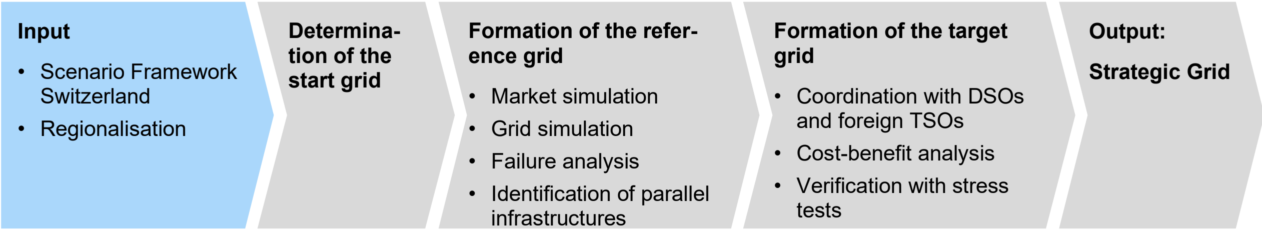
[12] Due to ongoing legal proceedings, some uncertainty surrounds this hypothesis.

[13] It is impossible to finalise this coordination in the space of nine months, particularly if joint studies are required.



7.1 Scenario Framework Switzerland

The SFOE prepares an SZR CH as the basis for grid planning of the transmission grid and of the extra-high-voltage distribution grids (NE1–3). The SZR CH is based on the energy policy objectives of the Federal Government and macroeconomic framework data, and it takes into account the international environment. The SZR CH declares the ENTSO[14] scenarios to be binding for other countries and links them to the scenarios in the SZR CH. The SZR CH is approved by the Federal Council and represents a binding basis for the authorities (including ElCom), Swissgrid and the distribution system operators for planning the grids at grid levels 1–3.

When drawing up the SZR CH, the SFOE involves the national grid company, representatives of the distribution system operators, the cantons and other stakeholders (including PPOs, SBB, and trade and environmental associations, which together form a support group). The SZR CH shows the range of possible energy industry developments (periods of 10 and 20 years). Figure 6 illustrates the preparation and approval process for the SZR CH.

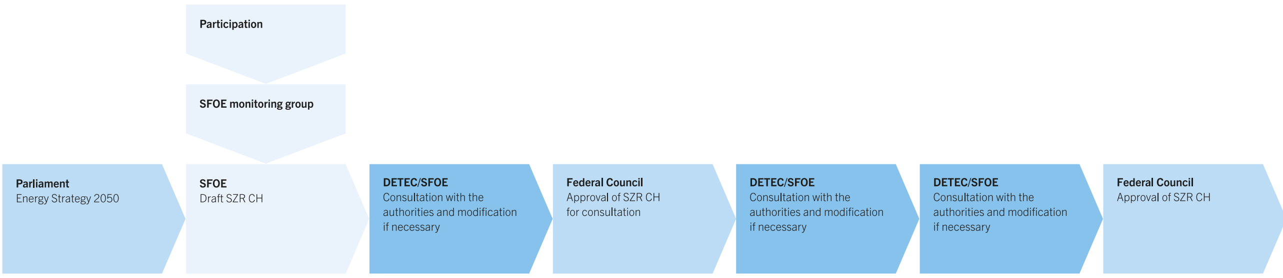


Figure 6: Preparation and approval process for the SZR CH

The SZR CH consists of a number of scenarios. According to Art. 9A, para. 3 ESA, there are a maximum of three.

A scenario describes the potential development of the power generation mix and electricity consumption in Switzerland.

A scenario is not a forecast of the future. Each scenario describes a conceivable, coherent and possible future development. The probable future development envisaged by the policy must be within the area covered by the scenario framework. The greater the number of challenges in the different scenarios the Strategic Grid can cope with, the more robust its planning.

[14] ENTSO-E and ENTSOG publish a jointly developed scenario framework for electricity and gas for all European countries every two years.

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7.2 Regionalisation in Switzerland

The SZR CH contains aggregated data at national level for the different types of power plants, storage systems and consumers for the current status and for the scenarios in the target years. The aim of regionalisation is to determine the change per parameter per grid node of NE1 and NE3 per scenario. This creates the data basis necessary for grid planning.

Possible methods of regionalisation are described in the SFOE document «Regionalisation guidelines». The SFOE guidelines are not part of the SZR CH and are not legally binding. Specific arrangements for regionalisation remain under the responsibility and jurisdiction of the relevant grid operators.

The SFOE guidelines distinguish between four principles for regionalisation. The description of these principles can be found in the following table.

Installed capacity	Principles	Description

≥ 10 MW	**A**
	No regionalisation
		• Location and capacity are known.
		• Decommissioning/increases in capacity and additional capacity of new plants per grid node are subject to compliance with the following principles by energy producers, storage system operators and large users:
		  • Notification of the grid operator to whose grid the system is/will be connected.
		  • No consideration during grid planning without notifications and construction permits.
		  • Construction permits and grid connection applications must be submitted by a deadline published by the grid operator.

Installed capacity	Principles	Description
< 10 MW	**B** Existing locations	• The regional key figure for capacity development can be distributed to existing plant locations in proportion to the capacity already installed.
	C Potential areas	• The regional key figure for capacity development cannot be linked to specific existing plant locations, as there are still too few or unevenly distributed locations or no locations at all. • Potential areas are identified on the basis of additional information. The capacity increase is distributed to the grid nodes that are located in the potential areas.
	D Nationwide development	• Regional development takes place proportionally per grid region or grid node, e.g. according to population change or economic development. • Also suitable for nationwide new constructions for which no specific locations/potential areas are available.

The table below contains the various parameters of the SZR CH and the principles for regionalisation recommended per parameter in the SFOE guidelines. In the case of photovoltaics, the SFOE guidelines in the text also consider that a combination of principles C and D would make sense.

Utility power generation	Principle
Run-of-river power stations	A
Storage power plants	A
Pumped storage power plants	A
Small hydropower plants	B or C
Nuclear power plants	A
Combined power plants	A
Waste incineration	A and B or D
Other thermal power plants	A and B or D
Biomass (wood)	A and B or D
Biogas power plants	A and B or D
Wastewater treatment	B or D
Geothermal energy	A
Photovoltaics	D
Wind power	C

Storage system	Principle
Pumped storage power plants	A
Decentralised batteries	D

Electricity consumption	
Conventional consumption	D
• Household sector	
• Industry sector	
• Services sector	
• Transport sector	
Electric mobility	D
Heat pumps	D
Power-to-X plants	A
Carbon capture plants	B
Supply pumps	–

Regionalisation is carried out for types of power plants with systems that usually generate less than 10 MW. The DSOs estimate the change in power output per technology per NE1 grid node and transmit these values to Swissgrid for the target years:

- **Small hydropower:** the DSOs on the TS take into account known projects and estimate the expansion in their area of responsibility.
- **Biogas and PV:** the capacity increases from the SZR CH are allocated to the NE1 grid nodes in proportion to the population.
- **Wind:** the wind farms with a high probability of implementation are included in the various scenarios with different numbers of wind turbines. The deducible capacity is allocated to the relevant NE1 grid nodes.

In accordance with principle A, no regionalisation takes place for power plant projects larger than 10 MW in order to avoid stranded investments in grid expansion. The grid operators hold talks with potential power plant investors about the likelihood of implementing each power plant project, the expected increases in capacity and the latest anticipated commissioning date.

Power plant projects that remain uncertain have the following impact on grid expansion:

- **Power plant connection:** a grid project that is only necessary for the grid connection of a new power plant is not included in the Strategic Grid until the construction decision for the power plant has been made, in accordance with principle A.
- **Grid enhancement requirements in the upstream grid:** this is usually based on the sum of several drivers (power plant, storage and/or consumer projects). To be included in the Strategic Grid, grid projects must be necessary due to grid expansion projects or new construction projects that have been definitively decided upon and approved. However, the increase in transmission power is already selected in

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such a way that the subsequent connection of the projects that have not yet been definitely confirmed is still possible without having to expand the grid again. This is to avoid time delays and additional costs.

Figure 7 gives a rough overview of how the target values per grid node, and thus the basis for grid planning, are determined according to the data in the SZR CH, the methodology in the SFOE guidelines, any cantonal specifications and data collected from existing and planned plants.

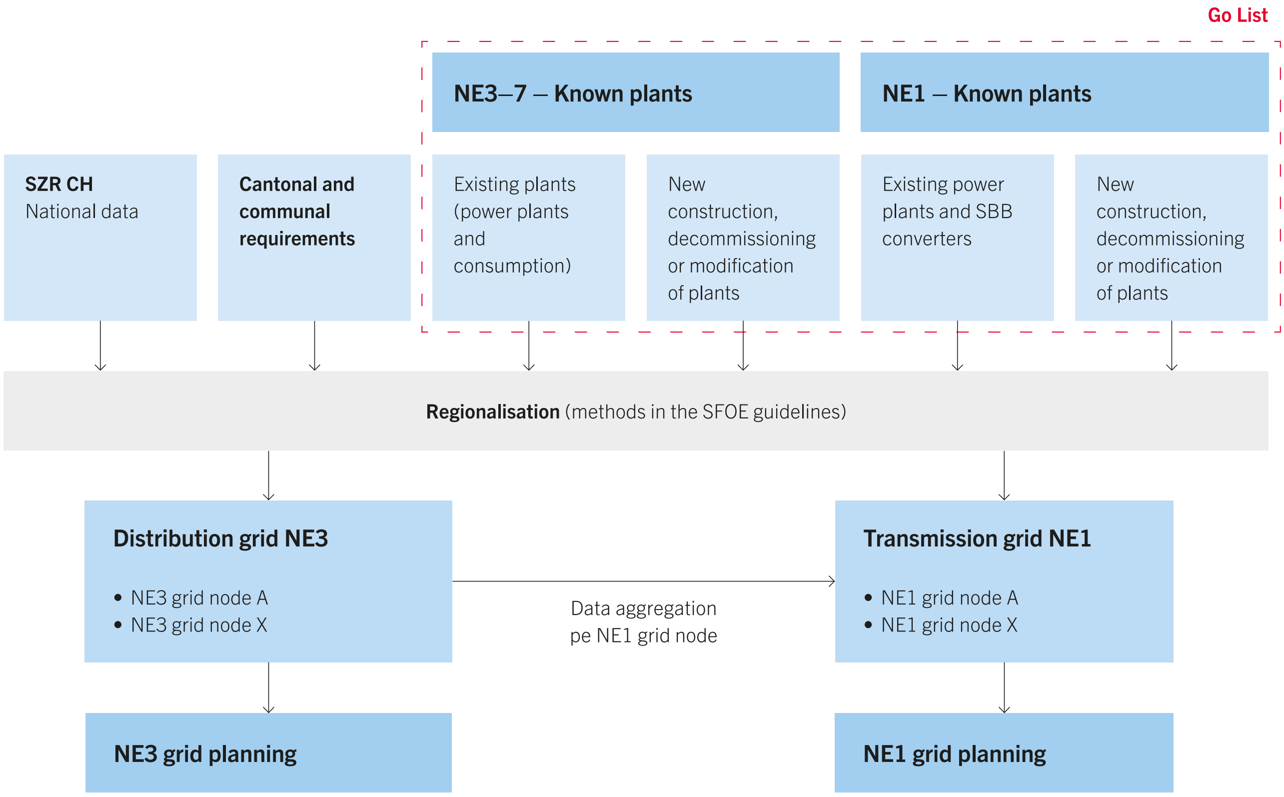


Figure 7: Overall process for the provision of data for grid planning

Swissgrid collects data on the planned expansion, new construction and decommissioning of generating plants and on the construction of large users from power plants on the TS, from SBB and from the DSOs on the TS.

Figure 8 illustrates the data that Swissgrid receives from partners and the grid modelling used by Swissgrid. The entire NE1 (380 kV (red), 220 kV (green), 380/220 kV transformers) is shown. The power plants feeding directly into NE1 are explicitly mapped. The illustration also shows the 50/16.7 Hz grid couplings (frequency converters and static frequency converter systems) through which SBB exchanges energy with the TS. NE2–7 are not shown in detail. They are described below, modelled by substitute elements per grid node. The totality of all power plants feeding into a grid node is represented by a virtual backup power plant per power plant type (note: the illustration does not show all conceivable types of power plant), the load by a cumulative load curve and the flexibility by a potential.

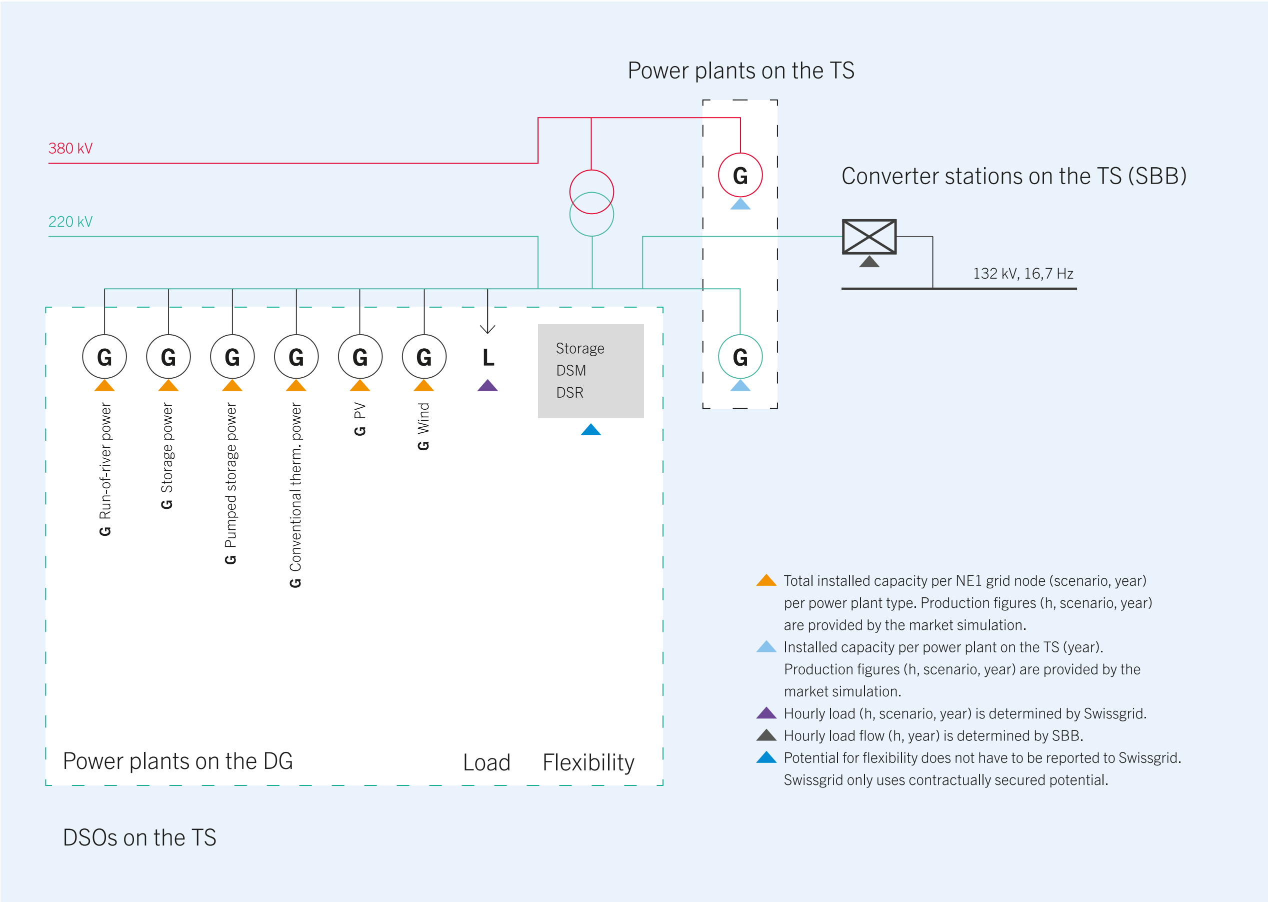


Figure 8: Illustration of the data collected per grid node

The power plants on the TS transmit their data on the planned change in installed capacity directly to Swissgrid.

SBB provides reports to Swissgrid on planned adjustments to the transformation power in the converter stations as well as an exchange profile for the target years.

The DSOs on the TS transmit data to Swissgrid on the installed capacity per power plant type, aggregated to the NE1 grid nodes. This applies both to the current plant park and to the target years.

The DSOs on the TS also provide information on major projects (e.g. large users, data centres) planned in their area of responsibility and the potential reactive power that they can make available per grid node or per grid region.

The DSOs on the TS coordinate with each other and with downstream DSOs for the registration of existing plants, the identification of planned plants and, as part of regionalisation, the recognition of any remaining expansion requirements for which no specific projects currently exist.

Grid planning only takes into account the flexibility that can be activated by Swissgrid itself at any time (e.g. redispatching contracts, integrated market, temporary load reduction, ripple control systems). Grid planning does not factor in the potential flexibility that may be activated in the future by consumers/power plants/storage systems in the distribution grid.[15] Grid planning, on the other hand, shows which flexibilities (controllable generators, storage systems and consumers) would be necessary to possibly avoid line projects.

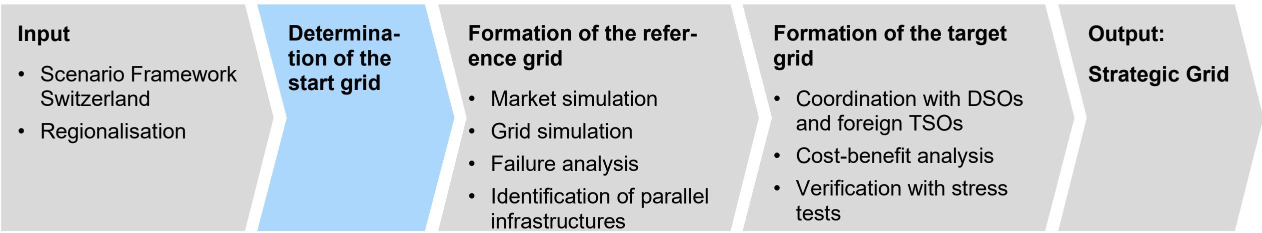
Swissgrid determines the load per NE1 grid node for each scenario by converting the total consumption in Switzerland per scenario in the target year into an hourly annual load profile using an ENTSO-E standard load profile.[16] This is then allocated to the NE1 grid nodes.[17] Today's consumption distribution (taking into account today's main points of consumption) is used as a basis for this. Consumption changes due to known major projects can be directly assigned to grid nodes. The remaining increase in consumption between today and the target year is allocated to the grid nodes in proportion to local population development. Note: in the long term, the application of customer group-specific load profiles would be conceivable. However, there is currently no sufficiently reliable data available.

7.3 Regionalisation abroad

As part of the TYNDP process, ENTSO-E provided its members with grid models containing data that had already been regionalised, which Swissgrid uses in its grid planning.

8 Determination of the start grid

In addition to the external input data from the scenarios and regionalisation, Swissgrid also needs a grid model, i.e. the start grid, that it can take as the initial situation for the grid planning process. As a result of the grid planning, the Strategic Grid comprises all grid projects that have to be added to the start grid in order to be able to guarantee secure grid operation in the target year.



The start grid includes the following Swiss grid elements:

- Grid elements that are in operation today or whose decommissioning is not foreseen by the target year
- Grid elements that are expected to be commissioned by the target year

The decision as to which of the grid projects that have not yet been put into operation will be included in the start grid is based on Swissgrid's technical multi-year planning.

For the rest of continental Europe, Swissgrid uses a grid model from ENTSO-E. The current grid model is expanded to include further grid projects in order to represent the probable state in the target year. The TYNDP lists all grid projects with the respective targeted year of commissioning and the current project status. On this basis, Swissgrid decides whether the project will be included in the grid model for the target year.

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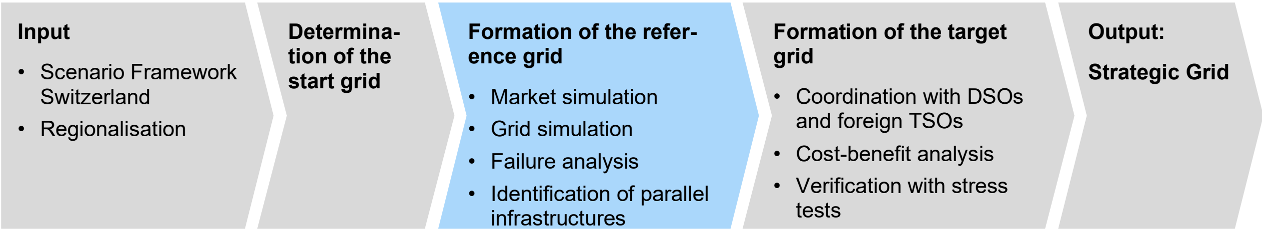
[15] The Strategic Grid 2040 project deviated from this principle in that the available flexibilities specified in the SZR CH were assumed to be usable in the market simulation. It was also assumed that PV/wind production that cannot be consumed or stored can be curtailed.

[16] The ENTSO-E load profile is generated for each bidding zone by taking the number of heat pumps, e-mobility vehicles, data centres etc. from the SZR CH and inputting this information into the ENTSO-E tool.

[17] Each municipality was allocated proportionally to the NE1 grid nodes by the DSOs on the TS.

9 Formation of the reference grid

This section describes how Swissgrid moves from the start grid to the reference grid. To do so, grid projects are added to the start grid until there is largely no more grid congestion in grid simulations with the scenarios from the SZR CH.



9.1 Description of the reference grid formation process

The overall process is shown in simplified form in figure 9 and described below.

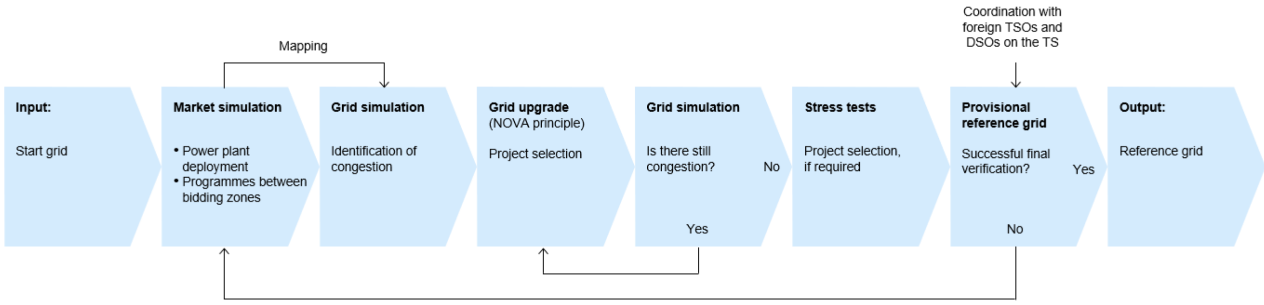


Figure 9: Reference grid formation process

Input values: the start grid according to section 9 and the data from the SZR CH, from the ENTSO scenarios and from the regionalisation process according to section 8, form the starting point for the formation of the reference grid.

Market simulation with FBMC: based on the scenarios per bidding zone and target year, the market simulation recognises the hourly consumption, the available power plant output per power plant type, the hourly cross-border capacity between the bidding zones, and hourly climate data, as a basis for supply-dependent generation (e.g. PV, wind, run-of-river). Market simulations are carried out for the various scenarios set out in the SZR CH. The market simulation delivers a result that indicates the hourly power plant deployment per bidding zone. The target function is to cover the load in each bidding zone, at minimum generation cost, taking into account the maximum cross-border capacities between bidding zones.

Mapping: the results per bidding zone from the market simulation are allocated to the nodes of the European grid model by means of mapping. This means that the hourly generation[18] and the consumption per grid node are taken as input values for the grid simulation.

[18] For each grid node, the mapping calculates the percentage of installed capacity that is utilised for each power plant type and thus the total local feed-in.

Grid simulation: for each scenario, grid simulations are calculated with the European grid model, and any congestion (n-1 violations)[19] is detected. At this point, it becomes clear where there is still a need for grid expansion.

Grid upgrading according to the NOVA principle: the NOVA principle is always applied when upgrading the grid. The NOVA principle stands for grid optimisation before grid enhancement before grid expansion. It aims to minimise the impacts of grid expansion on the environment and the landscape. If more efficient grid operation (e.g. topological measures, redispatching or use of flexibilities) is not sufficient to control the congestion identified, then the first measure is grid optimisation. If this does not achieve the objective, grid enhancement (e.g. more powerful conductor cables, higher voltage) is carried out and, as a last resort, grid expansion takes place (new route). Figure 10 illustrates how the reference grid is gradually formed from the start grid. (Note: this is determined from the European grid model).

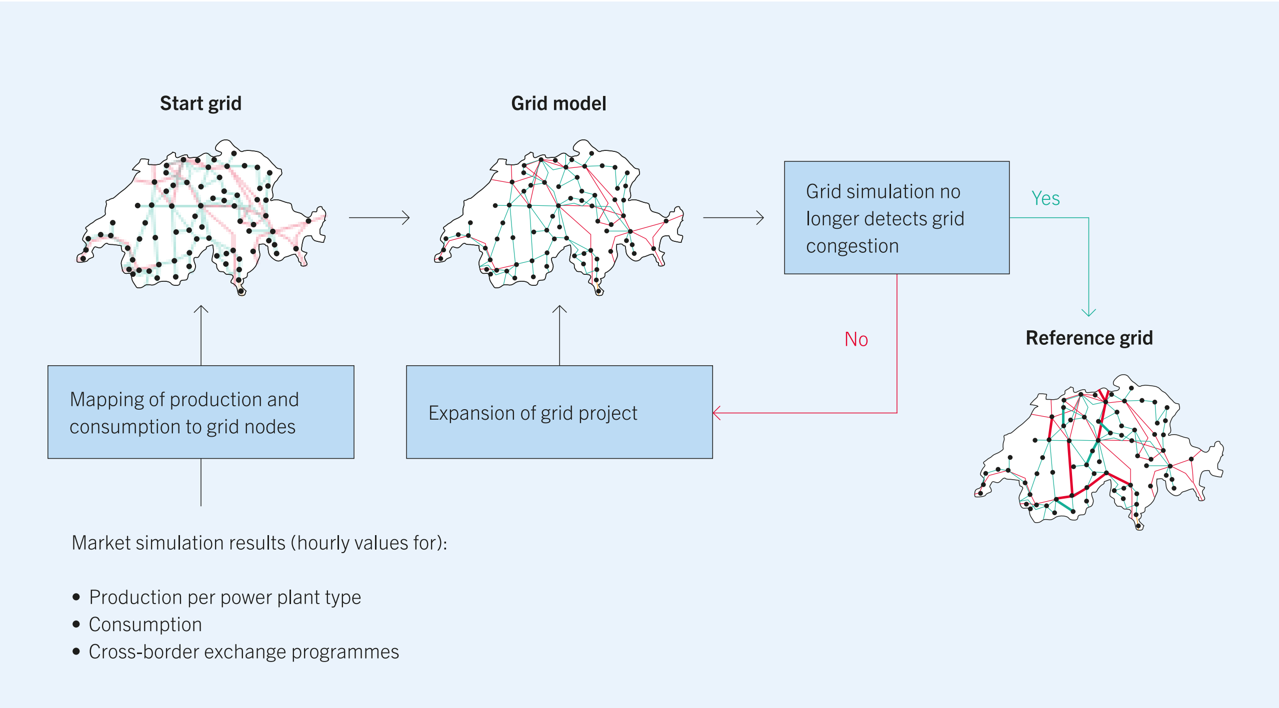


Figure 10: Formation of the reference grid

New grid simulation to determine whether congestion still exists: the grid simulation is carried out again for the scenarios set out in the SZR CH with the upgraded grid. If the significant congestion has not all been removed, then further grid upgrade measures must be taken (either by introducing new projects or by combining projects that have already been created in a more favourable way).

Communication with foreign TSOs and parties connected to the TS: the additional grid projects that are relevant to other grid operators are presented to them. Bilateral exchanges take place for this purpose with the neighbouring TSOs, and coordination in Switzerland is ensured with the affected parties directly

[19] Future voltage violations are determined using the target grid during stress testing.

connected to the TS (DSOs, PPOs and SBB). Negative influences on neighbouring grids, double investments due to parallel infrastructure projects and blind spots should thus be avoided.

Final verification of the temporary reference grid: the new grid projects change the grid model. The market and grid simulations must therefore be carried out again for control purposes. Theoretically, congestion could be identified again, which in turn could be resolved with the help of a grid upgrade according to the NOVA principle.

Output reference grid: the result represents the reference grid.

10 Formation of the target grid

Input	**Determination of the start grid**	**Formation of the reference grid**	**Formation of the target grid**	**Output:**
• Scenario Framework Switzerland • Regionalisation		• Market simulation • Grid simulation • Failure analysis • Identification of parallel infrastructures	• Coordination with DSOs and foreign TSOs • Cost-benefit analysis • Verification with stress tests	**Strategic Grid**

This section describes how the additional projects of the reference grid are coordinated with the affected grid operators and evaluated by means of a cost-benefit analysis (CBA). It also explains how decisions are made to determine which of these projects from the reference grid will actually be included in the target grid, i.e. the Strategic Grid.

The robustness and appropriateness of the target grid is also verified by means of stress tests.

10.1 Coordination of the reference grid with grid operators

Swissgrid coordinates its grid projects from the reference grid with the directly affected distribution system operators and the affected foreign TSOs.

10.2 Cost-benefit analysis (CBA)

The CBA gives an evaluation of each individual grid expansion measure from an economic, environmental and technical perspective, and thus serves as proof of need.

The latest version of the CBA document prepared by ENTSO-E forms the basis for the CBA.

The CBA is only carried out for the lead scenario set out in the SZR CH and thus the proof of need is given per project. If appropriate, up to three different climate years can be used in order to visualise the effects of different climatic developments on the benefit categories.

For each additional grid project X[20], the CBA is carried out as follows: costs and benefits are first determined for the reference grid. Costs and benefits are then determined for the reference grid without project X. By comparing the results once for the reference grid with project X and once for the reference grid without project X, the benefits of project X become clear. On this basis, a decision is made as to whether the benefits are sufficiently relevant for project X to be included in the target grid (Strategic Grid). This method of cost-benefit analysis is also called TOOT – «take out one at a time». Figure 11 illustrates the methodology.

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[20] A cost-benefit analysis is not conducted for smaller-scale grid projects costing less than CHF 1 million.

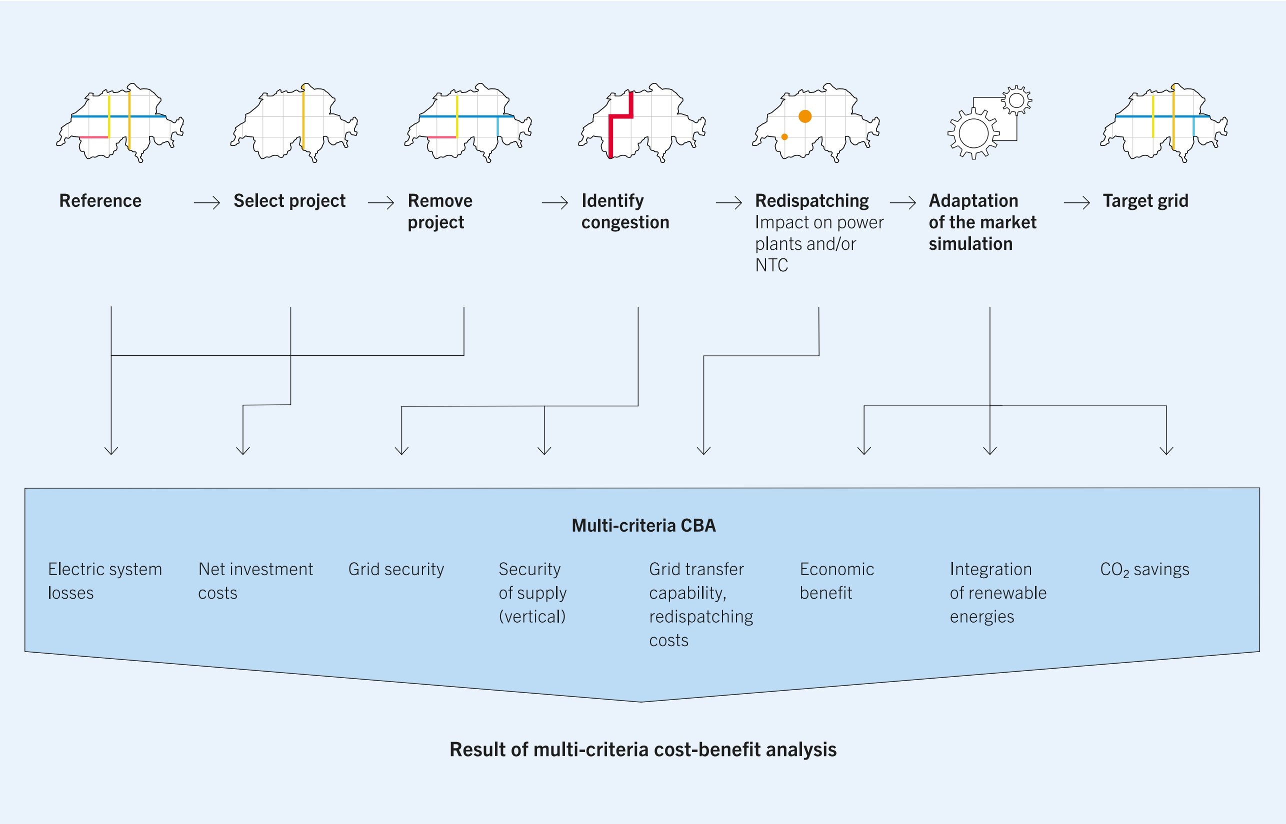

Figure 11: Application of a cost-benefit analysis to determine the target grid

The Net Present Value (NPV) method is used to determine the current monetary benefit of projects. All costs and the monetary benefits that are specified in [CHF/a] and are directly related to project X are taken into account; however, benefit categories that are specified in physical units (e.g. [t/a]) or qualitatively (e.g. 0 / + / ++) cannot be integrated into the NPV calculation.

If a grid project has a negative NPV, its implementation is not automatically ruled out. In individual cases, the non-monetary criteria can be decisive, if, for example, security of supply/grid security is significantly increased. In this case, a project-specific, comprehensible justification is given on the basis of the qualitative indicators.

For grid projects that could be replaced by the contractual development of existing or yet to be built flexibilities of power plants, consumers and/or storage facilities, the redispatching quantities that would be necessary annually are shown together with their estimated costs (benefit B9).

Figure 12 is based on ENTSO-E's CBA 4 and provides an overview of the different categories of benefits (B_i), costs (C_i), residual benefits (S_i) and additional benefits (Z_i) that are assessed. It also becomes clear which categories found in CBA 4 are methodologically applied in Switzerland and which are not. There are also additional benefit categories that only exist in Switzerland. The benefit categories that are monetised are also visualised.

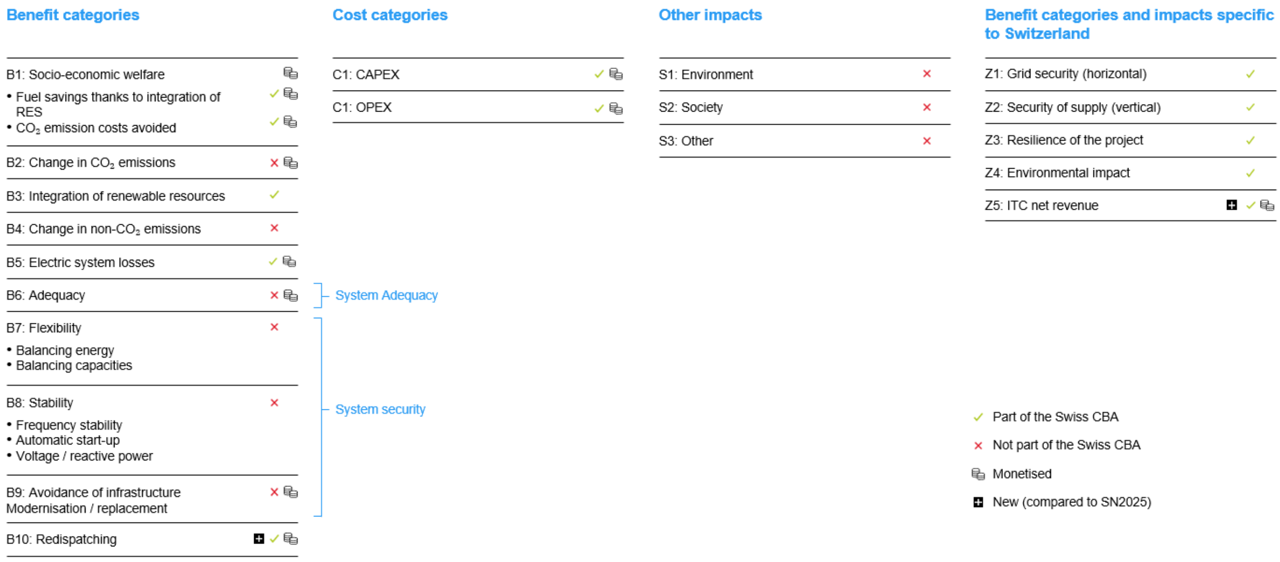

Figure 12: Cost and benefit categories in the CBA

The costs for a Swiss grid project are incurred in Switzerland (exception: international interconnection line with cost sharing), while the benefits from a Swiss grid project can be realised in Switzerland but also abroad. Within the framework of the CBA, Swissgrid only takes into account the costs and benefits that are incurred in Switzerland. The cost and benefit categories are defined as follows:

B1 Increase in socio-economic welfare	The increase in socio-economic welfare (SEW) due to the project is the difference in the sums of the profits of consumers, producers and transmission system owners that arise with and without the project, in [CHF/a].
B3 Integration of renewable re-sources	This benefit consists of two components: • The output part [MW/a] corresponds to the capacity of PV/wind power plants that can be newly integrated into the grid thanks to the project • The energy part [MWh/a] corresponds to the avoided curtailment of PV and wind power plants (e.g. peak shaving)
B5 Reduction of electric system losses	This benefit determines the change in electric system losses [MWh/a] resulting from the project and monetises this in [CHF/a].
B9 Reduction of redispatching / countertrading	This benefit shows how much redispatch energy [MWh/a] and how much redispatching costs [CHF/a] can be avoided by the project.
C1 CAPEX	This shows the total investment costs of the project [CHF].
C2 OPEX	This indicates the annual operating costs of the project in [CHF/a].
Z0 Grid security (horizontal)	This benefit qualitatively describes the extent to which the project in-creases operational security in the transmission grid by reducing the

	number or level of n-1/n-k violations or voltage violations and thus reducing the risk of grid failures or cascades.
Z1 Improvement in security of supply (vertical)	This benefit qualitatively describes to what extent the project increases the security of supply of end consumers, for example by increasing the number of grid connections from the distribution grid to the transmission grid or by reinforcing spur lines in the transmission grid with a parallel line.
Z2 Resilience	The more scenarios that prove the need for a project, the greater its benefit.
Z3 Increase in ITC net revenue	This benefit includes the increase in ITC net revenue for Switzerland generated by the project in [CHF/a].

A project profile with the same structure is created for each project. This includes the costs, the benefits per category, an implementation proposal and a statement on priority and urgency.

The grid planning process ends when the Strategic Grid is handed over to ElCom for review. It is then published following approval.

10.3 Stress tests

Stress tests and analyses are carried out on the target grid. Its robustness must be proved, even in extreme situations. Stress tests can simulate multiple failures, i.e. the failure of line sections or busbars. A voltage analysis is also carried out. In addition, the tests can factor in extreme scenarios in the power plant park, including power plant failures.

Risks such as cascade failures or voltage collapses may be detected. A conscious decision must then be made on a case-by-case basis to determine whether these risks are tolerable or whether appropriate measures need to be taken.

11 Strategic Grid

The sum of the projects required to develop the start grid into the target grid is referred to as the Strategic Grid.

This is now available. The recognised projects are necessary in order to ensure that the TS remains robust in the future. The added value of the projects has been demonstrated by the cost-benefit analysis. Coordinating the projects with neighbouring grid operators has also ensured that the projects will not have any negative implications for third parties.

The Strategic Grid is updated every four years on the basis of regularly updated scenarios.

12 Glossary and abbreviations

The following terms and abbreviations are important for understanding the document.

12.1 Glossary

ENTSO-E scenarios	ENTSO-E and ENTSOG jointly develop a scenario framework for electricity and gas in Europe every two years.
ERAA (European Resource Adequacy Assessment)	Annual, comprehensive adequacy analysis by ENTSO-E, prescribed by the Clean Energy Package (CEP) as a tool for assessing the need for capacity mechanisms.
Bidding zone	In this zone, a uniform market price applies at a given time or for a given billing period (hour or quarter hour). It is therefore referred to as a market area, price area or bidding zone. For market players, a bidding zone is an area without any congestion where there are no restrictions on energy exchange. The grid operators control congestion within the bidding zone by implementing topological measures or by redispatching generators, storage systems or consumers. Bidding zones are often identical to national borders. In Switzerland, this applies to a large extent, whereby the Swiss bidding zone also includes peripheral areas of neighbouring foreign countries, and peripheral areas of Switzerland belong to foreign bidding zones. In Italy and the Scandinavian countries, for example, there are several bidding zones on the national territories.
GO list	List of guarantees of origin: a list of all existing Swiss power plants.
Market simulation	For each bidding zone, hourly curves showing load, solar radiation and wind, as well as the composition of the power plant park (separated by technologies), fuel and CO_2 prices etc., are available for the target year based on the scenarios set out in the SZR CH and on the ENTSO scenarios. For each bidding zone and each scenario, the simulation indicates the hourly market prices, power plant deployment, the emissions resulting from the power plant deployment and the net position of the bidding zones. The latter is determined in an FBMC calculation. The prices in these bidding zones are equalised by exchanging energy between bidding zones.
Grid node	A grid node in the TS is a substation where power plants and/or distribution grids and/or converter/inverter stations are connected to the TS.
Grid simulation	The load and production from the market simulation are allocated to the grid nodes in the start grid via a defined key (mapping). Grid congestion can now be detected. Projects are added until there is no more congestion. The grid achieved by this is called the reference grid. Results of the grid simulation include the necessary grid expansion projects, location and frequency of grid congestion and voltage violations, electric system losses, etc.
NOVA principle	The NOVA principle stands for grid optimisation before grid enhancement before grid expansion. It aims to minimise the impacts of grid expansion on the environment and the landscape. If more efficient grid operation is not sufficient to manage the congestion that has been identified, the first step is to pursue grid optimisation and, if this is not effective, grid enhancement and, as a last resort, grid expansion.

Reference grid	This is the Swiss transmission grid which does not show any significant structural congestion when applying the scenarios for the target year.
Remedial actions	These are measures that TSOs take during ongoing operation to ensure stable grid operation. Topological measures that do not incur any costs are initially taken (e.g. switching measures, busbar section isolation, step-up or down transformers). If these are not sufficient, measures that involve costs are taken (e.g. redispatching power plants, countertrade between control areas)
SAFA	Synchronous Area Framework Agreement: in 2019, with the «Synchronous Area Framework Agreement» (SAFA), continental Europe's transmission system operators, including Swissgrid, became contractually obliged to abide by the network codes as well as the jointly developed implementation rules, which are necessary to ensure operational grid security.
SEW (socio-economic welfare)	The SEW of project X is the difference in the sums of the profits of consumers, producers and transmission system owners that arise with and without project X. ENTSO-E authorises two methods for determining SEW: the generation cost approach and the total surplus approach. The total surplus approach allows for country-specific project assessment and is used by Swissgrid.
Start grid	This refers to the transmission grid in Switzerland and the transmission grid in other continental European countries. It includes all the grid elements that are currently in operation or will be in operation by the target year.
Strategic Grid	This is the entirety of the grid expansion and grid decommissioning projects in Switzerland by means of which the start grid is transformed into the target grid.
Scenario framework	There is a national scenario framework (SZR CH) and a European scenario framework (ENTSO scenarios). The first SZR CH was published by the SFOE in November 2022. It is updated every four years.
TOOT («Take out one at a time»)	This is a method used by Swissgrid and ENTSO-E to determine the added value of each additional project X from the reference grid. In order to be able to determine the CBA costs and benefits, the analysis is first carried out for the complete reference grid. Project X is then dropped and the analysis is carried out again. By determining and comparing the costs and benefits in both cases, the costs and benefits of project X can be determined. This is done in a similar way for each project, at which point the costs and benefits of each project become clear. On this basis, Swissgrid decides which additional reference grid projects will become part of the target grid. Market and grid simulation are used as analysis methods.
Target year	The target year is the year for which the next Strategic Grid is determined.
Target grid	This is the Swiss transmission grid which is actually targeted for the target year. By applying the CBA procedure to the additional projects from the reference grid and carrying out stress tests, it becomes clear which projects offer sufficient added value and should therefore actually be implemented.

12.2 Abbreviations

AG RKN	«Regional Coordination of Grid Planning» working group
FEDRO	Federal Roads Office
FOT	Federal Office of Transport
SFOE	Swiss Federal Office of Energy
CBA	Cost-benefit analysis
DSM	Demand-side management
DSR	Demand-side response
ElCom	Federal Electricity Commission
ENTSO-E	Association of European Transmission System Operators
ENTSOG	European Network of Transmission System Operators for Gas
EP	Energy perspectives
ESTI	Swiss Federal Inspectorate for Heavy Current Installations
FBMC	Flow-based market coupling
FACTS	Flexible AC transmission system
HVDC	High-voltage direct current transmission
ITC	Inter-TSO compensation
PPO	Power plant operator
MW	Megawatt
NE	Grid level
NTC	Net transfer capacity
PST	Phase-shifting transformer
PV	Photovoltaics
ROK	Spatial Planning Conference
ESA	Electricity Supply Act
ESO	Electricity Supply Ordinance
SÜL	Transmission Lines sectoral plan
SZR CH	Scenario Framework Switzerland
TYNDP	Ten-year network development plan

TS	Transmission system
TSO	Transmission system operator
DETEC	Federal Department of the Environment, Transport, Energy and Communications
DSO	Distribution system operator

13 List of figures