Annual Report
Mission

As the national grid company, Swissgrid ensures the secure transport of electricity via both the national grid and the transmission grid connected to the European electricity system. This electricity forms the basis for the high quality of life and prosperity in Switzerland and Europe. Thanks to the central role it plays in the energy system, Swissgrid is actively shaping its sustainable transformation.

For more information on the transformation of the energy system, see the «Energy transition» section. Details of the sustainable development of the transmission grid are given in the «Environmental protection», «Biodiversity» and «Circular economy» sections.

GRI 203-1, 203-2

Security of supply

As a transmission system operator, Swissgrid is responsible for a critical infrastructure. Secure and efficient grids are of vital importance in order to guarantee the supply of electricity. The Federal Office for Civil Protection (FOCP) considers an electricity shortage to be the greatest financial risk for Switzerland. A major, nationwide power failure also ranks in the top ten[1] in the expected damage category. The Swiss transmission grid is closely interlinked with the European interconnected grid and, due to its central location in Europe, plays a key role in the exchange of electrical energy in Europe. An outage or disruption to the grid can therefore have far-reaching consequences that extend beyond Switzerland's borders.

[1]Federal Office for Civil Protection, report on the national risk analysis (disasters and emergencies in Switzerland 2020)

Grid-related security of supply – the sum of various components

In order to ensure a high level of grid-related security of supply and to protect the grid from an outage, Swissgrid takes action at various points.

Ensuring grid operations – around the clock

In Swissgrid's capacity as Coordination Centre South, its grid control rooms are responsible for ensuring the permanent balance between electricity generation and consumption to maintain a constant system frequency of 50 hertz – not only for Switzerland, but also for Europe. The grid control rooms also monitor the capacity utilisation of the transmission system and intervene in the event of congestion, impending line overloads or failures of grid elements. When operating its grid, Swissgrid follows the n-1 principle, which is an essential rule for ensuring secure transmission system operation.

This principle states that if any one grid element fails, no other element may be overloaded. Long-term planning is necessary for secure grid operation: this takes into account aspects such as the decommissioning of lines and power plants, as well as the schedules of power plant operators and electricity traders, which include all electricity exchange transactions in Switzerland and abroad. Swissgrid continuously coordinates its planning and real-time operations with the European transmission system operators.

Helping to shape and develop markets – in Switzerland and Europe

Another prerequisite for a high level of grid-related security of supply is the availability of control power to compensate for short-term deviations between production and consumption (balancing measures) and to manage grid congestion. That is why Swissgrid is continuously optimising the Swiss market for control power and cooperating with European transmission system operators.

The transmission system operators are also tasked with providing sufficient capacity on international interconnection lines for international electricity trading. In order to avoid grid congestion and to ensure non-discriminatory access, Swissgrid allocates capacity at the Swiss border by means of auctions. These processes are carried out in close coordination with the neighbouring transmission system operators.

Cooperation with Europe – in all areas

Swissgrid and the European transmission system operators cooperate closely in areas such as grid operations, control power markets and congestion management. The EU regulatory requirements for system operation are implemented to ensure that all grid operators adhere to the same rules in the interconnected grid. Cooperation across Europe is also crucial for the successful integration of increasingly decentralised energy sources into the overall system.

Due to the lack of an electricity agreement between Switzerland and the EU, it is becoming increasingly difficult for Swissgrid to help shape these pan-European developments. This has a negative impact on grid security, and hence on Switzerland's security of supply. The exclusion of Swissgrid from European platforms and coordination processes increases the risk of unplanned load flows in the Swiss transmission grid. Swissgrid is therefore taking various measures to counteract Switzerland's growing isolation (see the «Stakeholder engagement» section). Swissgrid welcomes the fact that Switzerland was able to successfully conclude negotiations on an electricity agreement with the EU.

Ensuring safety – at all levels

Important prerequisites for grid-related security of supply include a resilient grid infrastructure and the availability of IT and communication systems. To ensure the safe and reliable operation of the Swiss transmission grid, Swissgrid pursues an integral security policy.

This defines the objectives and framework for action for implementing precautions in a consistent and coordinated way according to standardised rules. The purpose of integral security management is, on the one hand, to protect people and the environment from negative influences caused by Swissgrid's activities and, on the other hand, to protect Swissgrid's employees, installations, systems and information from adverse effects.

Swissgrid's integral safety policy

Swissgrid's integral approach to safety management comprises seven security domains: operational security, physical security, information security, integral risk management, crisis management and business continuity management, as well as health protection, occupational safety and environmental protection. The integral safety policy sets out Swissgrid's safety objectives and regulates the essential aspects required for the effective implementation of company-wide integral safety management. These include the principles, the overarching framework conditions and domain-specific requirements, and security organisation.

Operational security

The aim of operational security is to ensure that Swissgrid provides a secure service in every grid state. It is based on the processes and elements of safety risk management, such as the reporting system, event investigation, safety risk analysis, safety culture and clearly defined roles and responsibilities. In particular, operational security aims to ensure that work can be carried out reliably in complex grid and system operations, and that the corresponding processes and instructions function properly. The following specific methods and processes are used, among others:

- Independent, continuous observation of operations with the aim of identifying instructions that are inappropriate or prone to errors, or procedures that deviate from the instructions, and improving them by means of incident analyses.
- The principles of «human factors» for designing a robust working environment that is tailored to people's characteristics.

A competence management system that consistently ensures and documents basic training, the retention of knowledge and skills, the further training of employees (especially in grid and system operations), and the building up of experience.

Physical security

The aim of this security domain is to ensure the physical security of employees, of third parties and of the Swissgrid infrastructure.

Swissgrid has developed its own company-wide standards based on best practice in order to meet the requirements of a critical infrastructure. Among other things, they take into account the ISO/IEC 27002 standard, the industry recommendation of the Association of Swiss Electricity Companies (VSE) and the regulations of the Federal Inspectorate for Heavy Current Installations (ESTI).

Information security

The aim of the «information security» domain is to guarantee the confidentiality, availability and integrity of data and information in physical form or based on Information and Communication Technology (ICT) systems for business and operating technology.

A risk-based information security management system built according to international standards, such as the standards of the ISO/IEC 27000 family, defines the regulations and measures to be applied. This management system supports the entire implementation process from implementation through to review and further development.

The basic measures to be applied and measures specific to the energy sector are derived and implemented from the same family of standards.

Crisis management and business continuity management

Swissgrid's crisis management and business continuity management (BCM) have the common goal of ensuring flexible incident management that is adapted to the situation so that the continuity of critical processes required for Swissgrid's key responsibility can be guaranteed in the event of an incident. Crisis management and BCM serve to continue Swissgrid's mission in accordance with the defined framework conditions, subject to certain restrictions, in the event of deviations from the normal situation. They are based on Swissgrid's mandate in accordance with Art. 20 ESA and Art. 5 ESO, the ENTSO-E requirements set out in the framework agreement between transmission system operators in the continental European synchronous zone on the minimum standards for joint operation of the transmission system, the Transmission Code, the VSE industry document, and the requirements of the Federal Office for Civil Protection.

The existence and proper functioning of crisis management and BCM correspond to the necessary level of basic protection. Swissgrid's business continuity management system, based on the ISO 223xx series, is being continuously developed for this purpose within the framework of a roadmap approved by the Executive Board, including annual targets. Among other things, it describes the creation of BCM specifications, the regular verification of BCM scenarios, and the development, testing and practising of risk-based business continuity plans. Business impact analysis is used to identify the critical processes required for Swissgrid's key responsibility and their requirements for restoring process performance, which are to be taken into account within the BCM framework. At the same time, this determines the corresponding level of protection. This analysis is repeated as necessary and reviewed on a regular basis. In addition, Swissgrid employees are trained to apply the correct conduct in the event of an incident as part of crisis exercises, and the functionality of existing systems and processes is checked. The implemented BCM processes are tested on an ongoing basis.

Every year, additional exercises lasting several days are conducted at the simulation centres in Prilly and Aarau. The aim of these exercises is to simulate a major disturbance or blackout and to practise grid restoration. Swissgrid, all distribution system and power plant operators connected to the transmission system, and the operators of restoration cells participate in these exercises.

In the reporting year, Swissgrid was part of the Federal Office for Civil Protection's general emergency exercise to simulate an emergency event at one of the three nuclear power plants currently in operation in Switzerland.

Swissgrid envisages that, in the event of a major event, personnel will be gathered at decentralised sites in Switzerland in order to carry out the necessary work on site. This procedure is repeated and practised with the involvement of external partners.

The status of BCM implementation and the company's business continuity capability are regularly reported to the Executive Board and the Board of Directors.

The topics of occupational health and safety and environmental protection are explored in greater detail in the «Occupational health and safety» section.

Key figures for grid-related security of supply

The transformation of the energy system is bringing new challenges for ensuring grid-related security of supply. Swissgrid addresses these challenges in its Strategy 2027 (see the «Strategy 2027» section). Swissgrid also describes the challenges and framework conditions in detail in the Sustainability Report (see the «Energy transition» section). Key figures on the energy flow and the use of control energy are also

included in this section.

Despite an increase in the average duration of interruption due to an incident in the canton of Glarus in November 2024, Swissgrid was able to guarantee an availability of the transmission grid of well over 99.9%.

	2024	2023
Number of supply failures in the meshed grid	1	1
Average duration of interruption	94 minutes	40 minutes
Energy not supplied in the meshed grid	2 MWh	113 MWh

«Energy not supplied»: both in the reporting year and in 2023, one line suffered an unplanned outage. However, the load connected to the line was considerably higher in 2023, which is why the volume of «Energy not supplied» was higher in 2023 than in the reporting year.

in GWh	2024	2023
Transported energy	69,609	74,134
Imported energy	25,262	27,017
Exported energy	39,175	32,888
Transit energy	22,155	21,591
Active power losses absolute	985	919
Positive control energy	963	1,033
Negative control energy	556	694

Active power losses of transported energy	1.41%	1.24%
Ratio of «energy not supplied» to transported energy	2.9E-8	1.5E-6

Continuing to ensure grid-related security of supply in the future

The transformation of the energy system is bringing new challenges for ensuring grid-related security of supply. Swissgrid addresses these challenges in its Strategy 2027 (see the «Strategy 2027» section). Swissgrid also describes the challenges and framework conditions in detail in the Sustainability Report (see the «Energy transition» section). Key figures on the reliability of the grid, the energy flow and the use of control energy are also included in this section.

GRI 203-1, 203-2

Grid transfer capacity

Swissgrid's aim is to provide a grid infrastructure that offers high availability and capacities, and that meets the requirements of the future energy system. This requires long-term planning, modernisation and optimisation of the grid, as well as ongoing inspection, maintenance and servicing.

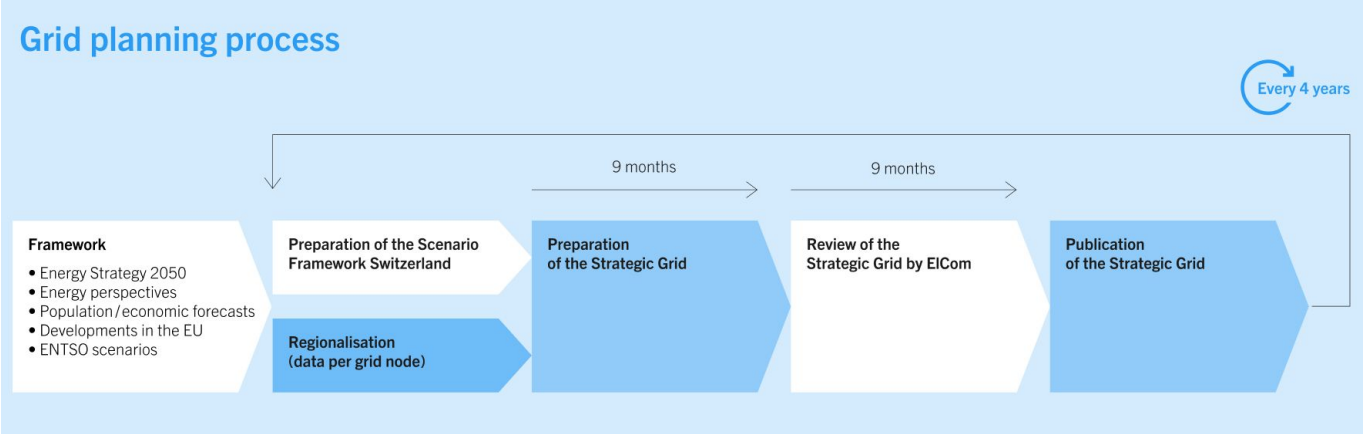
Planning the grid – the Strategic Grid

The requirements placed on the grid have changed significantly in recent years. This trend will intensify in the

coming decades as part of the energy transition. The Swiss Federal Office of Energy has set out these changes in the scenario framework for Switzerland, which contains national target values for each generation technology and consumer group for the years 2030 and 2040.

Swissgrid is developing the Strategic Grid 2040 on the basis of this scenario framework. In addition, Swissgrid receives information on the regional development of production and consumption within Switzerland from SBB and from the distribution system and power plant operators that are directly connected to the transmission system. Swissgrid uses this data to determine grid development requirements.

The process for the Strategic Grid 2040 is already well advanced. In 2024, Swissgrid will finalise the planning and submit it to the Federal Electricity Commission (ElCom) for review. Swissgrid will then publish the strategic grid in spring 2025. For the first time, this planning is based on the legal basis established in the «Electricity Network Strategy». It will be repeated every four years in the future.



Investment in the grid infrastructure – modernisation in line with demand

Swissgrid continuously invests in its grid infrastructure to ensure a secure, efficient grid in line with demand. The current modernisation projects are set out in the Strategic Grid 2025 and represent an investment volume of around CHF 2.5 billion. The grid projects included in the Strategic Grid 2025 are designed to eliminate existing congestion, ensure the transport of energy from large power plants in the Alps to urban centres, and strengthen the connection to the European grid.

Swissgrid has already been able to complete some of the projects from the «Strategic Grid 2025», while others are in the project planning or implementation phase.

Maintenance of a grid that is permanently in use

The Swiss transmission grid is one of the most reliable power grids in the world. To ensure that the grid functions perfectly at all times, it not only needs to be converted and expanded, but must also be continuously inspected, maintained and repaired. Maintenance includes regular cleaning and adjustment of technical systems. If installations are damaged after a storm or avalanche, they must be repaired quickly. Swissgrid also carries out planned repair work, such as the replacement of conductors and insulators, protection against corrosion, the revision of circuit breakers and deforestation. Two-thirds of the Swiss transmission grid, which is over 6,700 kilometres long overall, dates from before 1980. This work is therefore of great importance.

The right grid infrastructure for the transformation of the energy system

The modernisation of the transmission system lays the foundations for a sustainable energy future. At

present, however, the expansion of the grid cannot keep pace with the growth of systems to produce renewable energies. Objections and legal proceedings lead to significant delays in the realisation of grid projects. Swissgrid is committed to ensuring that approval processes are made more efficient and that grid expansion can be driven forward. In the «Grid Transfer Capacity» priority of its «Strategy 2027», Swissgrid also defines measures to increase the capacity of the grid in line with demand and to implement and operate the grid even more efficiently in the future. Digital solutions play a key role in addition to the Strategic Grid 2040. A completely digitalised grid image provides the basis for establishing data-driven system management.

GRI 203-1, 203-2

Innovation and digitalisation

The Research & Digitalisation (R&D) department at Swissgrid plays a key role in the further development of the Swiss extra-high-voltage grid. The department specialists actively drive forward innovation and technology to increase the capacity, security and reliability of the grid. By using state-of-the-art methods such as optimisation procedures and stochastic approaches, the department supports and improves work in all areas of the company. Innovation has a high priority at Swissgrid, which is reflected in its Strategy 2027. The company has set itself the goal of developing into an innovative, highly digitalised company in response to the increasing complexity and volatility of the electricity system resulting from the energy transition and the decentralisation of electricity generation.

To overcome these challenges, Swissgrid is relying on digitalisation as a catalyst for the energy transition. This will enable the company to cope with the growing demands being placed on the grid whilst increasing efficiency in all areas of the company.

By promoting a culture of innovation, for example by means of events such as the «Innovation Days» and «Inspiration Talks», Swissgrid creates an environment in which employees are encouraged to develop and implement new ideas. This is vital, because innovation and digitalisation make an important contribution to ensuring that Switzerland's supply of electricity will remain secure and efficient in the future.

A list of innovation projects is given below:

Use of drones and artificial intelligence

Autonomous drones and artificial intelligence help Swissgrid to optimise the maintenance and operation of the transmission system. Both technologies are digitalising asset management. Drones are used for line inspections to monitor the condition of the grid. In the long term, drones should also be able to quickly assess damage during initial inspections following disturbances and subsequently initiate repairs. The inspection images from the drones are generally scrutinised by experts. To optimise this process, Swissgrid is working with other grid operators to develop AI algorithms that can automatically detect potential damage. Drones ensure safe access to locations that are otherwise difficult to reach, as well as reducing the carbon footprint in relation to conventional methods such as helicopter flights. Following a preliminary study, Swissgrid has been working on a two-year pilot phase since mid-2023 as the basis for a possible broader roll-out.

Internet-of-Things sensors on pylons

Three years ago, Swissgrid launched the «Pylonian» Internet-of-Things project. This involved placing sensors on pylons to measure variables such as pylon vibrations, pylon inclination, temperature and solar radiation. At the end of the reporting year, Swissgrid installed additional types of sensors, particularly weather stations, to help forecast renewable energy production. Swissgrid also implemented «Sensorian», a telecommunication and sensor-independent platform that can host any type of sensor data on the Swissgrid data platform in a scalable, secure and flexible manner. In addition, experiments were conducted to simulate real events in order to link the data collected with potentially dangerous situations. This will allow the system to predict possible dangers so that Swissgrid employees can initiate measures at an early stage to prevent damage to the pylons.

Greater efficiency in grid operations

Forecast of production from photovoltaics

The «PV Forecasts» project aims improve grid stability by creating precise forecasts of solar power generation. To achieve this, the company relies on the use of publicly available data regarding the production capacity of the photovoltaic plants installed and on the collection of detailed sunshine information. These measures are essential for overcoming the challenges of increasing and fluctuating solar power production in the Swiss electricity grid whilst optimising the costs of control energy.

Closer cooperation between transmission and distribution system operators

The expansion of photovoltaics, heat pumping technology and electric vehicles requires closer coordination between grid operators in order to ensure secure grid operation. In association with Equigy, Swissgrid and distribution system operator carried out a pilot project to distribute the use of decentralised energy resources in a coordinated manner in order to provide ancillary services. More information can be found in the «Year in review» and «Energy transformation» sections.

Innovation and digitalisation as a new priority in Strategy 2027

The new «Innovation and Digitalisation» priority was included in Strategy 2027 in order to develop Swissgrid into an innovative, highly digitalised company (see the «Strategy 2027» section). A comprehensive package of measures creates the prerequisites at the data, technological and personnel levels so that the desired digital transformation can be successfully implemented in the company. The focus is also on developing a culture of innovation. To this end, Swissgrid organised innovation initiatives, during which employees were able to explore exciting topics for the future and receive incentives, and where ideas and interaction were promoted (see the «Attracting, retaining and developing skilled workers» section).