

Strategic

Grid 2025

47°08'47.60" N 9°13'43.62" E

The "Strategic Grid 2025" connects.

Swissgrid is creating a secure, efficient and sustainable energy future in dialogue with Switzerland.

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More information
www.swissgrid.ch

"In planning, taking the interests of nature and landscape protection into account from the start is crucial for the acceptance and sustainability of our grids."

Swissgrid has integrated leading environmental and economic associations in its grid planning. Their view of Switzerland's energy future is part of the strategy.

Dr. Raimund Rodewald,
Swiss Foundation for Landscape Conservation

Swissgrid

ASSOCIATIONS

47°01'06.25" N 8°42'00.03" E

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46°51'09.52" N 8°45'00.03" E

"The grid is the basis for electricity supply security. Therefore its modernisation has to be efficient and appropriate to needs in order to make a liberal power market possible."

Christian Wasserfallen,
National Council

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Swissgrid

ASSOCIATIONS 2025

Feder
46°5

46°39'20.64" N 8°17'26.66" E

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Swissgrid

ASSOCIATIONS

46°39'50.94" N 8°17'56.66" E

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POLICY

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Federal Palace of Switzerland, Bern
46°56'47.55" N 7°26' 39.32" E



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46°56'47.52" N 7°28' 39.32" E



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Swissgrid

POLICY

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Swissgrid secures the supply of electricity for all Swiss households



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Swissgrid

POLICY

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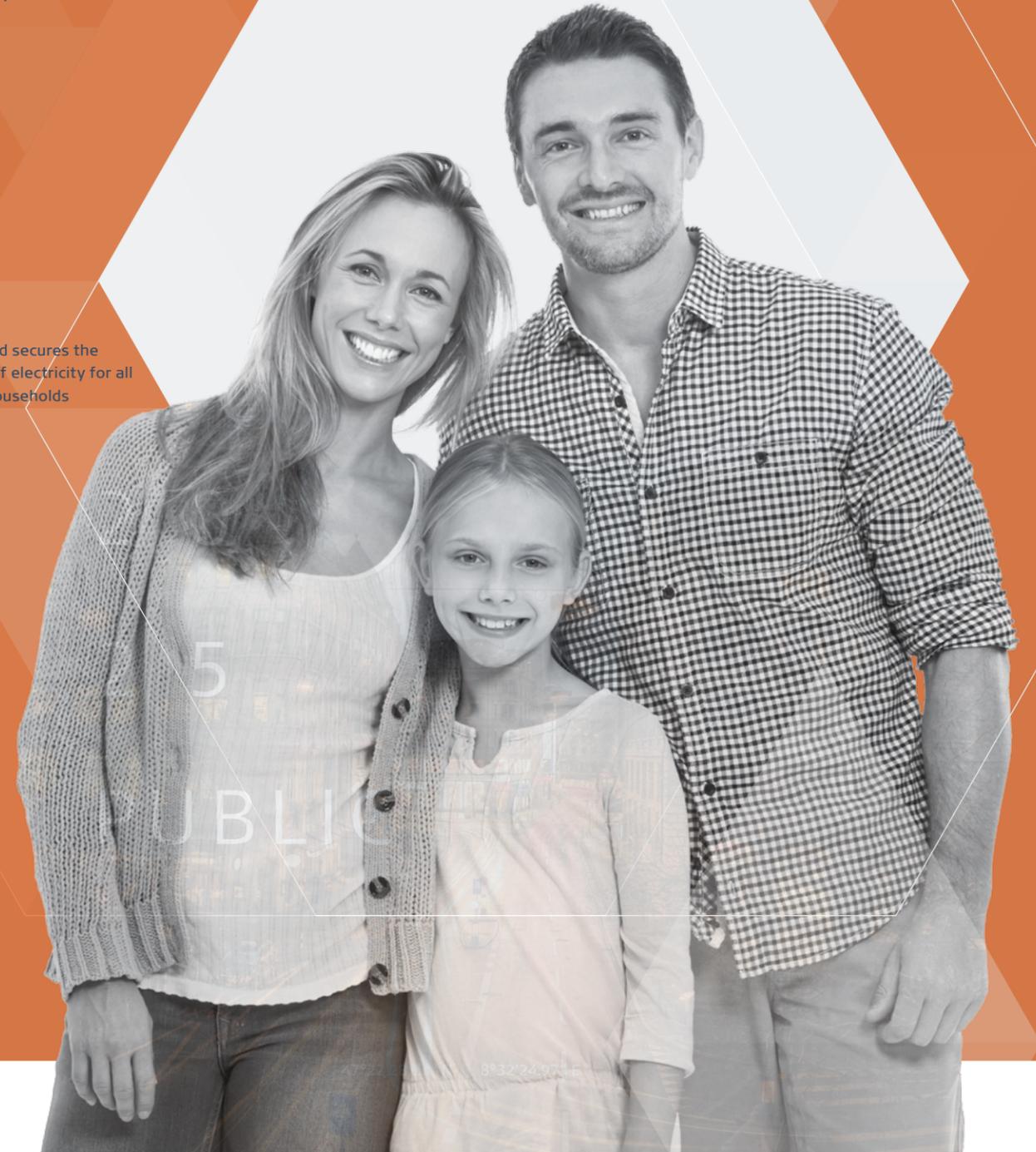
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PUBLIC

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Director Swiss Federal Office of Energy SFOE

Swissgrid

Headquarters of the Swiss Federal Office of Energy SFOE, Ittigen
46°58'31.39" N 7°28'21.94" E

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PUBLIC



47°22'28.13" N 8°32'24.97" E

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PUBLIC

47°55'58.73" N 8°35'54.93" E

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The administrations of the federal government, cantons and municipalities constantly exchange information with Swissgrid on the subjects of supply security and the energy future. All parties involved have committed themselves jointly to early modernisation of the grid.

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Swissgrid

ADMINISTRATION 20

Headquarters of the Swiss Federal Office of Energy SFOE, Ittigen
46°58'33.39" N 7°28'21.94" E

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A well developed and maintained grid is essential for the Swiss electricity industry. The dialogue with Swissgrid about the future of the national grid contributes to ensuring we will still be speaking the same language in ten years.

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Swissgrid

Michael Frank,
Director of the Swiss Association
of Electricity Companies

ADMINISTRATION 20

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Retaining dam of the pumped storage power plant Nant de Drance (commissioning from 2015)

47°27'43.95" N 8°22'51.85" E

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Swissgrid

ADMINISTRATION 2025

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Swissgrid

Michael Frank,
director of the Swiss Association
of Electricity Companies

INDUSTRY 2025



Retaining wall of the pumped storage power plant Nant de Drance (commissioning from 2017)
46°04'05.4" N 6°56'10.9" E

47°01'06.25" N 8°42'00.03" E

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Michael Fränk,
Director of the Swiss Association
of Electricity Companies

Retaining wall of the pumped storage power plant Nant de Drance (commissioning from 2017)
46°04'02.4" N 8°25'10.9" E

The continual renewal and further development of the grids makes sense and is necessary. The objective of the dialogue between science and Swissgrid is the creation of 'intelligent' grids, which take the social, technical and economic requirements into account. Numerous joint research projects support this process."

Dr. Christian Schaffner,
Executive Director,
Energy Science Center ETH

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Swissgrid

INDUSTRY 20

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Nikola Tesla

47°01'06.25" N 8°42'00.03" E

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Swissgrid

INDUSTRY



43°01.09'52.0" N 8°45.00'03.0" E

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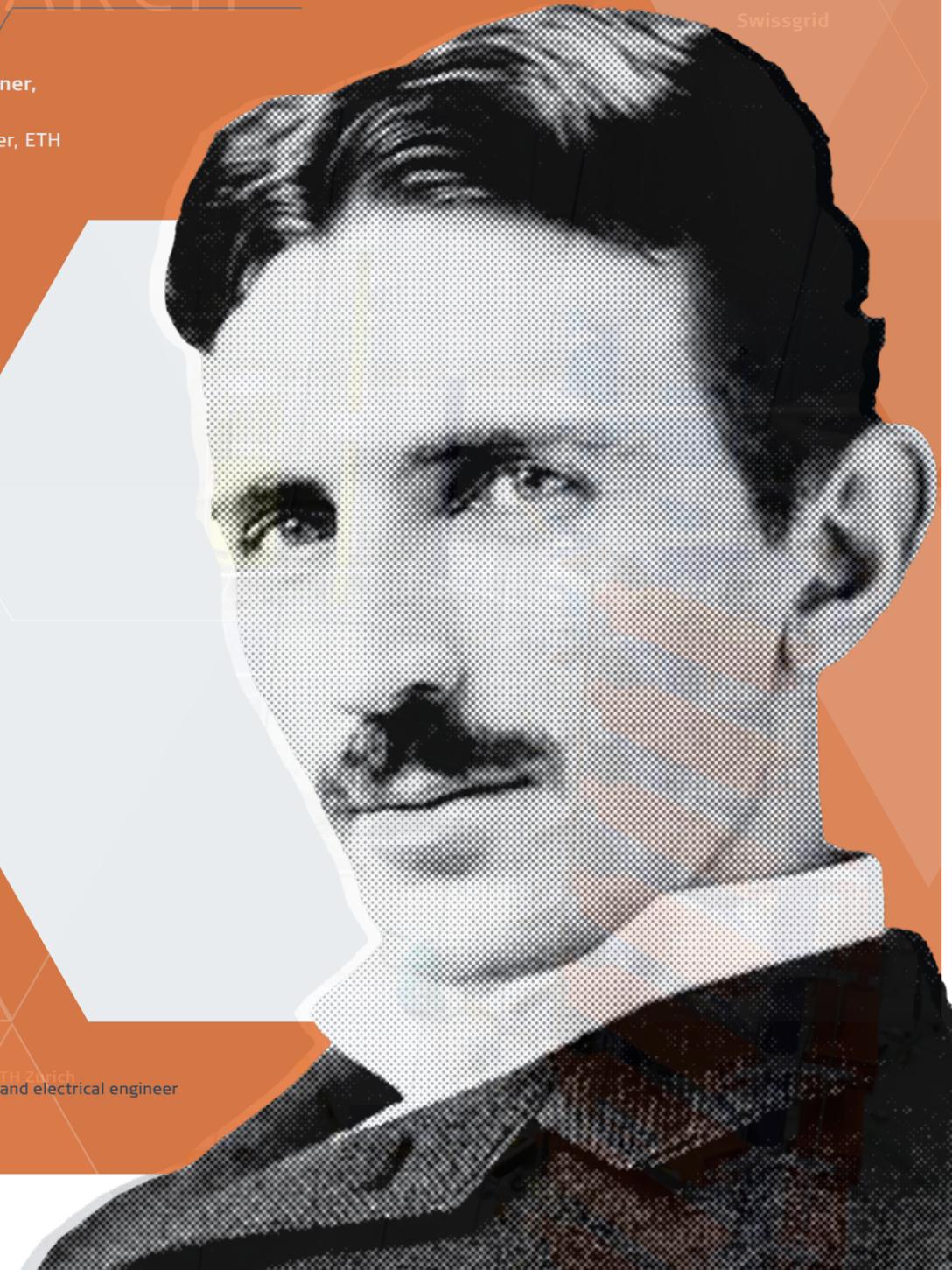
RESEARCH

Dr. Christian Schaffner,
Executive Director,
Energy Science Center, ETH

Swissgrid is engaged in continual further development of the grid in consultation with research partners in industry and at universities to ensure that it corresponds with the scientific and technical state of the art.

Swissgrid

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High voltage laboratory of the ETH Zurich
Nikola Tesla – inventor, physicist and electrical engineer



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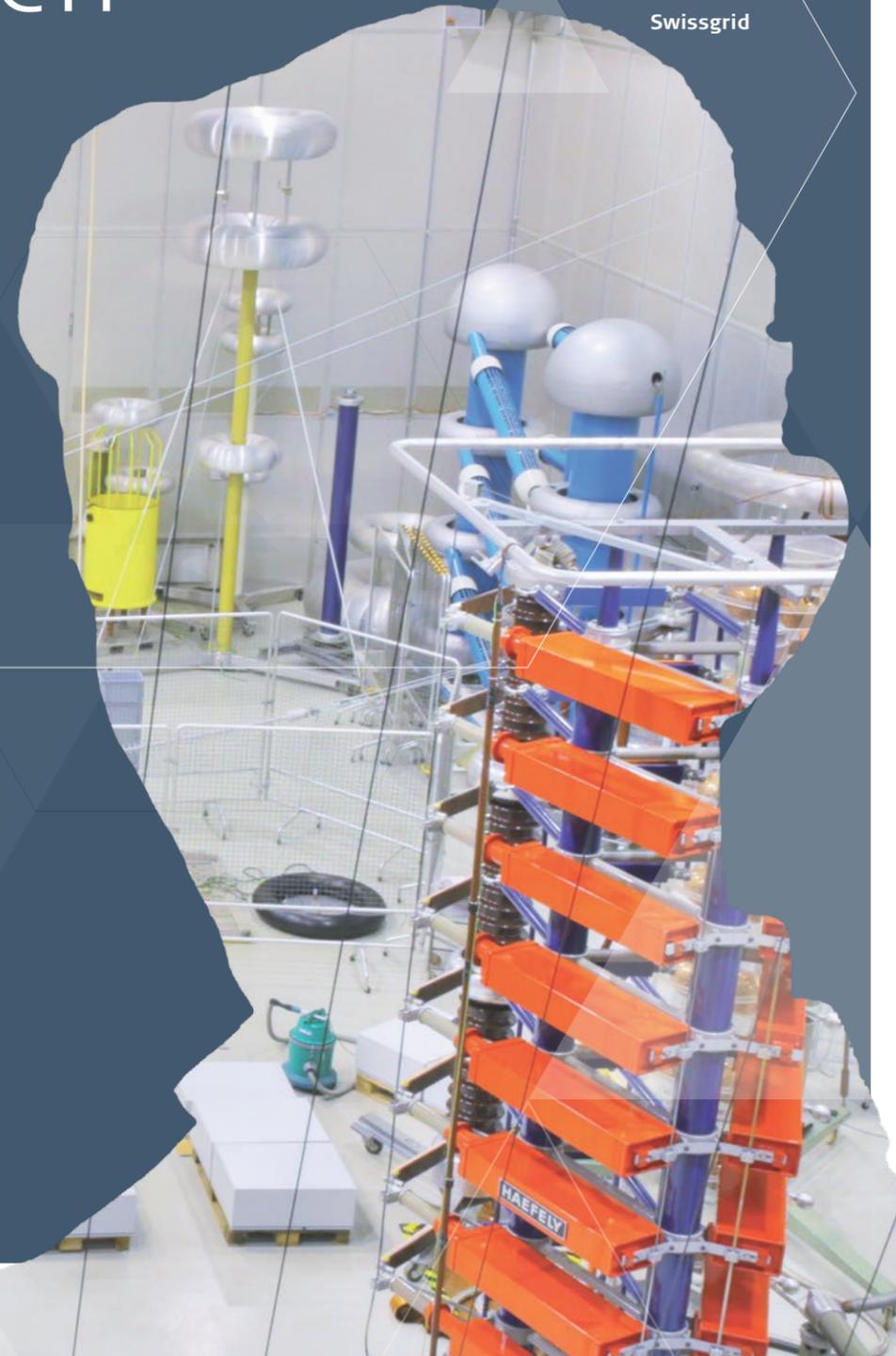
"Strategic Grid 2025"

The grid for the energy future of Switzerland

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RESEARCH

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Swissgrid

High voltage laboratory of the ETH Zurich
47°22'42.57" N 8°33'8.67" E

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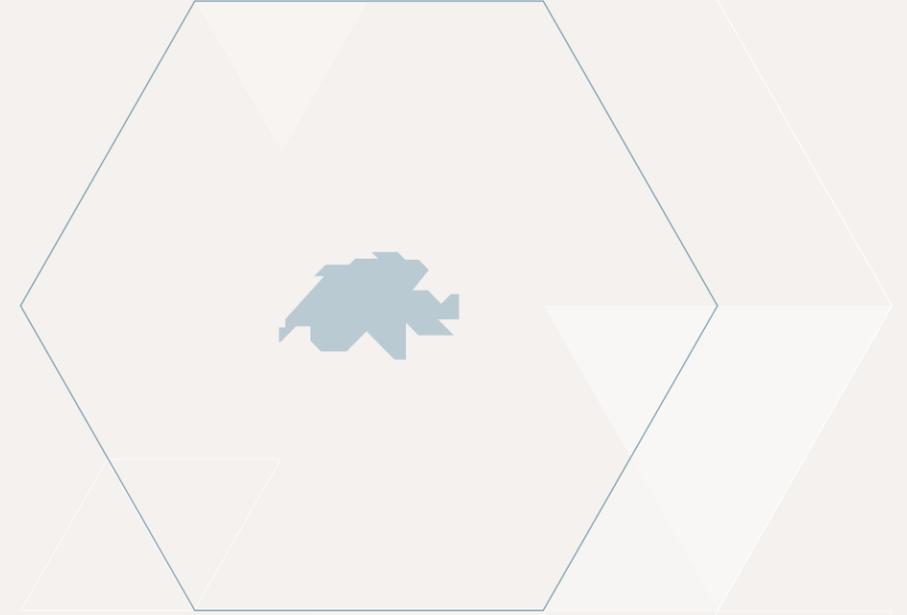
Swissgrid

RESEARCH

2022

High voltage laboratory of the ETH Zurich
47°52'45.27" N 8°33'8.67" E

"Strategic Grid 2025" The grid for the energy future of Switzerland





2015 ↻ 2025 2035

A modern grid for Switzerland

The electricity system is facing the greatest upheaval of its successful history. Because of this, it is not just that general technical conditions are changing - the entire electricity economy is being transformed.

However, the further development of the transmission grid has slowed dramatically in the last 40 years. Only a third of the total of 6 700 kilometres of grid length of Swissgrid dates from after 1980. And it is precisely in recent decades that the demands on the grid have been transformed. On the one hand, there are new energy sources and power plants, and on the other hand the consumption of electricity has grown over recent years.

In addition, as a result of its central location and topography, Switzerland is also an important electricity hub for Europe. The country's storage lakes are not only extremely valuable for its own supply security, but are also used by its neighbours to ensure the stability of their grids.

The rising overall demands are already leading to structural congestion in the transmission grid. In future this development is likely to continue. It is urgently necessary to compensate for these weaknesses, because they endanger the supply security and economic efficiency of the Swiss electricity system.

47°04'06.46" N 9°26'04.85" E

How Swissgrid is planning for 2025 today

Swissgrid is responsible for economic operation of the electricity transmission grid and is consequently pursuing modernisation of the grid that is technically secure, as environmentally friendly and economically efficient as possible, and as a result, sustainable. The "Strategic Grid 2025" must meet the still unknown supply task in 2025 without significant structural congestion. At the same time the conversion and expansion required should not occur in instalments, but according to understandable, transparent considerations.

Based on the most realistic scenarios possible, Swissgrid is simulating where recurrent congestion will occur in the grid. Subsequently potential development measures will be evaluated carefully according to technical, economic and social criteria. If the evaluation is positive, a project will be pursued as part of the "Strategic Grid 2025."

If a grid expansion is technically necessary or makes economic sense, it will be implemented in a manner that conserves the landscape as far as possible. Expansion will only be planned if optimisation of the existing infrastructure is out of the question and enhancement of the existing grid would not create the relief needed either.

What is impelling the Swiss grid

Swissgrid took advantage of the work for the «Strategic Grid 2025» to identify and explain the basic driving factors behind grid development. This is because the conditions underlying the conversion and expansion of the Swiss grid are unique and cannot be transposed from other countries.

The analysis of driving factors now available for the first time shows what movements in the electricity system affect the transmission grid. Three driving factors were identified in

this connection which make expansion of the existing grid necessary. These make themselves clearly noticeable as the basic causes for undesired structural infringements in the context of the grid analyses.

If the failure of a grid element results in overloading, at least one driving factor is always directly responsible for this. Consequently, measures to eliminate these structural weaknesses are directly attributable to these driving factors, although these may in turn be influenced by indirect driving factors.

Swissgrid has identified the following factors as direct driving factors in Swiss grid development:

The following factors affect the three direct driving factors and in this way indirectly determine the need for grid expansion:



Direct driving factors

Major new power plants in Switzerland

This can for example include the new construction of a large pumped storage facility, which greatly changes the transport task in a region. New pumped storage power plants in thinly populated regions with fewer strong lines in particular cause overloading of the grid.



CO₂ and fuel price development

The level and volatility of these prices as well as international differences have an effect on the costs of grid congestion and the flow of electricity between Switzerland and its neighbours.



Switzerland's nuclear energy phase-out

The effect of this driving factor in the "Strategic Grid 2025" is that the missing capacity has to be replaced by other domestic and foreign sources.



Direct driving factors

International association

Exchanging electricity abroad increases Switzerland's supply security. It permits the export of domestically produced electricity and the import needed at times of low domestic production (primarily in winter). In the event of increasing volumes overloading of the grid can occur. Expected imports and exports make domestic grid expansion necessary.



Power plant fleet and electricity demand in neighbouring countries

Changes in the power plant fleet and the demand abroad influence the international flow of electricity. The type of power plants and their availability have to be taken into account in this respect. Moreover, the expansion of the transmission grids between European countries outside Switzerland has an additional influence on the international flow of electricity.



Direct driving factors

Supply of downstream grids

The distribution grids are constantly adjusting to changes in electricity demand and generation. New connection requests can lead to structural congestion and as a result change the supply task for Swissgrid, which also has an effect on the "Strategic Grid 2025."



Electricity demand in Switzerland

The development of population and economic power, increases in energy efficiency, and new growth trends like electric cars also influence electricity demand. They influence the import and export volumes too.



Expansion of renewable energy in Switzerland

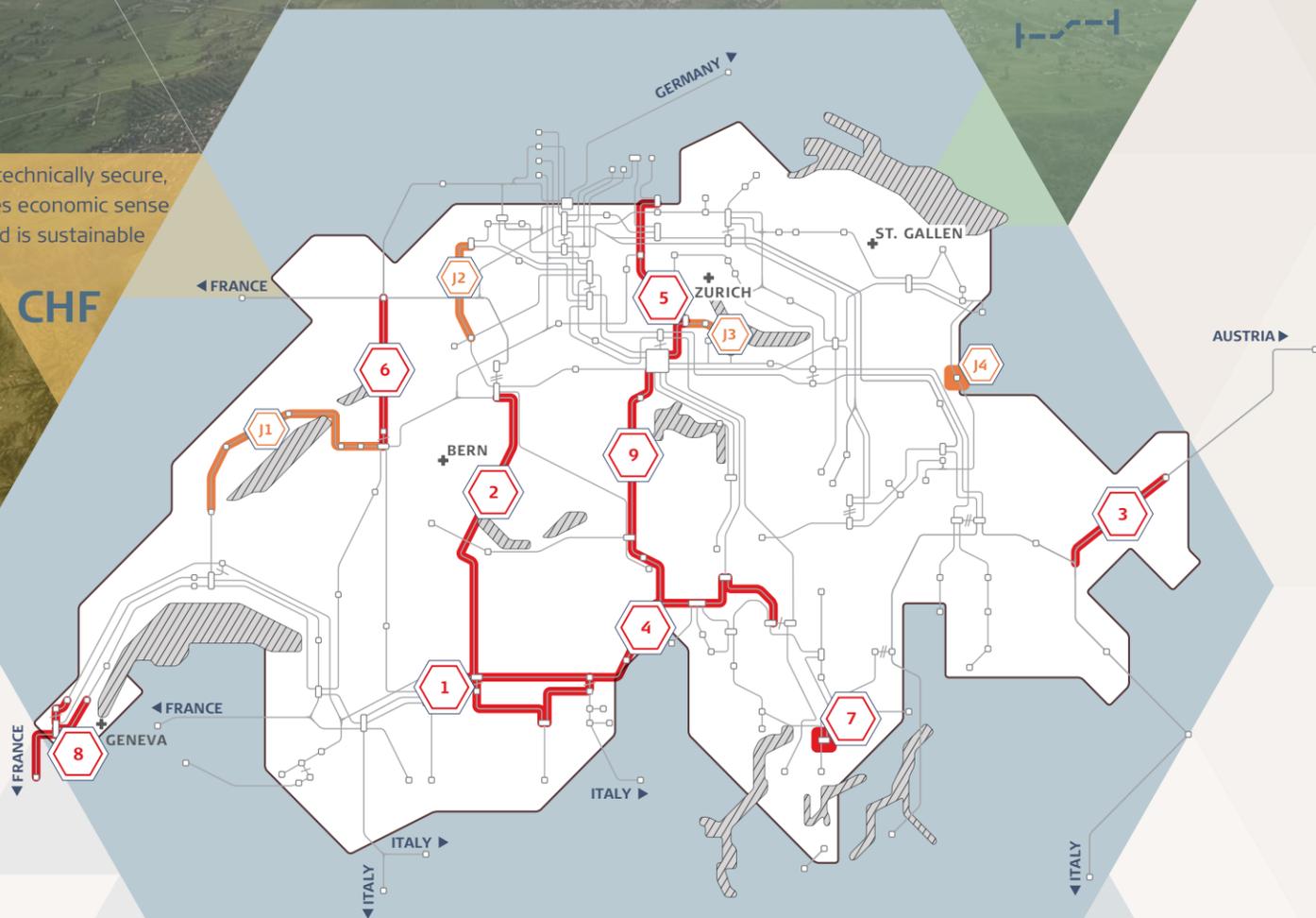
The expansion of photovoltaics, wind and hydroelectric generation has not proven to be the main driving factor for the expansion of the transmission grid. The energy transformation operates far more via primary driving factors like the modified deployment profiles of major power plants and international electricity flows.

The projects for the "Strategic Grid 2025"

... covers fewer line kilometres than the "Strategic Grid 2015"

... is technically secure, makes economic sense and is sustainable

CHF



... considerably reduces the landscape intervention compared to the "Strategic Grid 2015"

- Substations
- Lines
- Swissgrid projects
- Legally obligatory projects (explanation p. 10)

9/4
... includes nine projects justified by Swissgrid and four legally prescribed projects

Swissgrid takes the NOVA principle into account in the expansion of the grid according to needs.

According to this, a grid optimisation must be preferred to an enhancement, which in turn has priority over expansion. An optimisation is associated with no or only isolated structural interventions. An enhancement can cover structural interventions in the existing grid structure. According to this principle, a grid expansion is taken to mean new construction of routes or switching substations.



Chamoson – Chippis

› planned commissioning 2018
Reinforcement by new construction of a 30 km long 380 kV route, **dismantling** of 80 km of existing infrastructure

The economically advantageous project will enhance the integration of hydro-electric plants in Valais and as a result make a very great contribution to Swiss grid security.



Chippis – Bickigen

› planned commissioning 2021
Optimisation of a substation and of the existing route on a length of 106 km by voltage conversion to 380 kV

The power increase will improve the transport of electricity generation from Valais and is of great importance to Swiss supply security, which more than makes up for the neutral to slightly negative economic evaluation.



Pradella – La Punt

› planned commissioning 2020
Reinforcement of existing route on a length of 49 km, **reconstruction** of Pradella switching substation

The connection will eliminate existing congestion and is extremely advantageous for Swiss and European grid security. It will provide sustainable emissions relief to the environment and population.



Chippis – Lavorgo

› planned commissioning 2024
Reinforcement by new construction of a 380 kV route on a total length of 124 km, **dismantling** 67 km of existing infrastructure

This measure will supplement the important supply axis for Ticino. It will eliminate critical congestion, which threatens to occur during a quarter of the year, which more than makes up for the negative economic evaluation.



Beznau – Mettlen

› planned commissioning 2025
Optimisation of the existing route on a length of 40 km by voltage conversion to 380 kV, **reinforcement** of 24 km

The project will eliminate structural congestion and promises to have the effect of lowering prices for Switzerland due to increased capacities to Germany. Moreover, it creates the conditions necessary to combine the flexibility of Swiss hydro-electric power as needed with German wind and photovoltaic power plants.



Bassecourt – Mühleberg

› planned commissioning 2025
Optimisation of the existing route on a length of 45 km by voltage conversion to 380 kV

The price lowering effect due to increased import capacities from Germany and France promises to have high energy economy benefits. Moreover, the project will make an important contribution to grid and supply security in Switzerland.



Magadino

› planned commissioning 2018
New construction on a length of 1 km to connect the Avegno – Gorduno line to the Magadino substation

The project will eliminate the most frequently occurring congestion in the Swiss transmission grid, improve the feed-in situation for power plants in Ticino and increase the cross-border capacity to Italy.



Génissiat – Foretaille

› planned commissioning 2025 questionable
Reinforcement of the existing 220 kV line on a length of 17 km

The measure will eliminate frequently occurring congestion, which occurs during import situations from France. The price lowering effect of increased cross-border capacities and the reduction of power losses holds out the prospect of a clearly positive monetary net benefit for Switzerland.



Mettlen – Ulrichen

› planned commissioning 2025 questionable
Reinforcement of the existing 220 kV line to 380 kV on a length of 87 km

The project will eliminate existing congestion and create advantageous connections between load and production centres. It will permit reduction of non-ionising radiation and noise reduction on the route. Moreover, the increased cross-border capacities to Germany will possess great energy economy benefits.

Legally obligatory projects in the "Strategic Grid 2025"

The following connection lines are planned for new power plants or distribution grids on account the legally established connection obligation:

J1

Method – Mühleberg

› desired commissioning 2025

As part of the coordinated grid planning, the grid configuration to the north of Neuenburgersee will be developed. The expansion work will guarantee transport needs on the part of distribution grid operators, power plant operators and the SBB.

J2

Froloo – Flumenthal

› desired commissioning 2025

The project will create a redundant 220 kV grid connection of the Froloo substation to the transmission grid and as a result will be important for increasing supply security in the greater Basel area.

J3

Obfelden – Samstagern

› desired commissioning as soon as approvals available

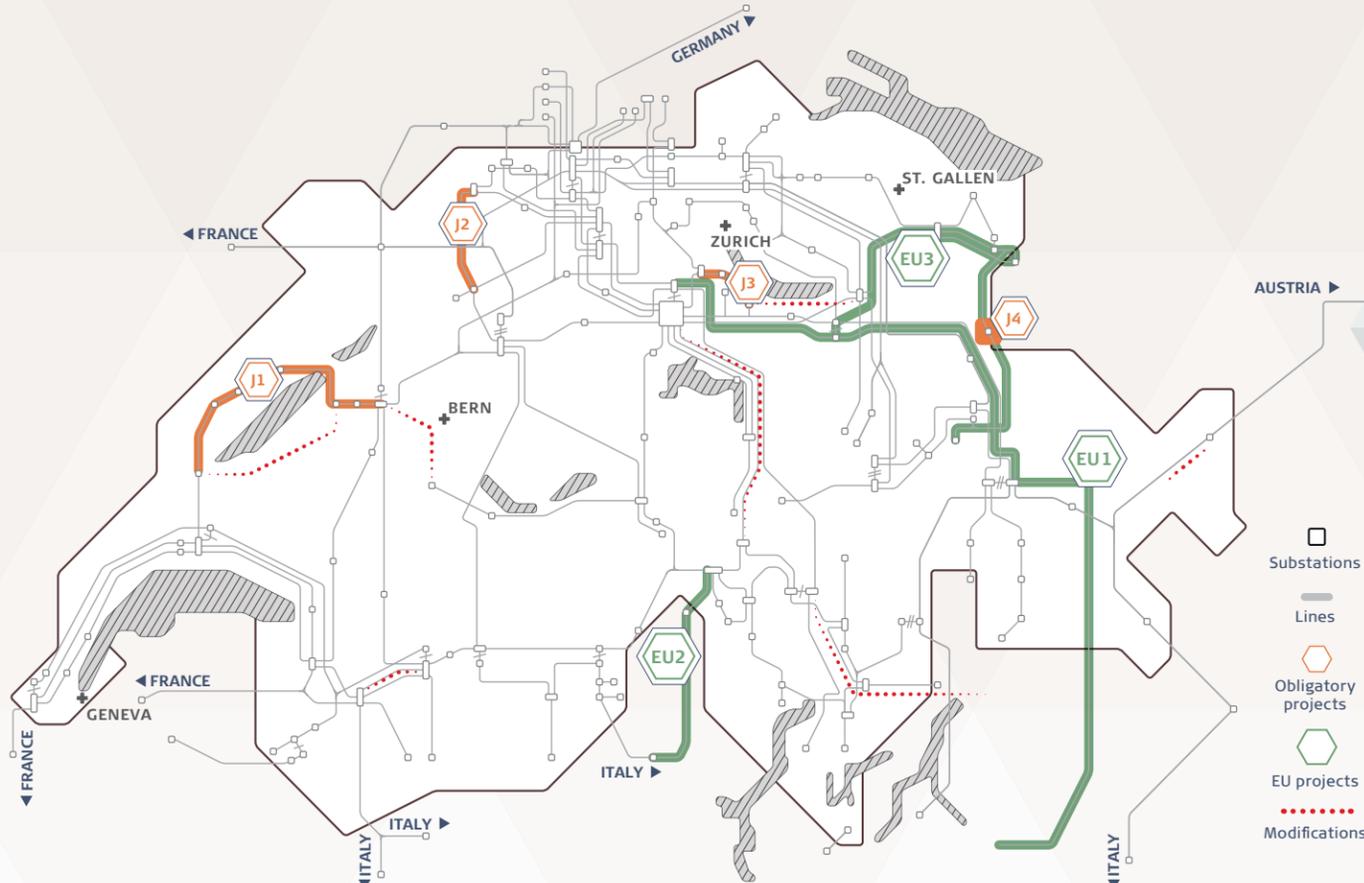
The grid enhancements are important to raise the supply security of the city of Zurich and the Thalwil region. The project will permit redundant connection of the planned Thalwil and Waldegg 220 kV substations.

J4

Balzers route laying

› desired commissioning 2021

The Balzers community (FL) has indicated it will not renew the expiring transit agreement. For that reason investigations are in progress to establish how the existing line through the municipality of Balzers can be relocated.



Swiss participation in European projects

As a reliable partner in the European electricity grid Switzerland and Swissgrid examine so-called 'projects of common interest'. These projects were evaluated in the context of the grid planning, but are not part of the "Strategic Grid 2025".

EU1

Mettlen – Verderio

Given the current capacity circumstances of Switzerland-Italy, the technical necessity of the project is non-existent. However, depending on the development of the projects planned in Europe, and in the case of a politically desired increase in capacities to Italy, this project would make technical sense. It will continue to undergo long-term evaluation in the context of European and Swissgrid planning.

EU2

San Giacomo

This project was planned in the past and has been partly realised. Given the current capacity circumstances in Switzerland-Italy, the technical necessity of the project is non-existent. However, in the event of a politically desired increase in capacities to Italy it would make technical sense.

EU3

Lake Constance interconnector

A new 380 kV connection from Switzerland to Austria and Germany would raise the important capacity in the north of the Alps (storage) and Italy (transit). The assumed import/export development on the northern border of Switzerland up to 2025 will not make conversion of the voltage necessary. Together with neighbouring grid operators, further analyses and an investment strategy will be prepared.

Modifications compared to the "Strategic Grid 2015"

Several expansion measures from the "Strategic Grid 2015" are no longer included in the "Strategic Grid 2025" due to a re-evaluation.

Lavorgo – Morbegno

From a transport point of view this project is no longer needed.

Wattenwil – Mühleberg

Due to other grid measures the supply security in the greater Bern area is guaranteed by the existing infrastructure.

Anschluss Ova Spin

As part of the planning of the Pradella – La Punt project, it has been decided to operate the existing 220 kV connection on 110 kV.

Auwiesen – Fällanden

Due to the coordinated "Obfelden – Samstagern" solution this enhancement is no longer necessary.

Obfelden – Thalwil – Grynau

Due to the "Obfelden – Samstagern" grid optimisation this project can be dispensed with.

Mettlen – Airolo

The "Mettlen - Ulrichen" project with the connection of new hydroelectric power plants was developed as an alternative.

Riddes – Chamoson

Enhancement of the existing 220 kV line is unnecessary in the scenarios considered.

Method – Galmiz

This connection is unnecessary according to the market and grid simulations carried out for the time horizon up to 2035.

With transparency to the grid of the future

Swissgrid relies on the latest recognised methods in grid planning. Apart from the technical and environmental policy criteria, Swissgrid is one of the first grid operators in Europe to evaluate the economic benefits of grid measures for the "Strategic Grid 2025".



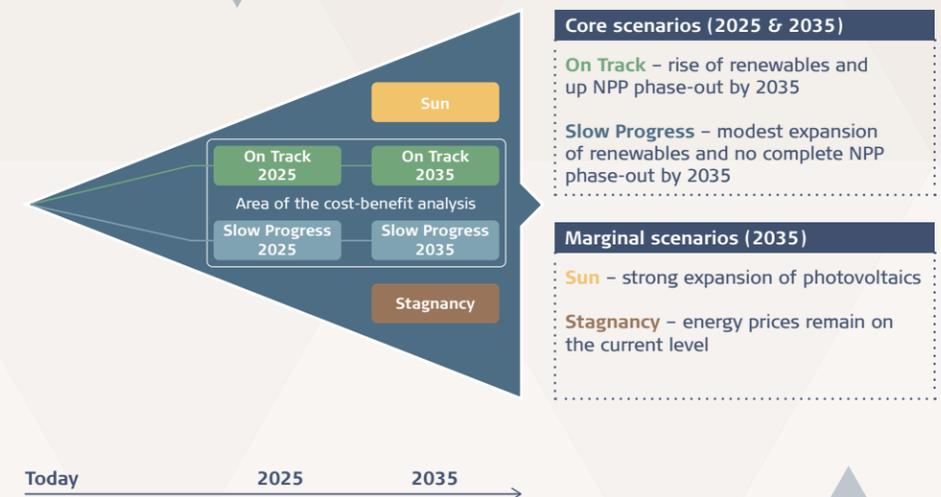
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Market simulation for the greatest transparency

The different scenarios constitute the foundation for the simulation of the future electricity market. The goal is to estimate how many power plants will be producing at home and abroad to cover the respective demand. The resulting domestic and cross-border electricity flows can be deduced from this and the electricity prices simulated.

Scenarios instead of forecasts

The grid planning for the "Strategic Grid 2025" is based on two different core scenarios for the years 2025 and 2035. These are flanked by two marginal scenarios for 2035. These should not be understood as a prediction of the future, but rather constitute a possible scope of developments, the so-called scenario funnels. The scenarios used are based on the energy perspectives 2050 of the Swiss federal government and the data of the European Network of Transmission System Operators for Electricity. As far as possible they have been discussed and agreed with representatives of the industry and politics and environment associations.



With transparency to the grid of the future

TOOT – Take Out One at a Time

The effect of a project is evaluated on the basis of a comparative case (here: comparative grid) in the context of the cost/benefit analysis. The benefit arises from the advantage that occurs if the project is removed from the comparative grid. TOOT stands for "Take Out One at a Time" and corresponds to the removal of a project from a completely expanded comparative grid.

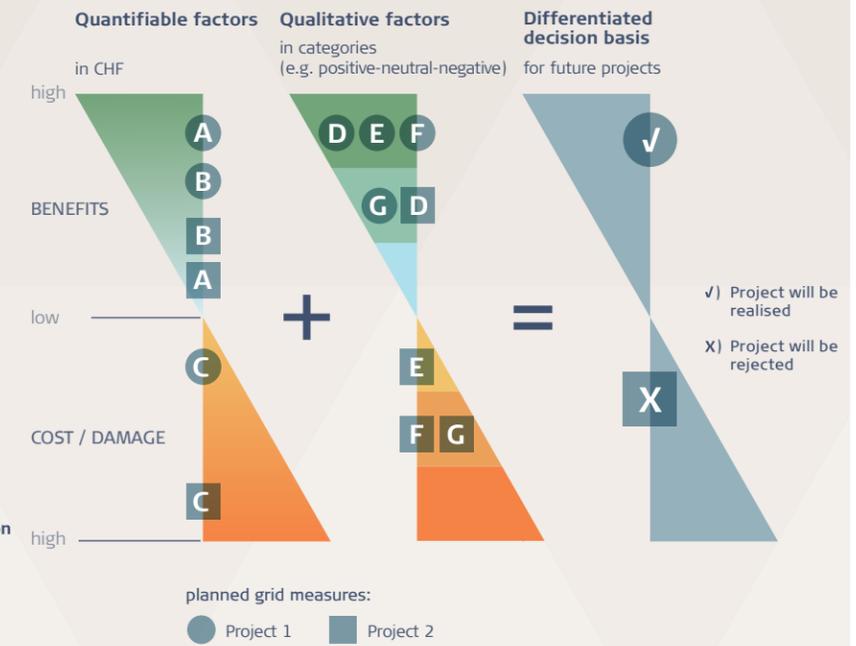
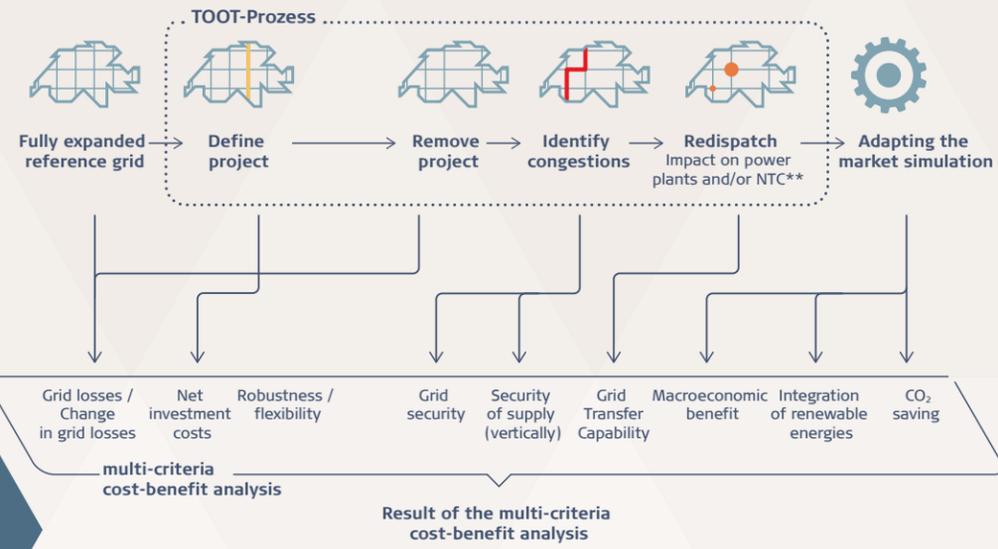
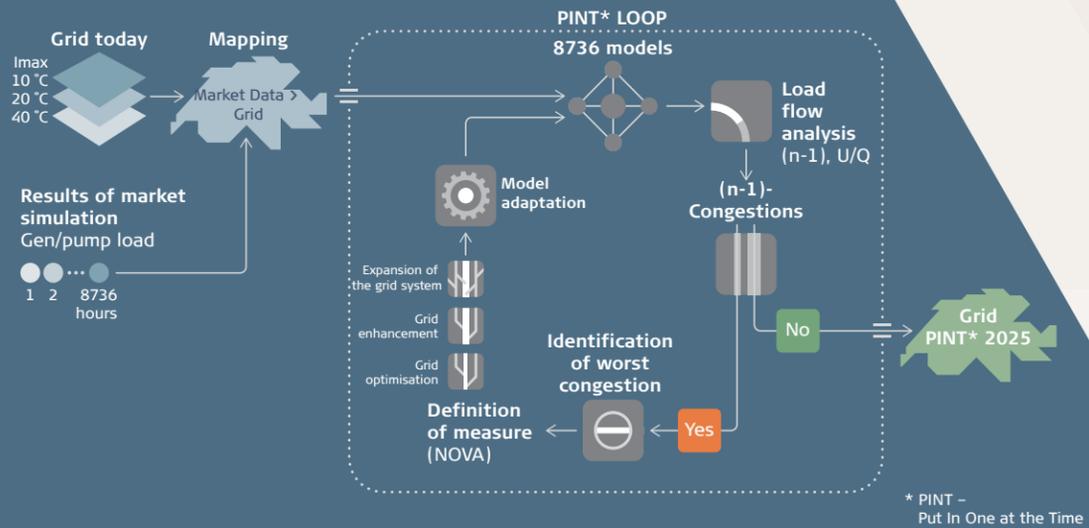
Multi-criteria cost-benefit analysis

The expansion measures determined will now be evaluated in a multi-criteria cost/benefit analysis for Switzerland. Apart from easily measurable monetary costs and benefits, this analysis takes qualitative criteria into account with equal weight, such as the contribution to supply security or environmental effects. If an expansion measure is evaluated according to the multi-criteria evaluation as positive, it is included in the "Strategic Grid 2025".

A seamless description of the methodology, the scenarios used and the cost/benefit analyses carried out can be found in the comprehensive "Report on the Strategic Grid 2025".

Grid mapping

The results of the market simulation are mirrored in a further step on the current grid. It now becomes clear whether the existing grid is capable of transporting the future energy flows. Where structural congestion emerges there is a need for planners to act.



- Factors in detail**
- A) Energy economy benefit
 - B) Costs through grid losses
 - C) Direct costs
 - D) Supply security for electricity recipients
 - E) Grid security
 - F) Robustness and flexibility
 - G) Environmental effects

Grid simulation

The focus will now be placed on Switzerland to determine the grid expansion projects needed in the Swiss transmission grid. The current grid will be supplemented by gradual measures until the structural congestion from the grid simulation has been eliminated. This will occur according to the so-called PINT procedure (Put In One at a Time). The following applies to minimise environmental and landscape influences: grid optimisation, before grid enhancement, before grid expansion (the NOVA principle). The result is a grid that permits secure operation in the scenarios used.

List of abbreviations

B	BDEW	Association of Grid Operators at the Federal Association of the Energy and Water Industry
	BoD	Board of Directors
C	CH	Switzerland
	CHF	Swiss franc
	CRF	Cost-covering remuneration for feed-in to the electricity grid
D	DETEC	Federal Department of Environment, Transport, Energy and Communication
E	ElCom	Swiss Electricity Commission
	EUR	Euros
G	GCN	Grid Control Network
	GW	Gigawatt
	GWh	Gigawatt hours
H	Hz	Hertz
K	km	Kilometre
	kV	Kilovolt
M	MW	Megawatt
N	NOVA	Grid optimisation before enhancement before expansion
	NTC	Net Transfer Capacity
O	OT	On Track
P	PCI	Project of Common Interest
	PINT	Put In One at the Time
	Plc	Public limited company
S	SBB	Schweizerische Bundesbahnen
	SFOE	Swiss Federal Office of Energy
	SP	Slow Progress
	StromVG	Swiss Electricity Supply Act
T	TOOT	Take Out One at a Time
	Tsd	Thousand
	TWh	Terawatt hours
V	VSE	Swiss Association of Electricity Companies

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Typographical/content errors/omissions excepted.

Editorial deadline: 2 April 2015

Security of supply is our task.

At all times.
 For the whole of Switzerland.

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The "Strategic Grid 2025" connects.
Swissgrid is creating a secure, efficient and sustainable energy future in dialogue with Switzerland.

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