Securing power supply in the next winters / summers

Technological solution opportunities

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- **Measures to influence electricity demand over time**
- **Increasing grid security with more heavily utilized transmission grids**
- **Reduction of other threats to electricity supply security**

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Measures to influence electricity demand over time

Information of the population about the generation and network status

By providing the population with targeted and constantly updated information about the current generation and grid status and that expected for the next hours and days, their voluntary grid-serving behavior could be achieve by moving energy-intensive activities such as charging of electric cars to periods when the grid status is stable.

> See how it works in France

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Measures to influence electricity demand over time

Meter data management systems

A grid-serving behavior of end-consumers providing better planning security could be achieved by the implementation and comprehensive use of meter data management systems.

In addition to better load monitoring, appropriately adapted price signals could make grid-serving behavior also economically worthwhile for consumers.

> Use of Meter Data by Konstant (Denmark)

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Measures to influence electricity demand over time

Transparency about the situational utilization of low-voltage grids

The need for monitoring low-voltage networks is increasing with volatile feed-ins, electromobility and heat pumps, and bidirectional power flows.

In future, equipping low-voltage networks with additional sensor technology combined with modern software systems can enable situational assessment that can be taken into account in grid management also at higher levels.

[> Kopernikus-Project for the powergrid of the future (German)]

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Measures to influence electricity demand over time

Planned / controlled load shedding

In case of an uneven generation-demand balance, the overall economic damage of a targeted, controlled, early planned and previously announced load shedding of individual network areas is usually lower than the damage caused by otherwise more likely unplanned and more widespread supply outages.

This could for instance be achieved by software applications for non-discriminatory planning and automated announcement of appropriate load shedding measures.

> See how it is done in South Africa

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Increasing grid security with more heavily utilized transmission grids

Dynamic line rating

Dynamic Line Rating allows to increase transport capacities situationally. Grid assets’ thermal limits are reached tremendously later when it is cold or windy. The assumptions that had to me made when designing the grid statically, considering extreme scenarios (like heat) can be adapted at lower temperatures.

Increasing grid security with more heavily utilized transmission grids

Protection studies to avoid false tripping in the event of a changed load situation

With increased utilization of transport capacities or increased operational loads, the risk of unintentional protection tripping increases, since the protection systems are designed for classic operational scenarios but possibly not for these new scenarios.

> Example from American Electric Power (AEP), U.S.A.

Increasing grid security with more heavily utilized transmission grids

Adaptive protection concepts

Due to strongly fluctuating operational loads, static protection settings may no longer be sufficient to protect the grid at all times with optimum utilization of transport capacities.

Implementing adaptive protection concepts by switching parameter groups in the protection devices based on corresponding commands from the control center could be implemented in the short term. "Real" adaptive protection concepts with recalculation and remote adaptation of individual protection settings could also be developed in the medium to long term.

[> Pilot project with UK Power Networks]

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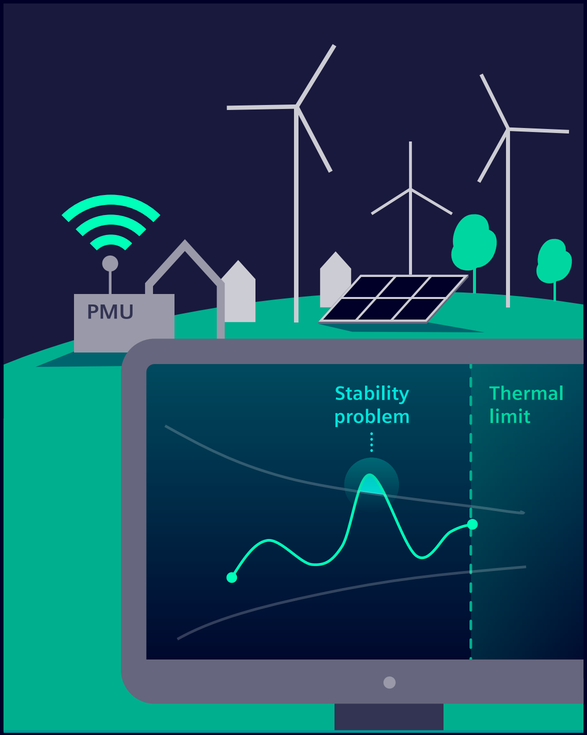
Increasing grid security with more heavily utilized transmission grids

Consideration of the grid's dynamic stability limits

An increasing share of renewable generation can lead to the dynamic stability limit of the grid being situationally below the thermal load limits in the case of increased grid utilization, which can lead to grid failures.

This can be made transparent through a communications link of so-called Phasor Measurement Units (PMUs) and countermeasures can be initiated more quickly.



[> In use at Red Electrica (Spain) and Georgian State Electrosystem (GSE, Georgia)]

[> Grid Software for Power Transmisison Operators]

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Increasing grid security with more heavily utilized transmission grids

Anti-disaster trainings

Preparing the operating personnel through special anti-disaster trainings can also make a contribution to network security. Similar to pilots, control center personnel can be specifically prepared for critical, fictitious or real operating situations.

Using past scenarios and confront people with their mitigation under quasi-real conditions, using system simulators, can help to be able to deal routinely and successfully with corresponding situations in real network operation.

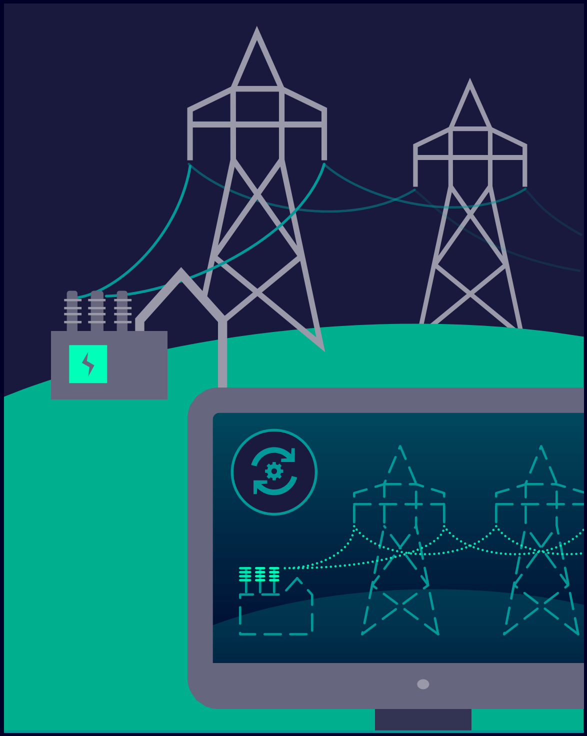
Increasing grid security with more heavily utilized transmission grids

Digital twins

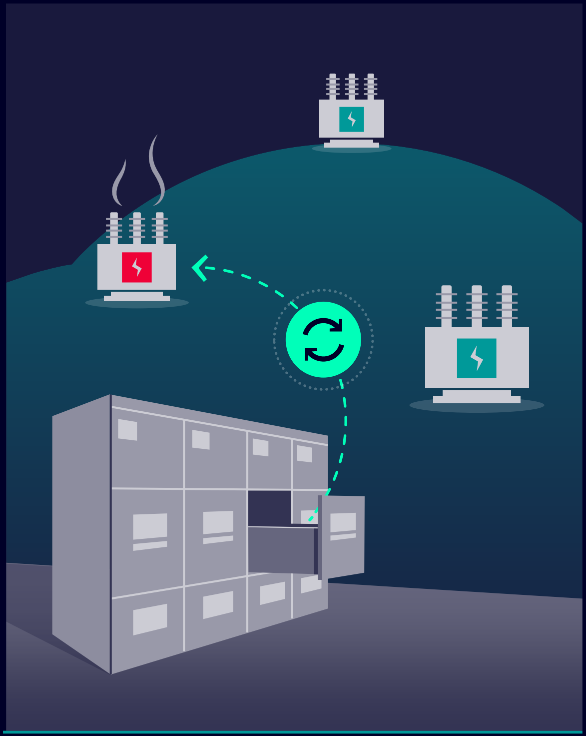
The basis for the implementation of all model-based analyses is the availability of accurate grid model data in the sense of a digital twin. Approaches for the central management of corresponding data optimize processes and support analyses on renewable grid infeed.

This enables efficient synchronization of data from different sources across all operational phases and operational units (e.g. also between TSOs and DSOs), and generally improves the transparency and controllability of the grid.

> Digital Twin at Fingrid (Finland)



Reduction of other threats to electricity supply security



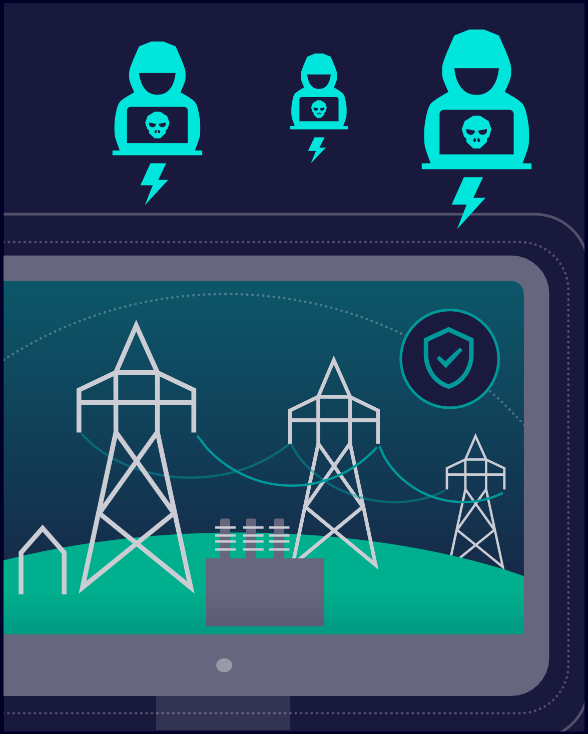
Improved safeguarding of the availability of critical assets

With heavily utilized transmission and distribution grids, the failure risk of individual assets, resulting in the outage of supply lines, increases – especially in the currently tense situation with raw materials and supply chains.

Targeted replacement supply concepts and contracts as well as asset management systems based on aging-relevant data for relevant equipment could provide a remedy.

> Example: NXpower Monitor

Reduction of other threats to electricity supply security



Increased cyber-security

The threat of politically motivated cyber attacks on power and communications networks appears is currently massive.

In this context, security gaps in the control systems of power grids must be urgently closed. In addition to central IT components, this applies in particular to the protection and automation devices and systems in substations.

[> Cybersecurity Consulting for grid operators]

[> OT Companion]

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Reduction of other threats to electricity supply security

Early detection, defense and limitation of the effects of sabotage actions

Other acts of sabotage on critical power supply infrastructure also appear more likely after the recently observed attacks on gas pipelines and German rail traffic.

Possible technical defense measures that can be implemented in the medium term include surveillance and access systems as well as the linking and analysis of available data from various sources (big data analytics) across system and organizational boundaries of critical infrastructure operators and security authorities.

[> Building security with Siveillance]

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The regulator sets the rules of the game

The energy sector is a highly regulated market. System operators depend on a stable regulatory framework. Several of the solution approaches described are built around digital technologies and software solutions, crucial elements for the successful energy transition.

However, investing in digitalization not only shortens the investment periods of system operators but also increases the share of OPEX. These kinds of investments are currently not incentivized by the regulator.

Future proofing the grid with digital technologies depends on the right regulatory framework and incentives, which have to be designed by the political and regulatory stakeholders.

System operators need stability and certainty for their planning and investment decisions.

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grid.software.si@siemens.com

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Contact

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Siemens AG
Siemens Smart Infrastructure Grid Software
Humboldstrasse 59
90459 Nuremberg
Germany
For more information, please contact
Email: grid.software.si@siemens.com
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