ETIP SNET

European Technology and Innovation Platform
Smart Networks for Energy Transition

Regional Workshop for Central Europe Region

16rd of May

Agenda

Item	Time	Session
10:00		**Start**
#1	10:00	**Introduction of ETIP SNET and workshop objectives** By Beatrice Profeta - PwC, ETIP SNET Secretariat
#2	10:10	**EU priorities for R&I in energy systems, grids and storage** By George Paunescu - Policy officer in DG ENER
#3	10:20	**The Central Europe region: Research initiatives and technological innovations** By Mihai Calin - AIT
#4	10:35	**Spotlight Sessions I – Priorities for applied energy research in selected countries** • DE: Thomas Degner - Fraunhofer IEE • AT: Michael Hübner - BMK and Clean Energy Transition Partner
#5	11:05	**Break out rooms I:** Exchanging views on the alignment of R&I priorities (at EU, regional and national levels) and local needs in view of consolidating the consistency
#6	11:45	**Discussion of results** Moderated by Mihai Calin - AIT
#7	11:55	**Coffe break**
#8	12:15	**Spotlight Session II – Applied energy research: Presentation of R&I projects and results in the Central Europe region** • DE: Diana Mincu-Strauss - Fraunhofer IEE • AT: Clemens Korner - AIT
#9	12:35	**Break out rooms II:** Lessons learned in the implementation of applied energy research projects and best practices
#10	13:05	**Discussion of results** Moderated by Mihai Calin - AIT
#11	13:15	**Closing remarks** By Mihai Calin - AIT

Introduction of ETIP SNET and workshop objectives

Beatrice Profeta
Senior Associate at PwC

Overview of ETIP SNET

Goal

Established with the vision of revolutionizing Europe's energy systems, it focuses on **fostering collaboration between key stakeholders to guide research, innovation and development in smart energy networks**, ensuring that they are efficient, resilient and capable of meeting modern demands. The focus is on coordination with policy makers for successful implementation of the proposed measures.

Governance

- **Governing Board (GB)** steer the initiative and provide strategic guidance
- **Executive Committee** facilitates processes, preparing decisions for the GB
- **6 working groups** provide technical inputs to the GB: *i) Reliable, economic and efficient energy system; ii) Storage technologies and system flexibilities; iii) Flexible generation; iv) Digitalisation of the electricity system and customer participation; v) Innovation implementation; vi) National Stakeholder Coordination Group*

Stake-holders

- TSOs
- DSOs
- Battery storage providers
- Research and Academia
- Regulators & Member States
- ICT & NON-ICT providers
- RES operators

Today’s workshop objectives

Exchange views on the alignment of European and national R&I priorities with local needs in view of consolidating consistency

Promote knowledge sharing between stakeholders in the energy field to address challenges, advance R&I initiatives and disseminate best practices across Europe

Gather insights to support the Commission in identifying and addressing current gaps, through the ETIP SNET R&I implementation plan, national and EU programmes

Workshop participants representing key stakeholder groups

76
organisations

Stakeholders	Organisations
Research and Academia	*AIT Austrian Institute of Technology , ASM Research Solutions Strategy , Brussels Research and Innovation , center for Green technologies (BRING) , CERTH , Clean Aviation , CTIC Centro Tecnológico , Delft University of Technology , DERlab , Dutch Institute for Fundamental Energy Research , Energy Institute Hrvoje Požar , ETRA I+D , FOSS University of Cyprus , Fraunhofer FIT , Fraunhofer Institute for Factory Operation and Automation IFF , Hasan Kalyoncu University , IERC, Tyndall National Institute , ITE , National Technical University of Athens , ProEuropean trading gmbh , R&D Nester , R2M Solution Spain SL , RSE SpA , SINTEF , Smart Innovation Norway , Technical University of Sofia , Tecnalia Research & Innovation , Technical University Dortmund, UAS Upper Austria , University of Ljubljana , University of Ruse Angel Kanchev , University of Stuttgart*
Equipment Manufacturers & suppliers	*Alpacem , ANDRITZ Hydro , Eaton , Siemens Energy*
ICT providers	*AMC TECH sp. z o.o.B23 , Cuculus GmbH , ESMIG , IDENER , RDIUP , SOLID.EU , UBITECH , Woodswallow , InescTec*
Non ICT providers	*BlueNewables S.L. , Business integrazione partners , ICLEI , RINA-C , Sinloc Spa , Wirepas Oy*
Renewable Energy Sources	*Airborne Wind Europe , Apio Srl , DTU Wind , OceanEnergy , PROTASIS S.A. , WindEurope*
DSO	*E.DSO , E-REDES , EU DSO Entity , Hellenic Energy Distribution Network Operator , i-DE*
Market player	*Banca Transilvania , E&C Consultants , META Group , smartEn, TUV Austria*
Storage	*betteries AMPS GmbH , CIDETEC , Consortium battery Innovation , FBS-Systems GmbH*
Thermal Generation (flexible)	*ATECYR , EUTurbines , Fortum*
TSO	*Terna*
Interface to other energy carriers	*GenCell Energy , COGEN Europe*

EU priorities for R&I in energy systems, grids and storage

George Paunescu
Policy officer in DG ENER

European Commission

Research and innovation for smart electricity grids and systems

=an EU perspective=

George Paunescu

Policy Officer – Research, Innovation, Digitalisation

European Commission, Directorate-General for Energy

HORIZON EUROPE €95,5 BN (2021-2027)

SPECIFIC PROGRAMME: EUROPEAN DEFENCE FUND

Exclusive focus on defence research & development

- Research actions
- Development actions

SPECIFIC PROGRAMME IMPLEMENTING HORIZON EUROPE & EIT*

Exclusive focus on civil applications

Pillar I
EXCELLENT SCIENCE (25%)

- European Research Council
- Marie Skłodowska-Curie
- Research Infrastructures

Pillar II
GLOBAL CHALLENGES & EUROPEAN INDUSTRIAL COMPETITIVENESS (53,5%)

Clusters

- Health
- Culture, Creativity & Inclusive Society
- Civil Security for Society
- Digital, Industry & Space
- Climate, Energy & Mobility 15,1 bn EUR (> €7 bn energy)
- Food, Bioeconomy, Natural Resources, Agriculture & Environment

Joint Research Centre

EU Missions

Pillar III
INNOVATIVE EUROPE (13,6%)

- European Innovation Council
- European Innovation Ecosystems
- European Institute of Innovation & Technology*

WIDENING PARTICIPATION AND STRENGTHENING THE EUROPEAN RESEARCH AREA (3,4%)

- Widening participation & spreading excellence
- Reforming & Enhancing the European R&I system

EURATOM

- Fusion
- Fission
- Joint Research Center

* The European Institute of Innovation & Technology (EIT) is not part of the Specific Programme

European Commission

Strategic Plan 2025 - 2027

- Sets out the strategic orientations for HE
- Facilitates the implementation of HE, serving as the interface between the overarching EU policy priorities and the Horizon Europe R&I activities set out in the (multi-)annual Work Programmes
- Is based on a comprehensive analysis (including stakeholder consultation).
- **Priorities of HE:**
  - **(i) the green transition;**
  - **(ii) the digital transition; and**
  - **(iii) building a more resilient, competitive, inclusive and democratic Europe**

Cluster 5 work programme – 2023-24: 2,5 bn EUR

(189 topics; ~360 projects)

Destination 1 – Climate science (9%)

Climate science

Destination 2 – Cross-cutting solutions (12%)

Batteries (220 M EUR) *[Batt4EU partnership]*

Other cross cutting issues: *cities, breakthrough technologies, citizen and stakeholder engagement*

incl. DUT (37 M EUR)

Destination 3 – Energy supply (43%)

Renewable energy (605M EUR)

Energy system, grids and storage (282 M EUR)

CCUS (70 M EUR)

incl. CET (68 M EUR)

Destination 4 – Energy demand (9%)

Buildings (172 M EUR) *[incl. Built4People partnership]*

Industry (36 M EUR)

Destination 5 – Transport modes (18%)

Zero-emission road transport *[2ZERO partnership]*

Aviation

Waterborne transport *[incl. ZEWT partnership]*

Transport-related health and environmental issues

Destination 6 - Transport and Smart Mobility services (10%)

*[CC*Connected, Cooperative and Automated Mobility *AM partnership]*

Multimodal and sustainable transport systems for passengers and goods

Safety and resilience

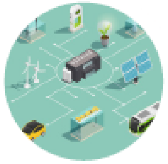
European Commission

Horizon Europe - Energy systems, grids and storage

- **Energy system, grids and storage** – WP 2021-22 + WP 2023-24: approx. €615 M EU funding; Next WP: 2025 (final budget tbc).
- **Overarching expected impacts:** More efficient, clean, sustainable, secure and competitive energy supply through new solutions for smart grids and energy systems based on more performant renewable energy solutions.
- **Examples of topics covered**:
  - energy sector integration across energy carriers; energy system planning and operation; grid resilience and reliability; grid-scale storage; flexibility services for grids; active consumers, energy communities and energy markets; digitalisation, data exchanges and interoperability, software solutions; AC / DC hybrid systems.
  - DC grids & power electronics; innovative storage systems; superconducting systems; innovative digital solutions (AI, IoT).

European Commission

ETIP SNET – Implementation Plans 2022 - 2025 & 2025+



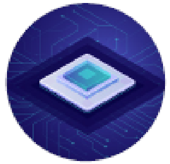
HLUC 1: Optimal Cross sector Integration and Grid Scale Storage

HLUC 2: Market-driven TSO–DSO–System User Interactions

HLUC 3: Pan European Wholesale Markets, Regional and Local Markets

HLUC 4: Massive Penetration of RES into the transmission and distribution grid

HLUC 5: One stop shop and Digital Technologies for market participation of consumers (citizens) at the center



HLUC 6: Secure operation of widespread use of power electronics at all systems levels

HLUC 7: Enhance System Supervision and Control including Cyber Security

HLUC 8: Transportation Integration & Storage

HLUC 9: Flexibility provision by Building, Districts and Industrial Processes

European Commission

The European Strategic Energy Technology Plan

	SET Plan key actions	14 implementation working groups
N°1 in renewables	#1 Performant renewable technologies integrated in the system #2 Reduce costs of technologies	→ Offshore wind → Photovoltaics → Deep geothermal → Ocean energy → Concentrated solar power / Solar thermal electricity
Energy systems	#3 New technologies & services for consumers #4 Resilience & security of energy system	→ Energy systems → Positive energy districts → High Voltage Direct Current (HVDC)
Energy efficiency	#5 New materials & technologies for buildings #6 Energy efficiency for industry	→ Energy efficiency in buildings → Energy efficiency in industry
Sustainable transport	#7 Competitive in global battery sector and e-mobility #8 Renewable fuels and bioenergy	→ Batteries → Renewable fuels and bioenergy
CCS - CCU	#9 Carbon capture storage / use	→ Carbon capture and storage Carbon capture and utilisation (CCS – CCU)
Nuclear safety	#10 Nuclear safety	→ Nuclear safety

IWG 4

BRIDGE

BRIDGE is the European Commission initiative that brings together Horizon 2020 and Horizon Europe **projects addressing Smart Grids, Energy Storage, Islands, and Digitalisation**.

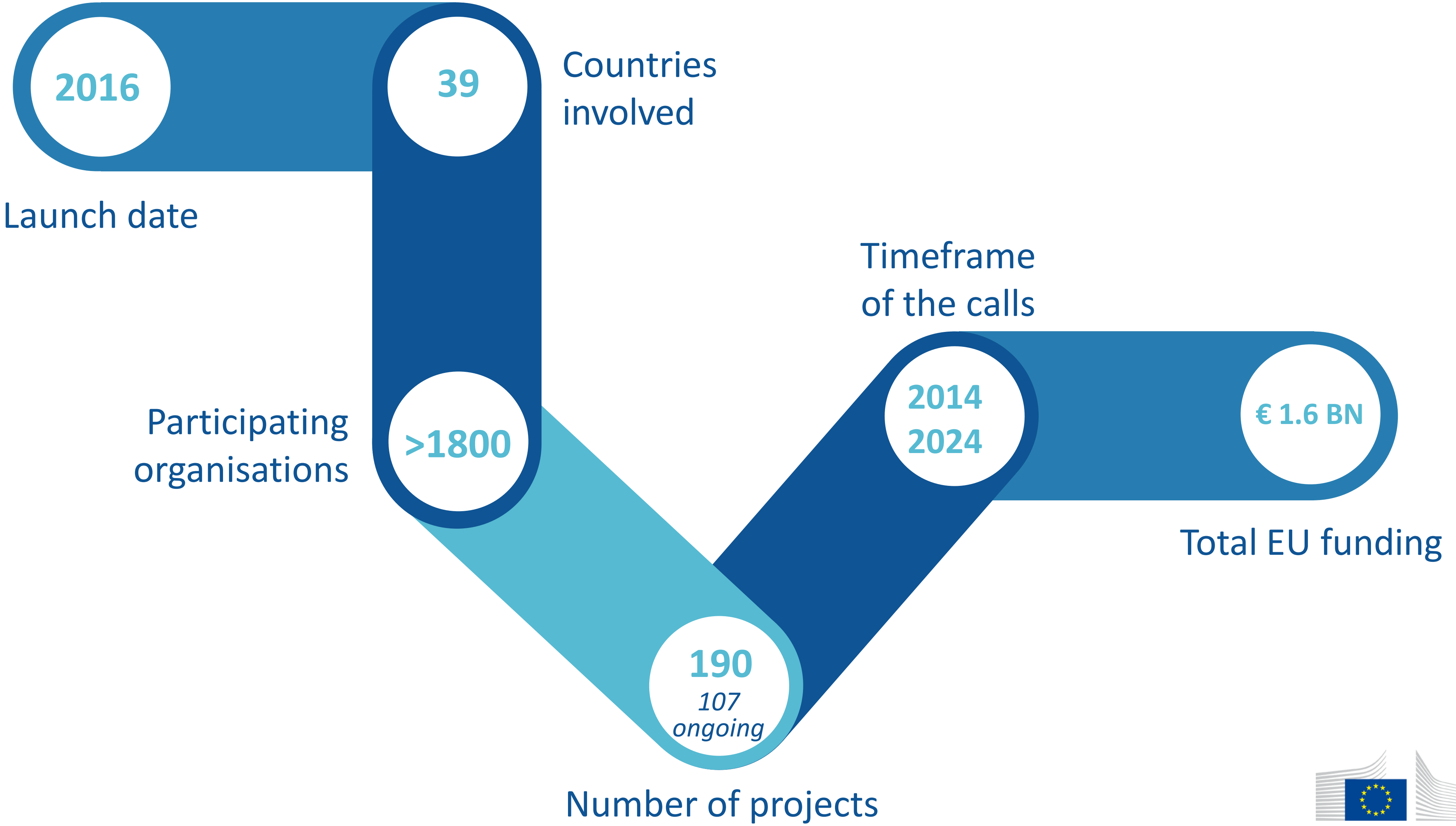
Two-fold objective:

- **To foster the exchange of information, experience, knowledge, and best practices** among its members
- **To provide feedback to the policy-making processes**, and bring up field experiences and lessons learned

https://bridge-smart-grid-storage-systems-digital-projects.ec.europa.eu/

European Commission

BRIDGE in numbers



European Commission

Thank you

European Commission

European Commission

The Central Europe Region

Mihai Calin
AIT

Central Europe Region

Focus: Austria

- ❑ Area: 83,850 km2
- ❑ Population: 8,8 Mio
- ❑ Number of TSOs: 2
- ❑ Number of DSOs: 122
- ❑ Peak load: 10,4 GW

Interconnectors with:
- ➢ Germany
- ➢ Czech Republic
- ➢ Hungary
- ➢ Slovenia
- ➢ Italy
- ➢ Switzerland

54-67% ELECTRICITY FROM HYDRO POWER

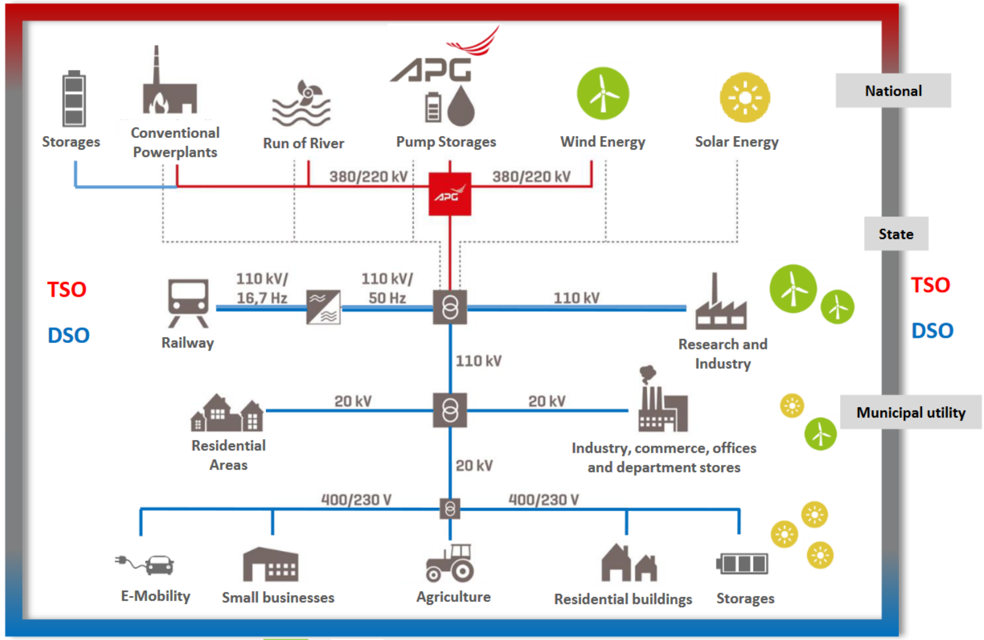
In 2022, hydropower accounted for up to 67% of the electricity generated in Austria.

87% ELECTRICITY FROM RENEWABLE SOURCES OF ENERGY

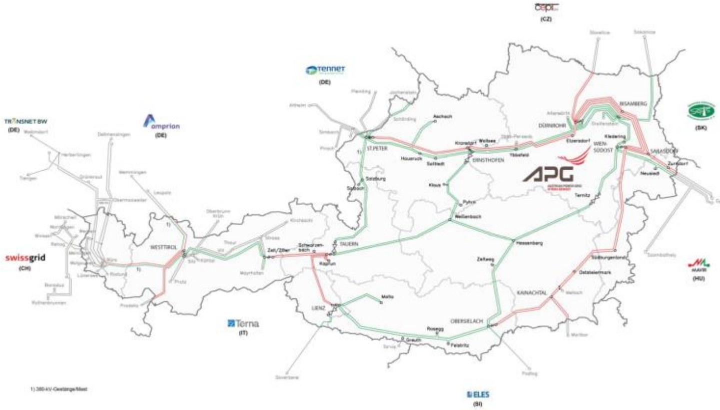
In 2023, renewable energy made up 87% of Austria's total electricity generation.

130 HYDRO POWER PLANTS

Austria's leading electricity company operates around 130 hydro power plants, including highly efficient storage power plants in the Austrian Alps and run-of-river power plants on all the country's major rivers.



WIENER NETZE · Kärnten Netz · ENERGIE NETZE STEIERMARK · NÖ Netz EVN Gruppe · NETZOO · Vorarlberg Netz · netz BURGENLAND · SALZBURGNETZ



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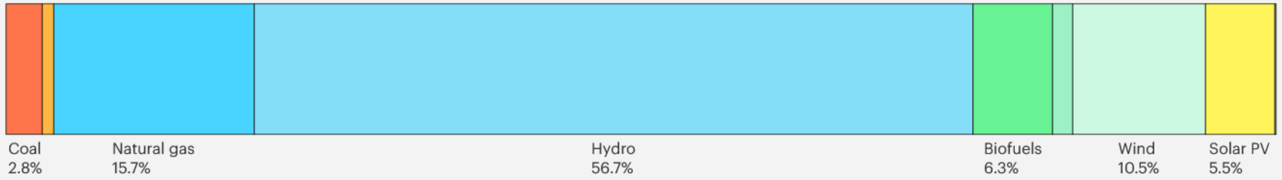
Electricity generation sources, Austria, 2022



Focus: Austria

- **Main topics and areas of focus:**
  - The Electricity Industry Act (Elektrizitätswirtschaftsgesetz) **is in the consolidation phase**
    - Improve network planning strategies for DSOs
    - New market roles
    - Mandatory consideration of flexibility

    This is the implementation of European Energy Act
- **Key objectives**
  - Climate neutrality in Austria by 2040
  - Total electricity consumption balance of 100 per cent from renewable energy sources by 2030 (87% in 2023).
  - Emission reduction until 2040 by 48% in comparison to 2005

Mobility transition

Energy transition

Circular economy

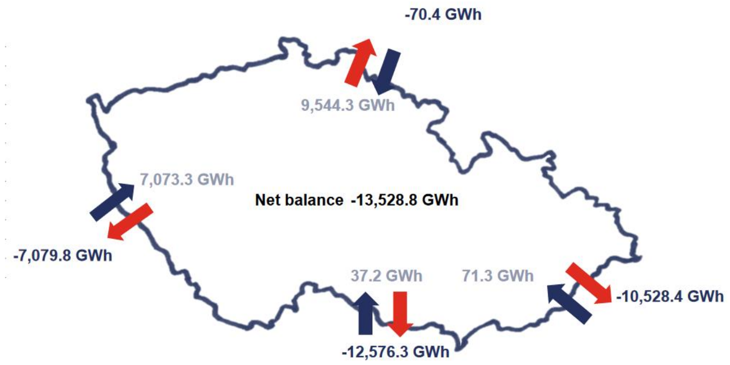
Climate-neutral cities

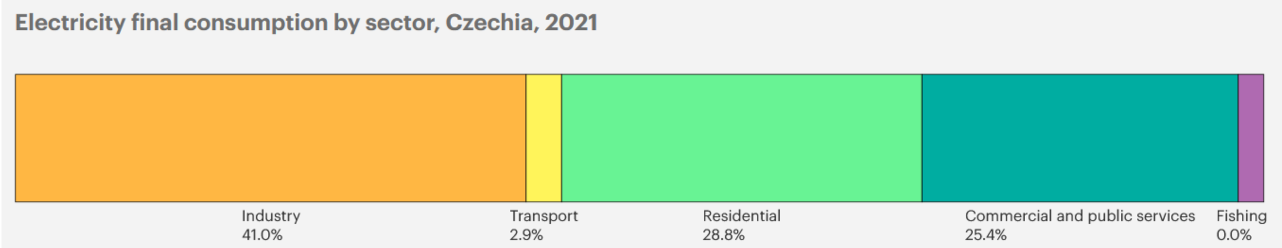
Focus: Czech Republik

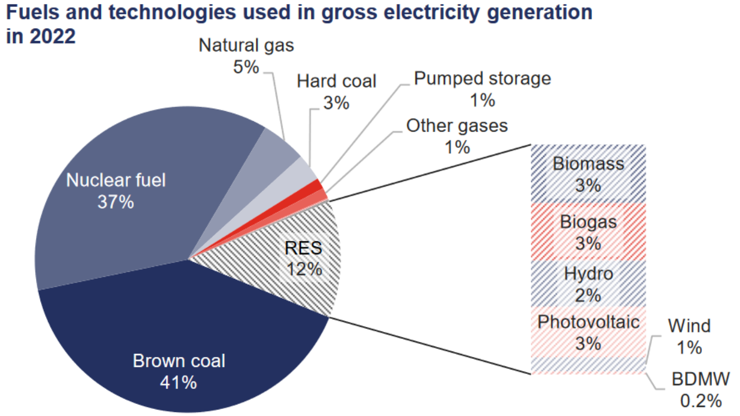
- ❑ Area: 78,866 km2
- ❑ Population: 10,69 Mio
- ❑ Number of TSOs: 1
- ❑ Number of DSOs: 255 (3 regional)
- ❑ Peak load: 11,8 GW

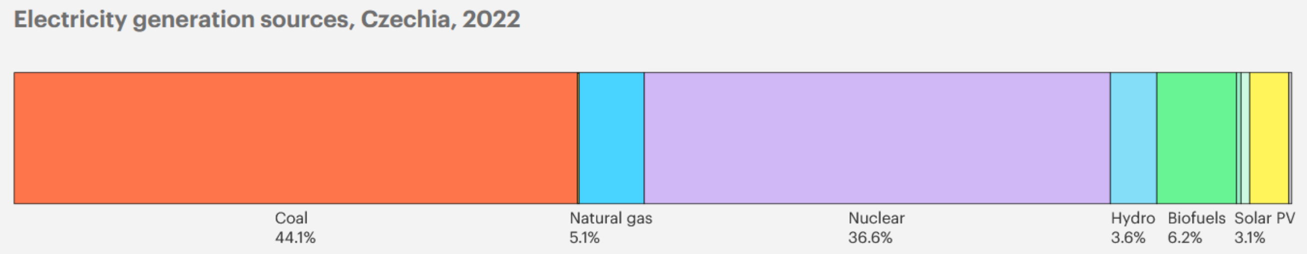
Interconnections with:

- ➢ Slovakia (SK)
- ➢ Poland (PL)
- ➢ Austria (AT)
- ➢ Germany (DE)





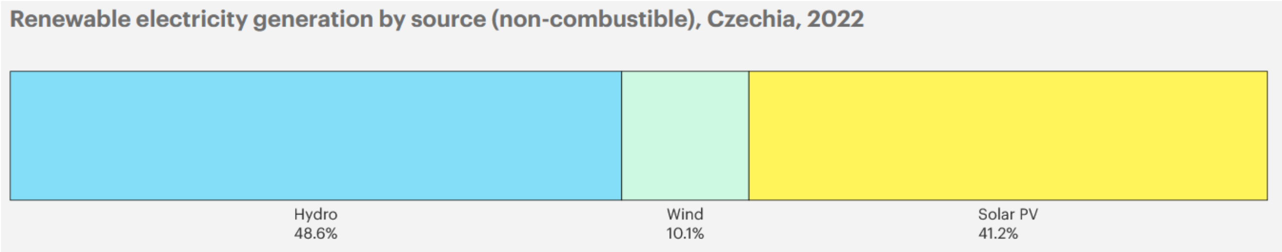




European Commission

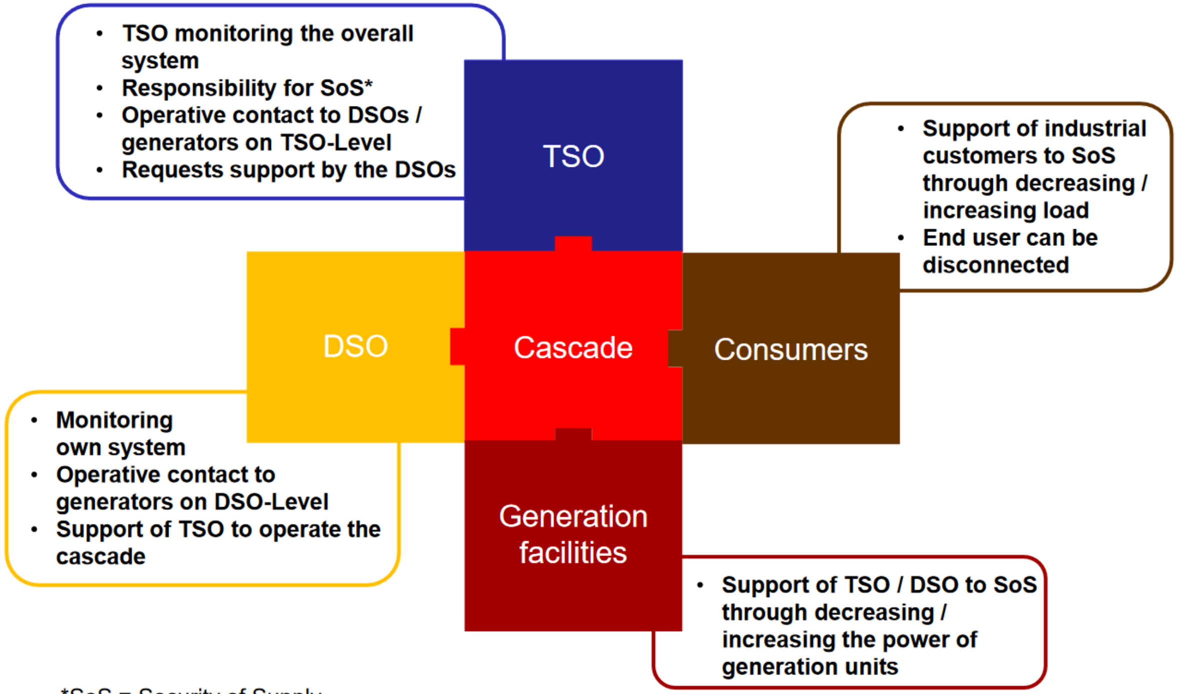
Focus: Czech Republik

- The largest share of production in the Czech Republic continues to be generated by power sources with fuel boilers and steam turbines (power plants, heat production plants and auto-producers), which primarily combust lignite and hard coal.
- Gradual decommissioning of 220 kV system in long term horizon until 2040 and strengthening of 400 kV system
- Energy Regulatory Office contributes to the design and running of the programmes of Technology Agency of the Czech Republic. These specifically include the BETA 2 (a programme of public procurement in applied research, development and innovation for the state administration's needs) and the THETA (a programme for modernising the energy sector, including research in public interest and energy strategies).
- The Progressive and Decarbonisation scenarios in particular also show that the Czech Republic will become a country with risky import volumes from 2025, assuming high dependence on electricity imports from surplus countries (France, Germany).
- The high domestic share of RES is unable to satisfy demand in winter months to ensure the supply-demand balance.

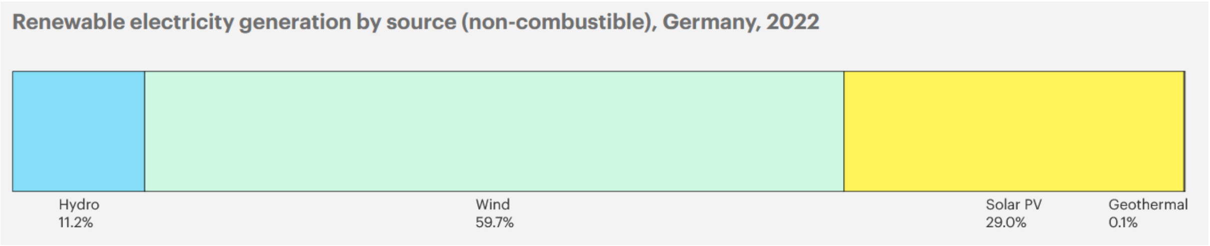


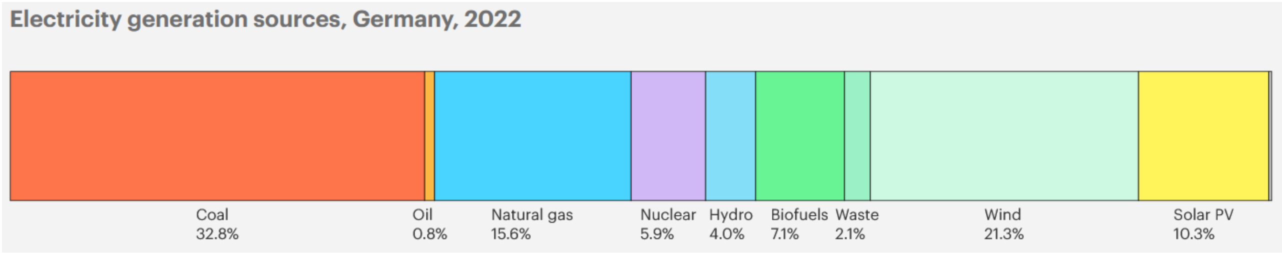
Focus: Germany

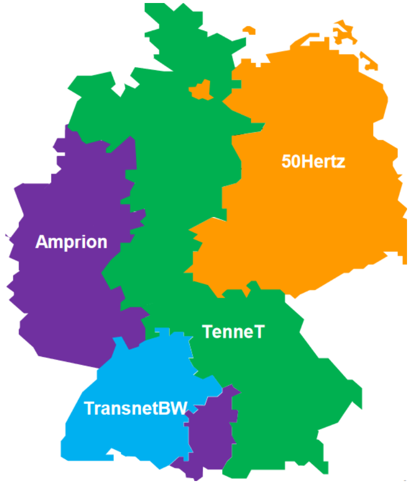
- Area: 357 168km²
- Population: 83,76 Mio
- Number of TSOs: 4
- Number of DSOs: 883
- Peak load: ~86 GW



*SoS = Security of Supply







Interconnectors to:

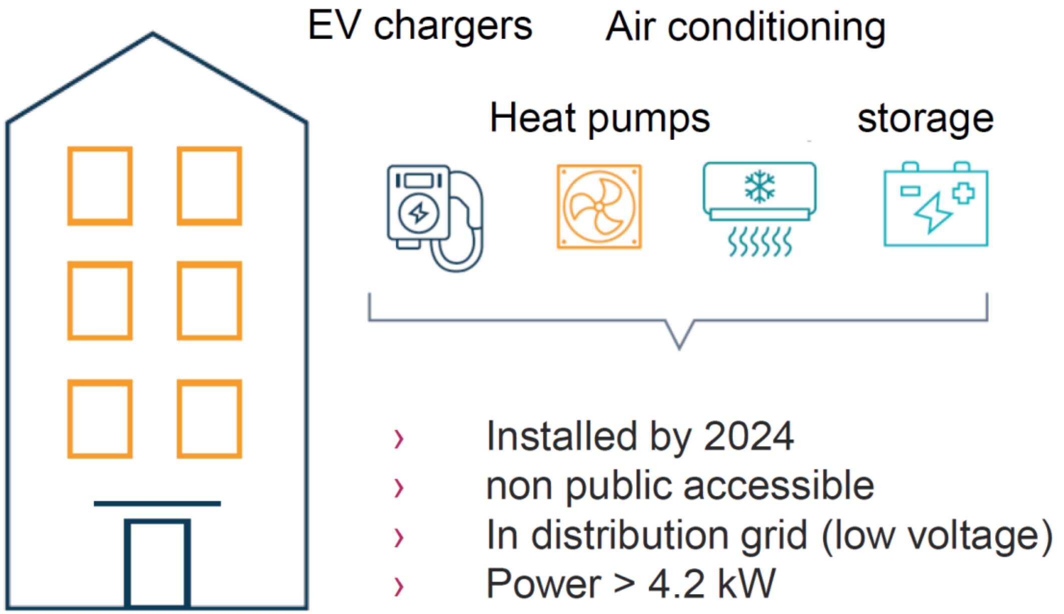
- Austria
- Czech Republic
- Denmark
- France
- Luxembourg
- Poland
- Switzerland
- The Netherlands

European Commission

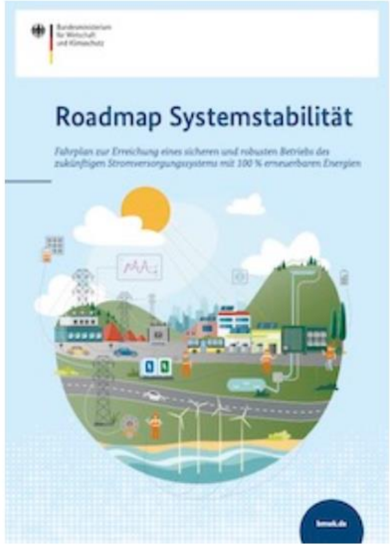
Focus: Germany

§ 14a Energy Industry Act (EnWG) Affective since January 2024

- Grid operators allowed to temporarily reduce the output of controllable energy-consuming assets
  - For example, heat pumps, night storage heaters, batteries or EVs
  - Guaranteed minimum power: 4.2 kW
- DSO must integrate grid-oriented or preventive control into their planning and actively implement
- Compensation by
  - Reduced grid fee
  - Reduction in energy price
  - Time variable grid charges

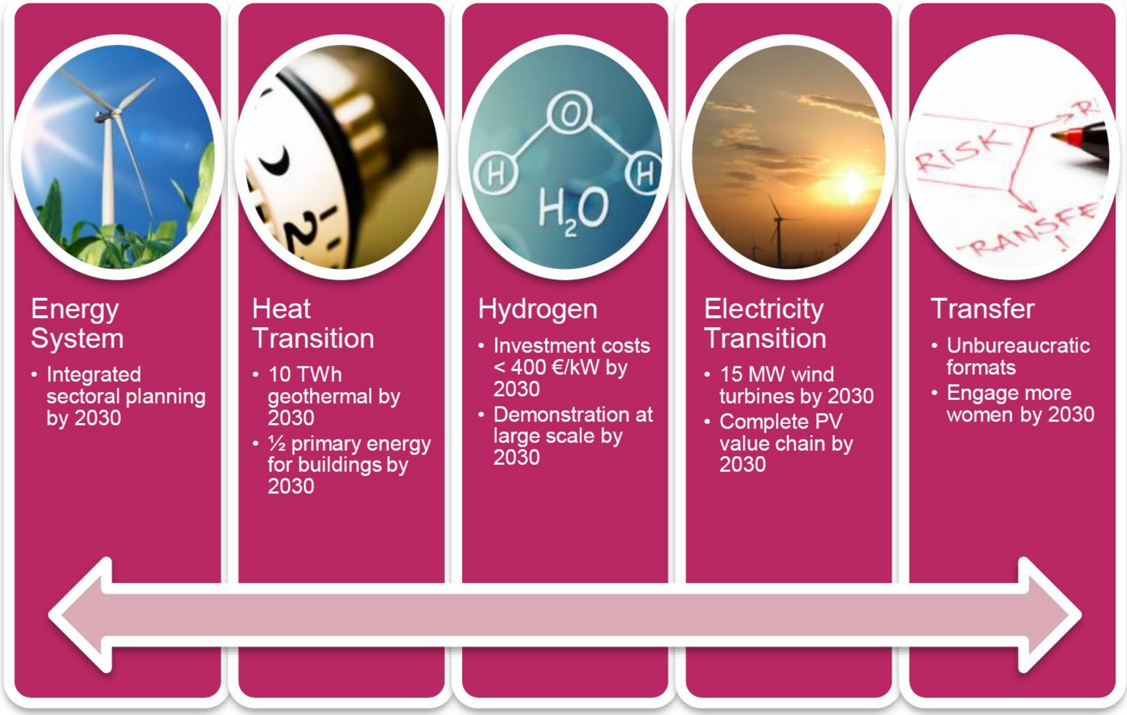


Focus: Germany



Roadmap for achieving secure and robust operation of the future electricity supply system with 100% renewable energies

- Identified stabilities, definitions, processes and services (inverters)
- Target scenario in 2030
- Specific milestones and responsibilities
  - Requirements, interfaces
  - Methodologies, development
  - Test, certification



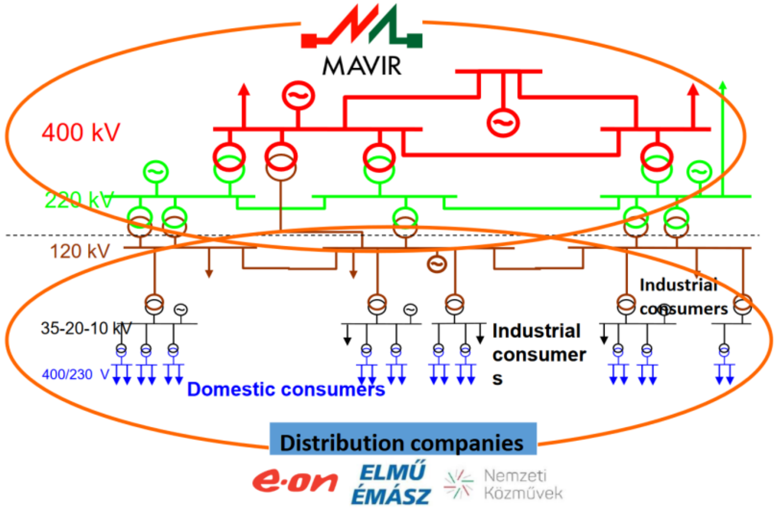
8th Energy Research Programme

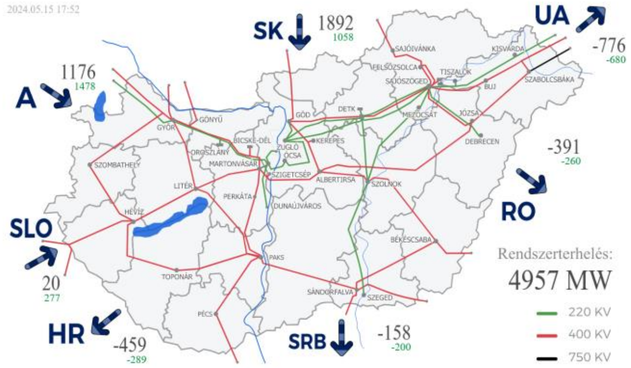
- Five year learning programme
- RDI from TRL 3 to TRL 9
- Mission oriented; 5 Mission for 2045
  - Sprint projects and targets
- Continuous evaluation and monitoring

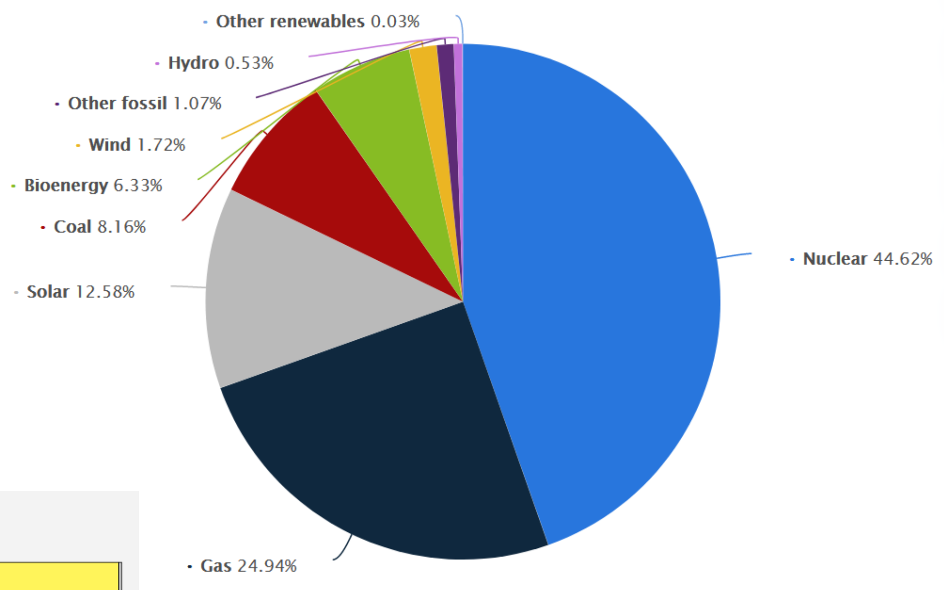
Focus: Hungary

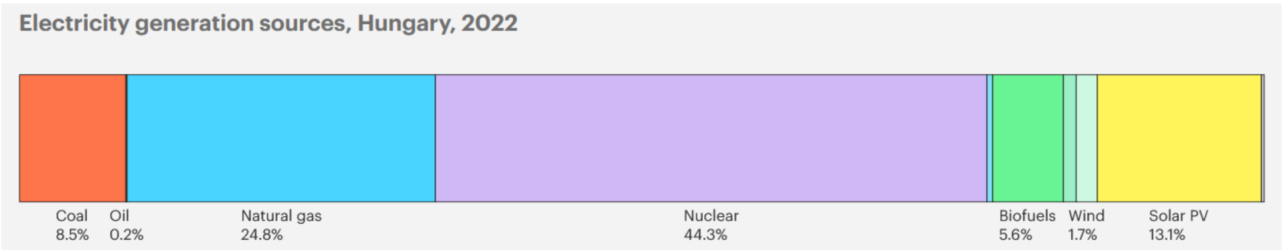
- Area: 93 030km²
- Population: 9,82 Mio
- Number of TSOs: 4
- Number of DSOs: 6
- Peak load: 7,3GW
- Installed Capacity: 10,3GW

Interconnections with:
- Austria (AT)
- Slovakia (SK)
- Ukraine (UA)
- Romania (RO)
- Serbia (SRB)
- Croatia (HR)
- Slovenia (SLO)









European Commission

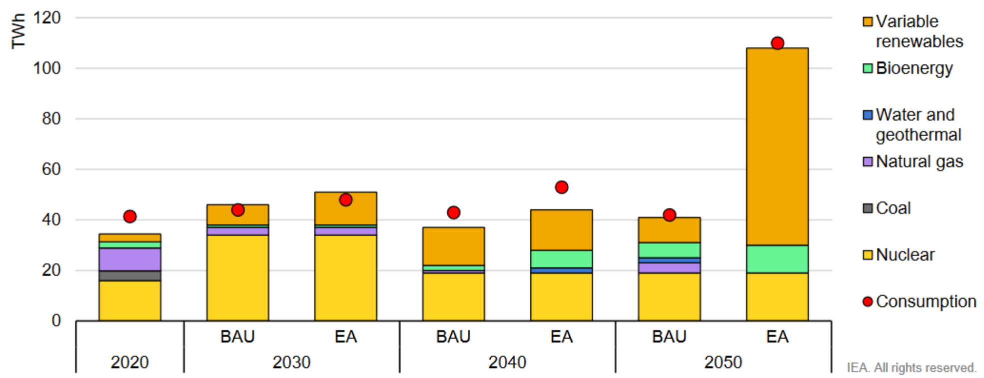
Focus: Hungary

- The share of fossil fuels in Hungary's electricity generation mix reflects continued reliance on gas and coal alongside nuclear.
- Electricity demand has been on an upward trajectory since the mid-2010s, driven by industry, which together with residential and commercial buildings account for the bulk of demand.
- Hungary is a net importer of electricity, with net imports satisfying around 30% of total consumption.
- The NES 2030 sets out a specific objective to reach 90% of electricity generation from "carbon-free" sources by 2030. Currently, 62% of electricity generation is derived from nuclear and renewables combined.

Capacity (GW)	2017	2022	2030*
Coal	1.17	1.17	0
Natural gas	4.19	4.01	1.92
Oil	0.41	0.42	0.42
Nuclear	2.00	2.03	4.54
Wind	0.33	0.32	0.33
Solar PV	0.07	1.83	6.92
Hydro (total)	0.06	0.06	0.06
Bioenergy	0.40	0.34	0.40
Geothermal	0	0.003	0.06
Total	**8.62**	**10.1**	**14.5**

* Estimates based on market simulations in the Hungarian Ten-Year Network Development Plan by MAVIR.

Source: MAVIR.

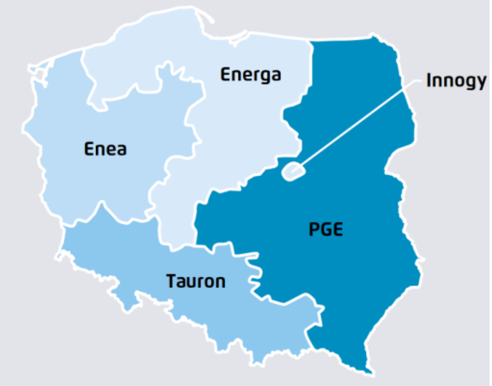


Notes: BAU = business as usual; EA = early action.
Source: Hungary (2021).

European Commission

Focus: Poland

- Area: 312 696 km²
- Population: 38,38 Mio
- Number of TSOs:1
- Number of DSOs: 5
- Peak load: 21,2 GW



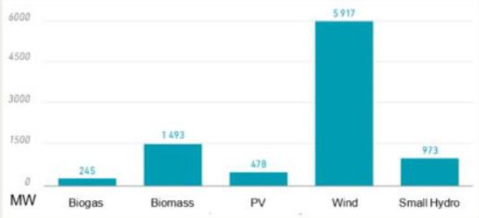
Distribution grid is divided into 5 sectors managed by 5 DSOs

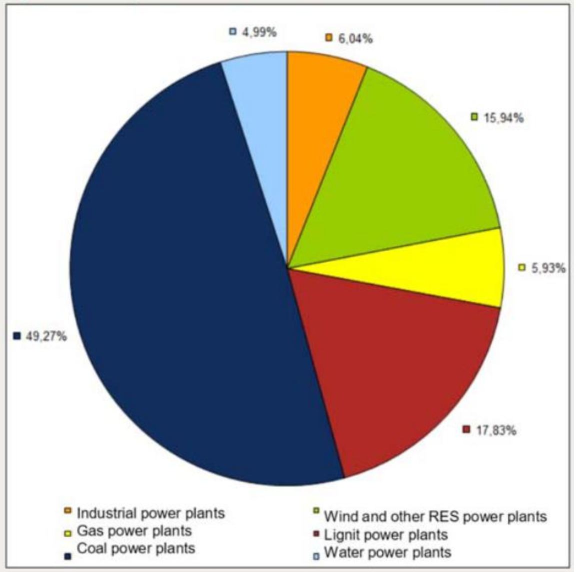
Interconnections with:

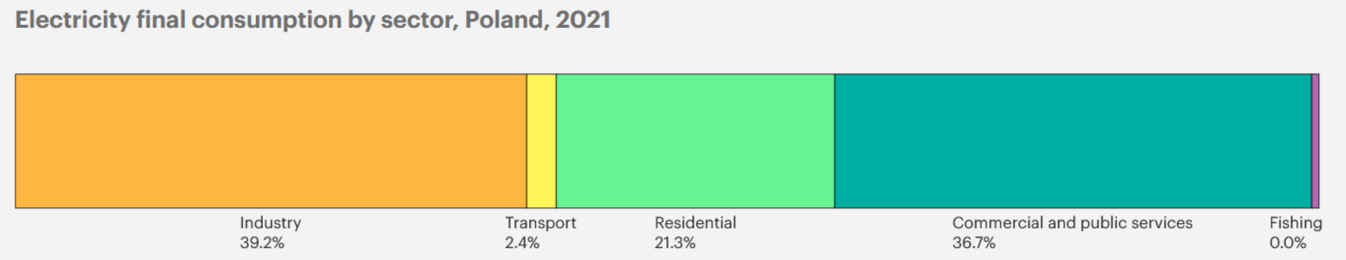
- Germany (2 PST link)
- Sweden (HVDC link)
- Czech Republic
- Slovakia
- Ukraine
- Lithuania (HVDC link)

Installed capacity: 46 799 MW

- Coal – 23 159 MW
- Lignite – 8 382 MW
- Gas – 2 788 MW
- Hydro power – 2 346 MW
- Wind and other RES – 7 490 MW
- Industrial - 2 634 MW







European Commission

Focus: Poland

- Poland's energy policy aims to decarbonize its electricity supply, increase electrification, and maintain electricity security and affordability.

- The EPP2040 sets several key goals for the electricity sector, with a focus on lowering carbon intensity by reducing coal-fired generation; expanding generation from renewables, natural gas and high-efficiency co-generation; and introducing nuclear generation.

- The EPP2040 includes targets to reduce coal-fired generation to 37.5% by 2030 and 11% by 2040.

- Poland plans to separate coal-fired generation assets from state-controlled utilities and transfer them to a new state-controlled entity, the National Energy Security Agency (NABE).

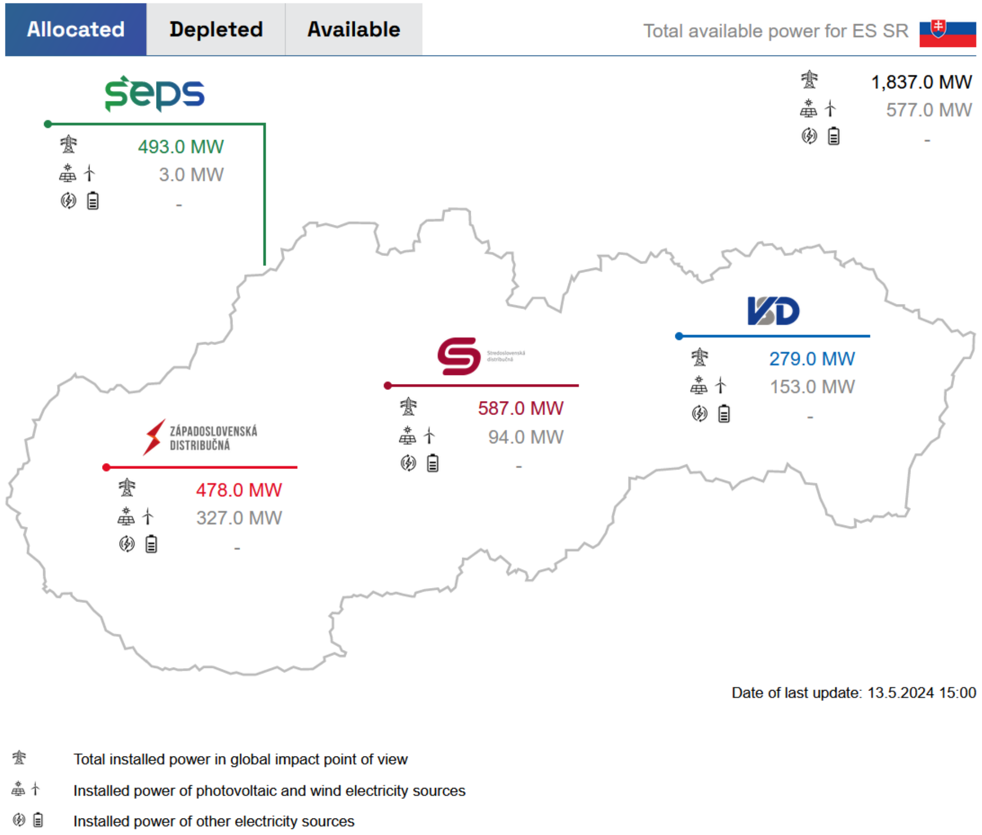
- Poland has a target for renewables to cover 32% of electricity generation by 2030 (versus 18% in 2020), with most of this generation expected to come from wind (offshore and onshore) and solar PV.

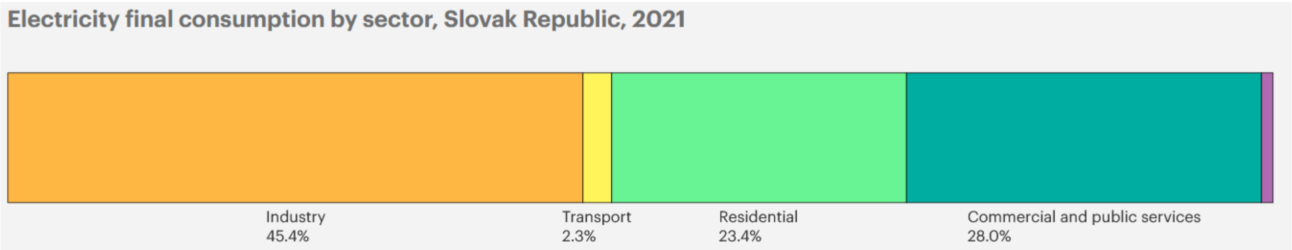
Focus: Slovakia

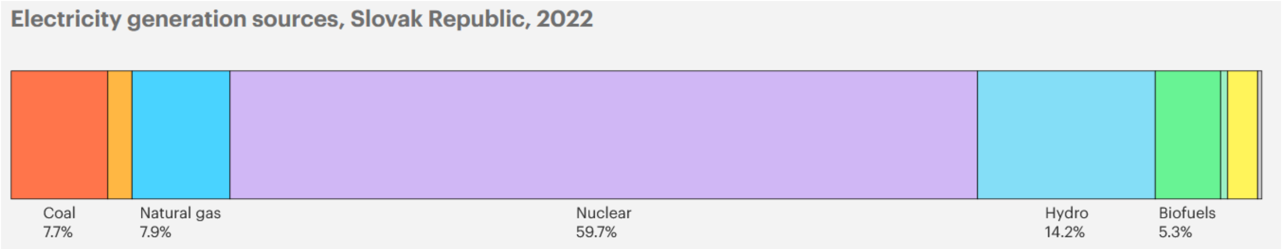
- Area: 49 036km^2
- Population: 5.45 Mio
- Number of TSOs:1
- Number of DSOs: 149 (3 regional)
- Peak load: 4.57 GW

Interconnections with:

- Czech Republic (CZ)
- Poland (PL)
- Hungary (HU)
- Ukraine (UA)







Interconnections with:

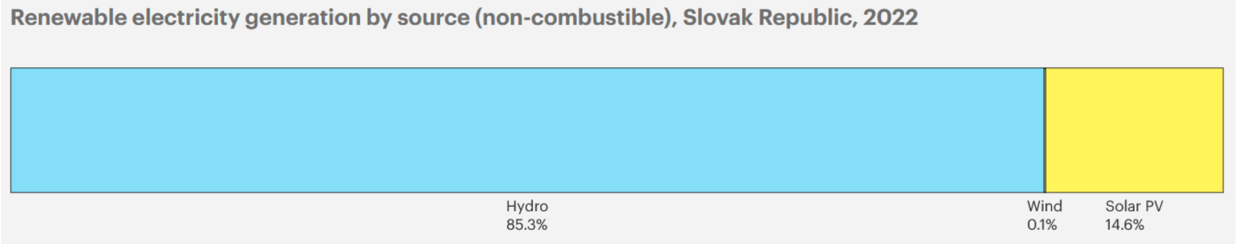
- Czech Republic (CZ)
- Poland (PL)
- Hungary (H)
- Ukraine (UA)

European Commission

Focus: Slovakia

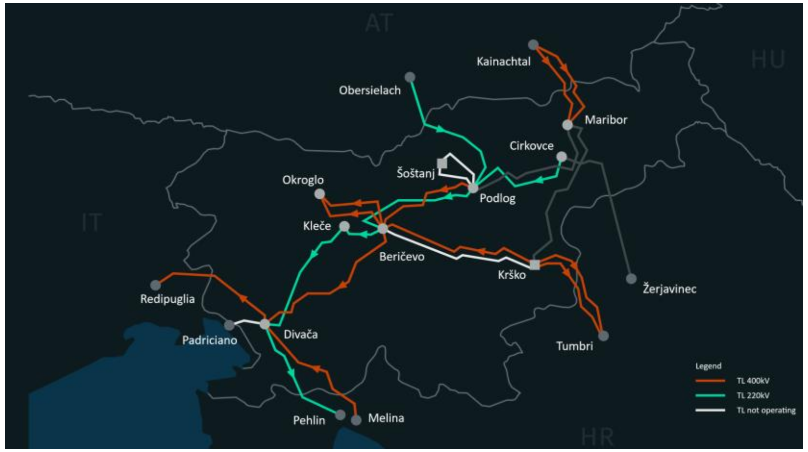
The key objectives of the Slovak energy policy agenda are:

- increasing efficiency in the power and end-use sectors
- reducing energy intensity
- reducing dependence on energy imports
- expanding the use of nuclear power
- increasing the share of renewables in the heat and electricity sectors
- supporting the use of alternative fuels for transport

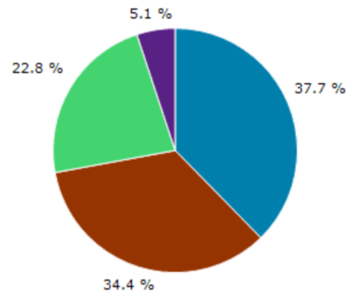


Focus: Slovenia

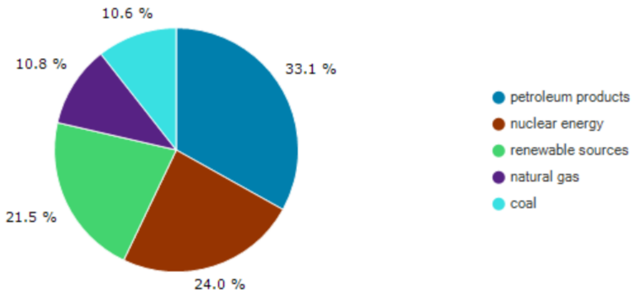
- ❑ Area: 20 273km²
- ❑ Population: 2.1 Mio
- ❑ Number of TSOs:1
- ❑ Number of DSOs: 5
- ❑ Peak load:2.22GW



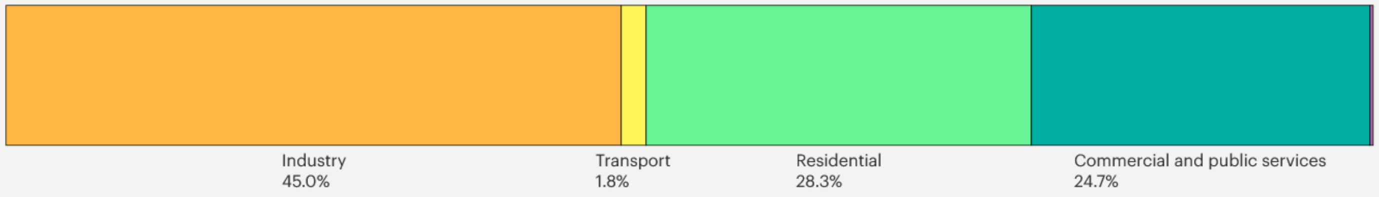
Electricity production, Slovenia, March 2024



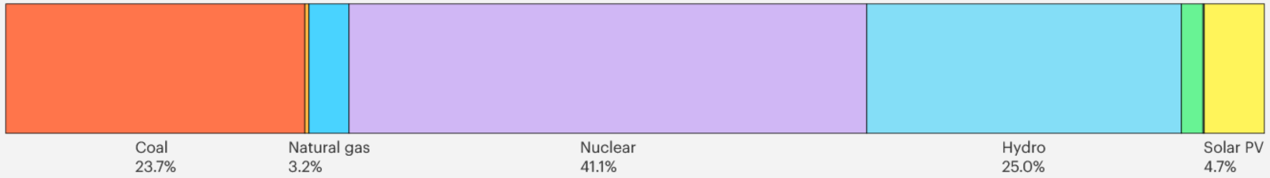
Share of sources in energy supply, Slovenia, 2023



Electricity final consumption by sector, Slovenia, 2021



Electricity generation sources, Slovenia, 2022

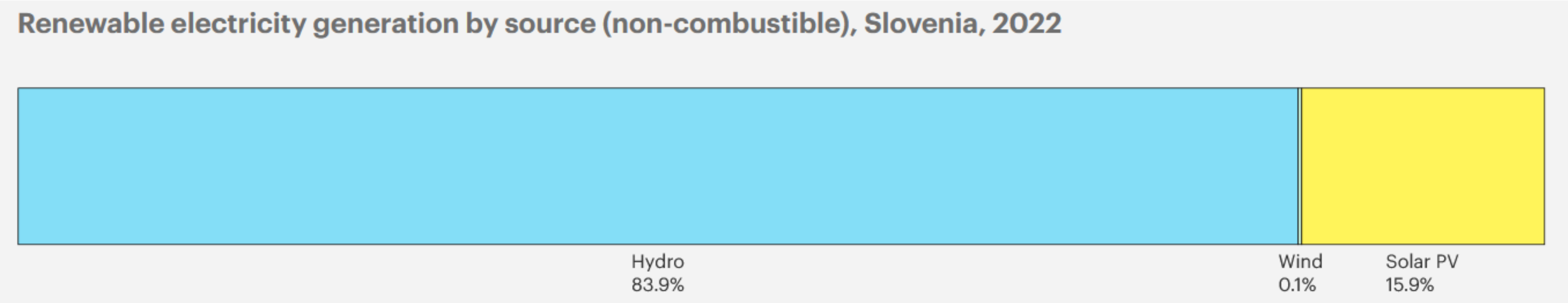


Source: SURS

European Commission

Focus: Slovenia

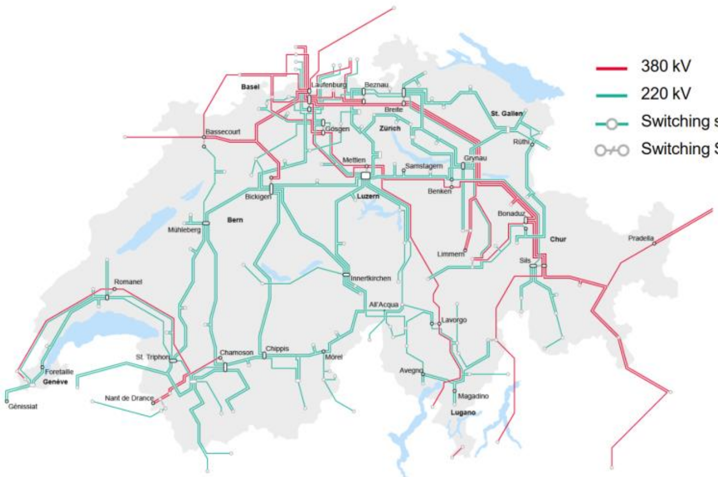
- In LV networks, the most common voltage in households is 230/400 V, and the industry also uses the following voltages: 400/690 V, 500 V, 750 V and 1000 V. MV networks in Slovenia have standardized voltage levels: 10 kV, 20 kV and 35 kV.
- The Slovenian high-voltage transmission network is composed of facilities for three voltage levels: 400 kV, 220 kV and 110 kV.
- TSO and DSOs share some of the 110kV lines
- **Slovenia provided the missing share of energy from renewable sources through statistical transfer**



European Commission

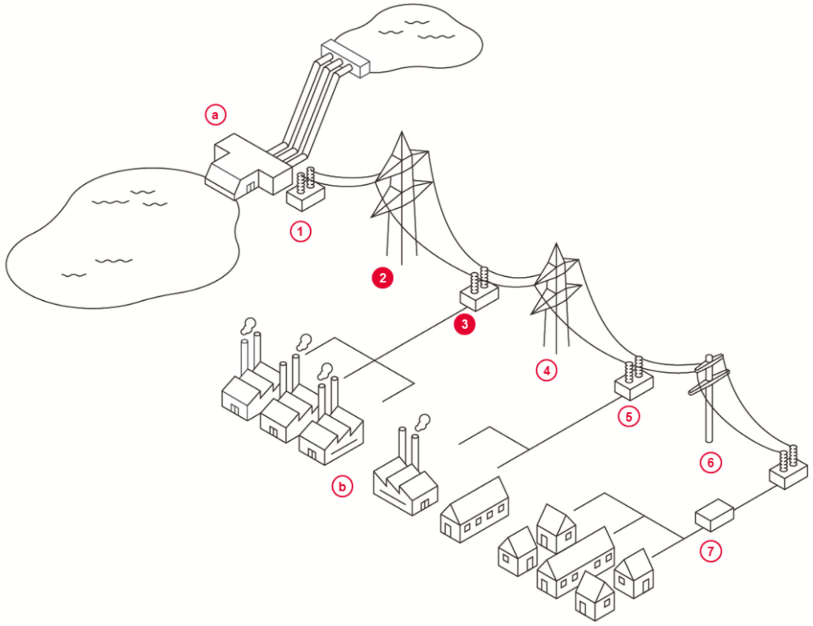
Focus: Switzerland

- Area: 41 285 km²
- Population: 8.42 Mio
- Number of TSOs:1
- Number of DSOs: aprox. 800
- Peak load:10.83 GW



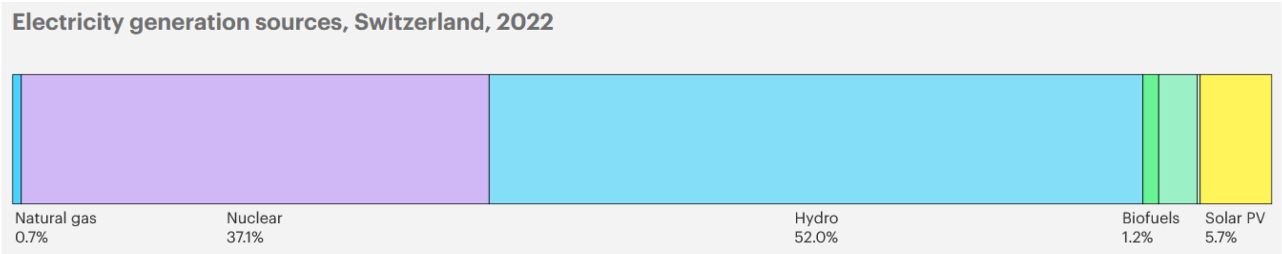
Source: Swissgrid

- There are seven grid levels in Switzerland, along with the traction network, which supplies electrified rail networks.



Source: Swissgrid

Interconnectors with:
- Austria;
- France;
- Germany;
- Italy.

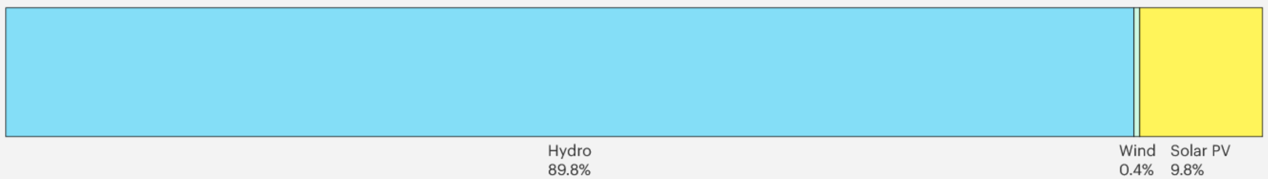


European Commission

Focus: Switzerland

- The energy research programmes managed by the Swiss Federal Office of Energy encompass the entire spectrum of energy research. It is currently managing 24 research programmes, half of which focus on energy efficiency and the other half on renewable energy.
- In June 2021, the Federal Council has adopted the Federal Act on a Secure Electricity Supply with Renewable Energies. The draft act includes a revision of the Federal Energy Act and the Federal Electricity Supply Act. The aim is to strengthen the growth of domestic renewable energies and of Switzerland's supply security, particularly during winter.
- “SWiss Energy research for the Energy Transition” – is a funding programme of the Swiss Federal Office of Energy (SFOE). SWEET’s purpose is to accelerate innovations that are key to implementing Switzerland’s Energy Strategy 2050 and achieving the country’s climate goals.

Renewable electricity generation by source (non-combustible), Switzerland, 2022



ELECTRICITY

Daily consumption

How much Switzerland consumed yesterday incl. storage pumps

169 GWh per day

Daily production

How much Switzerland produced yesterday

186 GWh per day

Lakes reservoir level

How much is still available in the storage lakes

19.6 % yesterday

Import

How much electricity entered Switzerland yesterday

38 GWh per day

Export

How much electricity exited Switzerland yesterday

75 GWh per day

Over/under consumption

The additional consumption has been since the beginning of the winter period.

0 % seit 01.10.2023

Sources: SFOE, ENTSO-E, Swissgrid

European Commission

207 m €
Available ERDF Funding

85%
Already Allocated To Projects

9
Countries

81
Regions

4
Priorities

9
Specific Objectives

Interreg Central Europe

- Interreg Central Europe is a European Union funding program that aims to promote cooperation and sustainable development in Central European regions.
- The program focuses on issues such as innovation, competitiveness, environment, and transport to improve the quality of life for citizens in the region.
- Interreg Central Europe supports projects that involve cross-border collaboration, knowledge exchange, and the sharing of best practices among participating countries.

European Commission

Interreg Central Europe

- **Priority 2: Cooperating for a greener central Europe**
- **SO 2.1: Supporting the energy transition to a climate-neutral central Europe**
- **<u>Potential fields to be addressed by project proposals</u>**
- → Smart integration of carbon-neutral solutions across sectors
- → Energy efficiency of buildings and public infrastructures
- → Energy planning at local and regional levels
- → Financing schemes for energy efficiency and renewable energy investments
- → Renewable energy sources
- → Reduction of greenhouse gas emissions from industry and other sectors
- → Energy demand management and behavioural change
- → Energy poverty
-
- **<u>Need support?</u>**
- contact helpdesk@interreg-central.eu if you have questions about this specific objective.
- **https://www.interreg-central.eu/**

ACER introduces the new 'Central Europe' electricity capacity calculation region

- **What has changed?**
- The Core CCR will include the Celtic interconnector, an undersea cable between Ireland and France. This will facilitate Ireland's further integration into the European electricity market.
- The Core and Italy North CCRs will be merged and form a new CCR called Central Europe. Initially, this merger will only apply to the day-ahead capacity calculation process. It will improve the coordination and efficiency of capacity calculation and allocation processes in continental Europe.

European Commission

Spotlight Sessions I

Priorities for applied energy research in Germany

Thomas Degner
Fraunhofer IEE

Michael Hübner BMK
and Clean Energy
Transition Partner

Dr. Thomas Degner

Innovations for Grid-Integration of Wind- and Solar Power systems

ETIP SNET Workshop on Applied energy research: Paving the way for climate neutrality, 16.5.2024

Grid-Integration of Wind and Solar
Agenda

1. Introduction
2. Grid Forming Inverter
3. Power System Studies
4. Conclusions and Next Steps

Fraunhofer IEE

Introduction

Overview of distribution of installed capacities per energy source in Germany

German Grid Development Plan: Scenario A

Total renewable generation:

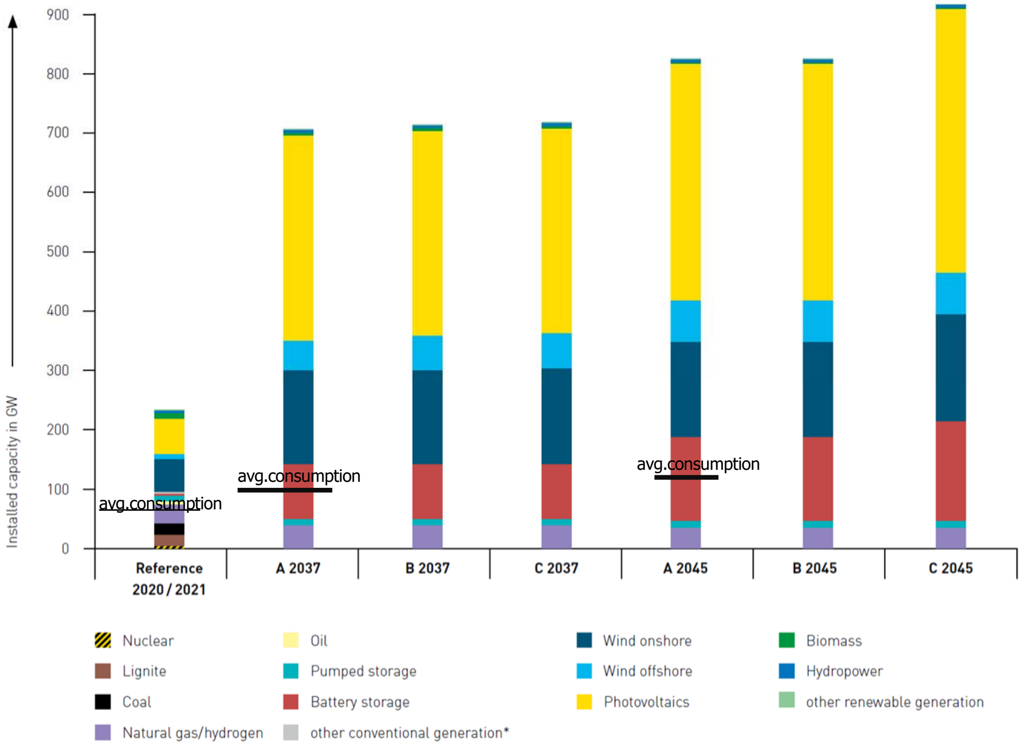
- 2021/22: 139 GW
- 2037: 565 GW
- 2045: 638 GW

Total generation:

- 2021/22: 232 GW
- 2037: 617 GW
- 2045: 686 GW

Gross power consumption:

- 2021/22: 533 TWh (61 GW avg.)
- 2037: 899 TWh (103 GW avg.)
- 2045: 1079 TWh (123 GW avg.)



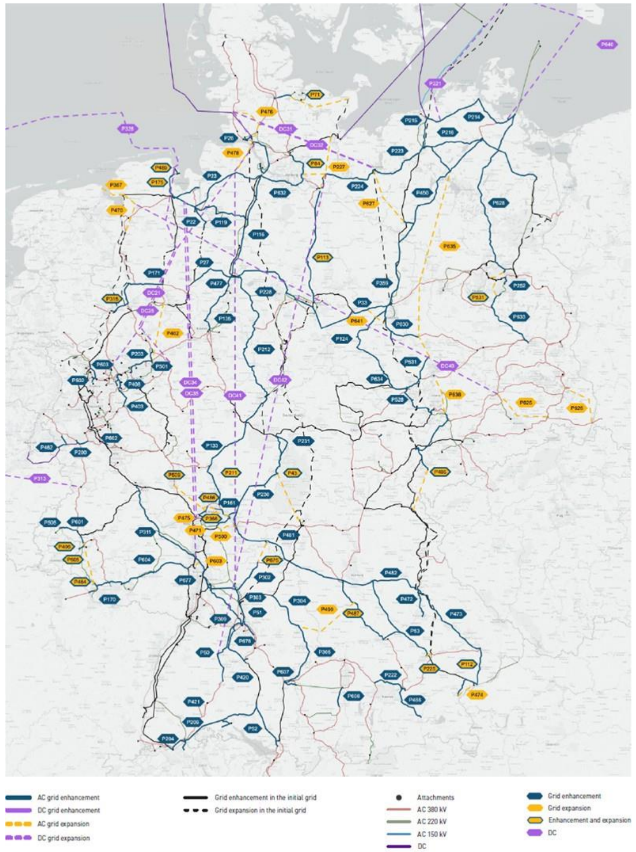
* other conventional generation plus 50% waste

Source: Grid Development Plan Electricity 2037 / 2045, (2023), second draft | Transmission system operator

Introduction
Changes to the energy supply system

- Shutdown of conventional power plants with synchronous generators
- Large generation capacities in the distribution grid
- High penetration of power converter-based generation systems
- Integration of HVDC corridors
- Increasing use of active network components
- Limited and delayed expansion of transmission and distribution grids

Onshore grid expansion scenarios A / B / C 2037, A / B / C 2045, only power line construction projects*



*The presentation of the new construction projects shows the starting and end points, but no specific routes. They will only be determined in downstream approval procedures.

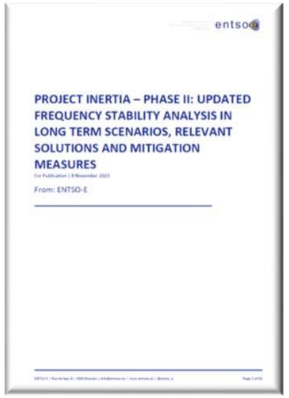
Source: Grid Development Plan Electricity 2037 / 2045, (2023), second draft | Transmission system operator CC-BY-4.0

Introduction
Changes (continued)

Changed system properties:
- Reduction of physically coupled inertia and short-circuit power
- Relevance of power converter control and operating point-dependent system perturbations
- New network usage scenarios

New challenges:
- Operating the system closer to stability limits
- New power converter-induced stability aspects
- Operation of low-inertia interconnected grids
- Complex analysis of power converter-dominated networks in the appropriate level of detail

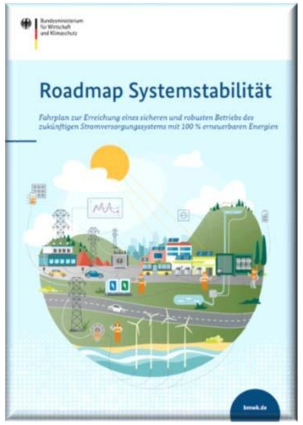
Aim: Safe System Operation with Distributed Energy Resources
- System services from conventional power have to be taken over by other generation units
- One approach: grid forming inverter control


entsoe
PROJECT INERTIA – PHASE II: UPDATED FREQUENCY STABILITY ANALYSIS IN LONG TERM SCENARIOS, RELEVANT SOLUTIONS AND MITIGATION MEASURES
From: ENTSO-E


High Penetration of Power Electronic Interfaced Power Sources and the Potential Contribution of Grid Forming Converters
Technical Report


Expert Group: Advanced Capabilities for Grids with a High Share of Power Park Modules
Report
Version 1.00


ACER


Roadmap Systemstabilität

 15.05.2024

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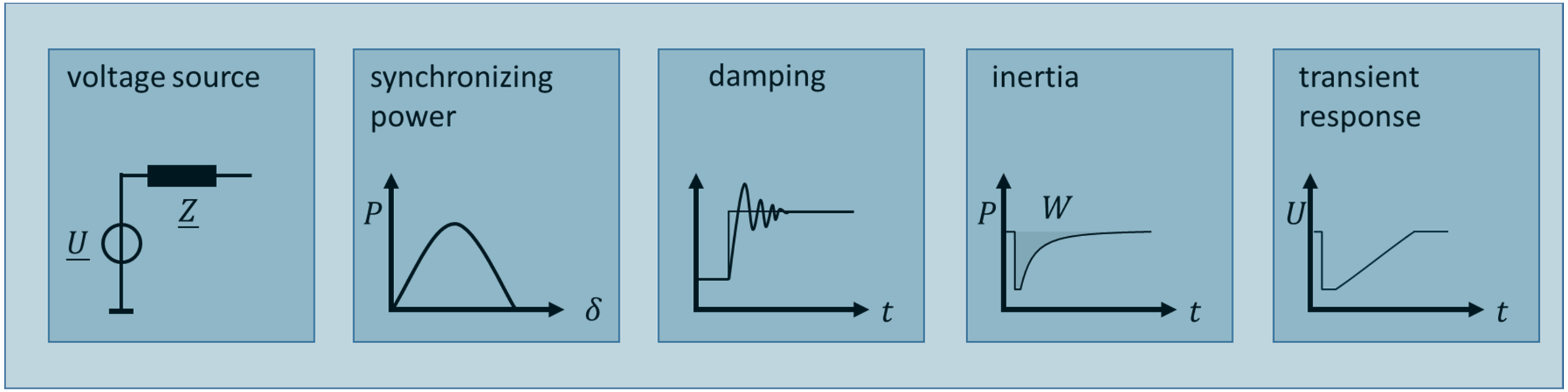
Grid-Forming Inverters
Overview of properties



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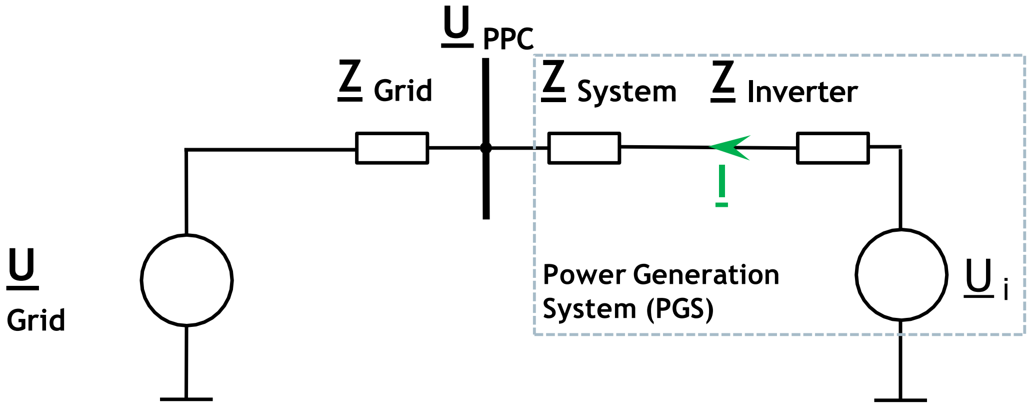
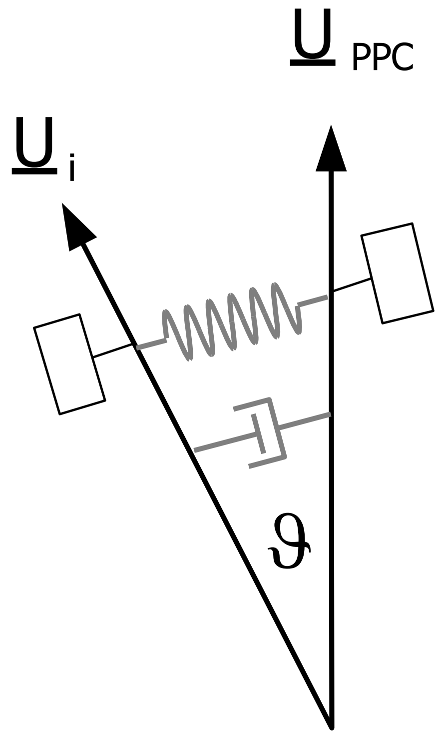
Source: Fraunhofer IEE in "Netzregelung 2.0 – Regelung und Stabilität im stromrichter-dominierten Verbundnetz", Final Public Report, 2023. Philipp Strauß, Thomas Degner (Editors), https://publica.fraunhofer.de/entities/publication/2c7f5fcd-4b4d-429d-a288-36b214ebfff5/details

Grid-Forming Inverters

Definition of voltage controlled, grid forming inverter operation





- In voltage-controlled, grid-forming operation, the power converter provides a grid-synchronous sinusoidal voltage
- During transient voltage changes at the network connection point, the power converter voltage follows the grid voltage delayed and with damping
- If current limitation is necessary to avoid damage of semiconductors, grid-forming control must be modified (several solutions are available)

Source: Fraunhofer IEE in "Netzregelung 2.0 – Regelung und Stabilität im stromrichter-dominierten Verbundnetz", Final Public Report, 2023. Philipp Strauß, Thomas Degner (Editors), https://publica.fraunhofer.de/entities/publication/2c7f5fcd-4b4d-429d-a288-36b214ebfff5/details

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Grid-Forming Inverters

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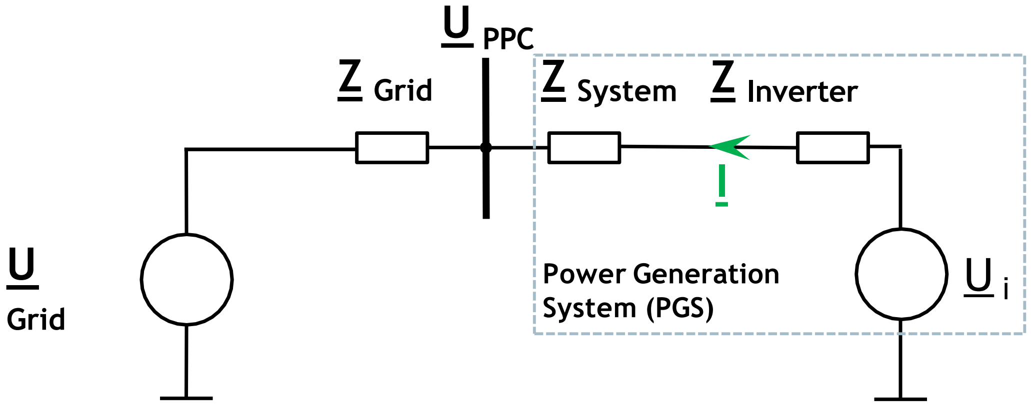

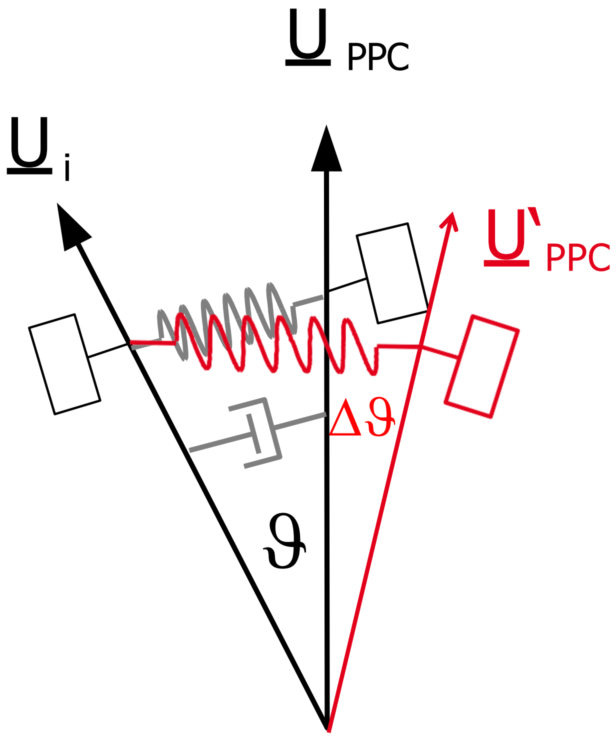

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Power System Studies

Frequency stability

Ability of an energy system to achieve and maintain a steady operating point after a disturbance with active power imbalance, while complying with steady-state and transient limits.

Steady State Limits*:

$f_{max} = 50{,}2$ Hz

$f_{min} = 49{,}8$ Hz

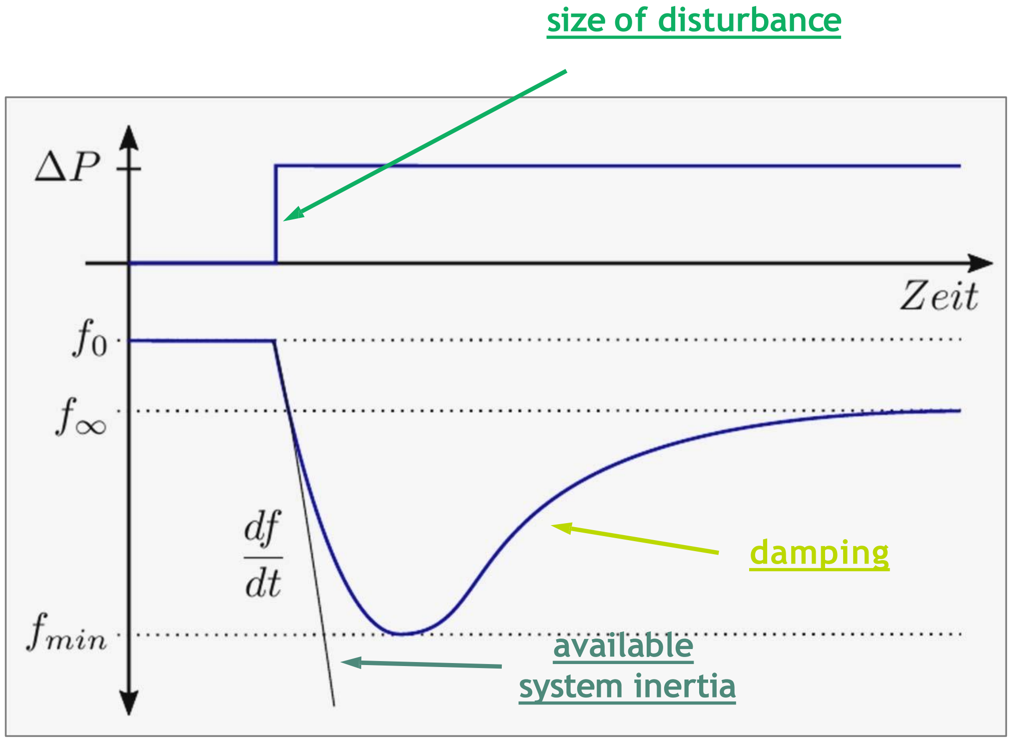
Transient Limits*

$f_{max} = 51{,}5$ Hz

$f_{min} = 47{,}5$ Hz

$^{df}/_{dt} = 2$ Hz/s

In case of violations, generation plants may disconnect. Due to the loss of generation the power system may collapse.



Frequency deviation after loss of power plant

[*] ENTSO-E, “P5 – Policy 5: Emergency Operations: Document Control”

Power System Studies
System split simulations

Frequency stability analysis in system split scenarios

- Test system for investigations of system split situation with large scale inverter shares designed by German TSOs[1,2].
- System split resulting in an over-frequency situation (power surplus with 40% Export)
- Decreasing share of synchronous generation
- Power reduction due to overfrequency (LFSM-O)
- Consideration of grid-forming and grid-supporting inverters[3]. With respect to frequency stability:
  - … limited allowable share of grid-supporting inverters.
  - … 100% inverters with utilization grid-forming units.

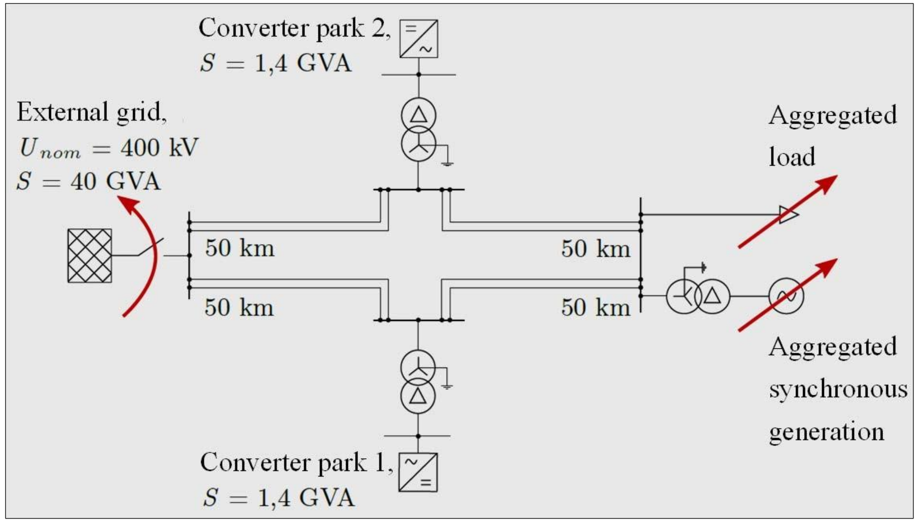


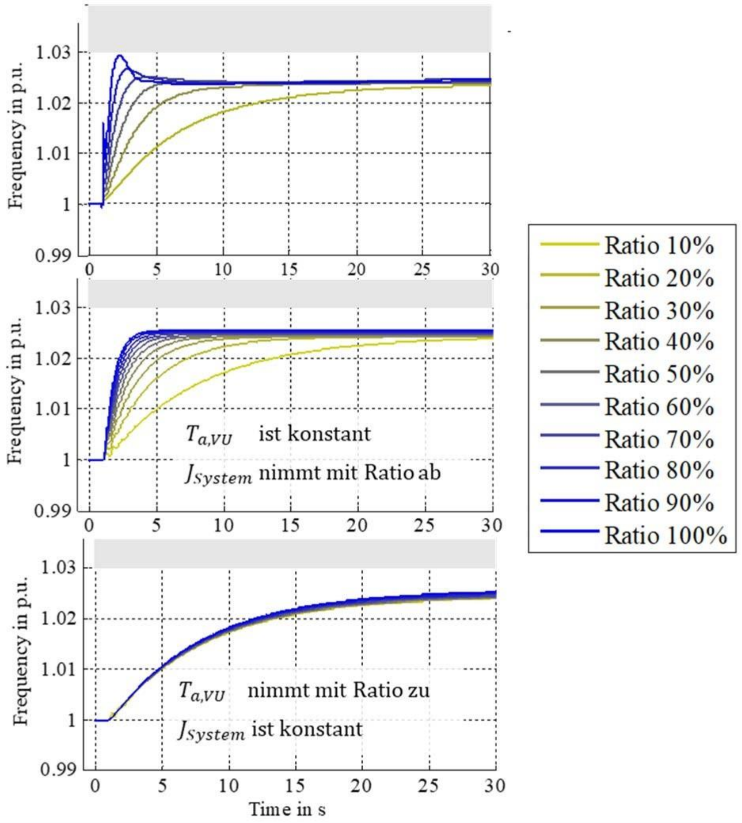
Fig.: Test system for investigations of system split situation

1 K. Vennemann et al., "Systemic Issues of Converter-based Generation and Transmission Equipment in Power Systems", Wind Integration Workshop, vol.17., Stockholm, Sweden, 2017
2 M. Nuschke, B. O. Winter, D. Strauß-Mincu, B. Engel, "Power system stability analysis for system-split situations with increasing shares of inverter based generation", NEIS 2019, Hamburg.
3 M. Nuschke, "Frequenzstabilität im umrichterdominierten Verbundnetz", Dissertation TU Braunschweig, Fraunhofer Verlag, June 2022.

Power System Studies

Grid forming inverter control vs current control

Current controlled inverter	Maximum penetration with current controlled inverter depends on parametrization between 20-60%.
Grid forming inverter control	Voltage controlled inverter limit frequency gradients. Considering frequency stability, a 100% inverter share is possible in the test system
Grid forming inverter control	Compensation of missing mechanical inertia realized by adaptation of parameters in the inverter control. Overall system inertia is kept constant for all considered cases



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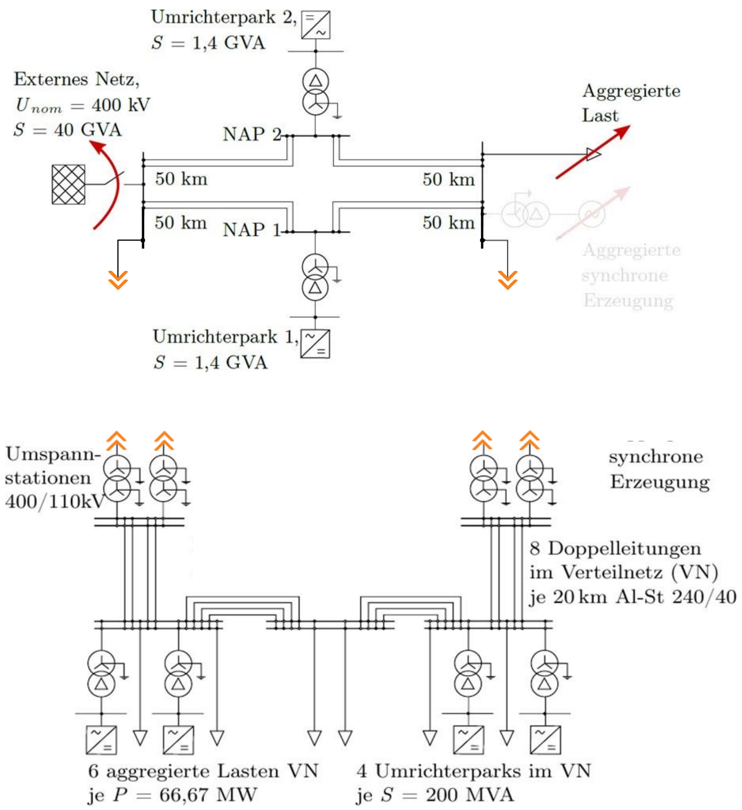
Power System Studies

Inertia from Distribution Grids

Why:
A significant share of power electronic coupled powerplants (esp. photovoltaic systems, storage systems und loads) will be connected to the distribution grids.

Case study:

- Grid model
  - Extended transmission grid model with distribution grid model (110kV)
  - Several grid forming inverter in the distribution grid, in total 800 MW (same magnitude as distortion)
  - Current controlled inverter in the transmission grid
- Scenario
  - System split resulting in an over-frequency situation (power surplus 40% Export)
  - Power reduction due to overfrequency (LFSM-O)



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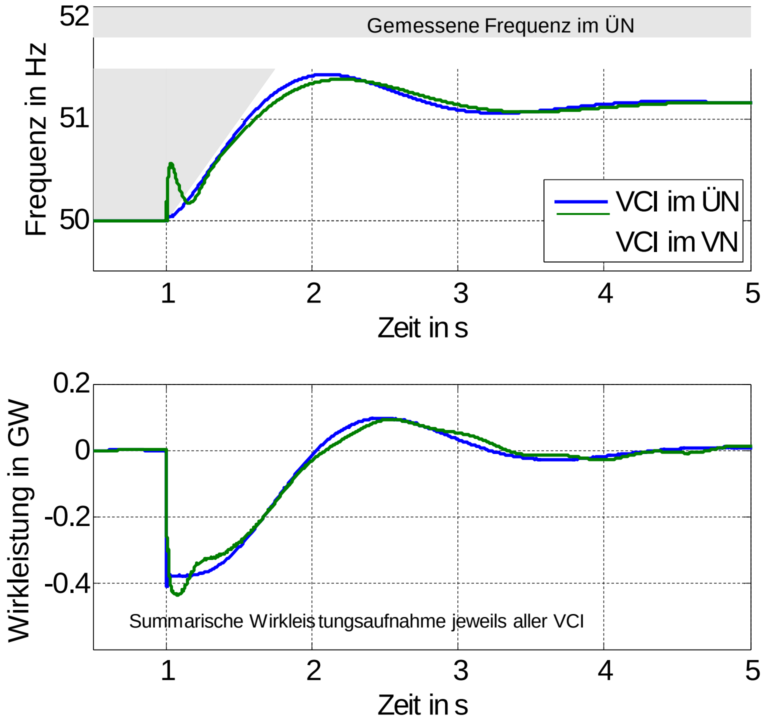
Power System Studies
Inertia from Distribution Grids

- Simulation results of system split
  - Only grid forming inverters (VCI) in transmission grid (ÜN)
  - Only grid forming inverters in distribution grid (VN)
  - In both cases: Current controlled inverter in transmission grid (ÜN)
- Result
  - Provision of inertia from distribution grids works
  - Several voltage controlled inverter may interact



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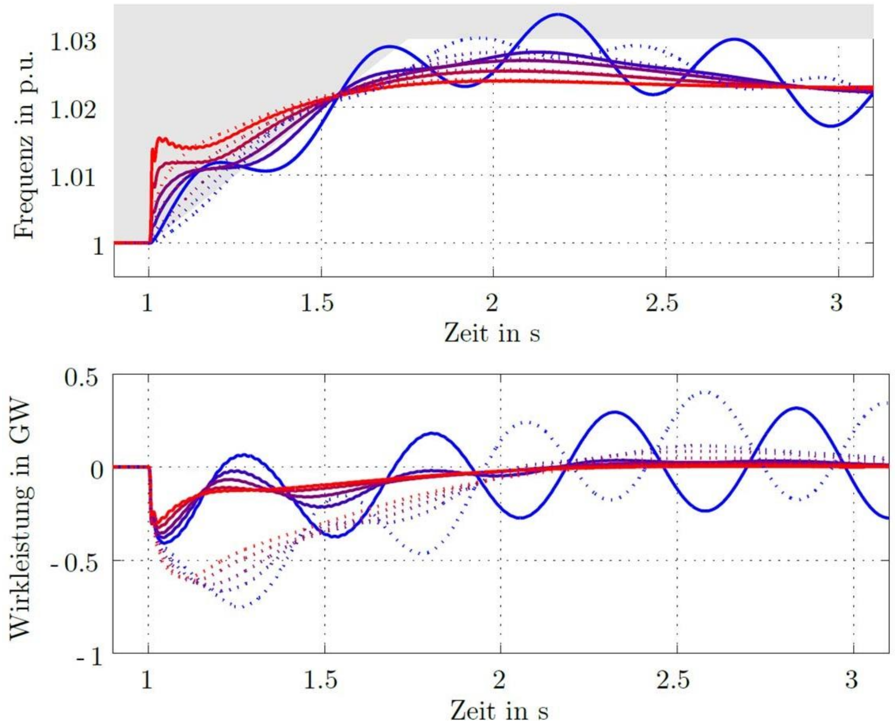
Power System Studies

Inertia from Distribution Grids

- Simulation results of system split
  - Frequency and active power at GFI terminal of GFIs in the distribution grid
  - Solid lines: GFI with smaller rated power, dotted lines GFI with higher rated power
  - Red to blue: variation of damping constant
- Result
  - Power oscillations between GFI in the distribution system
  - These oscillations should be avoided



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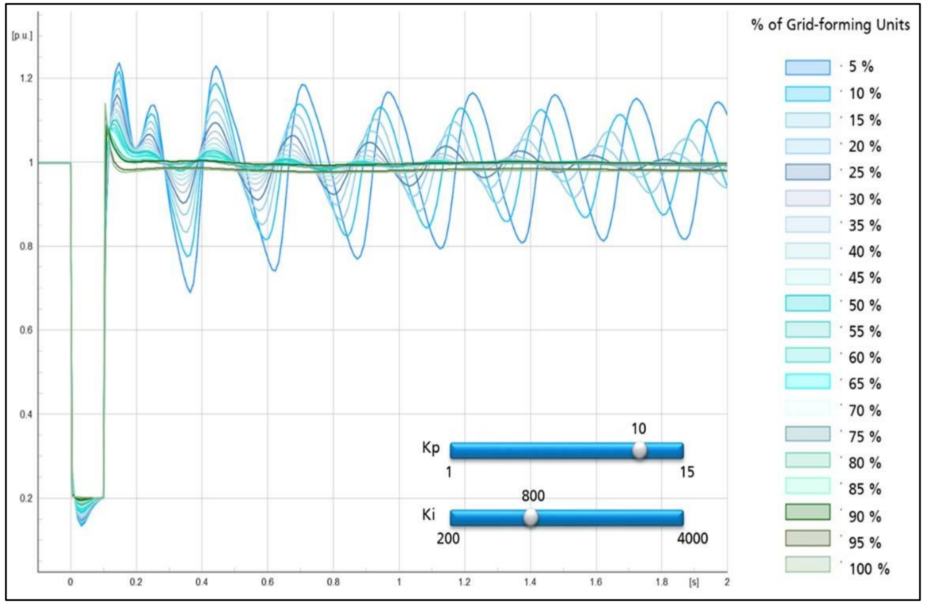
Power System Studies

Converter Driven Instability

- After a loss of line PLL instabilities may occur due to changed network impedance
- Grid forming inverters may help to damp oscillations



Example of a PLL instability. The parameters of the PLL are Kp=10 and Ki=800. The oscillations can be damped by grid-forming units. With a share of 25% grid-forming units, the occurring oscillations are strongly damped in less than 2 seconds.

Ref: Luis Pabon, Daniel Pabon, Valeria Usuga (Fraunhofer IEE), "Plausibility and implications of converter-driven oscillations induced by unstable long-term dynamics". In IEEE Transactions on Power Systems, Volume: 38, Issue: 6, November 2023.

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Conclusions

- To achieve carbon-neutrality in Germany until 2045 and to get more independent in terms of energy supply Germany plans to increase the installed capacity of renewable energies significantly.

- Essential conditions for maintaining a secure energy supply include:
  - Balance of generation and consumption at any time
  - Voltage and loading of network assets must stay within permissible limits
  - Power system stability must be ensured to be robust against disturbances

- Grid forming inverters are a key technology to enable systems pre-dominantly powered by renewables

- In Germany, a significant proportion of renewable energy generation and storage will be connected to distribution grids. The potential of grid-forming technology should also be utilized in the distribution grid. However, several issues need to be thoroughly researched and addressed before a widespread deployment can occur.

Next Steps

- Development of methods and metrics to quantify system needs
- Definition of requirements to enable qualification of generation systems, storage systems and loads
- Development of systems with grid forming control for different technologies
  (e.g. STATCOMs, wind turbines, photovoltaic systems, battery storage systems, loads, .).
- Advanced standard models for grid forming and grid-following inverter to enable grid studies
- Demonstration and pilot projects in distribution grids
- International exchange of development and experience

Thank you for your attention!

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Spotlight Sessions I

Priorities for applied energy research in Austria

Thomas Degner
Fraunhofer IEE

Michael Hübner BMK and Clean Energy Transition Partner

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

Innovation for the Energy Transition - Priorities in Austria

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Energy, Mobility, Innovation and Technology
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Transformative Innovation Policy

Impact Oriented

- Societal challenges as starting point
- Impact pathways and milestones
- Targeted Missions
- Monitoring and evaluation

System approach

- „Whole-of-Government"
- Mobilising all relevant stakeholders
- System transformation

Foresight and strategic intelligence

- Develop expertise to anticipate future developments
- Strategy & Scenario development

Agile und adaptive

- Organised and collective learning
- Evidence based knowledge

Illustrationen: uxwing.com

Thematic Priorities

Energy Transition

Focus:
Innovation

Impact Pathway 1:
Successful Energy Transition

Focus:
Technology

Impact Pathway 2:/a)
Successful Solution Providers in Global Value Chains

Focus:
Research

Impact Pathway 3:
Prepare for Future Development

~ 600 Mio €/a

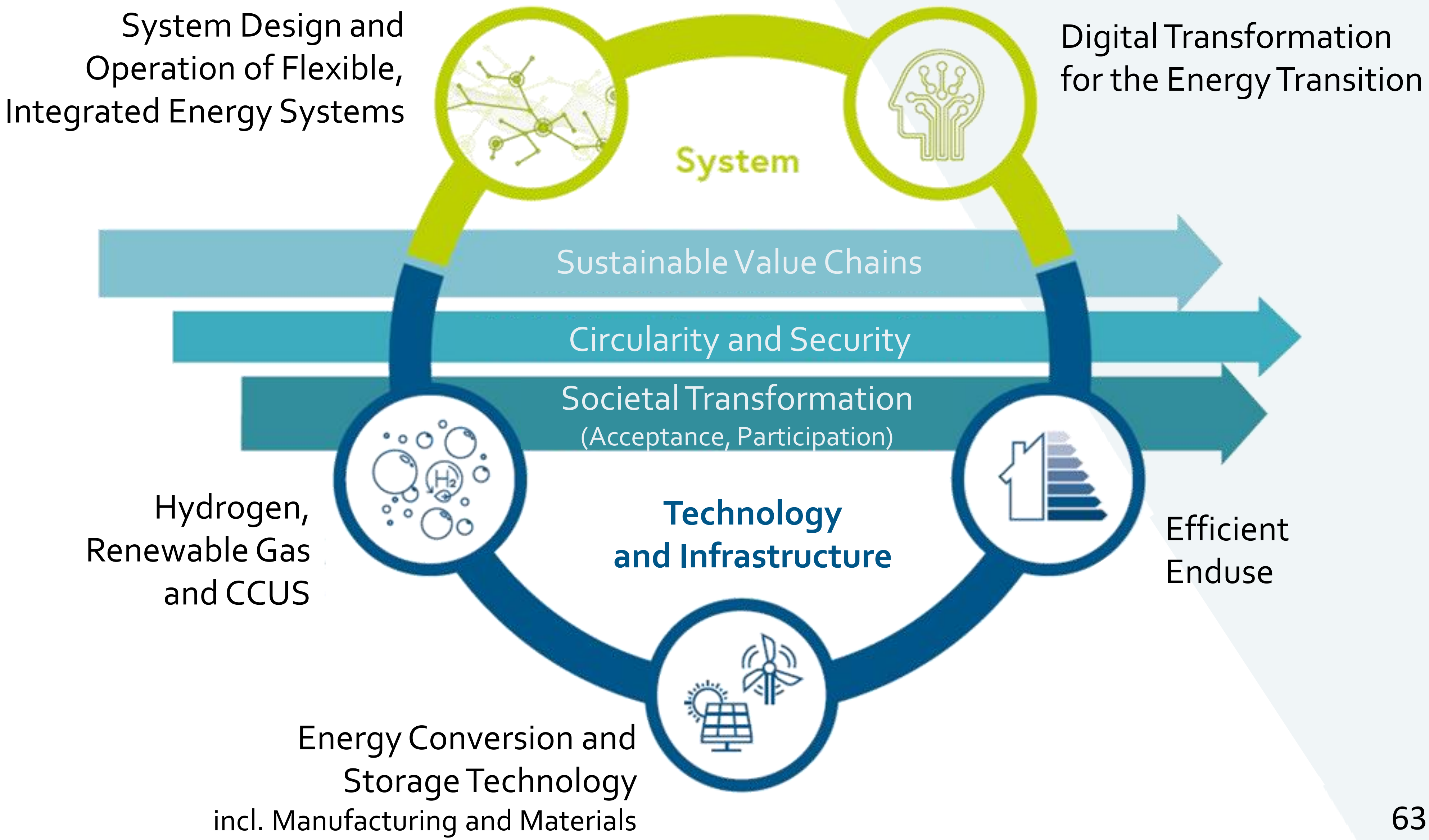
Transition of the Mobility System

Climate Neutral Cities

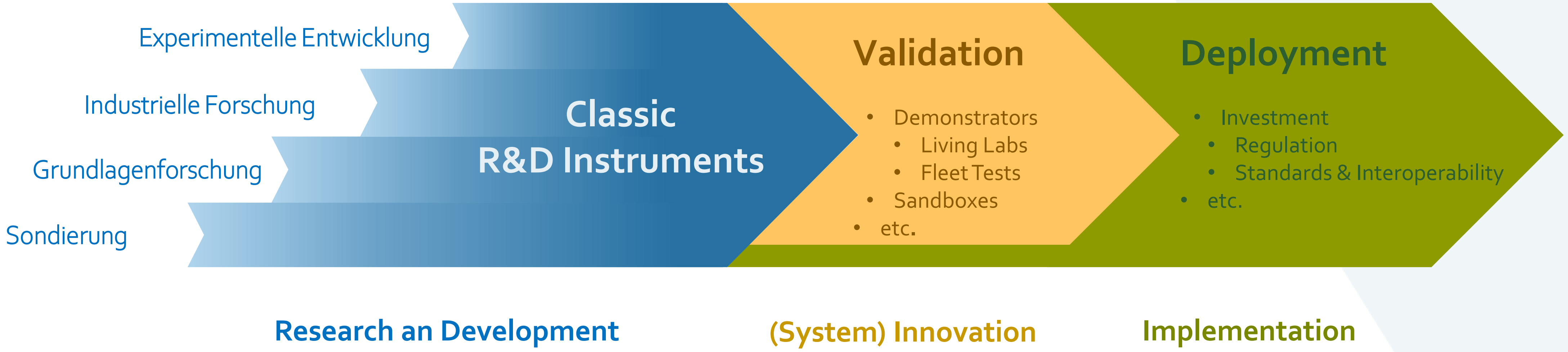
Circularity and Production

Transform Industry

Thematic Priorities



Phases of Innovation and Instruments



Cluster Energy Systems Demo

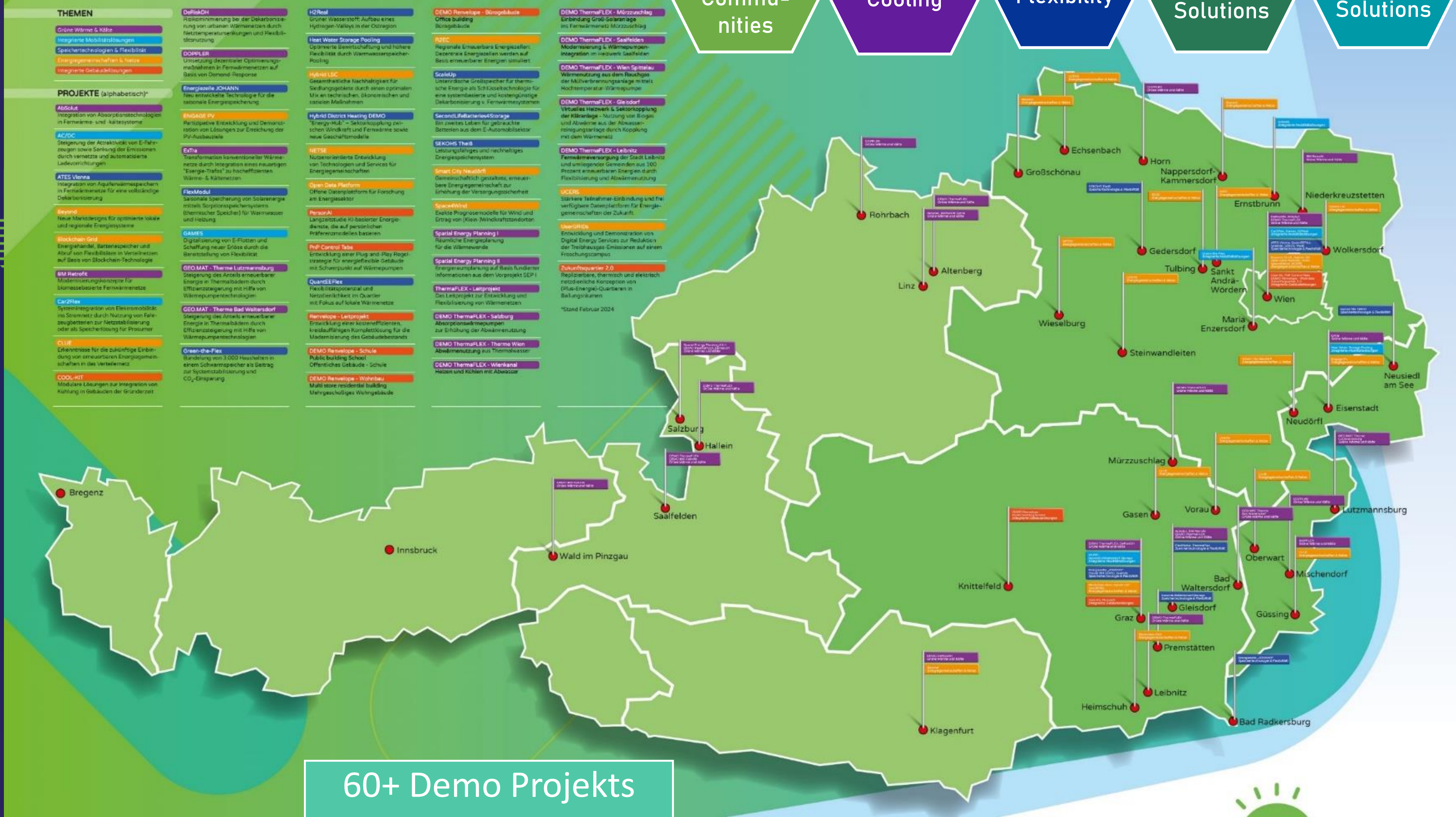
Grids & Energy Commu-nities

Heating & Cooling

Storage & Flexibility

Integrated Building Solutions

Integrated Mobility Solutions



60+ Demo Projekts

> 150. Mio.

Invest-Volume

green energy lab.at

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

Energy System Transition Labs

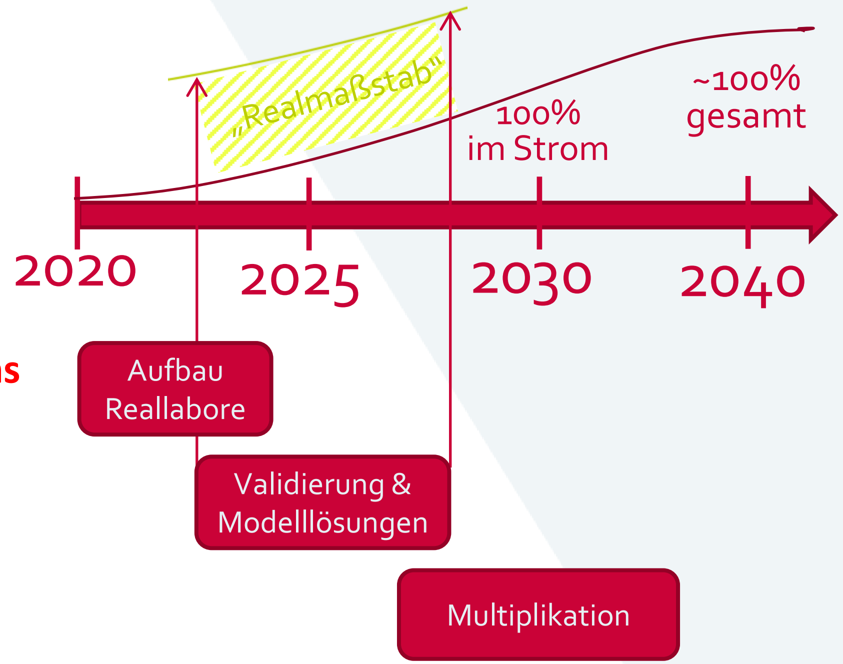
„test and develop in a close to future reality energy system“

- Output: **Prototype system solutions for 100% renewable energy supply** (e.g.: industrial region, wind- region, agricultural region, …)

- Measure: Austria wide innovation network with **5 Living Labs for Integrated Regional Energy Systems**

- Intervention targets: **Validation close to real live application**, targeted **innovation impulse**, **transition impulse** for concrete regions, **trans regional knowledge exchange**

- Focus:
  - **Interaction** of energy system components and assets in **Energy System Solutions** (energy production, buildings, production facilities, energy communities, grids, storage, etc.). Planning, implementation, operation.
  - **Cross sectoral and sector coupling** (Power, heating and cooling, mobility, …)
  - **Flexibility and resilience** of energy systems
  - **Emergence –** system characteristics are more than just a commulation of characteristics of the elements



Thank you for your attention!

Michael Hübner
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Federal Ministry of Climate Action, Environment,
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michael.huebner@bmk.gv.at

European Commission

Break out rooms I:

Exchanging views on the alignment of R&I priorities and local needs

Break out rooms’ topics

BREAK OUT SESSIONS

Discussion on the topics presented in the side

REPORTING IN PLENARY

Synthesis of the results

Round table → Presentation of questions by rapporteur → Discussion → Wrap-up

TOPICS FOR DISCUSSION

- How can we ensure that the research and innovation priorities set at the EU, regional, and national levels are effectively aligned with the specific needs and challenges faced by local communities?
- What mechanisms or strategies can be put in place to facilitate greater collaboration and communication between policymakers, researchers, and local stakeholders in order to better align R&I priorities with local needs?
- In what ways can the consolidation of consistency between R&I priorities and local needs lead to more impactful and sustainable outcomes for both research and innovation efforts and the communities they aim to serve?

Break out rooms' topics (1/2)

Room 1

1. Stefanie Thoms *(Airborne Wind Europe)*
2. Anabel Soria Estev *(ITE)*
3. Dimitrios Baros *(Eaton)*
4. Axel Bruck *(IDENER)*
5. Oscar Sainz *((BlueNewables S.L.)*
6. Wilhelm Süßenbacher *(UAS Upper Austria)*
7. Beatriz de Otto López *(CTIC Centro Tecnológico)*
8. Beatriz Alonso *(i-DE)*
9. Agnieszka Kowalska *(ASM)*
10. Quentin Donnette *(smarten)*
11. Nuria Gonzalez-Garcia *(betteries AMPS GmbH)*
12. Shaghayegh Zalzar *(Fortum)*
13. Maja Božičević Vrhovčak *(E.I. Hrvoje Požar)*
14. Ondrej Cerny *(E.DSO)*
15. Venizelos Efthymiou *(FOSS University of Cyprus)*
16. Debashrita Sarkar *(DIFFER)*
17. Manuel Alvarez Ortega *(Woodswallow ; ESMIG)*

Mihai Calin
AIT

Room 2

1. Clemens Korner *(AIT)*
2. Stefanos Dallas *(PROTASIS S.A.)*
3. Geo T. Sam *(RINA-C)*
4. Ander Zubiria *(Tecnalia Research & Innovation)*
5. Filipe Joel Nunes Soares *(INESC TEC)*
6. Alberto Dognini *(Fraunhofer FIT)*
7. Vassilis Boglou *(HEDNO)*
8. Fabian Fink *(FBS-Systems GmbH)*
9. Metody Georgiev *(Technical University of Sofia)*
10. Maddalena Lukasik *(META Group)*
11. Jorge Molina Torres *(ATECYR)*
12. Milana Karajic *(Alpacem)*
13. Mohammed ALSAADI *(DERlab)*
14. Pio Alessandro Lombardi *(Fraunhofer IFF)*
15. Nicolò Italiano *(R&D Neste)*
16. Olaf Bernstrauch *(Siemens Energy)*
17. Lianoudaki Aikaterini *(ProEuropean)*

Clemens Korner
AIT

Room 3

1. Udhaya Chandiran Krishnan Paranjothi *(Delft UT)*
2. Grigore Stamatescu *(TUV Austria)*
3. Anastasis Tzoumpas *(UBITECH)*
4. Sonja Klingert *(University of Stuttgart)*
5. Brian McSwiney *(OceanEnergy)*
6. Matteo Meneghetti *(Sinloc Spa)*
7. Luis González Pérez *(ETRA I+D)*
8. Antonio iliceto *(ETIP SNET)*
9. Lorena Garcia Lorenzo *(EU DSO Entity)*
10. Eduard Antics *(Clean Aviation)*
11. Silvia Anna Cordieri *(RSE)*
12. Peter STETTNER *(ANDRITZ Hydro)*
13. Ricardo Pastor *(R&D NESTER)*
14. Shafi Khadem *(IERC, Tyndall National Institute)*
15. Jan-Hendrik ERNST *(GenCell Energy)*
16. Emma Nocquet-Wass *(E&C Consultants)*

Barbara Herndler
AIT

European Commission

Break out rooms' topics (2/2)

Room 4

1. Laura Pérez *(R2M Solution Spain SL)*
2. Clara Sofia Teixeira Gouveia Moura *(INESC TEC)*
3. Balram Panjwani *(SINTEF)*
4. Tomasz Barszcz *(AMC TECH sp. z o.o.B23)*
5. Habib Nasser *(RDIUP)*
6. Alexandre Nuno Rocha Pinto Lucas *(InescTec)*
7. Nina Mavrogeorgou *(WindEurope)*
8. Matej Zajc *(University of Ljubljana)*
9. Ali Hainoun *(AIT)*
10. Vladimir Oleinic *(BIP)*
11. Ralf Wezel *(EUTurbines)*
12. Elissaios Sarmas *(NTUA)*
13. Nicola Filizola *(Consortium battery Innovation)*
14. Horst Toddenrott *(Cuculus GmbH ; ESMIG)*
15. İbrahim AKBEN *(Hasan Kalyoncu University)*
16. Petronela Despoiu *(Banca Transilvania)*

Beatrice Profeta
PwC

Room 5

1. Pencho Zlatev *(University of Ruse Angel Kanchev)*
2. Christian Kunze *(Smart Innovation Norway)*
3. Imane Worighi *(BRING)*
4. Agnes Jodkowski *(AIT)*
5. Magda Foti *(ubitech)*
6. Ju Feng *(DTU Wind)*
7. Grigorios Piperagkas *(CERTH)*
8. xia chao *(R&D Nester)*
9. Ricardo Almeida Henriques *(E-REDES)*
10. Dominika Lange *(COGEN Europe)*
11. Simone Polimeni *(RSE SpA)*
12. Martin Ibel *(-)*
13. Michael Di Genova *(Apio Srl)*
14. Magdalena Sikorowska *(ICLEI)*
15. Pilar Meneses *(CIDETEC)*
16. Rajkumar Palaniappan (TU Dortmund)

Andrea De Angelis
PwC

European Commission

Discussion of results

Break out rooms I:
Exchanging views on the alignment of R&I priorities and local needs

European Commission

ETIP SNET

Coffee break

Meet here at 12:15

European Commission

Spotlight Sessions II

Applied energy research: Presentation of R&I projects and results in Austria

Thomas Degner
Fraunhofer IEE

Clemens Korner
AIT

LI-SA

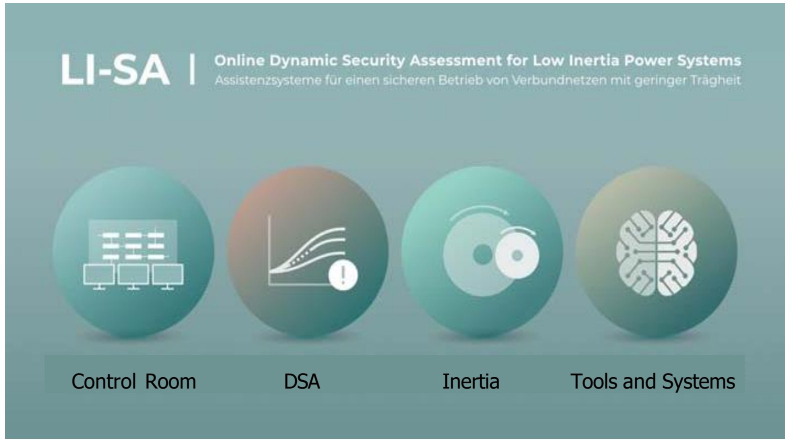
Tools for On-line Dynamic Security Assessment of Low Inertia Power Systems

Dr. D. Strauss-Mincu

ETIP SNET Workshop on Applied energy research: Paving the way for climate neutrality

Tools for On-line Dynamic Security Assessment of Low Inertia Power Systems

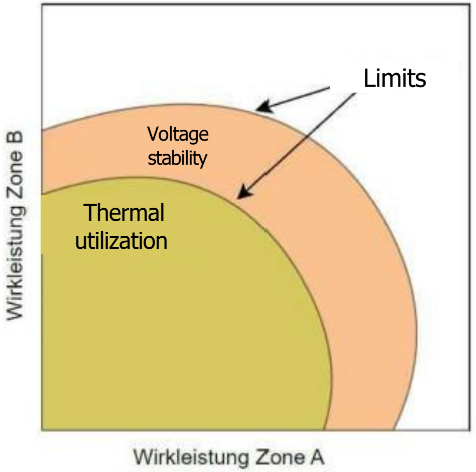
Contents



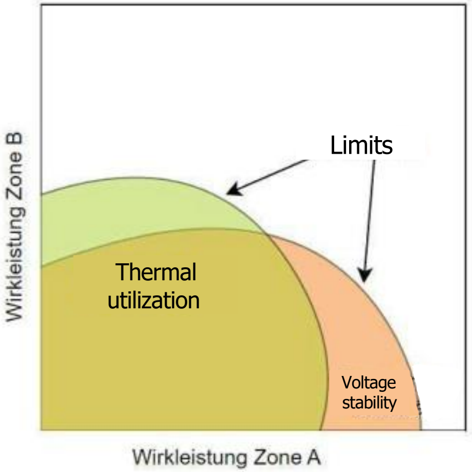
Context and Motivation

Changes in the energy supply system:

- Decommissioning of conventional power plants with synchronous generators
- High penetration of converter-based generation systems
- Bidirectional power flows
- Large generation capacities in the distribution networks
- Limited and delayed expansion in transmission and distribution networks, higher utilization
- High transits and increasing transmission distances
- Increasing use of active network components



The operating range is limited by thermal load



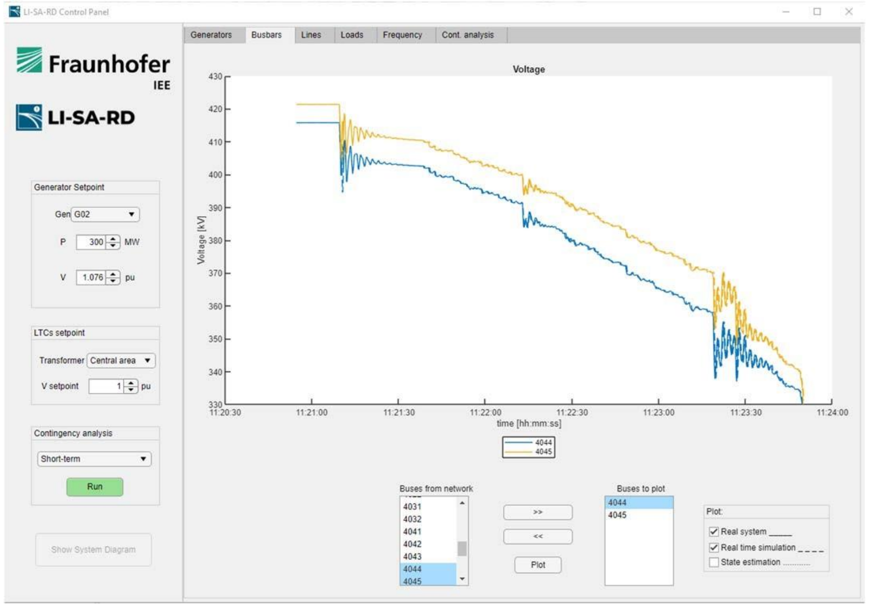
The operating range is limited by stability margins

Source: S. Eberlein

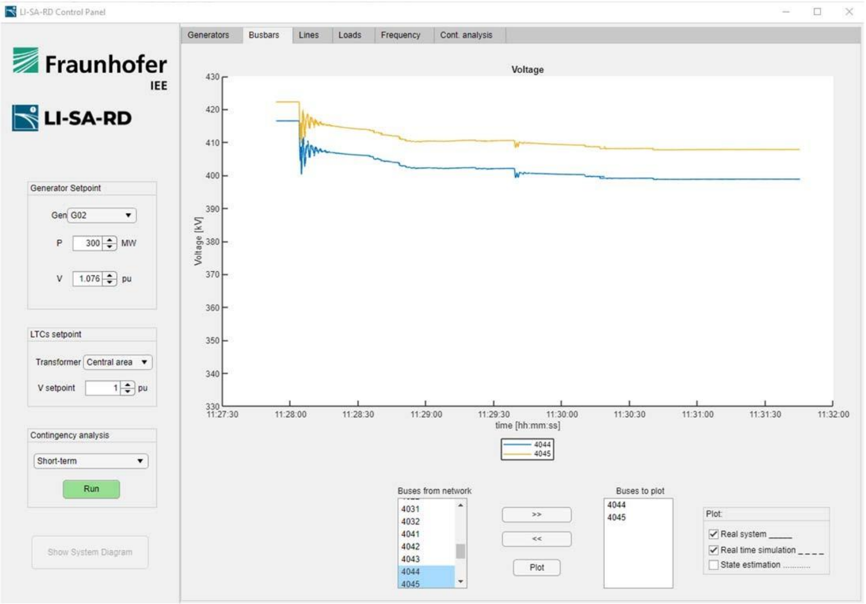
→ **Predictability in grid operation is significantly more difficult**
→ **The Power System is operated closer to the limits of system stability**

Context and Motivation

Online detection and avoidance of voltage-critical grid states



Contingency leads to long-term voltage instability



Detection of impending voltage instability and deployment of a countermeasure

Coordinated control of transformer tap changer and Q feed from decentralized IBG avoids voltage instability

LI-SA Research Project

Goal of the project:

Development of a modular DSA system for system security assessment for low inertia power systems - Low Inertia Security Assessment System (LI-SA)

Project duration:

01.01.2023-31.12.2025

Consortium:

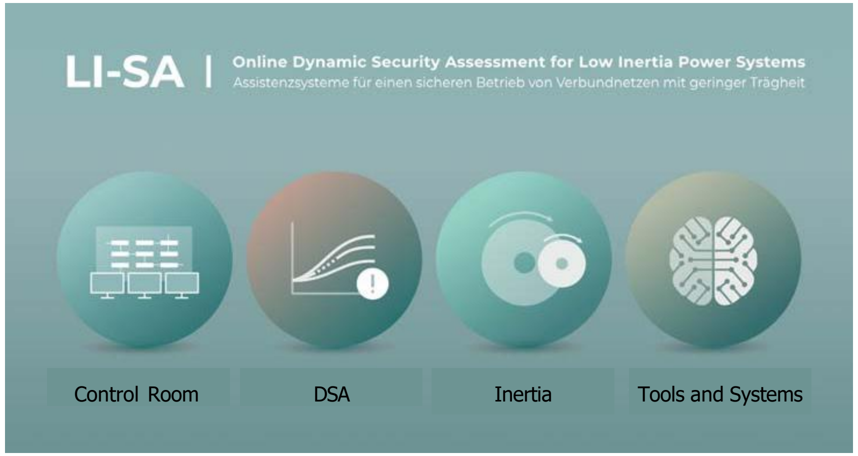
Fraunhofer IEE (Coordination), Fraunhofer IOSB-AST, PSI Software AG, Avasition GmbH, Tennet TSO GmbH, TransnetBW GmbH

Financing:

Funded by the BMWK with approx. 4 million EUR

Website:

https://www.iee.fraunhofer.de/de/projekte/suche/2023/li-sa.html



Project Goals

LI-SA

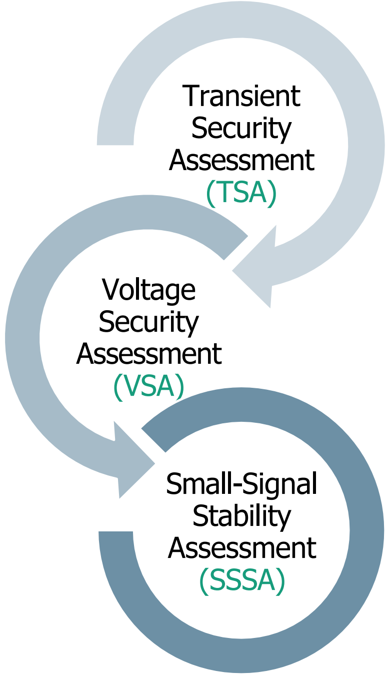
»Development of modules for assistance systems that enable safe and at the same time economical operation of interconnected grids with low inertia and a large proportion of renewable energies«

Sub-goals:

- Use of efficient models, computational methods, digital twins and dedicated computing hardware platforms in real-time network monitoring
- Development of methods for online monitoring and stability analysis for systems with low inertia and a large proportion of power electronically coupled systems
- Stabilizing measures and assistance systems to support decision-making
- Modular DSA research and development system LI-SA-RD
- Coupling the validation and testing environment LI-SA-VT based on industrial standard components, the research and development system LI-SA-RD and the dynamic real-time simulation LI-SA-RT
- Testing, verification and demonstration of the new procedures

Status of Activities

Stability Assessment – state of the art, main components and criteria



Stability.
- Ability to reach a new secure steady state after any credible contingency

Voltage excursions
- Compliance with maximum and minimum threshold/duration values
- Compliance with instantaneous excursion thresholds.

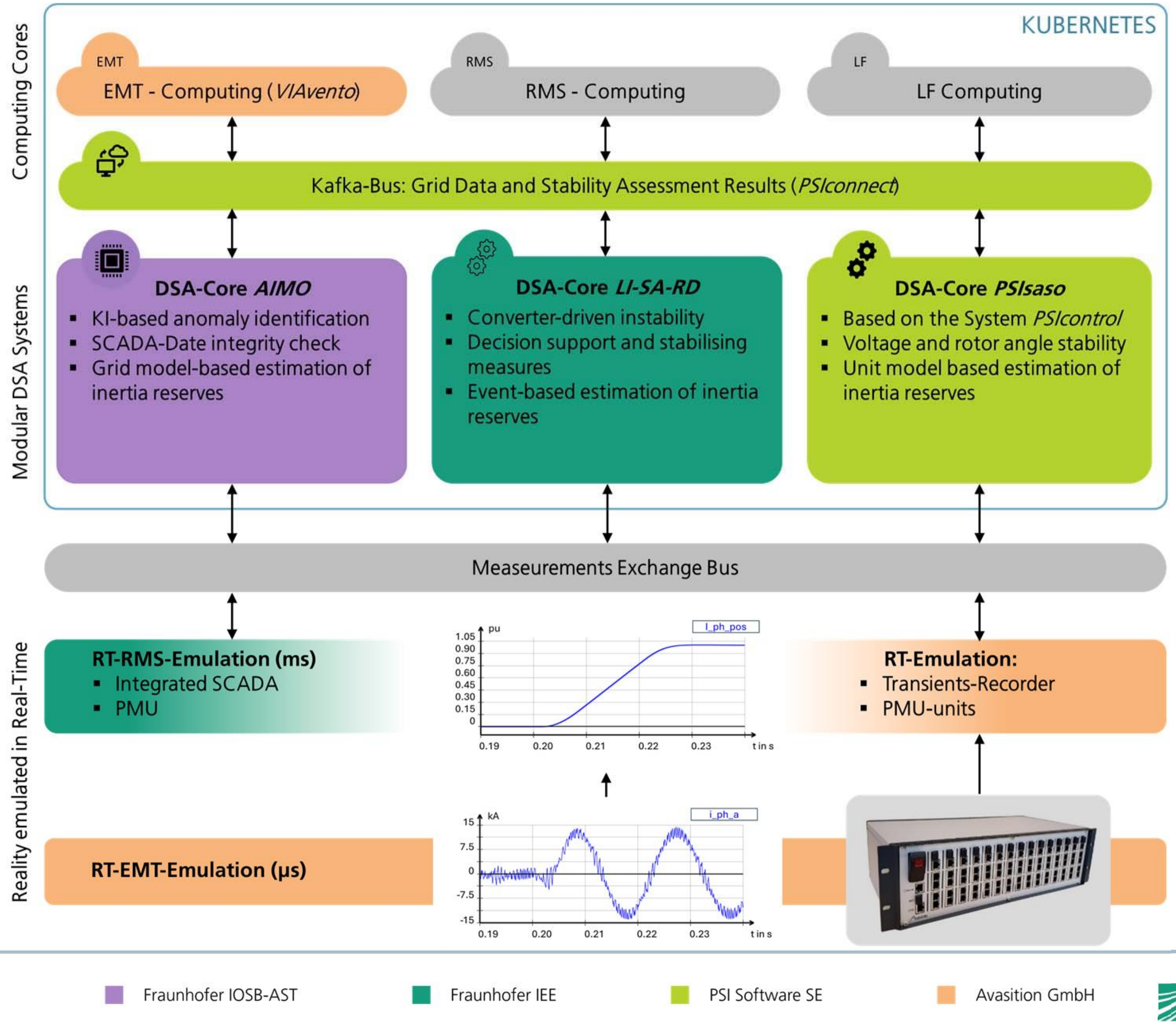
Frequency excursions
- Compliance with specified threshold level and duration.

Relay margin criteria
- If relay margin is violated for more than a maximum specified time after the disturbance, it is identified as insecure.

Minimum damping criteria
- Oscillations must have positive damping and acceptable damping ratio

Status of Activities

Overall Concept - Draft

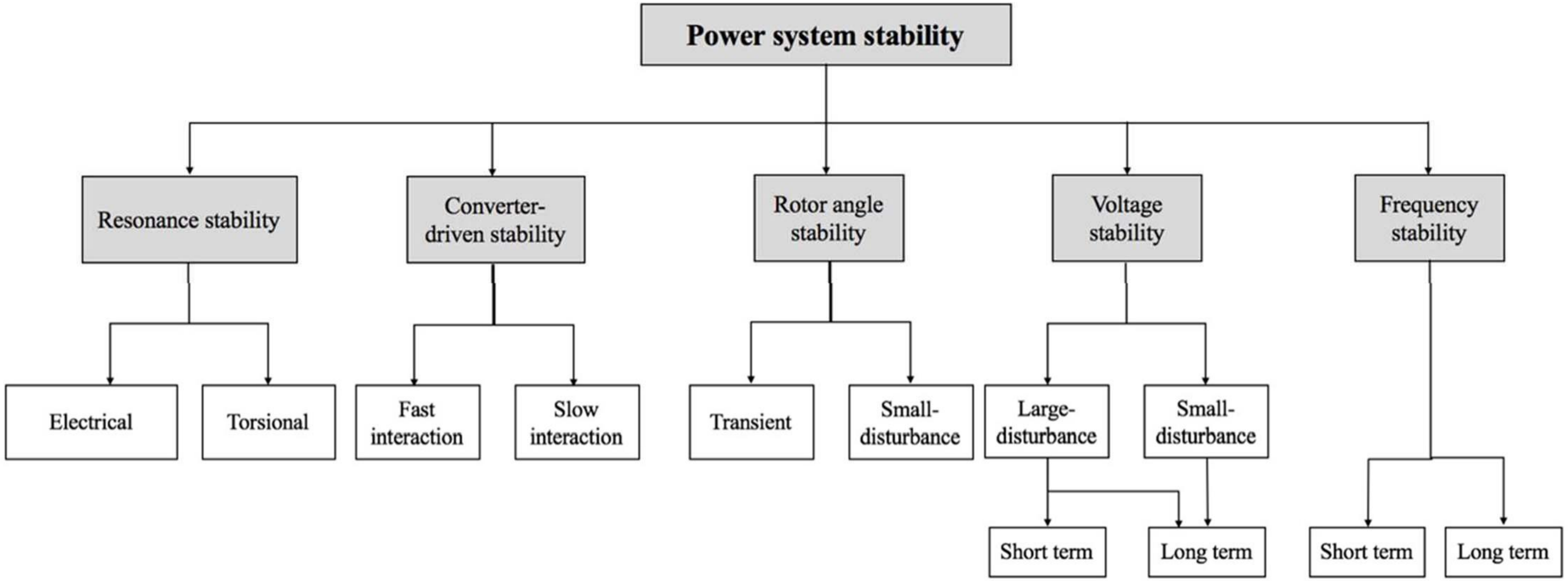


LI-SA

Fraunhofer IEE

Status of Activities

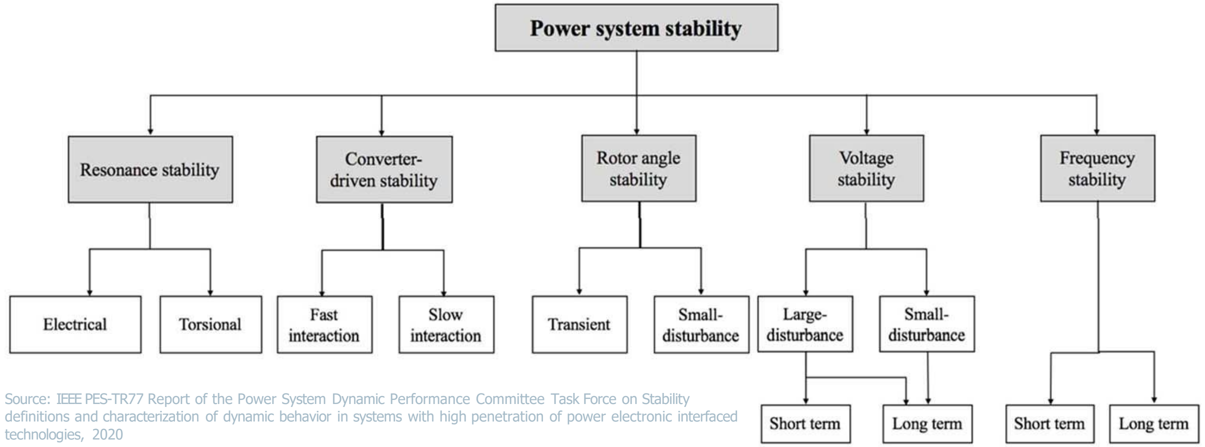
Stability Phenomena



Source: IEEE PES-TR77 Report of the Power System Dynamic Performance Committee Task Force on Stability definitions and characterization of dynamic behavior in systems with high penetration of power electronic interfaced technologies, 2020

Status of Activities

Focus of ongoing developments

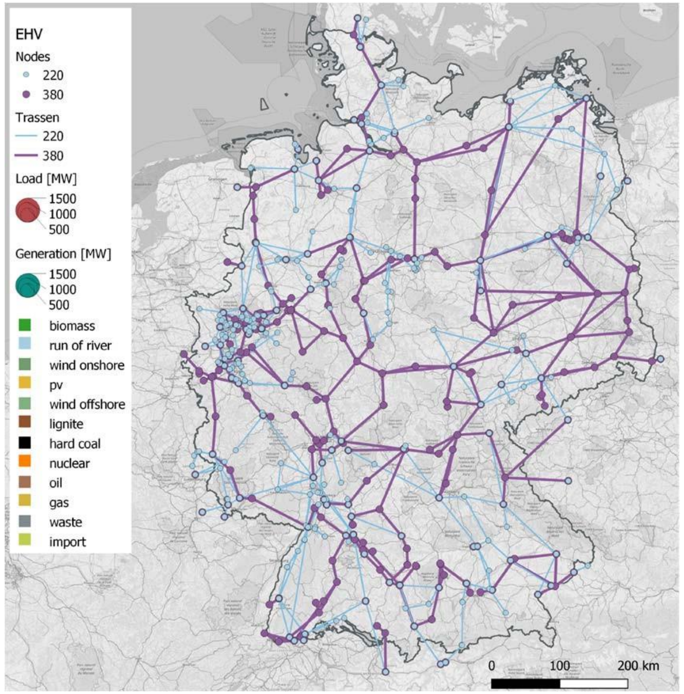


Source: IEEE PES-TR77 Report of the Power System Dynamic Performance Committee Task Force on Stability definitions and characterization of dynamic behavior in systems with high penetration of power electronic interfaced technologies, 2020

- **Methods for Estimating and Predicting Inertia (Frequency Divider)**
- **Methods and tools for determining voltage stability (modal and sensitivity analysis, PV/QV curves, RMS, LF, ...)**
- **Methods for determining converter-related instability (slow interactions)**
- **Analysis of the exact influence on system stability, determination of stability indicators**
- **Countermeasures → Decision support**

Status of Activities

Test systems and scenarios for DSA application



[Source: SimBench – Documentation: https://simbench.de/en/download/publications/

Grid model	SimBench grid model (EHV/ HV/ MV) - Plausibility-check and adaption of the LF-model - Dynamisation - Reduced and detailed modeling of the MV level (Regionalisation)	
Stability aspects	Inertia, short-term f-stability	Converter-driven instability
Regional coverage	The German transmission grid with modeling of neighboring grids	
Generation mix	Converter-interfaced IBG (wind / on-shore, off-shore, PV); conv. generation	
IBG-simulation models	GFM, GFL	
Loads	Converter-interfaced loads, conventional loads, dynamic equivalents	
Further units	HVDC, compensation units, storage	
Load profiles	Today, 2030, 2050	
Generation profiles	Today, 2030, 2050	
DSA-Functionalities, Developments	Decision support for the TSOs - Expansion of the portfolio of stabilizing measures Method for the automatic detection and classification of operational malfunctions Method for estimating and availability of inertia reserves Stability indicators	

Exploitation Prospects

- **Consulting TSOs on the topic of DSA**
- **Methods and tools for use in the control room**
  - Inertia monitoring and estimation
  - Determination of voltage stability
  - Module for decision support for network operators
- **Modular systems for the research and development of DSA procedures, methods and stabilizing measures**

Source: ENTSO-E, ENTSO-G TYNDP 2022 Scenario Report, 2022

Publications

- L. D. Pabon Ospina, S. Eberlein, M. Franke, S. Lohr, A. Alshawabkeh, D. Strauß-Mincu, Th. Degner "Dynamische Bewertung der Netzsicherheit: Werkzeuge für die Systemführung von Übertragungsnetzen mit großen Anteilen Erneuerbarer Energie", Zukünftige Stromnetze, 2024.
- M. Franke, A. Guironnet, C. Cardozo, "Comparing IEC and WECC Generic Dynamic Models for Type 4 Wind Turbines", PSCC 2024.
- L. Pabon et al, "Grid-Forming and Grid-Following inverters: a fair dynamic performance evaluation using RMS, EMT and small- signal analysis", IEEE Transactions on power systems, 2024.
- J. Stephan, C. Heising, "Decision Support for System Operators by Inertia Monitoring", CIRED 2024.
- S. Ruhe, K. Schäfer, „Nutzung Digitaler Zwillinge zur Identifikation optimaler Messlokationen", VDE ETG/FNN Schutz- und Leittechnik 2024.

Cooperation with International Committees

- CIGRE Study Committee C4, WG N° C4.71 Small Signal Stability Analysis in Inverter Based Resource Dominated Power System
- CRESYM "Collaborative Research for Energy SYstem Modelling"

Thank you for your attention!

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Fraunhofer IEE

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aufgrund eines Beschlusses des Deutschen Bundestages

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Fraunhofer-Institut für Energiewirtschaft und Energiesystemtechnik

Energiewende gestalten

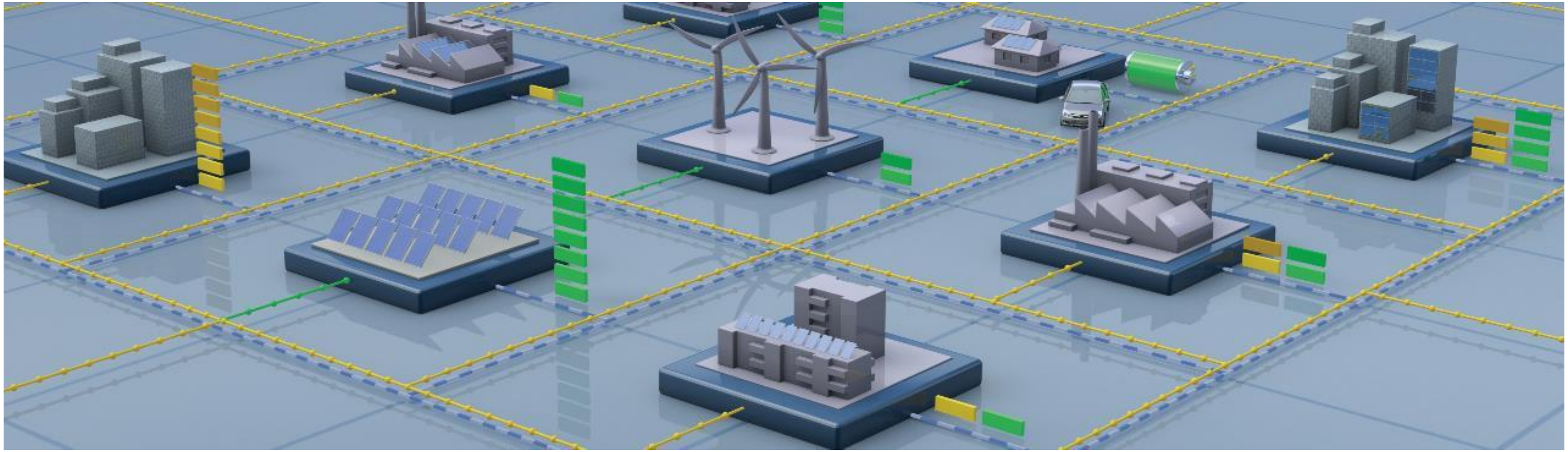
European Commission

Spotlight Sessions II

Applied energy research: Presentation of R&I projects and results in Austria

Thomas Degner
Fraunhofer IEE

Clemens Korner
AIT



PROJECT 567 – METHODS AND FUTURE SCENARIOS FOR STRATEGIC GRID DEVELOPMENT OF FULL LOW AND MEDIUM VOLTAGE DSO SUPPLY AREAS

ETIP SNET WEBINAR, May 16th 2024

Clemens Korner

OVERVIEW

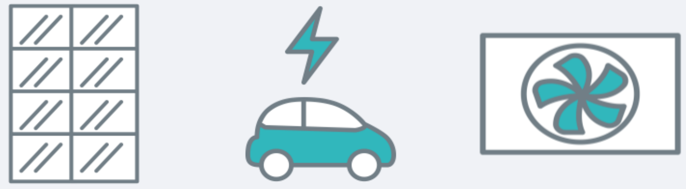
Objectives

1. Development of **future rollout scenarios** of energy technologies.
2. Specification of **different measures** to upgrade the MV and LV grid infrastructure.
3. Definition of approaches for the determination of the **future grid expansion** demand.
4. Evaluation of the **technical effectiveness** on the entire network area.
5. Provision and discussion of the **concepts and results** with DSOs.

Technologies

Photovoltaic

Heat Pumps

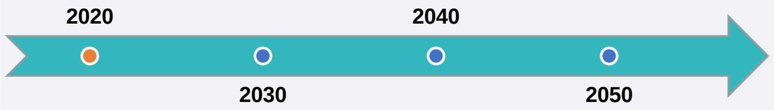


Electric Vehicles

Network levels

- Network level 5:. comprises medium voltage, with voltage levels between 10 kV and 30 kV.
- Network level 6: includes the conversion from 10 kV to 30 kV medium voltage to 400 V low voltage.
- Network level 7: includes low-voltage with a voltage of 400 V (and occasionally 900-980 V transformers to supply remote customers).

Scenario analysis



Assessment

Technical

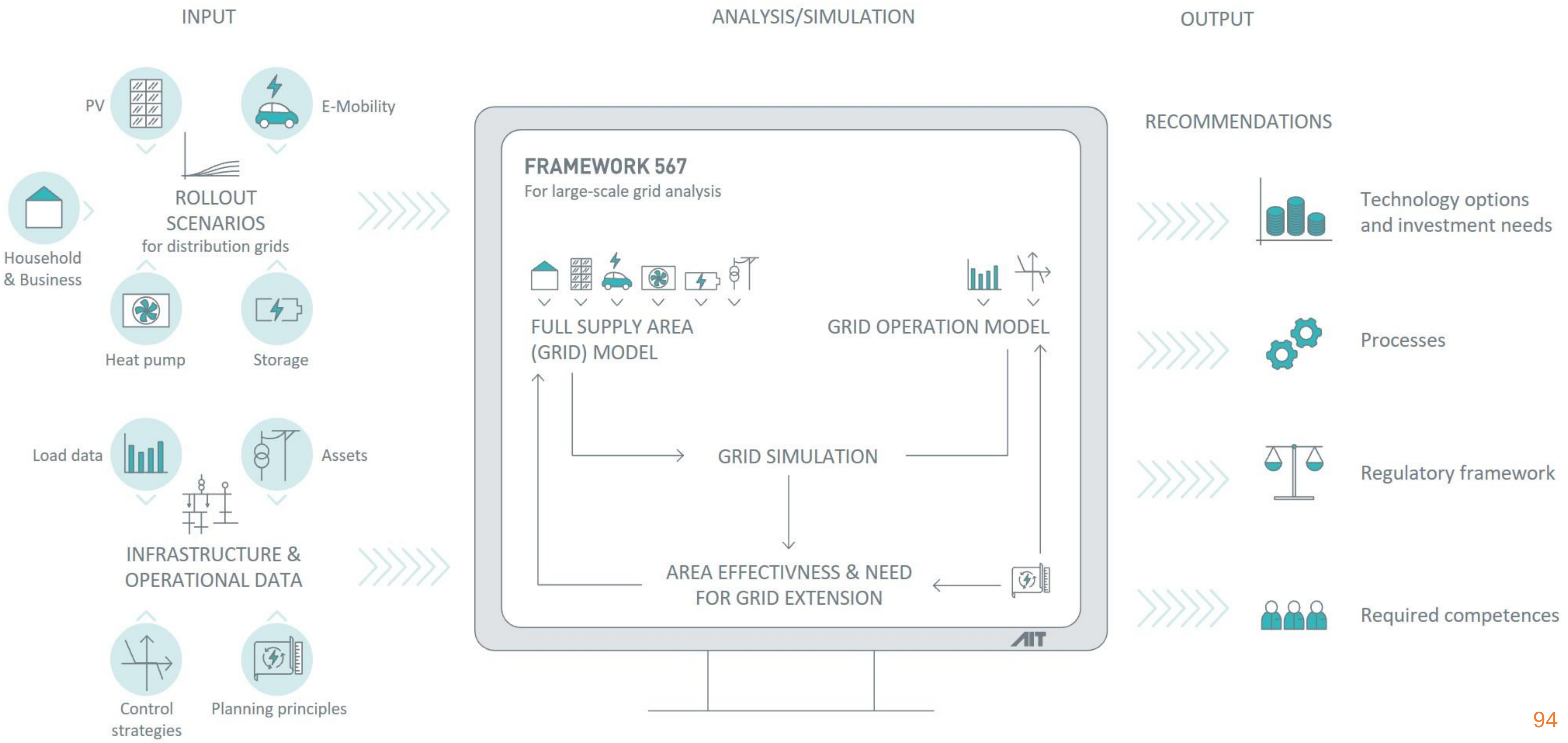
Economic

Funding

FFG Forschung wirkt.

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

METHODOLOGY

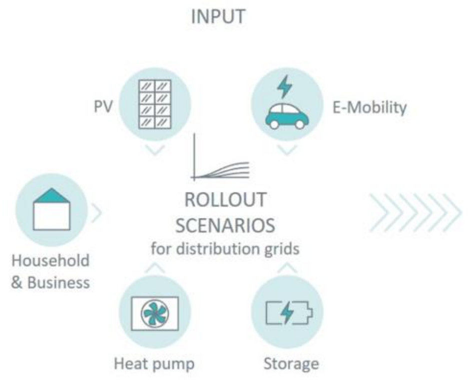


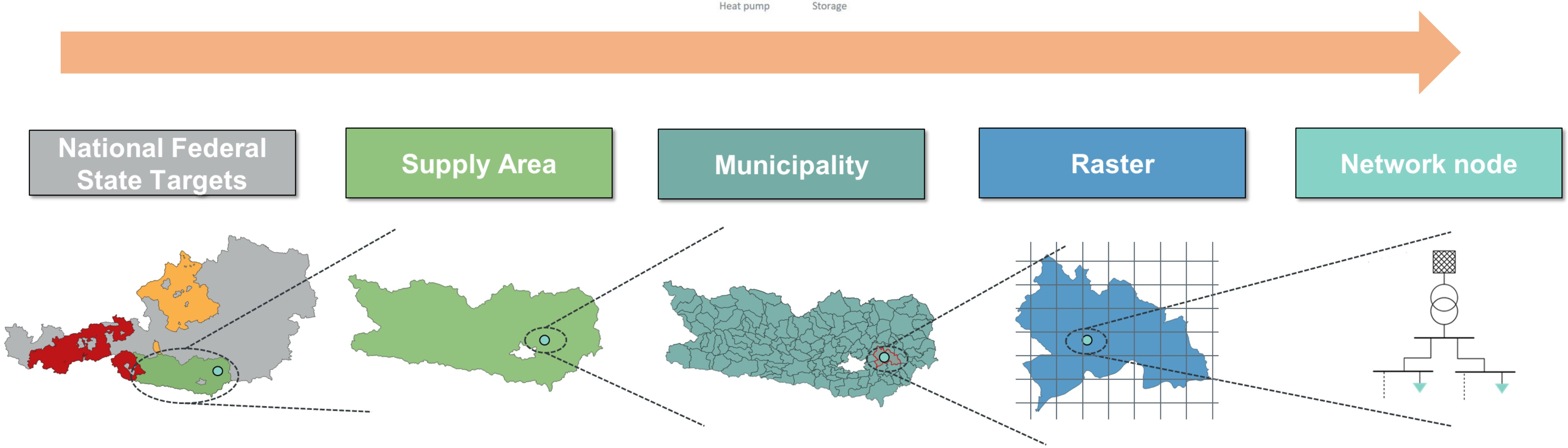
MEASURES

Measures to avoid voltage problems		Measures to avoid thermal overloading	
MV	LV	MV	LV
Increasing system voltage	Building new secondary substations	Increasing system voltage	Building new secondary substations
Reduction of intermediate voltage levels	Manual transformer stepping	Reduction of intermediate voltage levels	Manual transformer stepping
Reactive power compensation	950V-solutions	Reactive power compensation	950V-solutions
Primary substation – current compounding	OLTC (+voltage control strategies)	Primary substation – current compounding	OLTC (+voltage control strategies)
Voltage drop compensator		Voltage drop compensator	
Reactive power control		Reactive power control	
Active power control (P(U), PV 0.7*P_{nom}, EV 0.5*P_{nom})		Active power control (P(U), PV 0.7*P_{nom}, EV 0.5*P_{nom})	

LOAD AND GENERATION FORECAST

REGIONALIZATION – METHODOLOGY



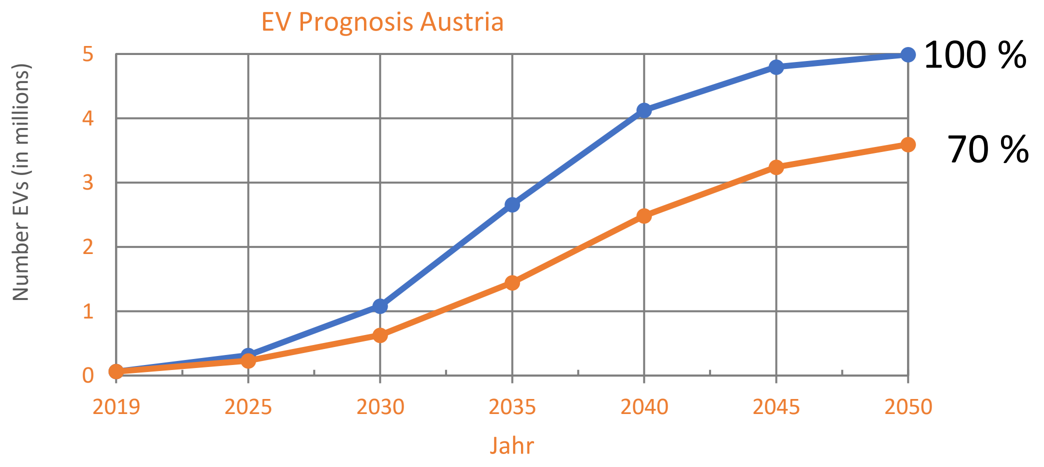


REGIONALIZATION – TARGETS

- **Georeferenced grid models** of all LV and MV grids
- **Photovoltaic**: rooftop, ground-mounted, agri-PV
- **Electric vehicles**: private charging, public charging, rest stops, shopping centers
- **Heat pumps**: households with/without heating rods
- **Data sources:** Strategy paper of States/DSOs, Statistik Austria, AGES, IEA, KAGIS, TIRIS, DORIS, ÖAMTC, BFW, …

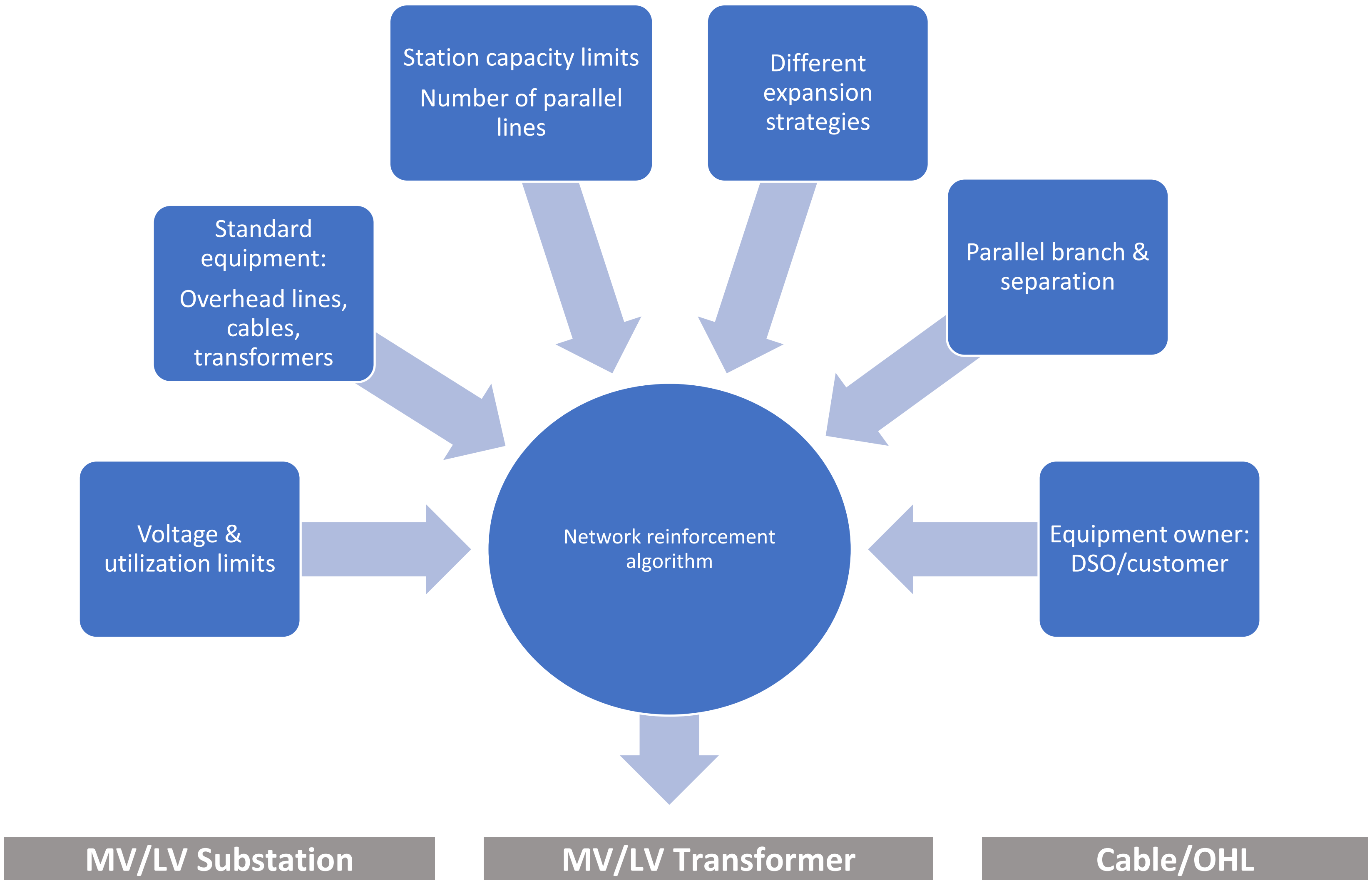
Year	PV-expansion targets	Heat pump exp. targets
	Total (MWp)	Power*) (MW)
2025	1 790	91
2030	**3 790**	**251**
2035	6 150	423
2040	8 740	561
2045	11 290	623
2050	**13 840**	**673**

*) summed power in the LV

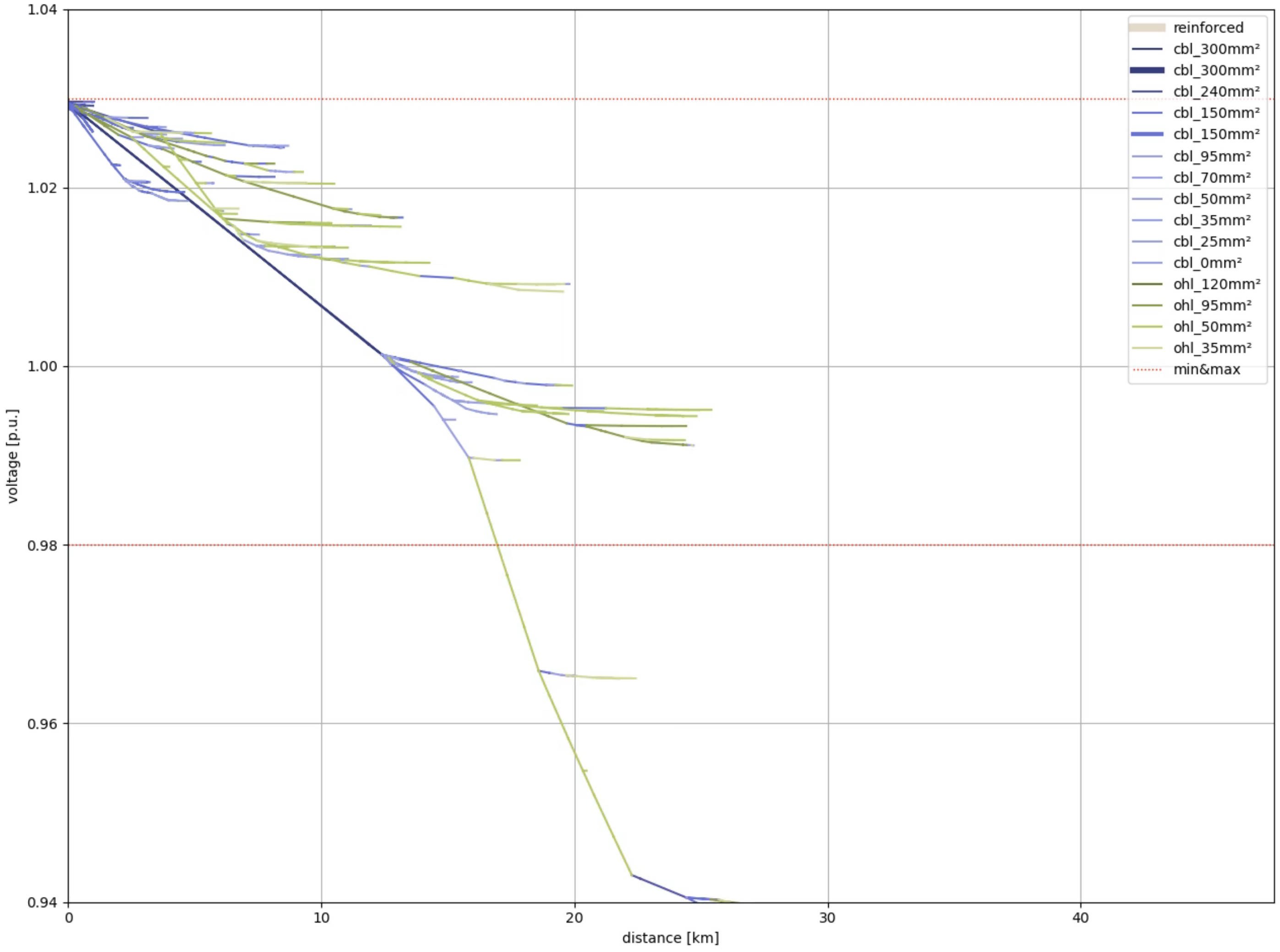


GRID REINFORCEMENT

STANDARD NETWORK REINFORCEMENT



STANDARD NETWORK REINFORCEMENT – EXAMPLE



AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

RESULTS

MEASURES AND THEIR COST REDUCTION

Measure	Scope (LV,MV)	Stakeholder involved			Cost damping (%) related to total costs (LV+MV) of the reference scenario	
		DSO	Customer	Regulator	2030	2050
OLTC and LV-SVR as a supplement to pure line reinforcement for voltage problems	LV	×			5 – 10	5 – 10
Prim. Substation-Compounding Active current-dependent voltage regulation in the primary substation	MV	×			10 – 20	5 – 15
MV-SVR as a supplement to pure line reinforcement for voltage problems	MV	×			5 – 15	5 – 15
PV-feed in limitation 70% of the module output correspond to max. 3% reduction in the feed-in p.a., use of surplus electricity for customer possible	LV+MV		×	×	5 – 15	10 – 15
PV-Q(U) Costs of reactive power generation at upstream grid levels not taken into account	LV+MV	×	×		10 – 30	20 – 25
EV peak time throttling Temporary charging power throttling of PRIVATE electric vehicle charging to 50% during peak load situations in the grid	LV+MV	×	×	×	5 – 25	5 – 15

SUMMARY

RESULTS OF THE PROJECT

- Scientifically based, **regionalized forecasts** of **future demand scenarios** for electromobility, heat pumps incl. general load increase and generation scenarios for photovoltaics
- **Area effectiveness** of various **grid-related measures** such as
  - ✓ „Conventional“ grid reinforcement
  - ✓ OLTCs (on-load tap changers), SVRs (series voltage regulators),
  - ✓ Primary substation current compounding
  - ✓ Increasing the operating voltage

  and network **efficiency-enhancing** operating concepts from
  - ✓ Active and reactive power control etc.

  on their **benefits/effectiveness** and their **costs**
- **Effects** of different **planning horizons** and different **interest rates**

THANK YOU

Questions?

Break out rooms II:

Lessons learned in the implementation of applied energy research projects and best practices

Break out rooms' topics

BREAK OUT SESSIONS

Discussion on the topics presented in the side

Round table → Presentation of questions by rapporteur → Discussion → Wrap-up

TOPICS FOR DISCUSSION

- What are some key lessons learned from the implementation of applied energy research projects in the Central Europe region, and how can these insights inform future R&I initiatives in the energy sector?
- What are some successful examples of best practices in the execution of applied energy research projects in Central Europe, and how can these be scaled up or replicated in other regions?
- How can collaboration between research institutions, industry partners, and local communities be strengthened to enhance the impact and sustainability of applied energy research projects in Central Europe?

REPORTING IN PLENARY

Synthesis of the results

Discussion of results

Mihai Calin
AIT

Closing remarks

Mihai Calin
AIT

Next steps

Share the results with participants for feedback

Use the inputs collected in further analyses of the region power system policies

Follow-up with participants in case further questions arise

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Smart Networks for Energy Transition

Thank you!