Intermittency and grid challenges (over the coming winter)

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Agenda

- **Security of supply after the energy crisis of 2022:** Recap of the crisis year 2022 and where we stand today

- **Main challenges for secure grid operation and security of supply**: (i) Delayed grid investments, (ii) lack of holistic approaches and (iii) developments in neighboring countries are central to guaranteeing security of supply in the long-run

Security of supply after the energy crisis of 2022

- Overview: European process of short-term and long-term resource adequacy monitoring
- Short recap of the energy crisis and current outlook on security of supply

Recap of the energy crisis 2022

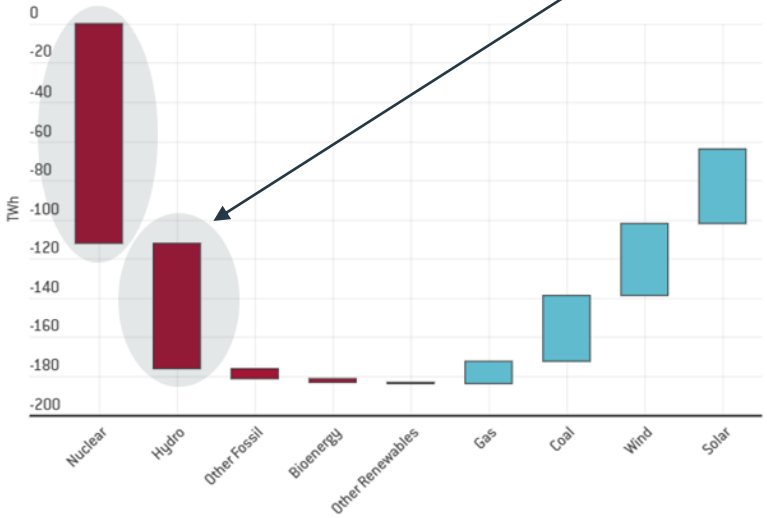
Situation before winter 2022/23 (Jan-Sep)

Causes of the energy crisis: situation in the EU by September 2022

Unavailability of nuclear power (esp. in France) meant a reduction appr. 120 TWh

- (prolonged) maintenance of French nuclear reactors, less efficiency because of higher-than-usual temperature in French rivers

Unavailability of hydropower meant a reduction of approx. 50 TWh (dry spells in spring/summer)



Source: https://www.bruegel.org/dataset/national-energy-policy-responses-energy-crisis; Comparison: Jan-Sep 2021 vs. Jan-Sep 2022

The energy crisis triggered by huge insecurity about gas supply: Additional demand for gas for electricity production in time of scarcity led to electricity prices sky-rocketing

Additionally, there were large insecurities regarding conventional generation units.

Monitoring Security of Supply closely …

Overview of different monitoring initiatives at APG and within TSO community

Pan-European processes and SoS monitoring by TSOs

ENTSO-E seasonal outlook

- **Winter Outlook** is published yearly in autumn for the coming winter
- **Summer Outlook** is published yearly in spring for the coming summer

+

APG „stress test“ for the crisis 2022

- **Due to the tense situation during the crisis, an additional stress test was carried out in 2022 to calculate additional sensitivities with an Austrian perspective by APG**

Long-term outlook: ERAA

- **Continuous monitoring of long-term security of supply over a period of 10 years into the future is carried out by ENTSO-E with strong involvement of APG experts**

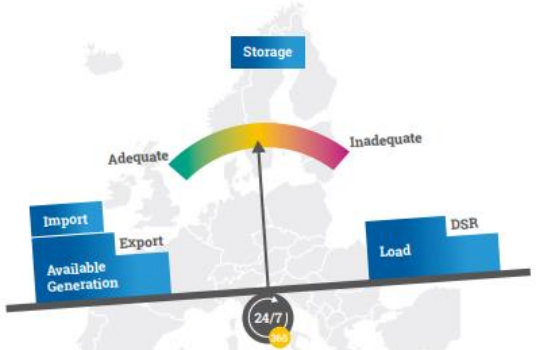


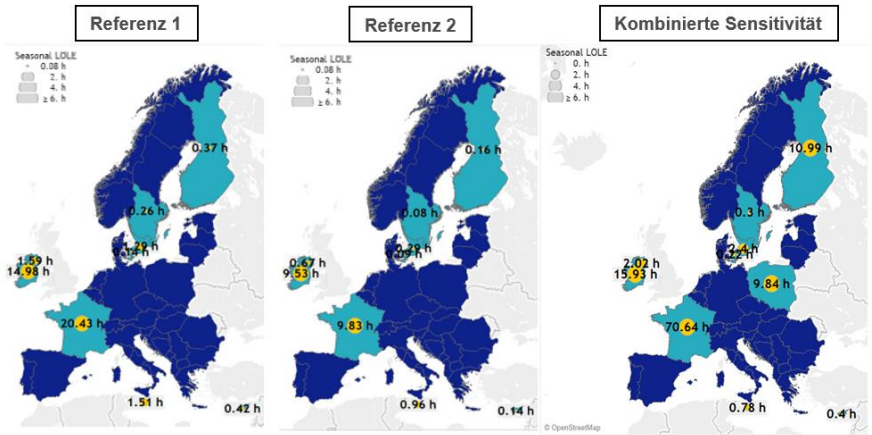
Figure 1: Resource adequacy – Balance between net available generation and net load

Source: ERAA 2022

Winter outlook during the crisis 22/23

Security of Supply (SoS) was closely monitored and necessary measures were prepared

ENTSO-E Winter Outlook 2022/23



Projected demand | 5% demand reduction | Nuclear reduction (FR,FI,SE) Coal reduction (DE,PL)

- **In all three scenarios, no major risk for SoS in Austria was predicted**
- **Critical situation for Austria only if gas supply <80% - this was analysed in depth in additional APG "stress test"**

Additional APG "stress test" with additional scenarios

	Combined scenario	Combined scenario - critical	Combine scenario – highly critical
	–	- 2 GW	- 3 GW
	reference	demand +5%	demand +5%
	no gas limit	gas limit (80%)	gas limit (60%)

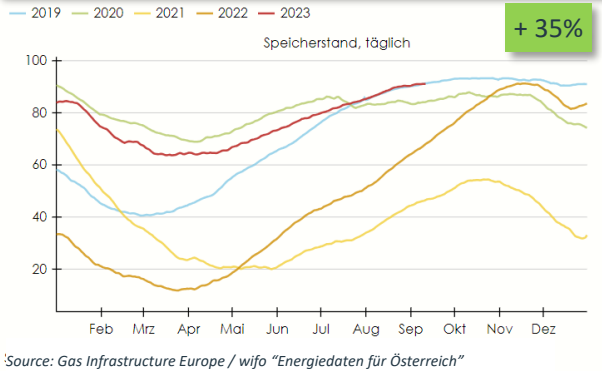
+ Additional critical assumptions for all scenarios (reduced nuclear production in France, no export from Poland, reduction of coal generation in Finland,…)

- **Only in highly critical scenarios (low probability) were significant risks for SoS predicted**
- **An overall mild winter and improved gas storage conditions meant that there were no major interruptions for Austrian SoS**

Winter outlook for the upcoming winter 2023/24

Overall, preconditions for the coming winter are greatly improved - some examples:

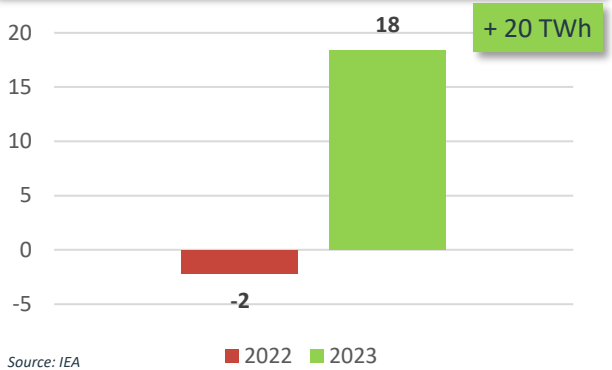
Gas storage in Austria



Source: Gas Infrastructure Europe / wifo "Energiedaten für Österreich"

Gas storage levels in Austria is at its highest level since 2019 (near full capacity)

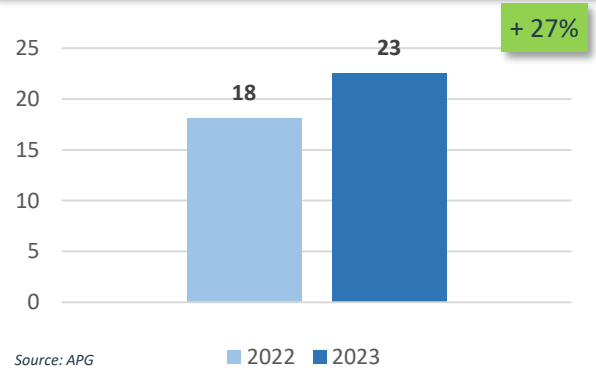
France: Import-Export (Jan – June)



Source: IEA

France (after becoming a net importer for the first time in 42 years) is exporting electricity again.

Hydro Power in Austria (Jan – August)



Source: APG

Hydro generation in Austria improved y-o-y by approx. 5 TWh

Outlook for upcoming winter 2024

- Situation for security of supply is greatly improved when compared to last year
- ENTSO-E winter outlook is expected to be published in November – APG experts heavily involved
- The "great unknown" are climatic conditions – a prolonged cold spell could pose risks
- Gas supply routes through Ukraine /eastern Europe still present a possible risk in the future

… but going back to "business as usual" is not an option!

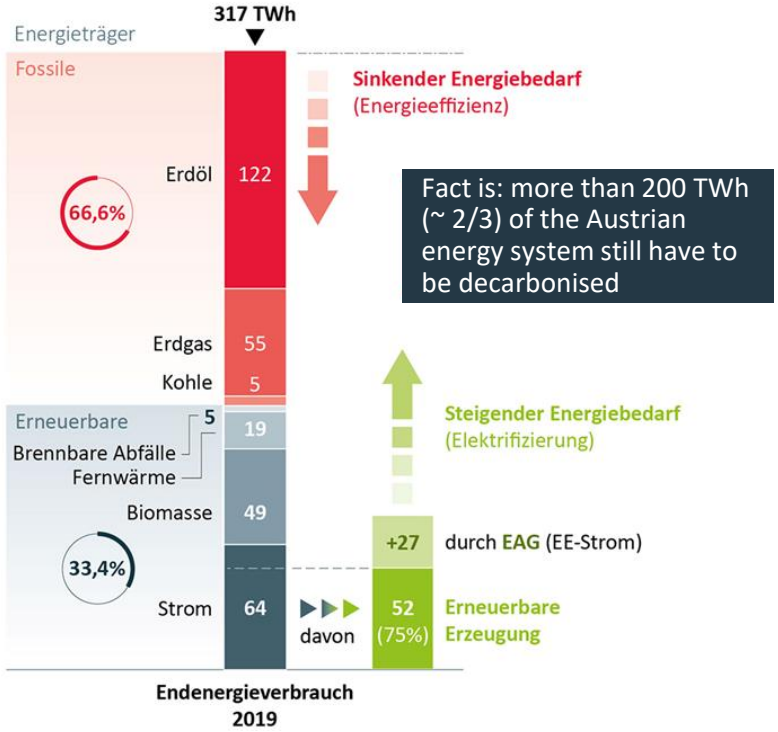
Main challenges for secure grid operation and security of supply:

- Delayed investments in transmission infrastructure as one of the main challenges for security of supply
- Key driver for Austrian security of supply will be developments in neighbouring countries
- The solution will require coordinated and holistic planning along the whole value chain

Decarbonising the electricity sector is only one aspect

To achieve decarbonisation, deep electrification of the energy system will be needed

The challenge



Milestones and key indicators

Milestone 2030

Until **2030**, the electricity sector in Austria will have to be fully decarbonised (national yearly balance; this implies a range of RES expansion of +27 TWh EAG and +39 TWh ÖNIP)

Milestone 2040

Until **2040**, Austria aims to have reached full decarbonisation of the economy. This implies that > 200 TWh still need to be substituted (currently: oil, gas and coal)

Necessary Investments

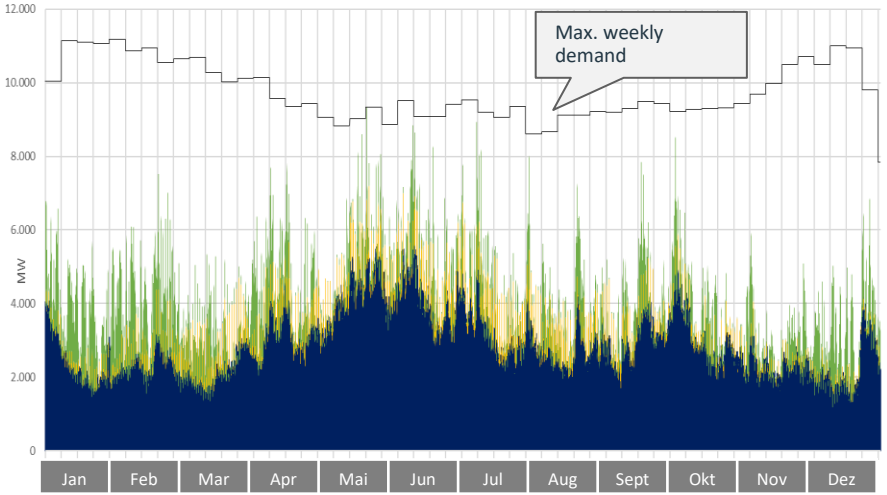
According to one recent estimate by the WKO, investments of approximately **70 billion euro** are needed until **2030**. As an indicator, roughly **twice that amount** is required to decarbonise the economy until **2040**.

Source: BMK 2020, Statistik Austria 2020, E-Control 2020, APG 2020; Energiemasterplan WKO, values in TWh

Main challenges to be addressed today

Missing transmission grid causes significant and avoidable costs for consumers

Meeting demand 2022 in APG control area



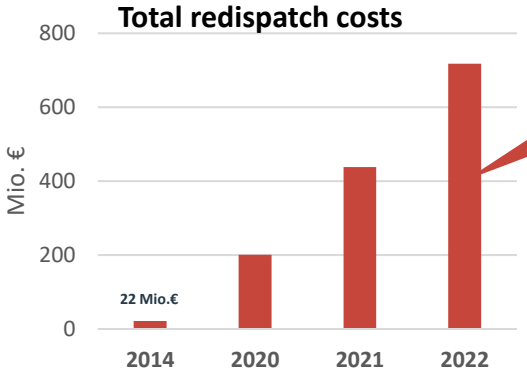
4.0 GW

3.8 GW

5.7 GW

Significant residual load that has to be covered by imports and fossil generation units

Grid unable to meet market requirements



Ca. 700 million €

Congestion between DE/AT due to bidding zone split

Price spread AT / DE [€/MWh]	
2019	2.4
2020	2.7
2021	10.0
2022	26.0

Ca. 1,800 million €
(at 70 TWh demand)

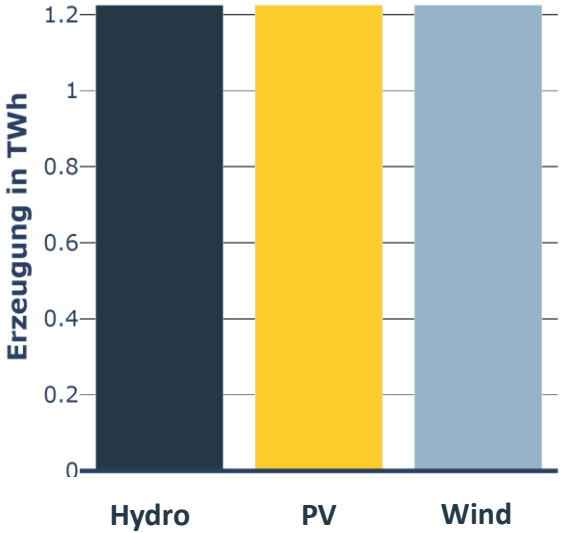
Missing transmission grid infrastructure causing additional costs of 2,500 Mio. €

Key for **technical challenges** ahead: Massive increase in capacity

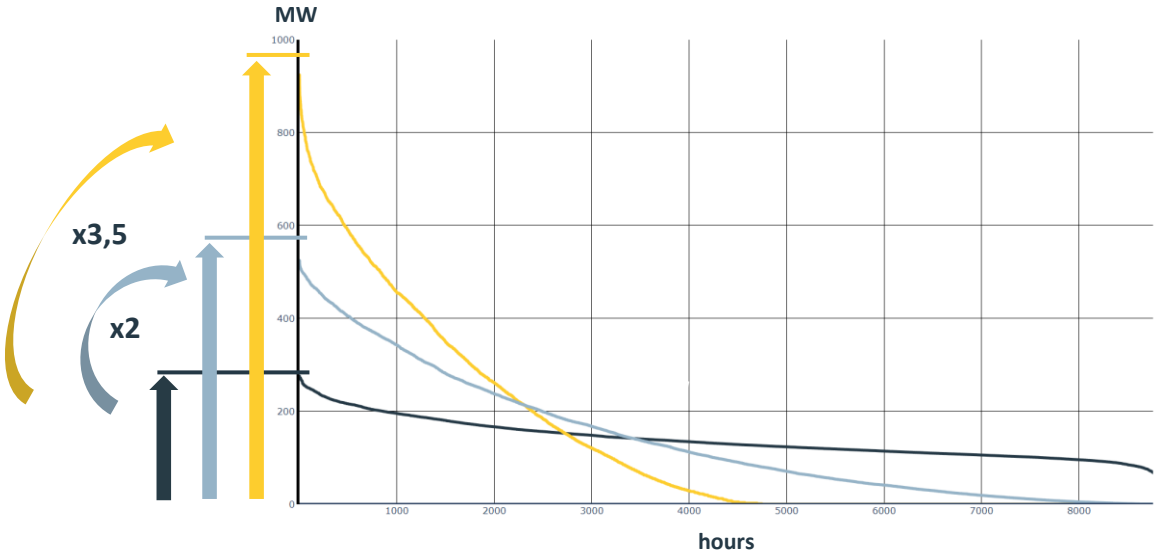
Peak capacity sets the threshold for grid development

Direct comparison between hydro power, wind and solar PV shows:

In order to produce the same amount of energy...



... almost twice the capacity for wind and 3.5 times the capacity for PV are needed



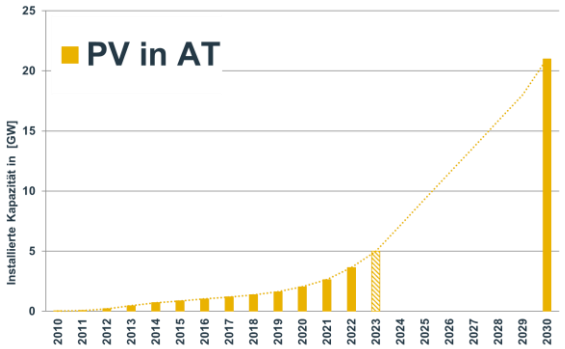
Generation from wind and solar PV have fundamentally different characteristics than generation from (flexible) hydro or gas. This effect is greatly enhanced by additional electricity demand through electrification of the economy!

Source: APG, E-Control

Current dynamics in PV expansion

Intermittency will soon represent a huge challenge

PV-expansion is booming in Austria



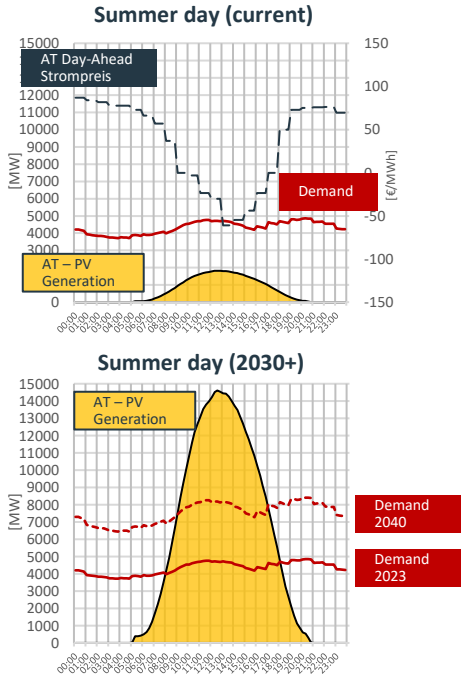
Quelle: E-Control Betriebs- und Bestandsstatistik (Kraftwerkspark 2022); Integrierter österreichischer Netzinfrastrukturplan (2023); ÖNIP Szenario: Transition S.33

→ **Currently, around 150 MW additional PV capacity in Austria per month**

→ **June 2023: installed capacity roughly 5 GW**

→ **Current peak demand roughly 11 GW**

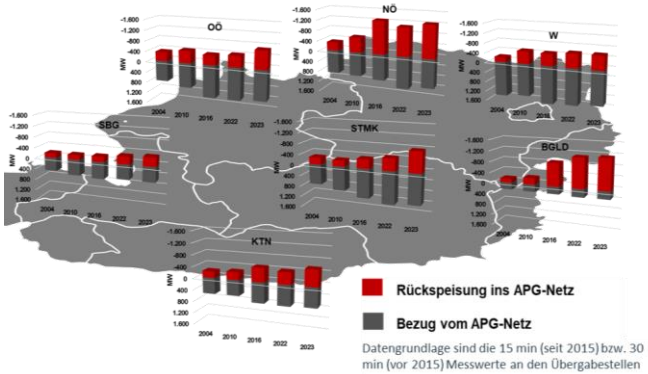
System integration of PV urgently required



→ **Negative/very low prices a reality**

→ **Market induced reduction of hydro & wind generation**

Increase in PV infeed to transmission grid



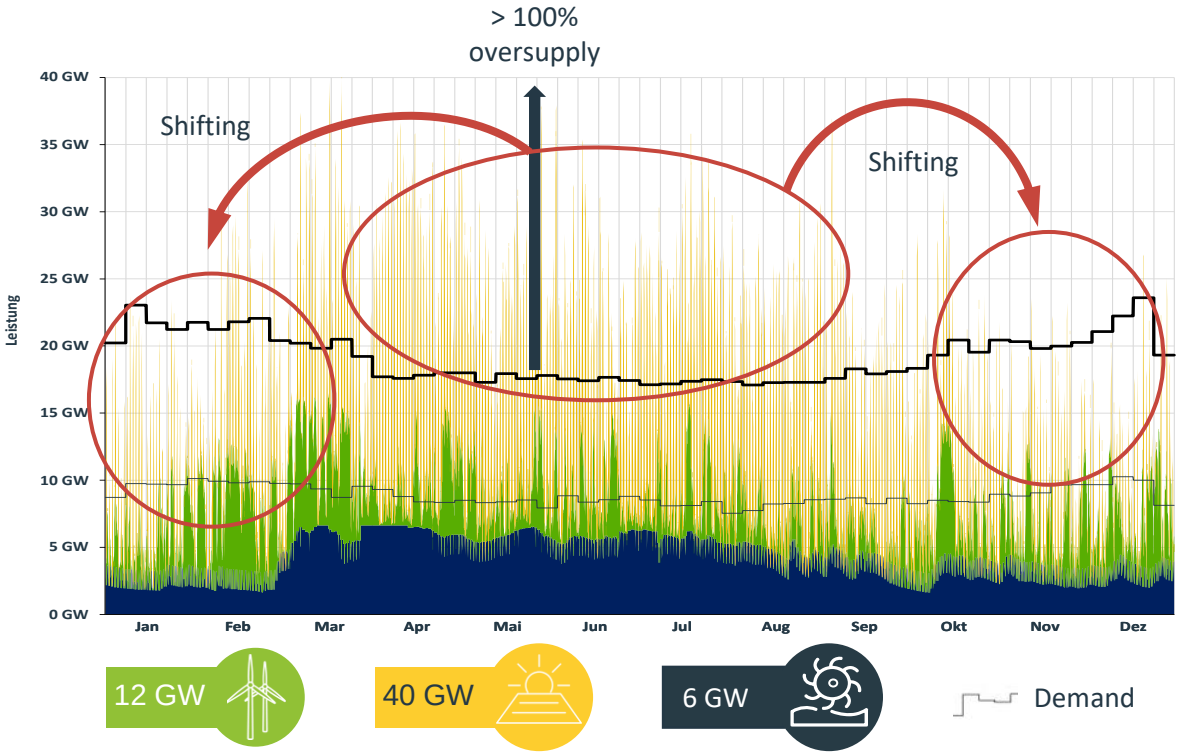
→ **Excess generation/demand to be managed via TSO grid**

→ **Curtailment of hydro and wind necessary already today**

Outlook 2040: Results of the integrated Austrian Network Plan (ÖNIP)

No convergence between intermittent RES and demand

Providing flexibility to the system is the most important challenge ahead



- **No temporal or geographical convergence between generation and demand**
- **Providing flexibility to the system will be key** – electricity is the most important energy carrier of the future (balancing measures take place every 2 seconds)
- **Massive grid expansion required** to integrate RES into the system
- **Short-term and seasonal shifting of energy essential** – power-to-gas and batteries are no-regret measures that must be built urgently

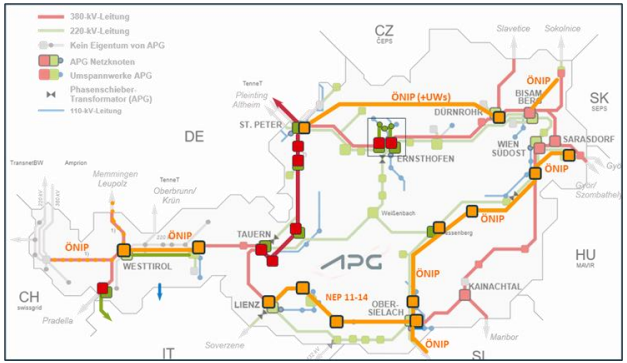
[1] Demand projection 2030+ based on TYNDP 2020 NT 2030 (90 TWh) | RES expansion based on ÖNIP Transition Szenarios (UBA)

Outlook 2030+: Quantifying the challenges from APG perspective

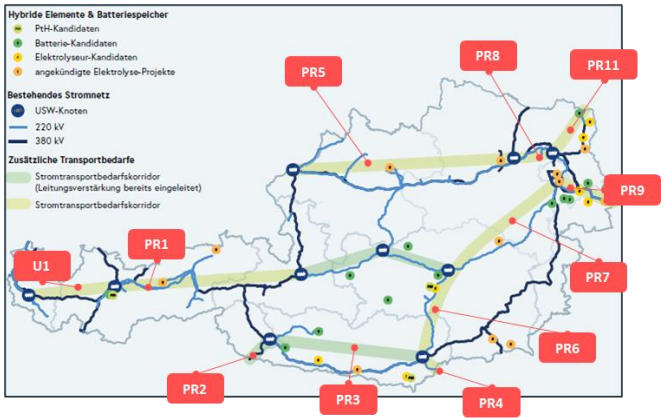
Necessary grid expansion based on ÖNIP and APG projections

APG calculation confirmed by ÖNIP

APG

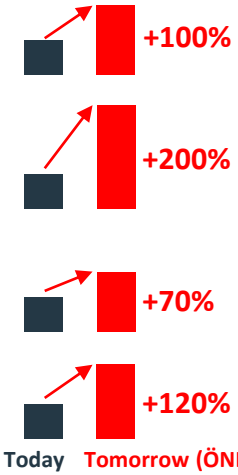


ÖNIP



Massive challenges until 2030+

	Today	Tomorrow (ÖNIP 2030+)	Increase
Grid length [380 kV]	1.200 km (in 60 years)	+ 1.200 km (in 13 years)	+100%
UVP Verfahren [environmental impact]	2 (max.)	5-6 (in parallel)	+200%
Substations	65	+45	+70%
Trans-formers	95	+110	+120%

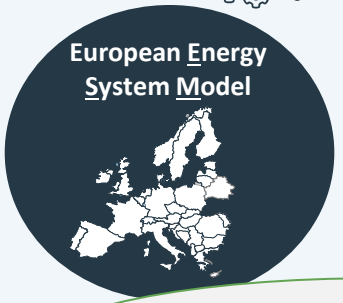


Massive challenges ahead and urgent action required!

APG project "zusammEn2040": Improved network planning through utilizing state-of-the-art planning tools and modelling approaches

ESM

European Energy System Model



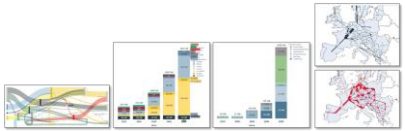
Electricity system of the future
will be planned based on an optimised vision of the total system needs

zusammEn 2040

Stakeholder process

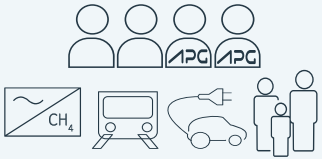
- Vision stakeholder 1
  - Vision stakeholder 2
    - Vision stakeholder 3
      - …

One unique vision per stakeholder



Interactive results visualisation on a transparent basis and possibility to **publicly disseminate results**

Identification of no-regret measures



Determination of infrastructure needs for grid planning

Electricity, methane, hydrogen, production, storage, …

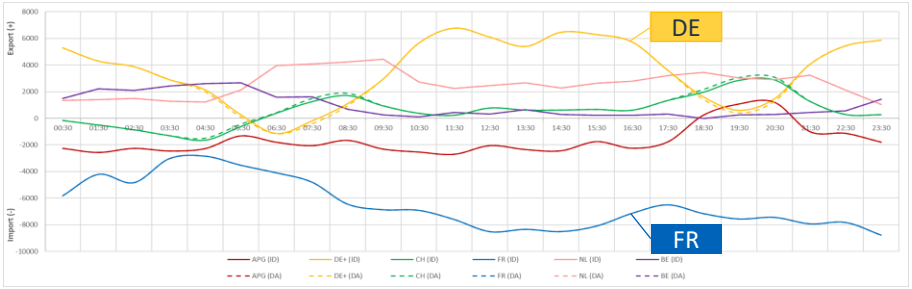
Input for APG-processes

- → Strategic Network Development
- → NEP, ÖNIP
- → TYNDP
- → ERAA
- → …

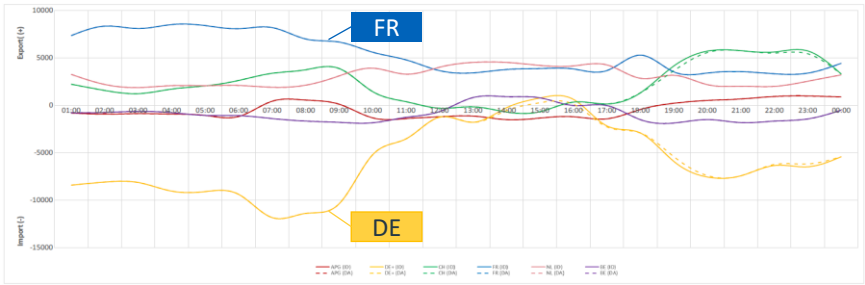
Final issue: Turning to our favourite neighbour …

Germany increasingly becoming a net importer of electricity (nuclear phase-out)

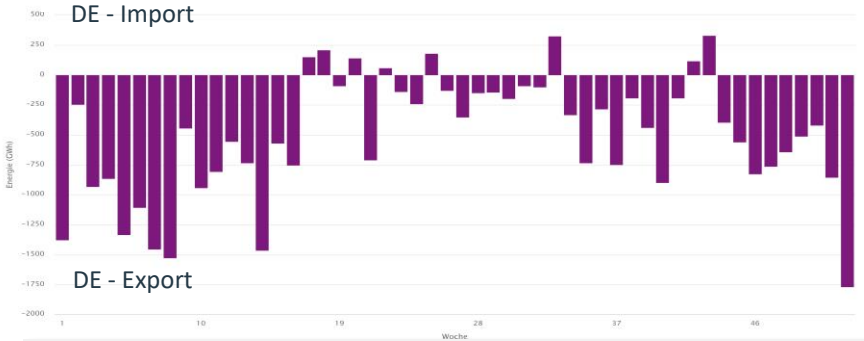
01.09.2023



22.08.2023



Weekly import-exports for Germany 2022



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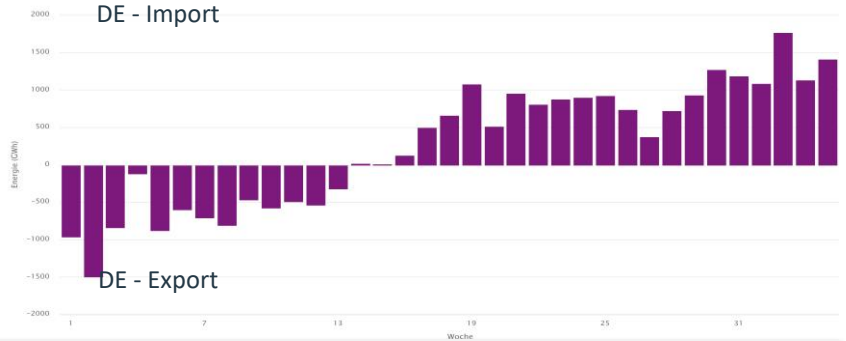

Due to Austria's unique situation in the heart of Europe, it will be key to monitor developments in neighbouring countries (which overall face the same pressures of electrification, RES-integration and SoS)

Key take-aways

What needs to be done in order to ensure security of supply?

Action on no-regret measures: Grid expansions needs to be accelerated in order to allow renewables to be integrated into the system. Transmission grid is the key towards diversification of electricity supply and hence central to risk mitigation

Ensuring security of supply: Efforts towards monitoring of security of supply will need to be intensified. Assessment of market design options will be necessary. Hence, APG is establishing a process for **national resource adequacy monitoring** (on top of existing European processes)

Integrated and holistic planning: New planning instruments are needed to achieve security of supply at optimal costs. Key is increased coordination among actors to allow for energy exchanges across sectors in real-time.


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