RES and Continuity of Supply

Presentation to the ERRA EMER Committee

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ERRA EMER Committee Meeting
September 12, 2024 | Online meeting

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Dimensions of Quality of Supply

Quality of supply comprises three dimensions.

Continuity of Supply

- Reliability of electricity supply
- Performance indicators (e.g. number and frequency of interruptions)

Technical Quality

- Physical properties of electricity
- Performance indicators (e.g. voltage stability, dips, flickers)

Commercial Quality

- Customer service quality
- Performance indicators (complaints from consumers, response time to consumer complaints, etc)

Continuity of Supply

Reliability Indicators (absolute)

Number of interruptions	Number of customers affected	Duration (cumulative)	Unsupplied energy
Total number of times during a year that supply to one or more customers was interrupted	Number of customers affected for each consecutive outage in that year	Aggregated time that customers who have experienced an outage have actually been interrupted in the year (in minutes or hours)	Aggregated energy not supplied to customers during the year as a result of the interruptions (in MWh)

Continuity of Supply

Reliability Indicators (normalized)

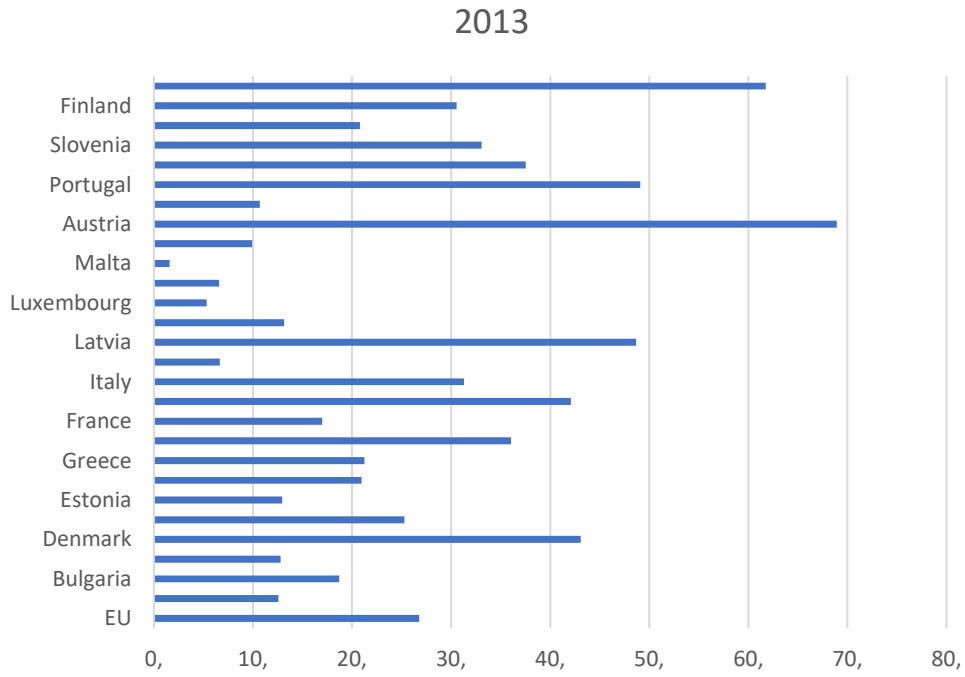
System Average Interruption Frequency Index (SAIFI)	System Average Interruption Duration Index (SAIDI)	Customer Average Interruption Frequency Index (CAIFI)	Customer Average Interruption Duration Index (CAIDI)	Average Energy Not Supplied (AENS)
Average number of outages per customer	Average time of interruption per customer	Average number of interruptions for a customer who experienced at least one interruption	Average time required to restore service to an interrupted customer	Average amount of energy not supplied per customer because of interruptions
$SAIFI = \frac{\sum_i N_i}{N_t}$	$SAIDI = \frac{\sum_i r_i N_i}{N_t}$	$CAIFI = \frac{\sum_i N_i}{N_a}$	$CAIDI = \frac{\sum_i r_i N_i}{\sum_i N_i}$	$AENS = \frac{\sum_i r_i P_i}{N_t}$

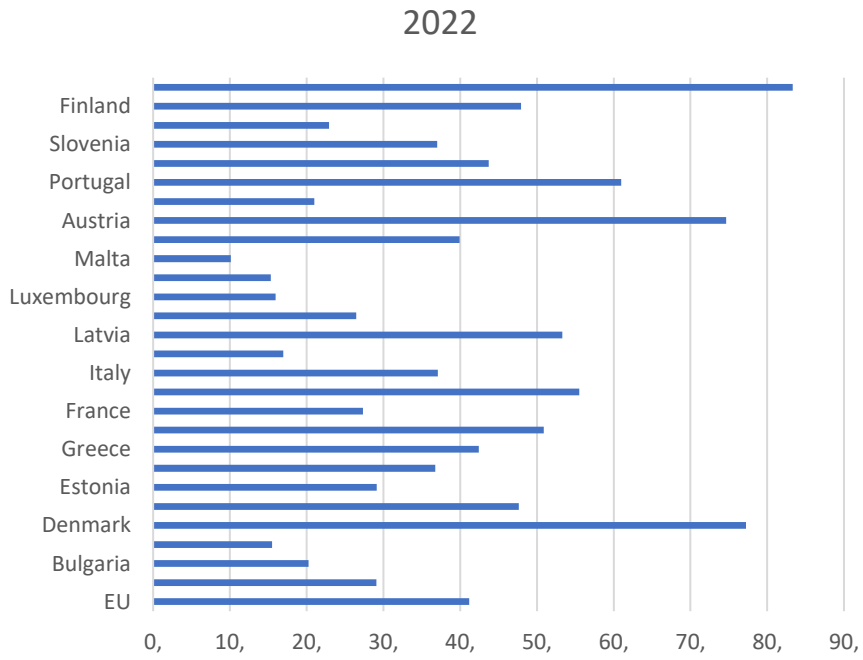
N_i: Number of interrupted customers for interruption i
N_t: Total number of customers served
N_a: Number of customers affected by at least one outage

r_i: Restoration time for interruption event i
P_i: Interrupted Power for interruption i

RES Production in Europe

The RES production in the European Union has significantly increased in the last decade.

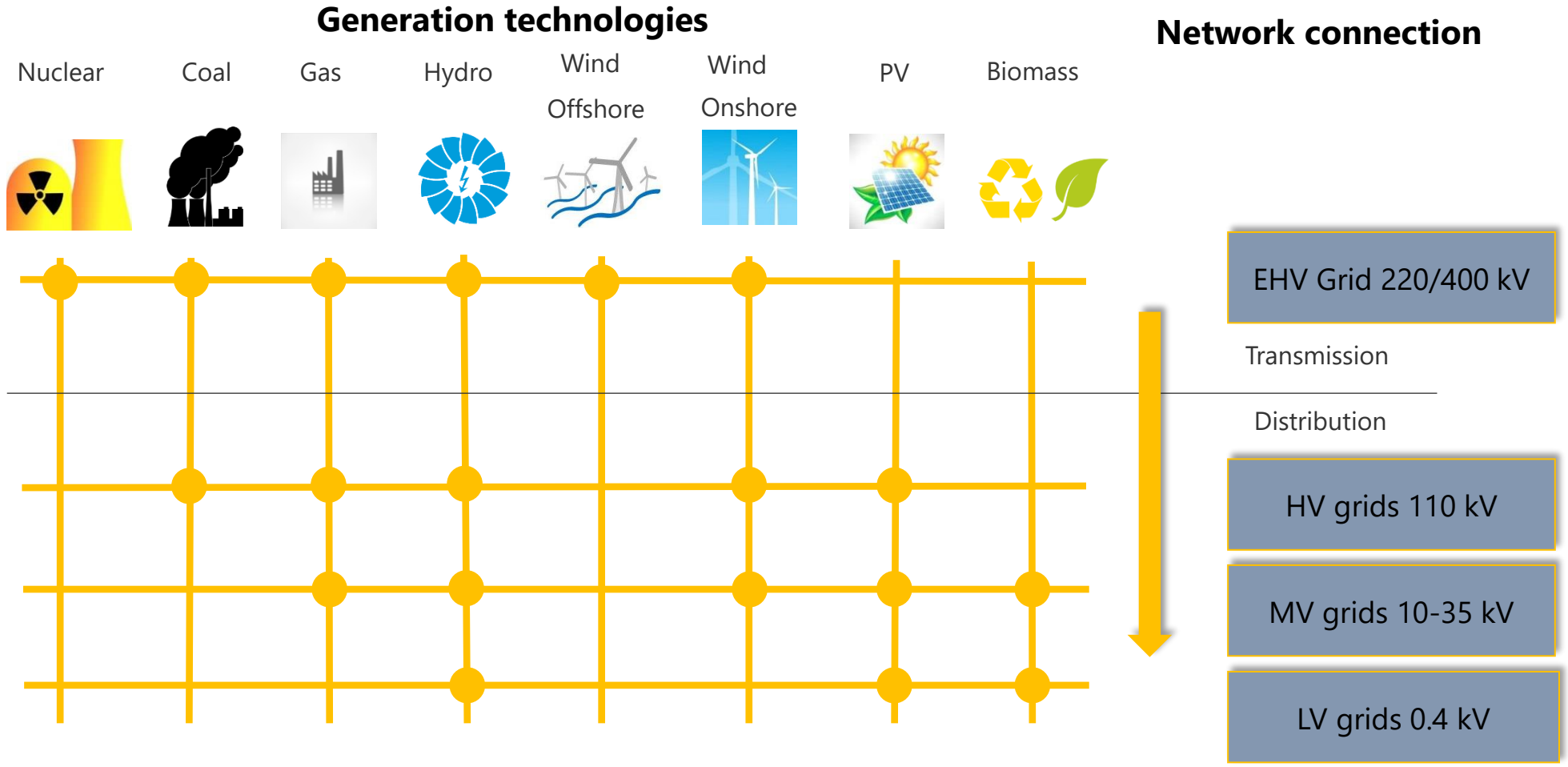




Source: Eurostat

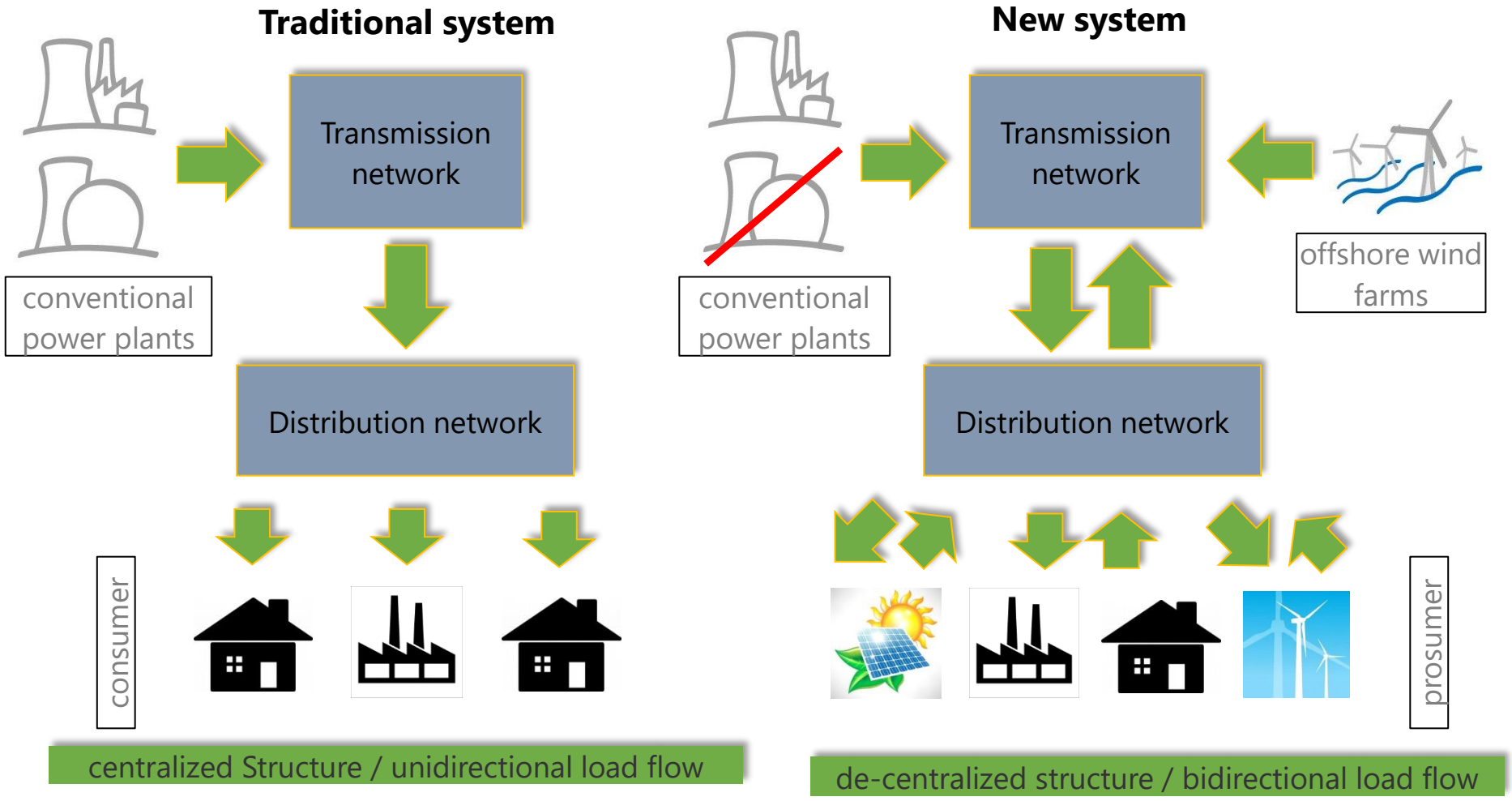
RES Connection

Connection of RES generation to electricity networks



System Impact

The rapid growth of RES leads to changes in electricity flows.



System Impact

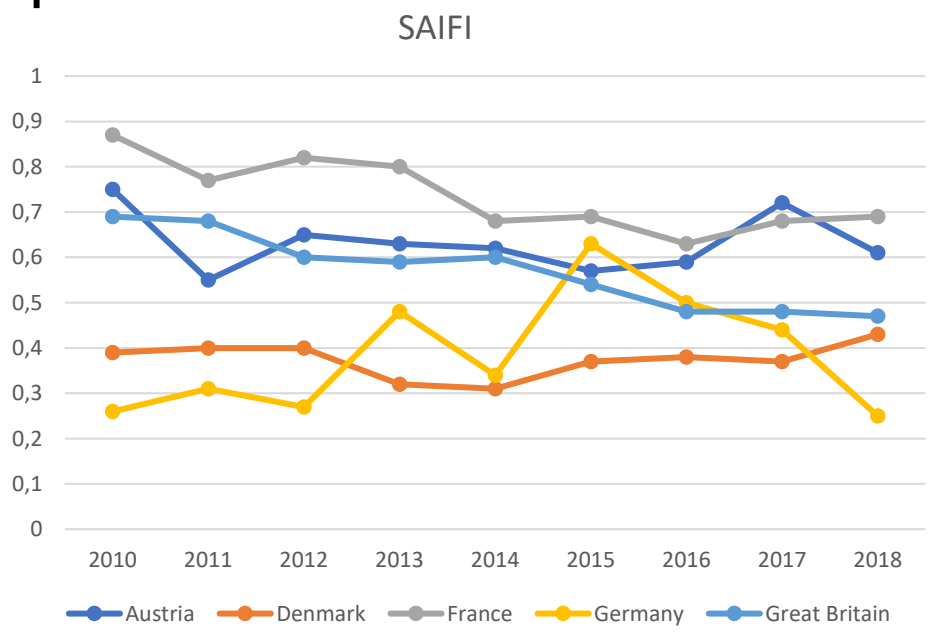
Increasing penetration of variable RES leads to a wide range of technical challenges for the power system.

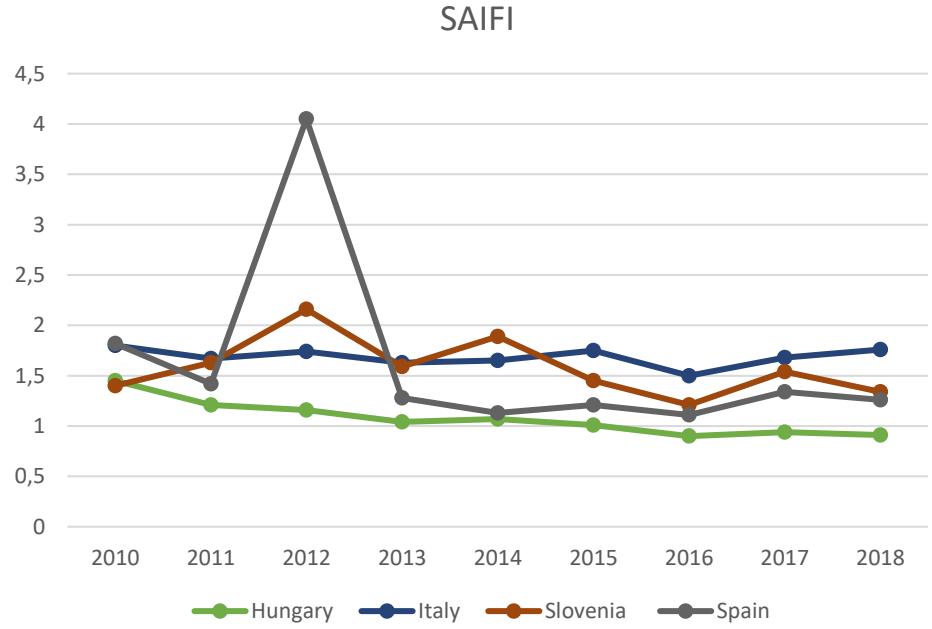
	System Adequacy	System Security /Operation
Challenges	• Geographical dispersion of RES • Declining capacity factors • Firm generation capacity requirements • Reversed flows / thermal overload / network capacity insufficiency	• Intermittency / forecast errors • Operating reserves / flexibility (frequency control and balancing) • Voltage instability

Risk of power system outages and deterioration of quality of supply

Continuity of Supply in Europe

The published SAIFI Index remains reasonably stable / slightly improves.





SAIFI (excluding exceptional events)

Source: CEER

Continuity of Supply in Europe

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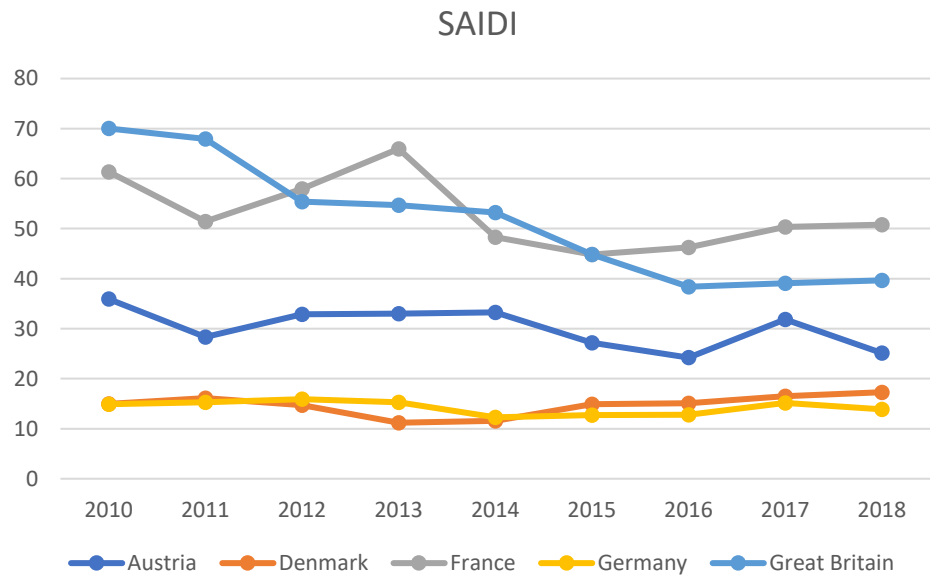

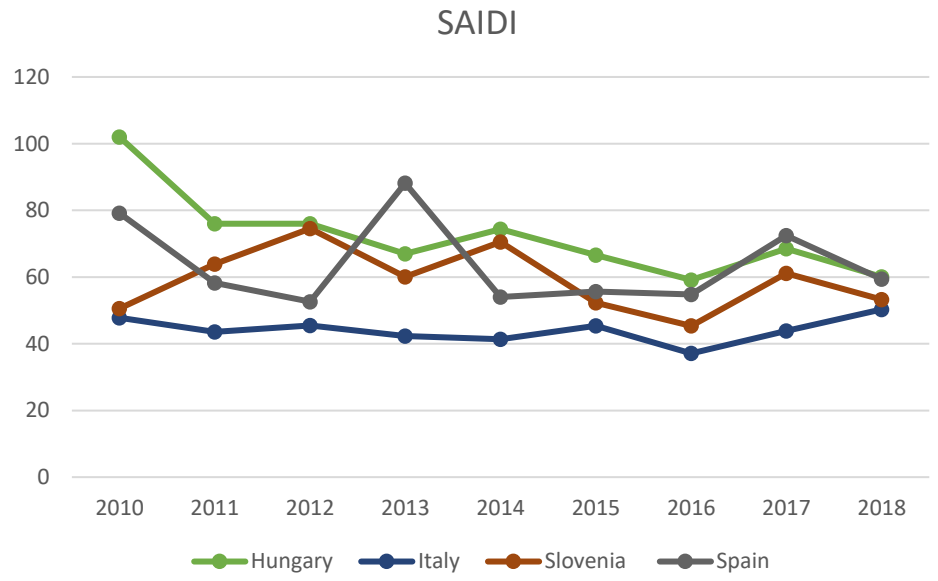

SAIDI (excluding exceptional events)

Source: CEER

Mitigation Measures

Network operates have been able to mobilize various effective measures to enable RES integration and maintain quality of supply.

	System Adequacy	System Security /Operation
Solutions	• Improved coordination in planning of RES • Back-up generation capacity • Network extension • Connection policy	• Improved RES forecasting • Dimensioning of operating reserves • Voltage management concepts • Procurement of flexibility • Smart grids

Concluding Remarks

- RES production has been steadily increasing
- Increasing penetration of variable RES leads to a wide range of technical challenges for the power system
- The observed SAIDI and SAIFI remain reasonably stable / slightly improves
- Network operates have been able to mobilize various effective measures to enable RES integration and maintain quality of supply
- Regulators play an important role in this process

ERRA's upcoming training course explores the **principles underlying regulation of quality of supply** including the **dimensions of quality of supply** as well as **regulatory fundamentals and methods**. Theoretical presentations will be extended with **country case studies and exercises** providing relevant example from regulatory practice.

Day 1

- More than two decades of quality of supply regulation: where we came from and where we go?
- Dimensions of quality of supply
- Methods to regulate quality of supply
- Performance standards
- The case study of Italy

Day 2

- Financial incentive schemes
- Reliability and outage cost
- Experiences with quality of supply regulation
- The case study of Lithuania
- Final test

➲ https://erranet.org/regulation-of-quality-of-supply/

Confirmed Speakers

Konstantin PETROV

Course Director

Managing Consultant, Energy Markets and Regulation
DNV Energy Systems, Germany

Luca LO SCHIAVO

Director, System Services and Energy Monitoring Directorate
Italian Regulatory Authority for Energy, Networks and Environment (ARERA)

ERRA

Hybrid Training

Regulation of Quality of Supply

November 11 – 12, 2024 | Budapest, Hungary

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THANK YOU FOR YOUR ATTENTION!

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