

New Technologies, New Skills for Utilities

22nd May 2026

What does it really mean to develop the skills required by energy transition and digital transformation?

Energy and Digital Transformation

The energy sector is undergoing major shifts due to energy transition and digital transformation megatrends.

Evolving Skill Requirements

Traditional skills are not enough; new competencies are required to support changing business models and operations.

Dynamic Workforce Planning

Utilities must adopt continuous learning systems over static workforce planning to stay competitive and resilient.

Aligning People and Technology

Aligning people strategies with technological evolution ensures organizations adapt and



Technical Skills Are Not Enough

Technical expertise alone is insufficient due to growing system complexity and integrated domains.

Need for Hybrid Skill Sets

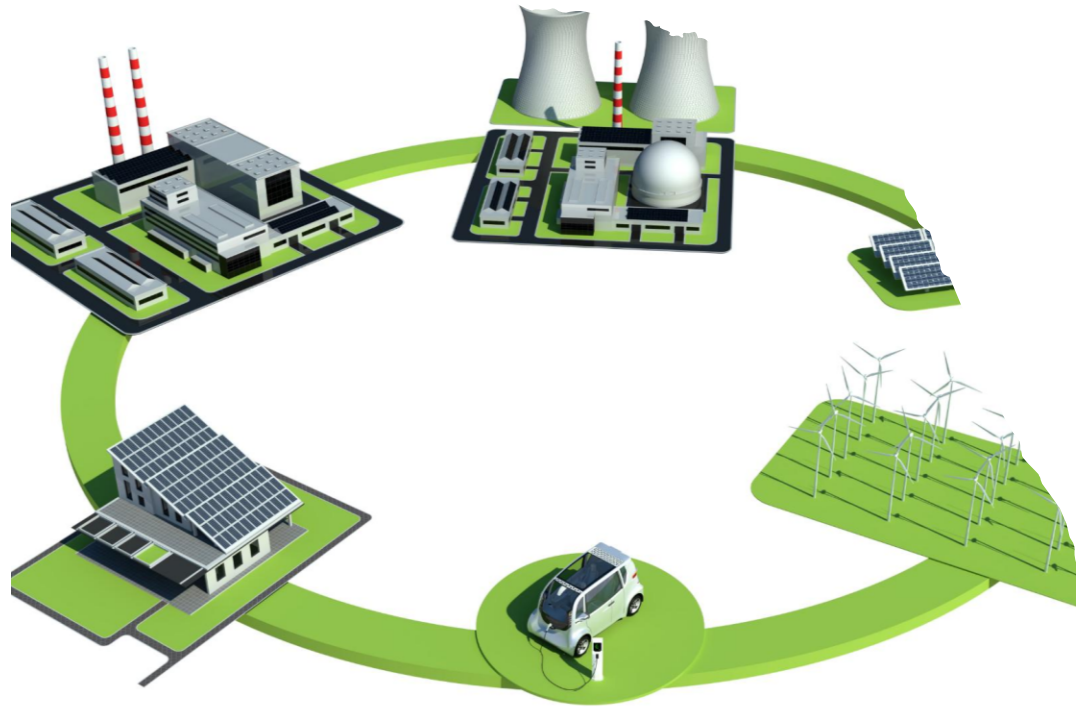
Emerging roles require combining disciplines, making traditional job categories less applicable.

Importance of Power Skills

Communication, adaptability, problem-solving, and decision-making empower effective action in complex environments.



The real shift: a systemic transformation



Drivers of Transformation

Decarbonisation Shift

Decarbonisation drives adoption of renewable energy and low-emission technologies to reduce carbon footprint.

Electrification Expansion

Electrification extends electricity use across transport and industry, transforming energy patterns.

Digitalisation Integration

Digitalisation integrates data management, automation, and smart technologies to optimize energy systems.



Changes influence each other

Faster Decision Cycles

Utilities have to answer quickly to changing conditions using real-time data, shortening decision-making cycles.

Increased System Interdependencies

Stronger interconnections between systems and stakeholders demand better coordination and integration.

Rising Operational Risks

Complex energy systems face higher risks and require sophisticated risk management strategies.

Adaptive Workforce Skills

Employees need agility, collaboration skills, and ability to manage complexity in dynamic environments.

The Shift Toward Hybrid Skills

power systems and data

operations and digital platforms

engineering and cybersecurity

technical expertise and system-level understanding



In search of new skills

Electrical Engineering

Continuous innovation and the growing complexity of the electricity market, the automation of analysis systems, monitoring, control and protection of the power grid, and emerging technologies require the updating and evolution of our company's traditional knowledge and skills.

Automation, IoT, AI and Cyber

There can be no energy transition without a digital transition to support it. Investments in digital technologies and tools will enable the grid to become increasingly connected, smart and secure in terms of physical assets and cybersecurity.

Continuous Improvement

The ambitious 2024-28 Industrial Plan requires the ability to organize and manage complexity, improve operational efficiency, mitigate risks, minimize environmental impact and improve relationships with local communities.

Organizational culture

People are the beating heart of the transformation underway and are at the center of an ecosystem characterized by mutual respect, inclusiveness, widespread well-being, a sense of responsibility and results orientation.

Sustainability

The shift to a decarbonized energy scenario, based on renewable sources, requires ever more specialized skills, as well as new system solutions and technologies for efficient grid management and the evolution of markets.



👉 **WHERE DO THESE HYBRID
SKILLS COME FROM?**

BUILDING SKILLS IN PRACTICE

Post Graduate Learning Programs

Hybrid Skill Development

Programs focus on building hybrid skills combining energy systems knowledge with digital and innovation capabilities.

Collaborative Educational Initiatives

Initiatives like T-Lab and PoliTech Lab partner with universities to target graduates entering the energy sector.

Practical, Project-Based Learning

Programs emphasize real business challenges and hands-on project-based learning to apply theory in practice.

Bridging Education and Industry

These programs integrate academic learning with operational exposure to prepare individuals for evolving energy industries.



III EDIZIONE | NOVEMBRE 2024 - NOVEMBRE 2025

MASTER DI II LIVELLO

DIGITALIZZAZIONE DEL SISTEMA ELETTRICO PER LA TRANSIZIONE ENERGETICA

Master PoliTech Lab

The Polytechnic Network of High Expertise

On 16 April 2025 in Rome, in the presence of the Magnificent Rectors and company management, the Framework Agreement for collaboration between Terna and the Politecnici of Bari, Milan and Turin was presented.



Research & Development

The Agreement promotes joint R&D initiatives, participation in calls for funding, and the promotion of science.

Open Innovation

The Agreement paves the way for technology scouting and transfer activities, as well as innovative entrepreneurship.

The only Italian Master's with a joint degree from the three Politecnici

Master Universitario II Livello

Education & Training

The Agreement promotes the organization of and access to training initiatives at all levels (e.g., master's programs, internships, PhDs).

Social Impact

The Agreement supports the co-design and co-development of social impact and social inclusion projects.

2026-27: 90 hires

in the Terna Group throughout all of Italy

The Results: Additional Synergies

- | 28 internships/traineeships activated
- | 25 technical seminars
- | 32 plant visits (830 visitors)
- | 20 events with universities
- | 17 career days



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



UNICA
UNIVERSITÀ
DEGLI STUDI
DI CAGLIARI



UNIVERSITÀ DEGLI STUDI
DI SALERNO



ITS Academy: securing the operational backbone

Specialized Technical Training

ITS Academies provide focused training on practical and technological skills, bridging education and employment.

Industry-Education Collaboration

Strong partnerships between companies, universities, and public institutions align training with technological advancements.

Workforce Development Impact

These academies address skilled technician demand, support innovation, and aid economic growth.

Hands-on Learning Experience

Students gain practical experience through real-world projects and industry exposure.



RETI, IMPIANTI E SISTEMI ENERGETICI (Plants and Energy Systems)

- 21 students belonging to GenZ | Their hiring is expected at the end of the course
- 2 years of training (classroom teaching + internship)
- 1.100 hours of teaching experiential
 - | 14 training modules
 - | 140 hours of teaching by Terna and Tamini
- 900 hours of internship at Terna and Tamini
- Financial support for each student
 - | Coverage of tuition fee: 2.000 €
 - | Internship allowance: 500 €/month



RETI, IMPIANTI E SISTEMI ENERGETICI (Plants and Energy Systems)

Two-year post-diploma course | Ed. 1, 2025-27 | Lombardy

We will train highly qualified technical professionals able to design, manage and optimize complex energy plants, electrical grids and energy production and distribution systems

We will welcome them into the Terna Group and help them become specialized technicians in technological innovation, environmental sustainability and operational efficiency of electrical systems

Training Modules

- ✓ Fundamentals of electrical engineering
- ✓ Systems for energy production
- ✓ Energy plants
- ✓ Conversion and storage
- ✓ Energy market
- ✓ Transmission and distribution
- ✓ Plant control, maintenance and diagnostics
- ✓ AI and enabling technologies
- ✓ Sustainability

The Results with Schools

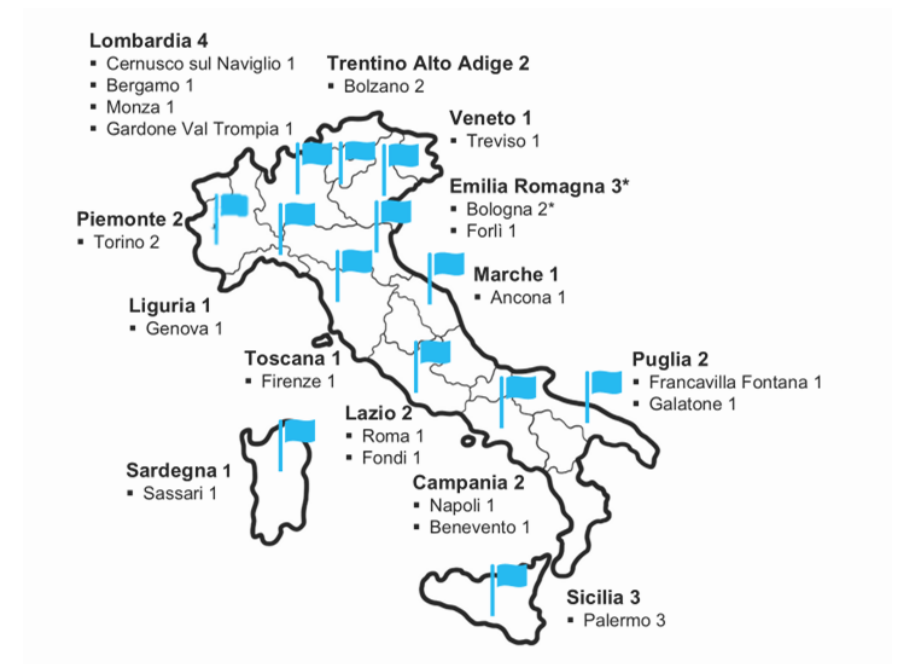


Training Program with Middle Schools (lower and upper secondary)

- Awareness- raising and guidance meetings on Terna, the electricity sector, and safety.
- Terna professionals as trainers
- In addition to classroom teaching, hands-on experiences (e.g. visits to substations, drone demos, VR experiences, educational games, challenges on sustainability and the environment, PPE demos)
- Families involved in workshops for lower secondary schools

2025:

| **21** Technical Institutes + **5** Middle Schools activated
| **13** Italian regions visited
| **1.255** students involved
| **9.498** hours of training delivered





Induction

Specialized Technical Training

ITS Academies provide focused training on practical and technological skills, bridging education and employment.

Industry-Education Collaboration

Strong partnerships between companies, universities, and public institutions align training with technological advancements.

Workforce Development Impact

These academies address skilled technician demand, support innovation, and aid economic growth.

Hands-on Learning Experience

Students gain practical experience through real-world projects and industry exposure.

ENABLING PERFORMANCE THROUGH POWER SKILLS: WHY TECHNICAL SKILLS ALONE ARE NOT ENOUGH



The Role of Power Skills

Core Power Skills

Power Skills include communication, problem-solving, decision-making, and adaptability essential for complex environments.

Challenges Beyond Technical Skills

Operational challenges often arise from poor communication and misunderstandings rather than lack of technical knowledge.

Enhancing Collaboration and Innovation

Power Skills foster collaboration and innovation, improving workforce effectiveness and project outcomes.



A Structured Approach to Skills Development

Skill Categories Overview

Skills in utilities are grouped into Power Skills, Core and Business Skills, and Compliance and Culture Skills.

Power Skills Importance

Power Skills enable collaboration and execution, enhancing workforce effectiveness and teamwork.

Core and Business Skills

Core and Business Skills provide technical expertise aligned with specific roles and functions within utilities.

Compliance and Culture Skills

Compliance and Culture Skills ensure safety, ethics, and organizational values compliance across the workforce.

FINAL TAKEAWAY



Final Takeaway

Continuous Skill Development

Utilities must build capabilities to continuously develop skills to meet evolving demands and sustain energy transition progress.

People as Critical Infrastructure

Human ability to learn, adapt, and collaborate is vital for successful organizational transformation in the energy sector.

Holistic Skill Approach

Focusing on both technical and enabling skills creates a resilient, innovative workforce capable of navigating complexity.

European power system

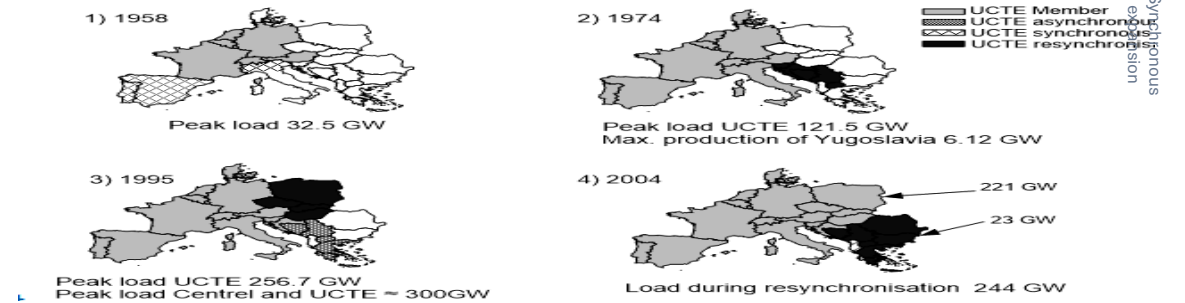
From synchronisation growth to new operational complexity

A larger synchronous area

Decades of interconnection have increased scale, distance and operational interdependence.



Grid evolution: scale + geographical reach



Recent synchronisation milestones



Why this becomes harder to operate

The same grid is now more converter-dominated, less observable at distribution level, and more exposed to non-traditional dynamics.



IBR penetration ↑

Lower natural inertia and new converter-driven dynamics



Observability gap

Distributed resources not fully visible to TSOs



Long-distance flows

HVDC links and periphery-to-centre transfers increase



Overgeneration & climate

Balancing, over-frequency and extreme-weather stress

Climate change VS Operation

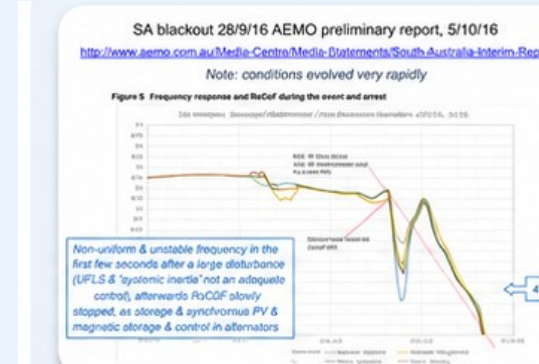
⚠️ ASSETS DAMAGES



i.e. Black out Cortina 2013



Increase of lighting → lines trips



i.e. Black out Australia 2016



Fires



High temperature at water discharge



High temperature at gas discharge



Low rivers water level



Low temperature (ice, snow)



High temperature out of historical mean values



i.e. 24th July 2021



Increase of extension and incidence of fires



Challenges for the next generation Engineers

System inertia

Frequency transients

Significant reduction in system inertia as a natural consequence. This represents a key performance indicator that measures the system's capability to withstand frequency transients

H / RoCoF

Short-circuit capacity

Voltage transients

Fault current and electrical strength no longer come “for free”. reduction of short circuit capacity normally provided via synchronous reactance which represents the principal Key Performance Indicator which provides a measure of the system robustness to withstand voltage transient

SCR / fault level

System stability

Margins after disturbances

IBR controls change dynamics, interactions and damping. reduction of the traditional regulation capability which significantly affects the system stability meant as *system's ability to remain in a steady operating condition under normal circumstances or to return to an acceptable operating point after a disturbance.*

ζ / modes

Overgeneration

Balancing and over-frequency

The increasing RES production especially in low load period implies significant issue in balancing the system in absence of adequate resources capable of adsorbing the exceeding power/energy with a direct effect in containing potential over-frequency transients

curtailment / storage

Renewables, inverter-based resources, storage and grid-forming controls are changing the physics of system operation

A master should not only teach components but also the system physics, controls, markets and real-time operation.

Large disturbances in Continental Europe

Voltage control and reactive-power margins are becoming a central system-security issue

3 European large disturbances in the last three years

Energy transition

Renewables and IBR not as “the cause” of instability, but as a change in system physics that requires new engineering capabilities.

Key message

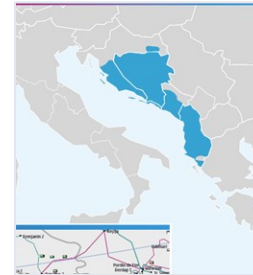
Voltage/reactive-power control must be actively prepared, monitored and coordinated across TSOs, RCCs and generation fleets.

21 Jun 2024

Balkans BO

Albania, Montenegro, Bosnia & Herzegovina and parts of Croatia

Voltage collapse



18 May 2025

North Macedonia BO

Blackout in the North Macedonian power system; cross-border relevance

Overvoltage / separation



28 Apr 2025

Iberian Peninsula BO

Spain and Portugal total blackout; limited affected area in south of France

Loss of voltage control

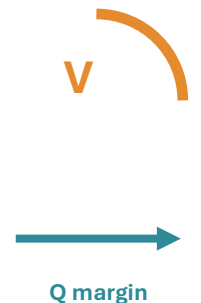


2024–2025

System lesson

Large events point to a need for stronger dynamic voltage capability and reactive margin management

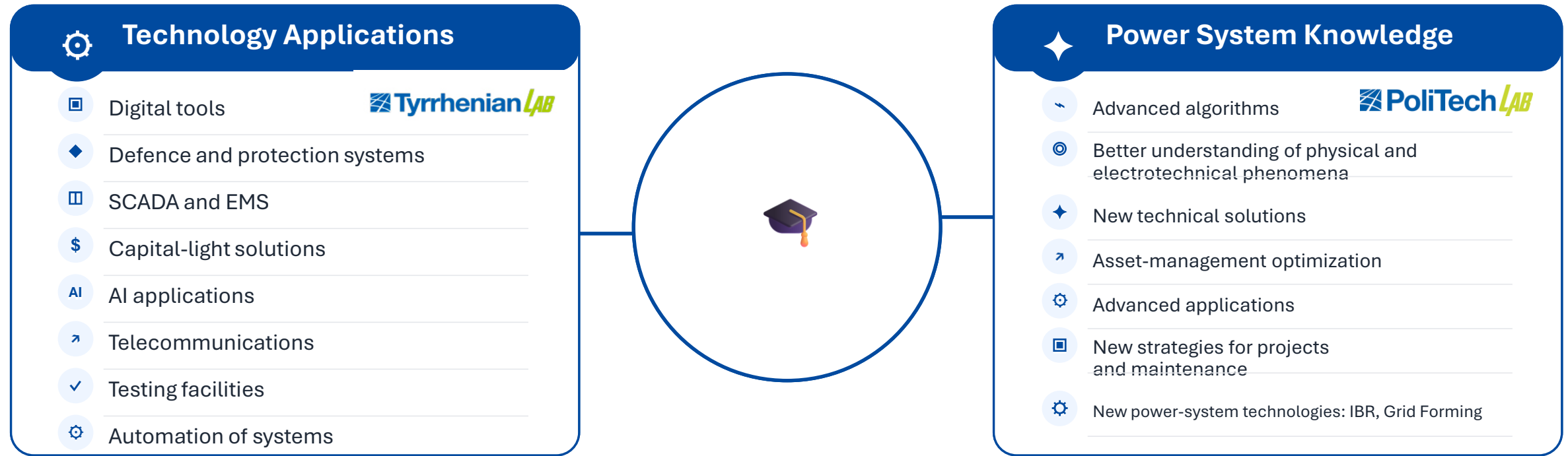
Preparation & tools



Energy transition requires stronger voltage / reactive-power observability, dynamic tools, training and coordinated operating rules

Terna master approach

Needed competencies



Outcome: analytical, operational and innovation capabilities



European power system

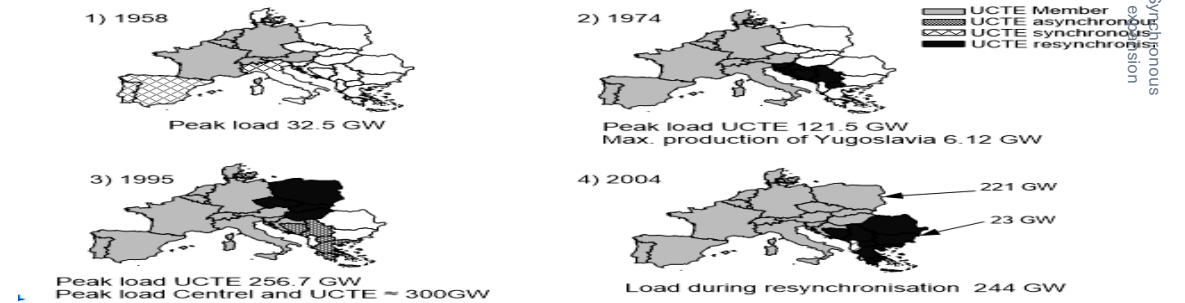
From synchronisation growth to new operational complexity

A larger synchronous area

Decades of interconnection have increased scale, distance and operational interdependence.



Grid evolution: scale + geographical reach



Recent synchronisation milestones



Why this becomes harder to operate

The same grid is now more converter-dominated, less observable at distribution level, and more exposed to non-traditional dynamics.



IBR penetration ↑

Lower natural inertia and new converter-driven dynamics



Observability gap

Distributed resources not fully visible to TSOs



Long-distance flows

HVDC links and periphery-to-centre transfers increase



Overgeneration & climate

Balancing, over-frequency and extreme-weather stress

Climate change VS Operation

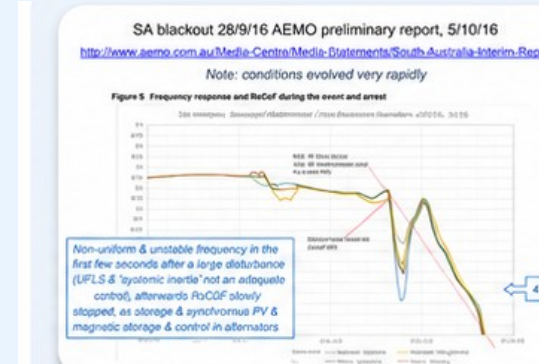
⚠️ ASSETS DAMAGES



i.e. Black out Cortina 2013



Increase of lighting → lines trips



i.e. Black out Australia 2016



Fires



High temperature at water discharge



High temperature at gas discharge



Low rivers water level



Low temperature (ice, snow)



High temperature out of historical mean values



i.e. 24th July 2021



Increase of extension and incidence of fires



Challenges for the next generation Engineers

System inertia

Frequency transients

Significant reduction in system inertia as a natural consequence. This represents a key performance indicator that measures the system's capability to withstand frequency transients

H / RoCoF

Short-circuit capacity

Voltage transients

Fault current and electrical strength no longer come “for free”. reduction of short circuit capacity normally provided via synchronous reactance which represents the principal Key Performance Indicator which provides a measure of the system robustness to withstand voltage transient

SCR / fault level

System stability

Margins after disturbances

IBR controls change dynamics, interactions and damping. reduction of the traditional regulation capability which significantly affects the system stability meant as *system's ability to remain in a steady operating condition under normal circumstances or to return to an acceptable operating point after a disturbance.*

ζ / modes

Overgeneration

Balancing and over-frequency

The increasing RES production especially in low load period implies significant issue in balancing the system in absence of adequate resources capable of adsorbing the exceeding power/energy with a direct effect in containing potential over-frequency transients

curtailment / storage

Renewables, inverter-based resources, storage and grid-forming controls are changing the physics of system operation

A master should not only teach components physics, controls, markets and real-time operation.

Large disturbances in Continental Europe

Voltage control and reactive-power margins are becoming a central system-security issue

3 European large disturbances in the last three years

Energy transition

Renewables and IBR not as “the cause” of instability, but as a change in system physics that requires new engineering capabilities.

Key message

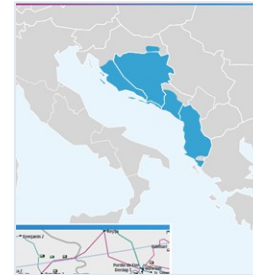
Voltage/reactive-power control must be actively prepared, monitored and coordinated across TSOs, RCCs and generation fleets.

21 Jun 2024

Balkans BO

Albania, Montenegro, Bosnia & Herzegovina and parts of Croatia

Voltage collapse



18 May 2025

North Macedonia BO

Blackout in the North Macedonian power system; cross-border relevance

Overvoltage / separation



28 Apr 2025

Iberian Peninsula BO

Spain and Portugal total blackout; limited affected area in south of France

Loss of voltage control

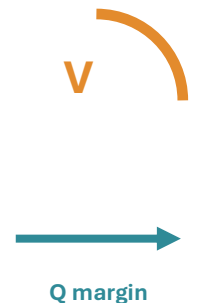


2024–2025

System lesson

Large events point to a need for stronger dynamic voltage capability and reactive margin management

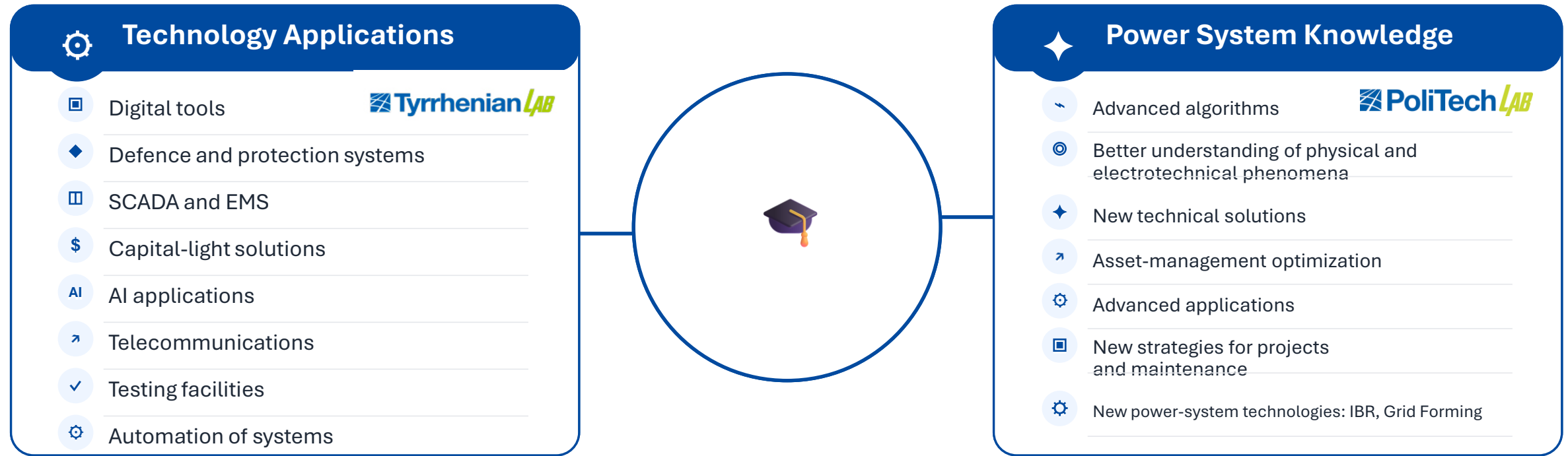
Preparation & tools



Energy transition requires stronger voltage / reactive-power observability, dynamic tools, training and coordinated operating rules

Terna master approach

Needed competencies



Outcome: analytical, operational and innovation capabilities

