IRENA INNOVATION WEEK 2025

Renewable-based solutions for sustainable development

Master of Ceremonies

Nolwazi Khumalo

Programme Officer
IRENA

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IRENA INNOVATION WEEK 2025

Modernising power grids for a renewable future in EMDEs

Session organised in partnership with

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Supported by

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UTILITIES FOR NET ZERO ALLIANCE

11 June 2025 | 13:30-15:00

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IRENA INNOVATION WEEK 2025

Scene Setting

Gayathri Nair

Programme Officer
Technology and Infrastructure for Grid Integration
IRENA

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Grid 2.0
Driving Resilience and Renewables in EMDEs

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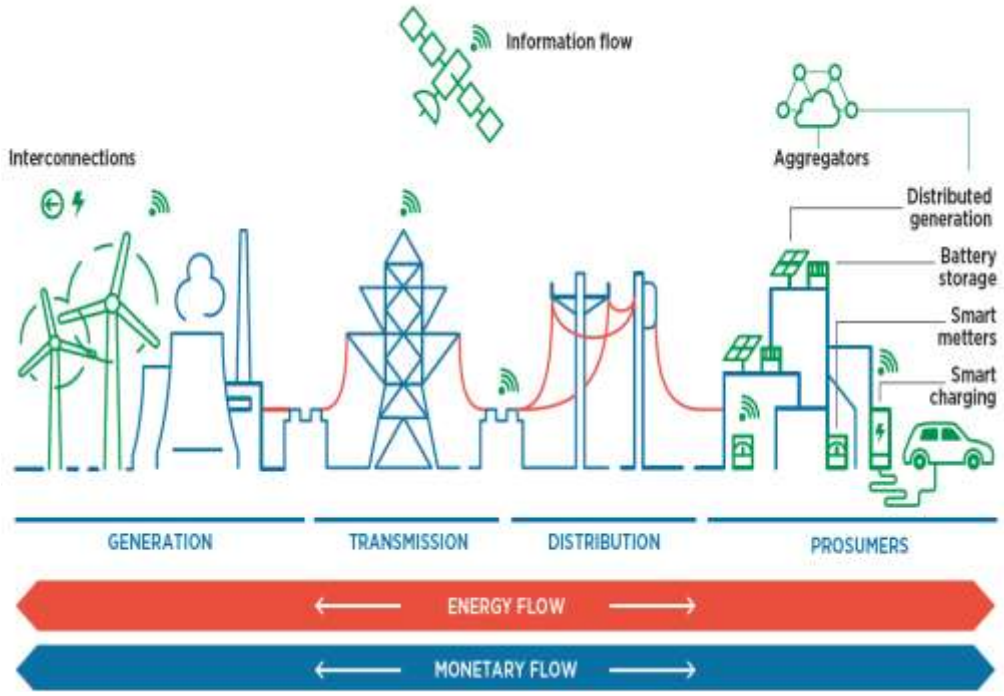
Why grid modernisation matters?

Strengthening grids –a key to climate resilience, enhancing the security and reliability of a power system.

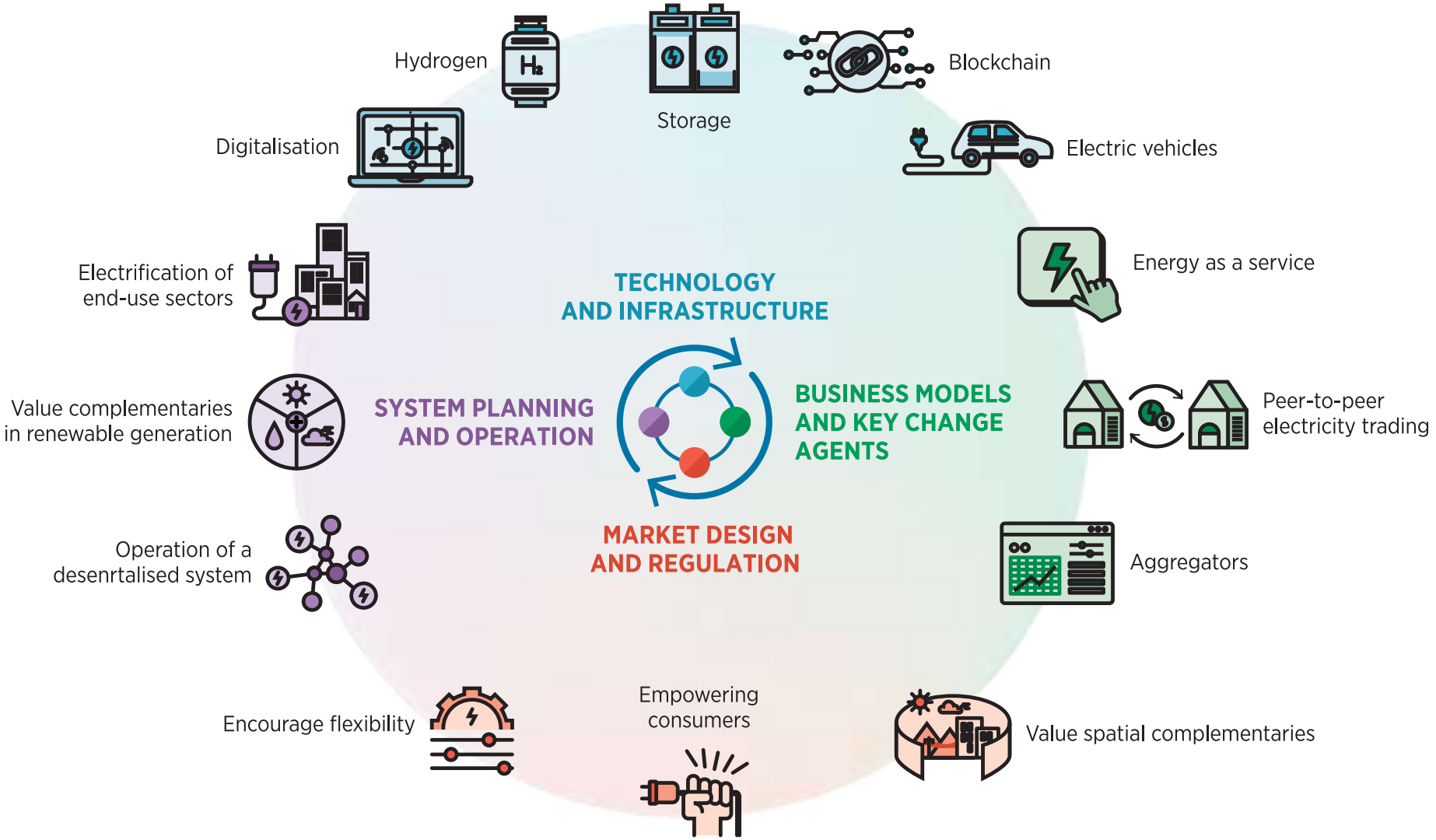


Drivers to grid modernisation

- Climate and development imperatives
- Increased energy demand through end-use electrification
- Renewable energy integration challenges
- Need for reliability and resilience
- Aging infrastructure
- Limited automation and visibility
- High technical and commercial losses
- Weak rural connectivity and supply reliability

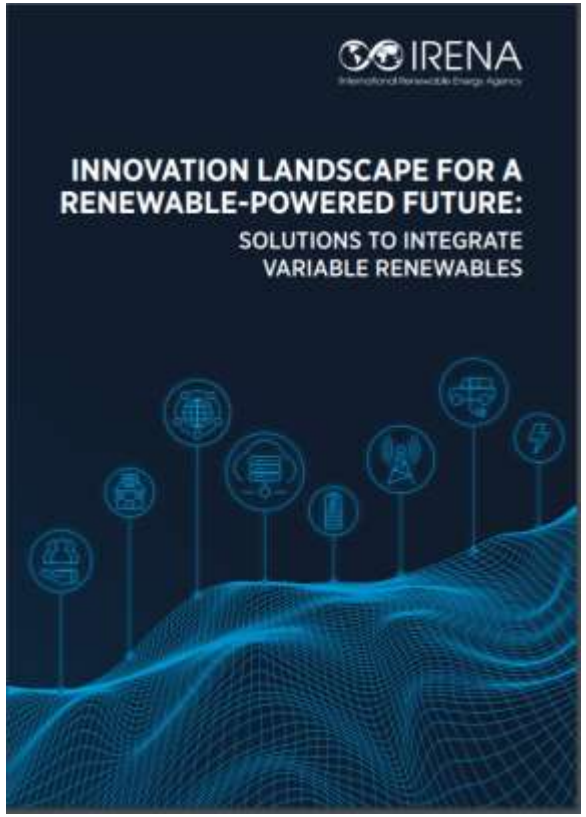
Systemic innovation is key for successful solutions.

Systemic solutions ensure that modernization efforts are coherent, scalable, and sustainable.



IRENA Innovation Landscape provides implementable toolboxes.

No “one-size-fits-all” solution is available.



How to increase flexibility in power systems?

https://www.irena.org/Publications/2019/Feb/Innovation-landscape-for-a-renewable-powered-future

How to smart electrify end-use sectors?

https://www.irena.org/Publications/2023/Jun/Innovation-landscape-for-smart-electrification

How to achieve sustainable growth powered by renewables?

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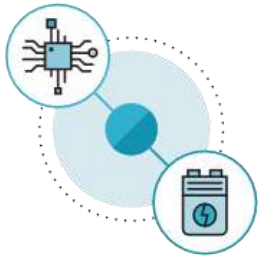
The Innovation Toolbox -Solutions for resilient power systems.

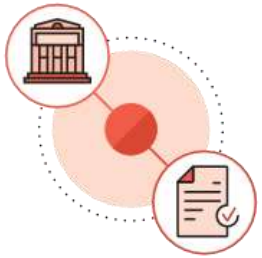


TECHNOLOGY AND INFRASTRUCTURE

- Increased flexibility in existing generation batteries
- Data acquisition and management
- Advanced monitoring systems
- Smart and autonomous systems
- Renewable mini-grids
- Supergrids
- Electrification of end-use sectors
- Energy efficiency

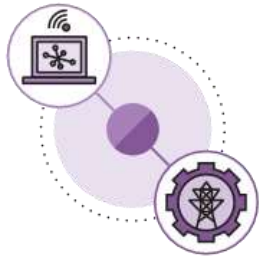
BUSINESS MODELS AND KEY CHANGE AGENTS

- Key change agents to support renewable development
- Crowdfunding
- Corporate renewable sourcing
- Aggregators
- Storage as a service



MARKET DESIGN AND REGULATION

- Fiscal instruments
- RE Auctions
- RE portfolio standards
- Regional markets
- Grid connection codes
- Innovative ancillary services
- Time of use tariffs



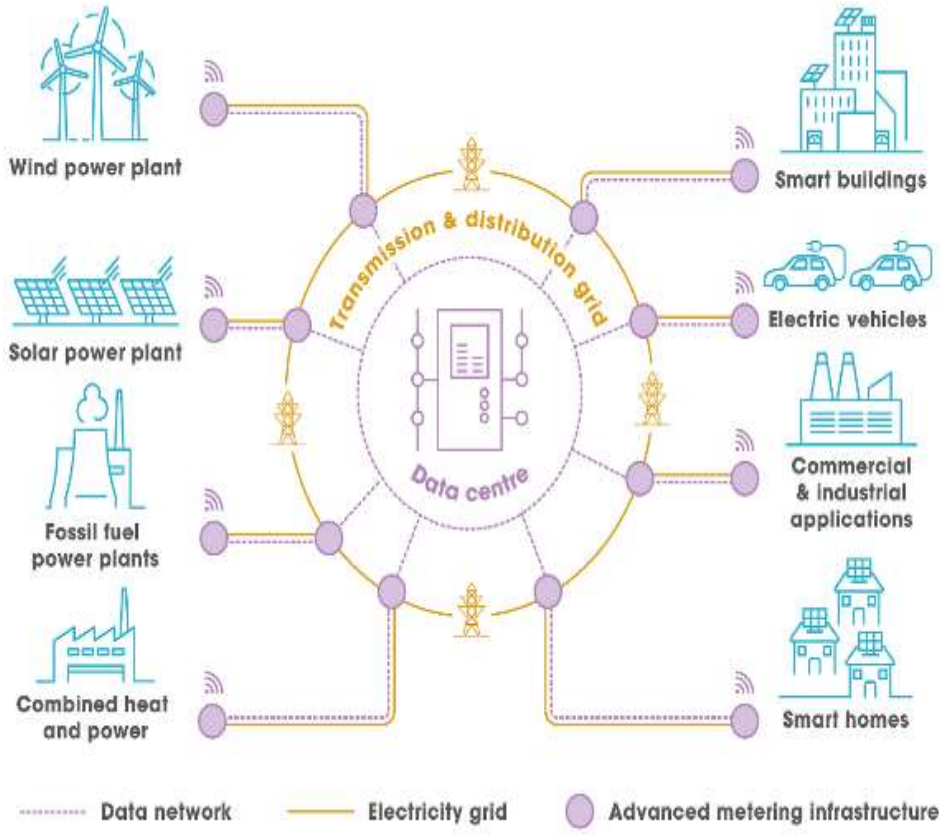
SYSTEM PLANNING AND OPERATION

- Storage as virtual power line
- Dynamic line rating
- Installing compensation devices
- Enhance forecast of VRE
- Electricity losses reduction
- Planning for regional interconnections

Designing solutions that are context-sensitive and scalable

Developing flexible transmission and distribution systems

Grid Strengthening Solutions	Storage	Virtual power lines
	Dynamic line rating	
	Compensation devices	FACTS devices Synchronous condensers Power flow controllers
	Enhanced forecasting of VRE generation	
Data Acquisition and Monitoring	SCADA	
	EMS	
	Wide Area Monitoring – Phasor Measurement Units	
	Smart and autonomous systems	AI Big data Blockchain



Energy transition and innovation can drive sustainable growth.

For innovative renewable solutions to thrive and be scaled efficiently, policymakers should focus on creating an enabling environment:

Clear vision:
energy transition roadmap for
long-term predictability and stability

Value creation locally:
develop local industries and
value supply chains

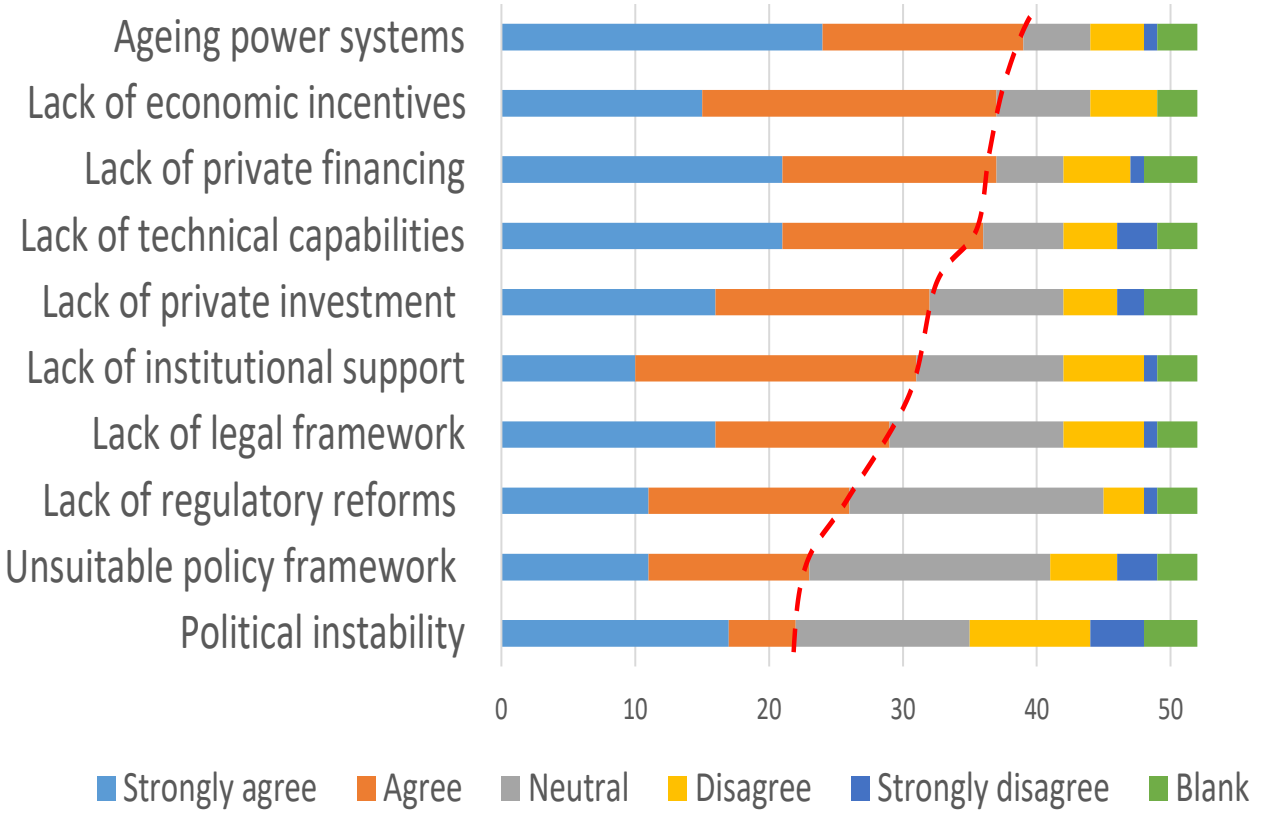
Increase ownership:
design inclusive participatory
decision-making process

Finance the transition:
affordable access to finance
and innovative funding models

Collaborate and leverage insights:
with a stronger focus on South-South and regional cooperation
to identify synergies and share replicable success stories

Powering Resilient Islands: Grid Modernization Toolkit for SIDS

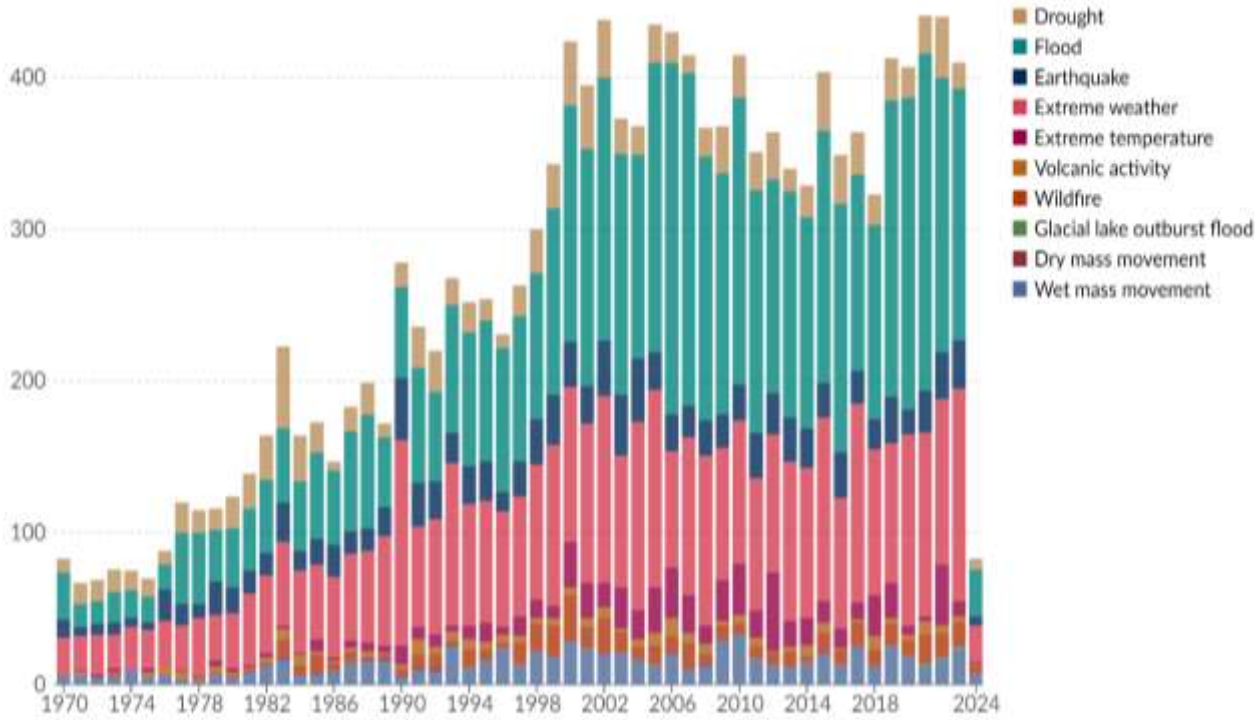
Island Grid Modernization Toolkit: 10 Actions for Transformation



- Assess and prioritize
- Update grid codes
- Invest in grid-forming DERs
- Demand-Side solutions
- Grid Services revenue streams
- Targeted upgrades
- Anticipatory planning
- Skills and knowledge transfer
- Engage commercial customers
- Showcase SIDs Innovation

Enhancing resilience: Climate-proofing the Power Infrastructure

Enhancing resilience: 10 Actions for Climate-proofing the Power Infrastructure



Source: https://ourworldindata.org/grapher/natural-disasters-by-type

- Identify Extreme Weather events and System Vulnerabilities
- Identify resilience enhancing measures
- Perform cost-benefit analysis
- Enabling Policies for Proactive Resilience
- Secure Investment for Resilience
- Hardening Infrastructure
- Foster distributed energy resources
- Integrate Grid-Forming Renewables
- Implement Smart Grid Solutions
- Facilitate Knowledge Sharing

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Scene Setting

Mark McGranaghan

EPRI Fellow
Electric Power Research Institute (EPRI) Europe

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Grid Modernization Challenges for the Developing Grid

IRENA Innovation Week 2025

Mark McGranaghan
EPRI Fellow
EPRI Europe
mmcgranaghan@epri.com

June 11, 2025

Innovation is key to decarbonization pathways

Decarbonization

~10-15 years

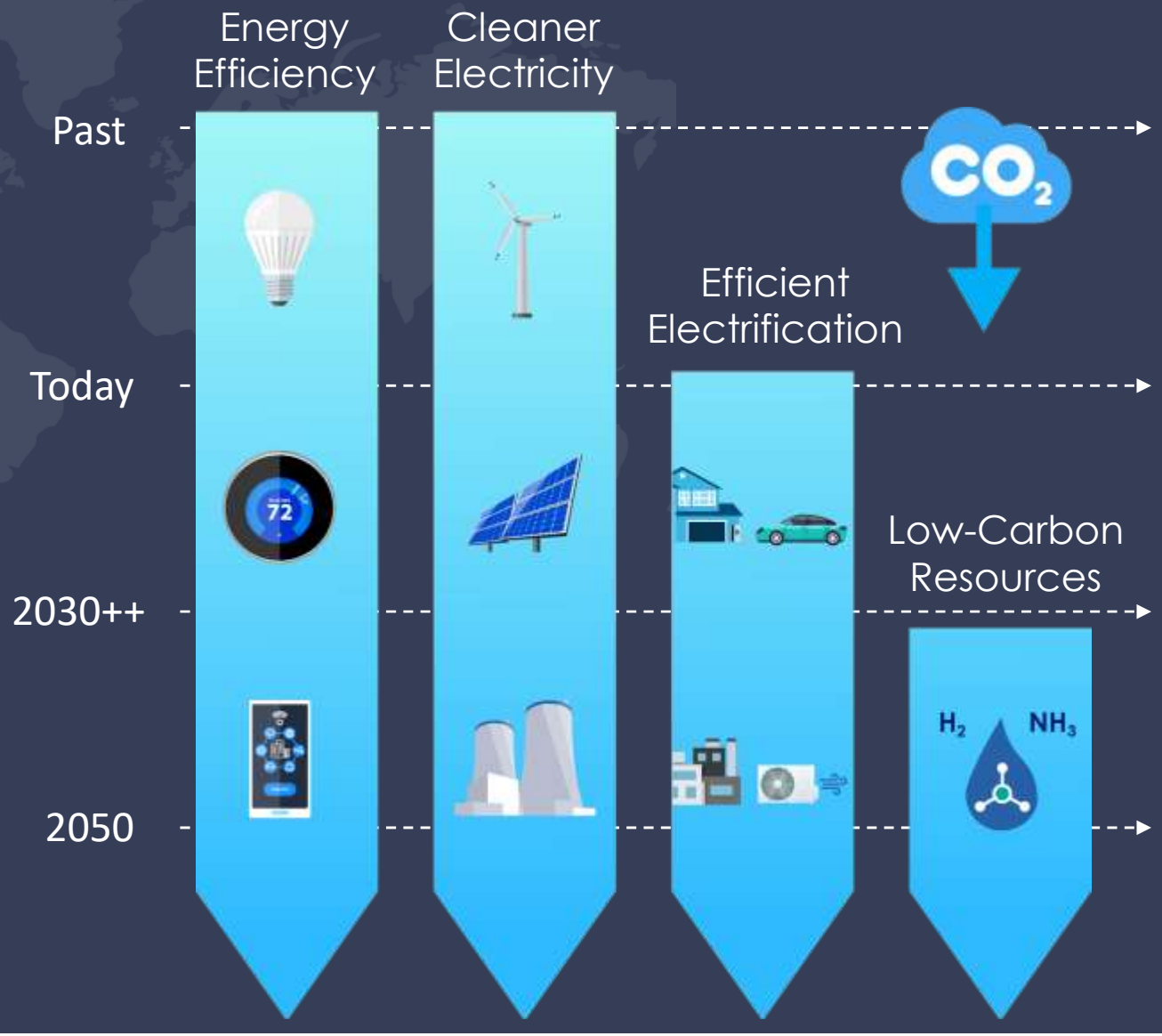
Accelerate economy-wide, low-carbon solutions

- Electric sector decarbonization
- Transmission and grid flexibility: storage, demand, EVs
- Efficient electrification

~15-30 years

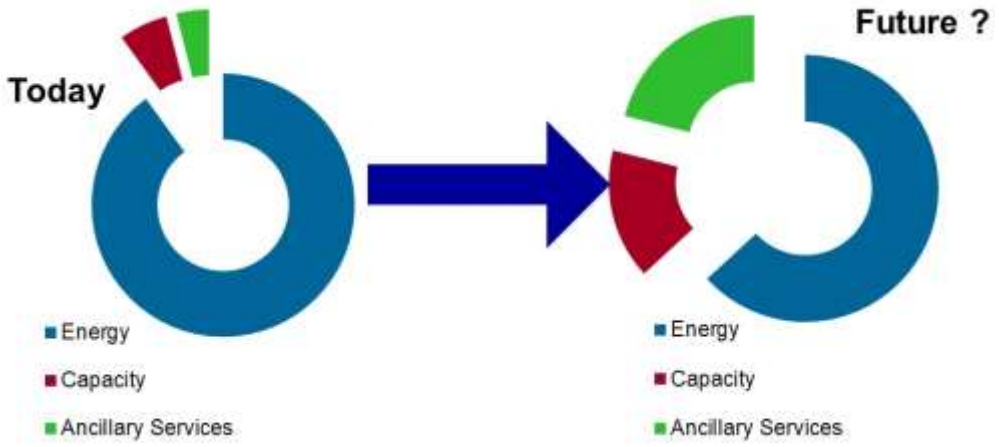
Achieve a net-zero clean energy system

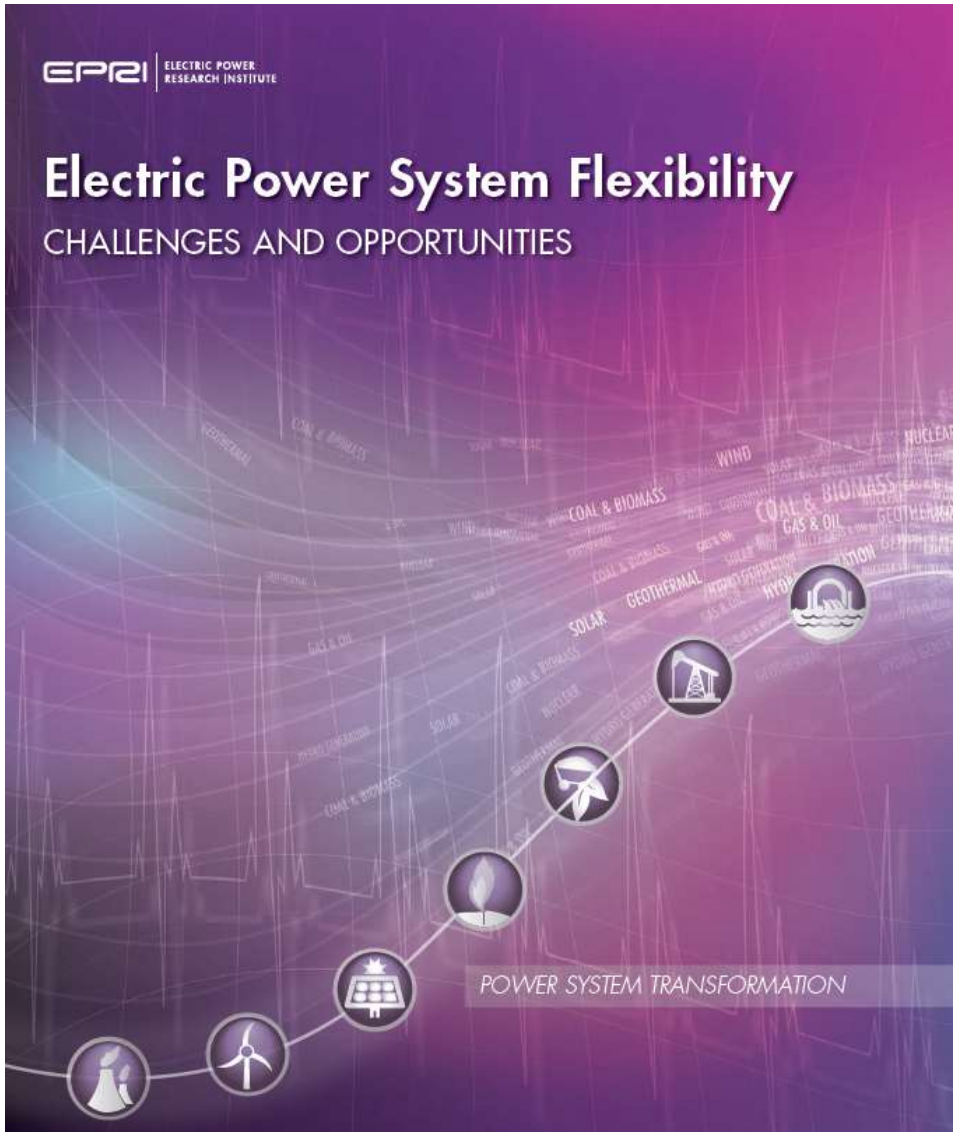
- Ubiquitous clean electricity: renewables, advanced nuclear, CCUS
- Negative-emission technologies
- Low-carbon resources: hydrogen and related, low-carbon fuels, biofuels, and biogas



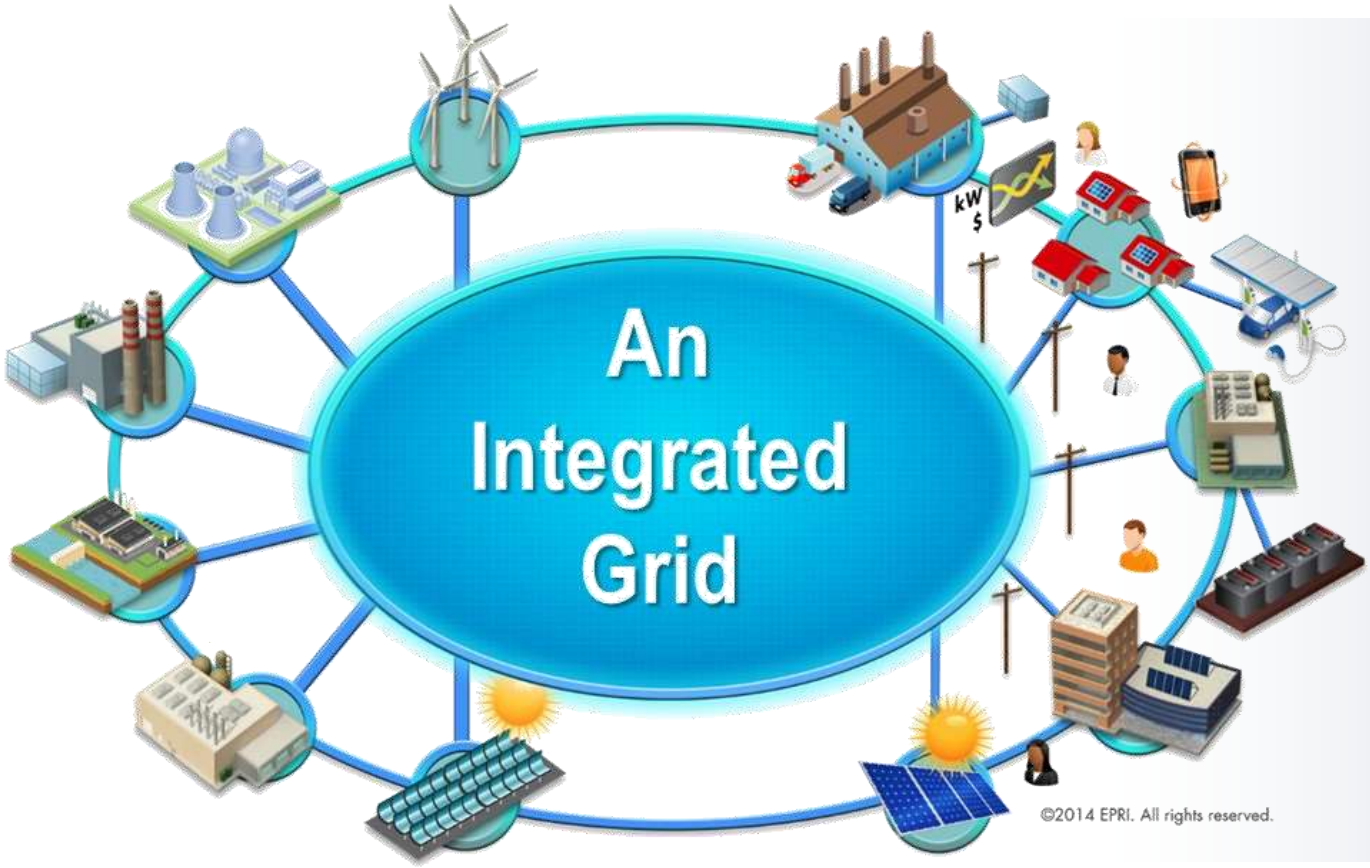
Flexibility is key to grid modernization

1. Sources of flexibility
2. Getting flexibility from distributed resources, communities and customers
3. Interoperability challenges





Grid Modernization means an Integrated Grid



Integration of:
Electricity,
Telecommunications, and
Customer Local Energy
Networks

The Integrated Grid Enables Local Energy Optimization to be part of Global Energy Optimization

Innovation Challenges for an Integrated Grid

Regulatory
Investments in shared customer resources benefit all

Grid Operations & Planning
Integrated, system-level approach

Customer Engagement
Greater choice, comfort, convenience, control

Affinity Partnership
From tech companies to the environmental justice community

Integrated Grid
Ubiquitous communication and DERMS integration

TOGETHER…SHAPING THE FUTURE OF ENERGY®

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Scene Setting

Leonard Hülsmann

Renewable Energy Engineer Research & Development
Energynautics

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energynautics
solutions for sustainable development

IRENA Innovation Week 2025
Modernizing power grids for a renewable future in EMDEs

M.Sc. Leonard Hülsmann
Energynautics GmbH

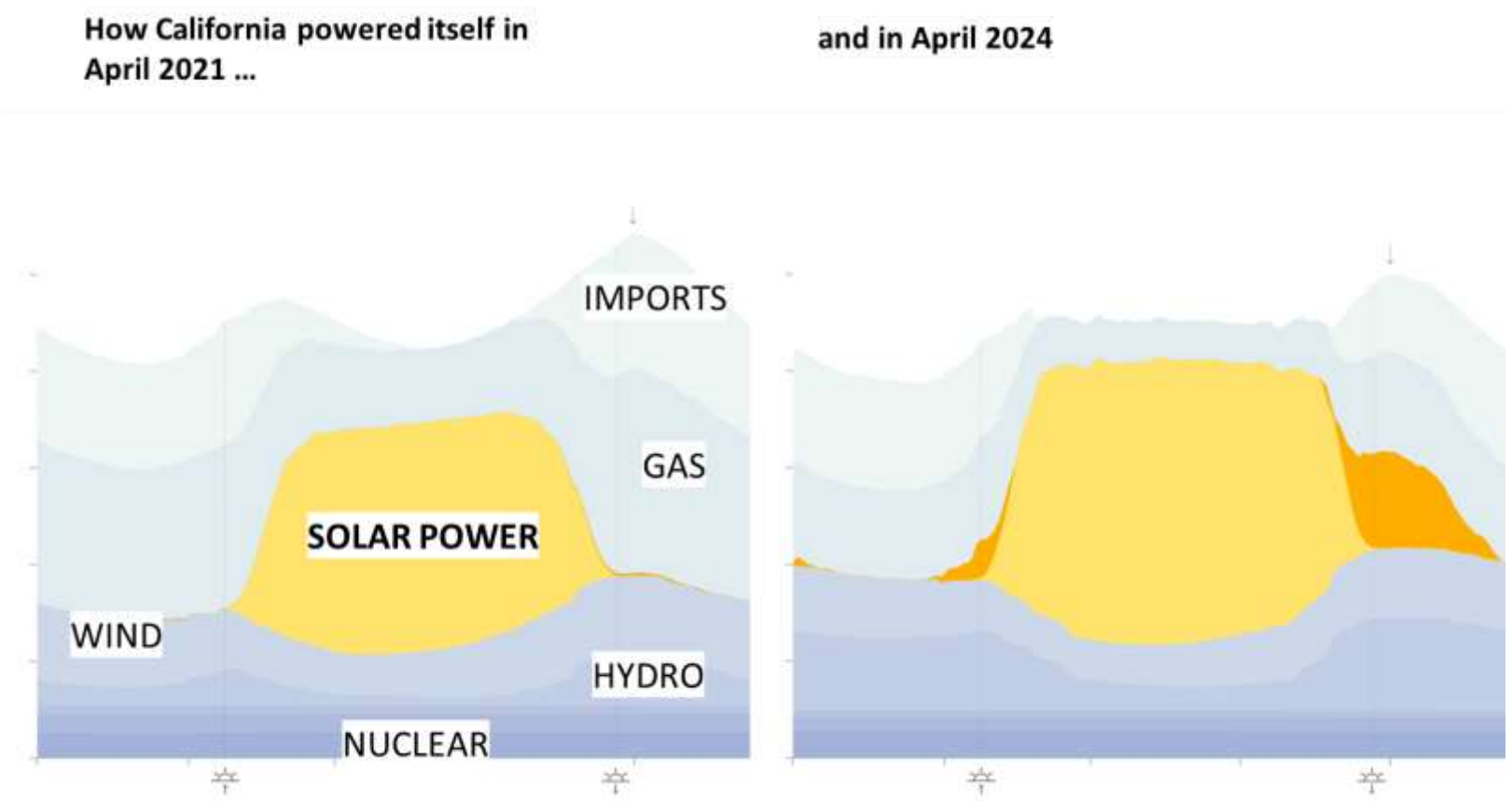
Bonn, Germany
June 11, 2025

A broad picture of grid modernization

Transmission networks

Planning & Regulation

- Gx & Tx Network Development Plans (Regional, National)
- **Storage & Sector coupling (BESS, PHS, H_2)**
- Market & Ancillary Service Design
- Grid Codes



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Operation

- Power Plant Flexibility
- VRE Forecasting
- Grid-Enhancing Technologies
  - **Dynamic Line Rating**
  - Power Flow Controllers
- Advanced Tx Management
  - Congestion Management
  - Dynamic Security Assessment
  - HVDC control
  - BESS use cases
- Demand response

Netherlands: Dynamic Line Rating already in implementation for the majority of Tx lines

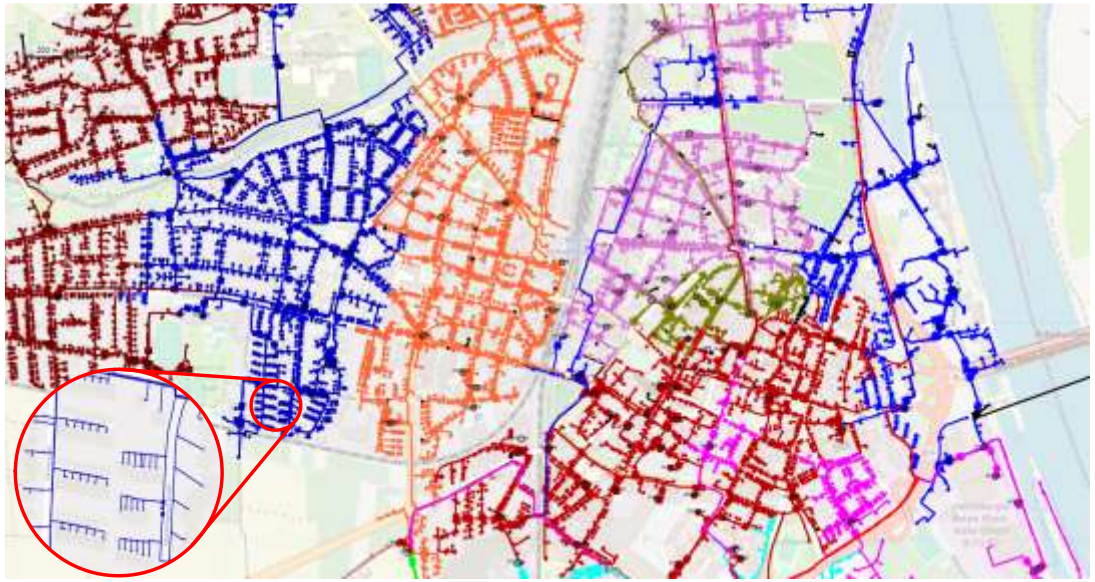
A broad picture of grid modernization

Transmission networks

Planning & Regulation

-
-
-
-

Operation



GIS-based power system model of the city of Worms, Germany
Source: Energynautics

Distribution networks

Planning & Regulation

- Dx Network Development Plans
- **Dx Data Digitalization**
- Grid Codes
- Permitting Processes (Fast-tracking, Grid Impact Studies)

A broad picture of grid modernization

Transmission networks

Distribution networks

Planning & Regulation

Operation

Planning & Regulation

Operation

- Gx & Tx Netw
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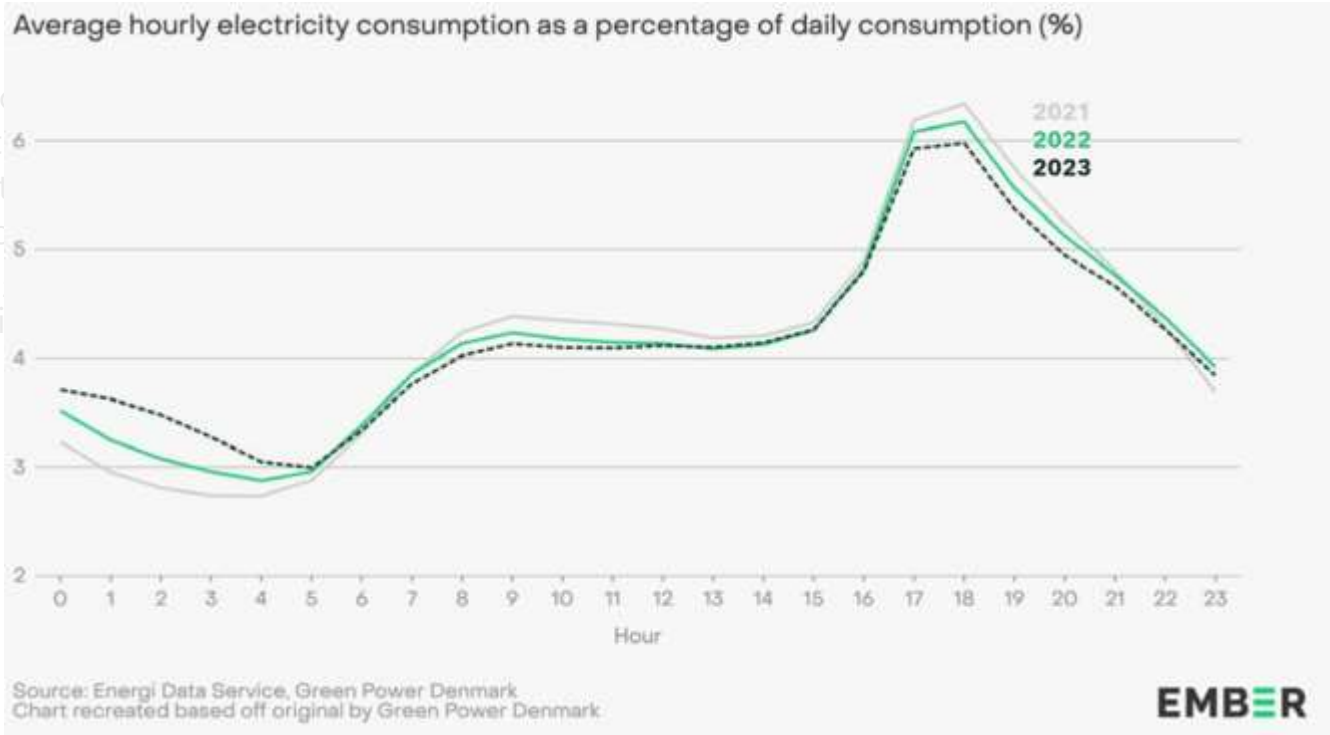

- **Demand response** (Time-of-use & real-time tariffs, EV smart charging)
- DER Controllability (DERMS, VPPs)
- Dx Monitoring & Automation (ADMS, Smart Meters, Smart Dx Substations)

Source: European Electricity Review 2024

A broad picture of grid modernization

Transmission networks

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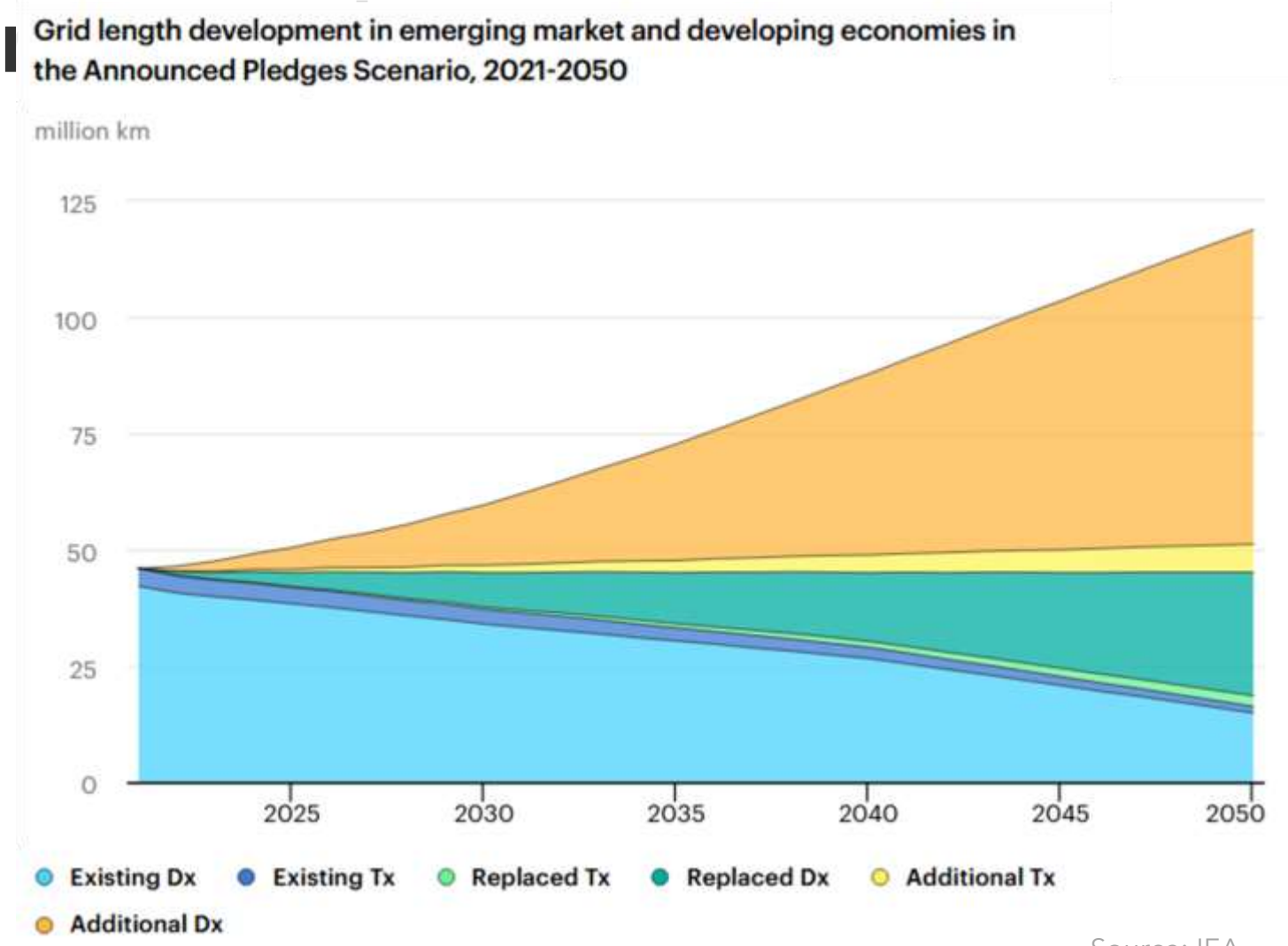
Massive grid expansion will be



Source: IEA

Digitalization, Smarter Controls & Automation?

Different Economies, Different Challenges

	Developing Economies	Emerging Markets	Advanced Economies
!	Grid extension & densification	Rapid DER growth in weak grid infrastructure	Legacy systems
!			Communication & Inter-Operability vs. Cyber-Security
?	Off-grid & Solar Home Systems?	Leapfrogging “conventional” grid modernization?	Grid defection in the global sun belt, e.g. Australia, later elsewhere?

Proud partner of GET.transform

GET.transform
Transforming Energy Sectors Globally

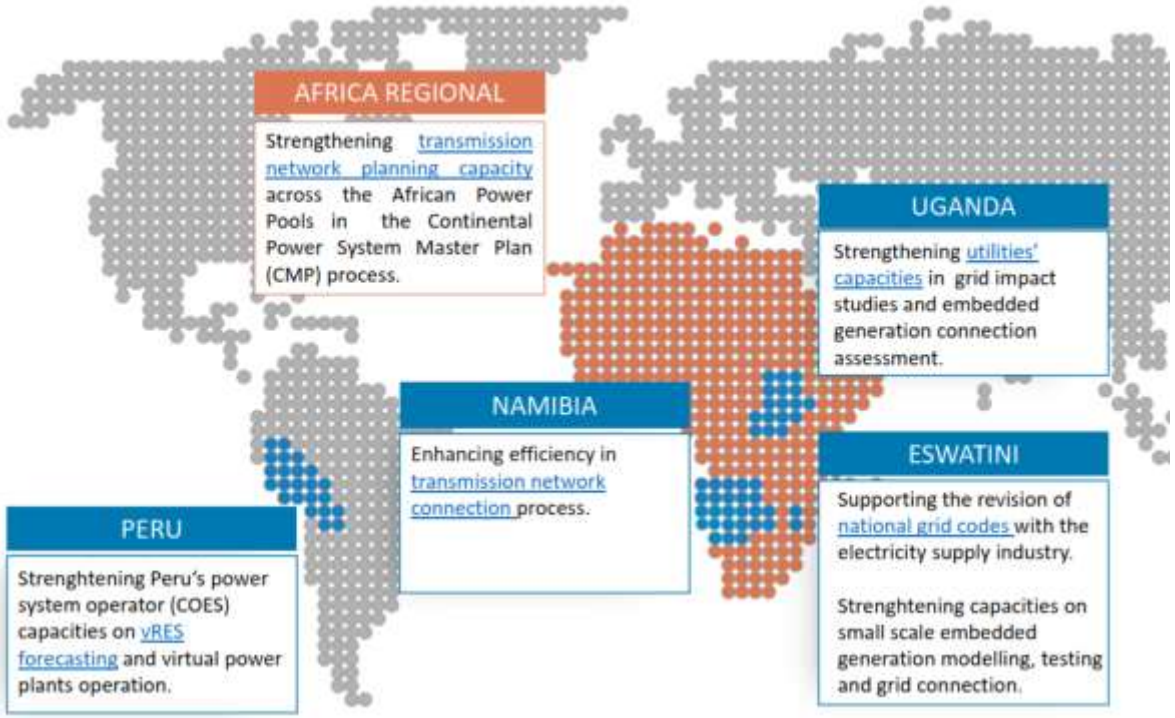
Long-term Energy Planning

Developing least-cost, low carbon **capacity expansion and investment plans**, outlining development paths for power generation projects

Renewable Energy Grid Integration

Updating of **technical power system planning and operational procedures** that enable the operation of renewable energy dominated power systems

80+ projects delivered & ongoing



Eco-System for the Energy Transition

GET.transform is co-funded by
german cooperation
Norway
Sweden Sverige
Austrian Development Cooperation

Thank you for your attention!

Leonard Hülsmann
Senior Renewable Energy Engineer
l.huelsmann@energynautics.com

energynautics
solutions for sustainable development

Technical Consultants for the Energy Transition

64
Countries

370
Projects worldwide

2000
Year of foundation

35
Employees

10
Spoken languages

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Panel discussion

Moderator

Mark McGranaghan

EPRI Europe

Abel Didier Tella

Director General Association of Power Utilities of Africa (APUA)

Manoj Gupta

CEO TATA Power Microgrid India

Eden R Uchel

Director Palau Energy & Water Administration (PEWA)

Götz von Stumpfeldt

Advisor IKI JET, GIZ

Pemy Gasela

UNFCCC TEC Member & Chief Director of International Climate Change Relations and Reporting at DFFE South Africa

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How essential is grid modernisation for achieving sustainable development and economic growth? (1 = Low, 5 = Critical)

What is the most significant challenge in modernizing the grid in your region?

IRENA INNOVATION WEEK 2025

Panel discussion

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Developed by the **UNFCCC Technology Executive Committee (TEC)** in partnership with the **United Nations Industrial Development Organization** & the **UNEP Copenhagen Climate Centre**, this TNA guidebook on renewable energy:

- Provides practical guidance to developing countries, with the aim of achieving net zero emission in **energy supply, energy storage, energy transmission & distribution**;
- Provides an overview of **up-to-date information on a wide range of renewable energy technology options**, as well as enabling conditions, barriers & good practices for their deployment;
- Highlights **aspects of just transition** that could be considered to promote a fair and inclusive workforce transition to meet Paris Agreement goals.

Audience Q&A

What is one key action that you believe should be prioritized to accelerate grid modernization in underserved regions?

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Renewables and Digitalisation for a Sustainable Energy Future

Thank you!

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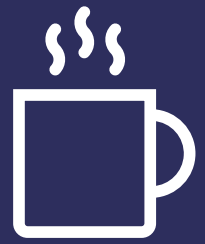

Coffee Break

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