EXECUTIVE SUMMARY

Session 5 – Planning of Power Distribution Systems

SUMMARY

Session 5 received 153 accepted papers, organized into four oral blocks and several poster tours. The session reflected the profound transformation underway in distribution planning, driven by electrification, digitalization, growing flexibility needs, and resilience objectives. A special emphasis was placed on low-voltage networks, increasingly recognized as pivotal to enabling the energy transition. The contributions illustrated a clear evolution: from deterministic approaches to scenario-based and AI-supported planning; from hardware-centric investments to software-enabled optimization; and from centralized architectures to distributed intelligence. Forecasting and flexibility emerged as foundational pillars, alongside the integration of DERs, MVDC systems, and sector-coupled resources. Digital tools, co-simulation platforms, and probabilistic models were prominent across the papers, pointing to a sector embracing complexity and progressing toward more intelligent, adaptive planning frameworks.

MAIN SESSION 5 - BLOCK 1

Resilient grid development

This block included 6 presentations covering congestion management, TSO/DSO coordination, reinforcement strategies, DER-based system restart, and infrastructure development factors. Solutions addressed grid planning under evolving risks, including voltage control, overhead and underground network resilience, and the role of energy communities in long-term planning.

MAIN SESSION 5 - BLOCK 2

Planning with Flexibility

Flexibility took centre stage in this block, which included 6 presentations illustrating its transition from a supporting element to a core driver of distribution planning. Topics covered dynamic interconnection limits, hybrid planning frameworks, and practical case studies on probabilistic planning, digitalization, and the integration of flexibility solutions. The session underscored flexibility's dual role as a tool for risk mitigation and a means to defer traditional grid investments.

MAIN SESSION 5 - BLOCK 3

LV Grid Planning

Focusing on the strategic importance of low-voltage networks, this session featured 6 presentations addressing their evolving role in the energy transition. Topics included geospatial forecasting, smart meter analytics, load balancing, and fleet electrification. The contributions showcased data-driven methodologies aimed at enhancing planning accuracy and leveraging LV flexibility to support medium-voltage grid operation.

MAIN SESSION 5 - BLOCK 4

Planning integrating DER

This block included 6 presentations and explored how the integration of DERs and market signals can shape comprehensive planning frameworks. Topics covered hosting capacity assessments, flexibility planning tools, MVDC system architectures, and neighborhood-scale storage solutions. The session highlighted how DSOs are adopting whole-system thinking, combining technical innovation with practical planning tools to enhance investment efficiency and operational effectiveness.

ROUND TABLE 15

How can standardization contribute to planning and development criteria for distribution networks?

Moderated by Riccardo Lama (CEI), this round table examined the role of standards and network codes in supporting transparency, consistency, and interoperability in grid planning. Terrien Pascal (IEC – EdF), Maurizio Delfanti (Politecnico di Milano), and Martin Uhrig (LEW) discussed how harmonized methodologies and cross-border regulatory frameworks can help DSOs manage increasing system complexity. The debate also emphasized how standardization can accelerate innovation uptake and facilitate the integration of active customers and DERs by ensuring compatibility and scalability of planning tools.

ROUND TABLE 17

Forecasting Methodologies for the Distribution Network of the Future

Convened by Ricardo Prata (ENOWA/NEOM), this round table, participated by Jouni Peppanen (EPRI), Andrea Michiorri (Mines Paris), Yun-su Kim (Gwangju Institute of Science and Technology), Jonas Wafler (ewz), and Bastien Gauthier (Enedis), focused on how DSOs are leveraging data and AI tools to improve forecasting for planning and operation. Discussions addressed EV and heat pump load modeling, scenario generation, and AMI integration, with emphasis on aligning forecasting with flexibility enablement and market-driven planning.

ROUND TABLE 18

Planning the Next Decade: DSOs' Strategies, Challenges and Stakeholder Dialogue

Led by Alessio Marcelli (e-distribuzione), this round table explored how DSOs are adapting their planning strategies to meet long-term energy transition goals. Rimnesh Shah (ENOWA), Jennifer Han (Enedis), Diana Moneta (RSE), and Fabrizio Pilo (University of Cagliari) discussed regulatory planning requirements (e.g. 10-year development plans), stakeholder engagement, and the integration of flexibility into strategic planning frameworks. A key part of the discussion focused on the distinction between scenario definition and forecasting, highlighting how long-term planning requires structured scenario narratives, while short- to medium-term planning increasingly relies on data-driven forecasting to anticipate evolving system conditions.

RESEARCH & INNOVATION FORUM

The RIF session featured 5 presentations exploring advanced analytics, AI applications, and data-driven methods for grid planning. Topics included graph theory, physics-informed neural networks, deep learning for contingency analysis, and hydrogen system modelling. These contributions highlighted the potential of interdisciplinary innovation in supporting resilient, efficient, and flexible distribution systems.

POSTER TOURS

The session featured eight guided poster tours covering sub-topics such as resilience, asset management, flexibility, smart grid development, and digital planning. Each tour included real-world case studies, simulation-based tools, and early demonstrators. Posters illustrated strong geographic and thematic diversity, enriching the dialogue with insights from pilot projects and operational trials.

CONCLUSIONS

Session 5 of CIRED 2025 confirmed that distribution planning is undergoing a deep transformation. Key trends include the adoption of AI-driven forecasting, the integration of operational flexibility into planning practices, and the emergence of whole-system approaches that span energy vectors and voltage levels. Low-voltage networks are no longer peripheral: they are at the core of the energy transition. Papers and discussions highlighted how DSOs are moving from static planning toward modular, scenario-based processes that incorporate uncertainty and digital intelligence. Yet challenges remain in terms of interoperability, regulatory alignment, and scaling field-tested innovations into mainstream practice. Looking ahead, planning will increasingly serve as the interface between energy system complexity and societal expectations for reliability, sustainability, and participation. It is now desirable—and urgent—that these concepts evolve into concrete, scalable applications across DSO organizations, enabling the sector to fully translate innovation into operational reality.