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DSOs FOR EUROPE

Digital Solutions for Handling Connection Requests

Developed by DSO Entity's Task Force Digitalisation of the Energy System (TF DESAP)

October 2025

1 Executive Summary

This report explores how digitalisation and process innovation are transforming the connection request landscape and enabling DSOs to meet growing demands while maintaining system reliability and customer service quality.

Drawing on hands-on case studies and structured inputs from DSOs across Europe, the report identifies persistent challenges and promising enablers.

The following takeaways provide a comprehensive overview of the current state and future directions for managing connection requests in the context of digitalisation and the energy transition. Further details are available in the following chapters.

General Takeaways

1. **Rising Demand from Electrification and Sector Coupling**: The electrification of transport and heating, as well as the integration of AI-driven technologies and data centres, is creating new demand profiles. These shifts are increasing the complexity, urgency, and volume of connection requests, highlighting the strategic importance of grid planning, proactive capacity management and automation.
2. **Noticeable Reduction of Time Lag and Backlog:** Despite ongoing disparities across regions, many DSOs report notable progress in handling grid connection requests, largely driven by digitalisation. These improvements highlight the strategic value of digital tools in managing rising volumes and complexity. However, delays linked to external stakeholders remain, underscoring the need for sustained collaboration beyond digital solutions.
3. **Accommodating Process Diversity:** The diversity in connection request processes across the EU allows for the accommodation of specific regional and user needs in line with national requirements. This variety helps in addressing the unique requirements of different types of users, regions and their related complexity.
4. **High Correlation between Variance of Processing Times and Process Complexity:** Processing timelines are closely linked to both the nature of the request (fast vs. binding) and the technical profile of the installation. Larger or more complex installations—such as EV charging hubs, self-consumption with storage, or industrial loads—require detailed grid impact assessments, often involving reinforcement studies and multi-stakeholder coordination.

This highlights that a **one-size-fits-all approach is not feasible**; connection processes must be adaptable to accommodate the diverse technical and regulatory requirements of different request types.

5. **Permitting and Supply Chain as Main Bottlenecks:** Major delays in the connection process are often due to permitting and supply chain issues due to a combination of global and regional factors, including geopolitical tensions and network asset shortages. These bottlenecks extend beyond the connection request sub-process and impact the overall timeline. Early engagements with permitting bodies and suppliers could positively impact these bottlenecks.
6. **Cross-stakeholders Coordination as a Limiting Factor**: Handling connection process is a systemic issue which requires addressing the interactions across various stakeholders. Transparent and timely information exchange with third parties—including municipalities, customers, and TSOs—remains inconsistent. Gaps in coordination frequently delay grid assessments and decision-making, especially for complex or large-scale projects. DSOs recognised cross-stakeholder coordination as structural challenge but also, recognised the strength of close collaboration as a crucial enabler.
7. **Balancing Efficiency with Inclusiveness through Multichannel Service Provision**: While digitalization is advancing, many DSOs continue to maintain multichannel access—including in-person and telephone support —in parallel with digital platforms. Although less efficient and more costly to operate, these more traditional channels play a critical role in ensuring accessibility and inclusiveness, particularly for customers with limited digital literacy or specific support needs. This approach reflects a strategic choice to prioritise equitable access and user trust, even at the expense of operational efficiency, highlighting the social responsibility dimension of the energy transition.
8. **Clear Regulatory Mandates for Connection Order and Queue Management:** Queue management schemes are emerging as instruments for enhancing transparency and enabling the prioritisation of connection requests that are prepared for technical assessment. However, the responsibility for defining the order of connections—whether based on chronological order or public-interest (social welfare) criteria such as critical infrastructure—lies solely with national regulators or competent authorities. DSOs act as neutral facilitators, applying these rules transparently, without discretion over prioritization. This safeguards fairness, prevents market distortion, and aligns with Electricity Directive´s principles of non-discriminatory, transparent and marked-based third party access.

9. **Complementary Regulatory and Technical Solutions:** Digitalisation alone is insufficient. It must be supported by innovative regulatory and technical solutions, which require strong coordination among stakeholders to unlock grid capacity faster while maintaining reliability, and even with new organisational and management solutions. National regulators need to ensure that all kinds of expenditure are properly recovered and received whilst avoiding distortions.

Digitalisation-focused takeaways

- **Leveraging Data Analytics:** Digitalisation accelerates the connection process and enhances transparency for customers. Without digitalisation, DSOs cannot handle the increasing volume and complexity of connection requests efficiently.
- **Customisation of Digital Solutions Needed:** Digital solutions must be tailored to meet national legal and regulatory requirements as well as specific needs. Customisation ensures that digital tools are effective.
- **Need of Robust Business Case:** Digital implementation, connection process alignment and IT specifications should be subject to a comprehensive business case. Upfront costs must be weighed against long-term benefits, considering the need for interoperability with legacy systems, customisation needs and potential for efficiency.
- **Data Privacy, Compliance, and Cybersecurity:** Digital solutions must embed data privacy, compliance, and cybersecurity by design to protect sensitive information and ensure regulatory adherence.
- **Challenges of Partial or Fragmented Digitalisation:** Incomplete integration of digital systems (e.g., customer portals not connected to internal GIS) leads to manual workarounds, reducing the benefits of digitalisation in terms of speed and transparency.
- **Process Complexity and Automation:** Data quality issues and the need for system operators to process some manual work when dealing with more complex connection requests to ensure grid reliability limit the possibility of full automation of the process.
- **AI Optimisation:** Leveraging AI can expedite approvals for routine applications, enhancing efficiency and reducing processing times.
- **Scalability and Modularity:** Digital twin technology can be leveraged to provide a robust foundation for optimising and integrating various grid processes.
- **Maximisation of User-friendliness and Customer Experience:** They are crucial when digitalising the connection process as they ensure accessibility, trust and buy-in.

- **Maturity of Digital and Organisational Solutions:** Developing, testing, and rolling out new IT tools takes time before functionality is fully operational. Successful digitalisation also depends on process alignment and even organisational transformation. Anticipating future needs early and aligning investments with long-term demand are therefore essential to ensure that new solutions deliver their intended impact.

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2 List of Abbreviations

Abbreviation	Full Term
ADMS	Advanced Distribution Management System
AI	Artificial Intelligence
API	Application Programming Interface
CAPEX	Capital Expenditure
DCC	Demand Connection Code
DSO	Distribution System Operator
EU	European Union
EV	Electric Vehicle
FCA	Flexible Connection Agreement
GHC	Grid Hosting Capacity
GIS	Geographic Information System
IT	Information Technology
NC RfG	Network Code on Requirements for Generators
OPEX	Operational Expenditure
PV	Photovoltaic
TF DESAP	Task Force on Digitalisation of Energy System Action Plan
TSO	Transmission System Operator

3 Introduction

Distribution System Operators (DSOs) play a crucial role in the evolving energy landscape. As central enablers of the energy transition, DSOs are responsible for operating, maintaining, and developing electricity distribution networks that serve millions of consumers across Europe. Their infrastructure and services are essential for integrating renewables, supporting the electrification of sectors such as transport and heating, and ensuring that energy remains secure, affordable, and sustainable.

In light of national and European climate targets, DSOs´ role is fundamental to enabling the shift toward electrification and digitalisation, both of which are necessary to meet long-term energy and climate goals. A key aspect of the DSO mandate is managing connection requests to the electricity distribution grid (at low, medium and sometimes high voltage). These requests come from a wide range of sources or applicants. The surge in connection requests across EU Member States reflect the growing momentum behind electrification, particularly through the adoption of technologies such as solar panels, electric vehicles, and heat pumps, alongside fast-growing technologies like AI that further increase grid demand and complexity.

While this trend presents significant operational and planning challenges, DSOs across Europe are actively adapting to meet demand. Through digitalisation, process optimisation, and the exchange of best practices, DSOs are improving their ability to handle connection requests in an efficient, transparent, and timely manner. These efforts are helping to modernise grid operations and ensure that DSOs remain responsive to evolving energy needs.

Moreover, connection requests are far more than administrative tasks. They are strategic points of interaction shaping grid development and customers engagement. Recognising this, DSOs are implementing forward-looking approaches, including digitalised connection processes, automation efforts and customer self-service portals. In this context, this paper explores the emerging trends related to grid connection requests and examines how DSOs are evolving to support energy transition. It highlights the measures being taken to manage growing demand while maintaining system reliability and delivering high-quality service to customers.

Connection Request Trends

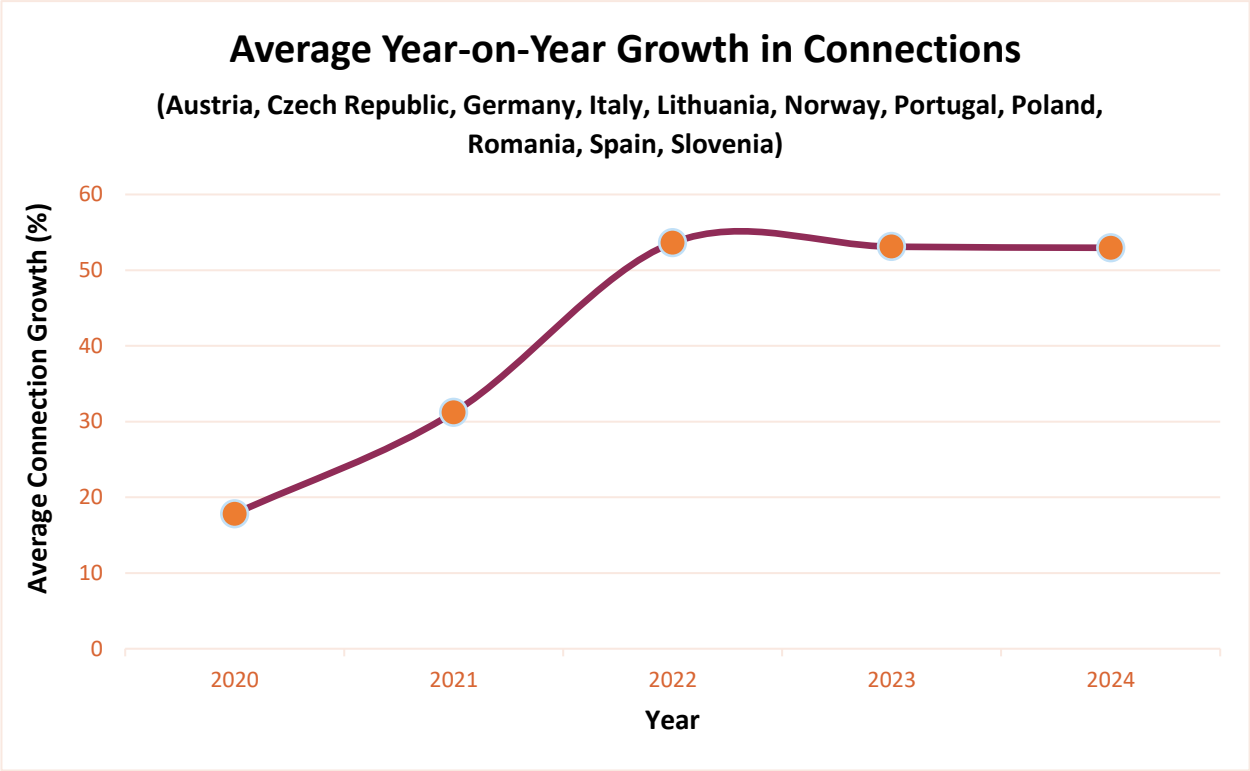

Figure - Annual Growth Rate of Connection Requests

Increase in application requests reported by some DSO TF DESAP members in 2025.

Identifiable Trends: Connection requests are a critical function for DSOs serving as a primary customers interface, a key enabler of the energy transition, and a critical input for efficient grid development. They facilitate increased integration of renewable energy sources and the adoption of new technologies into the grid. While noticing the large heterogeneity across distribution areas, and although the restricted sample precludes any statistical inference, the observations offer a meaningful glimpse into relevant patterns and tendencies in the last years:

- **Growth from 2020 to 2022:** Connection requests grown annually by 15-20%, peaking in 2022 due to policy developments at EU level and geopolitical shifts in the region.
- **Post-2022 Plateau:** Growth plateaued but remained high compared to pre-2022 levels.
- **Connection Queue Variability:** Significant regional differences exist, with some high-voltage projects taking up to +5 years.

Looking Ahead: While the future demand remains uncertain, future demand will certainly rise, at different pace yet depending on the distribution areas due to the following trends:

- **Impact of Data Centres:** Likely to increase connection requests, especially for high-capacity demands. The potential implications for DSO operations remain significant and warrant close attention.
- **Broad Electrification and Sector Coupling:** Technologies like EVs and heat pumps will significantly raise demand and introduce further complexities.

Therefore, along with grid expansion, which is crucial, DSOs are constantly upgrading grids to support energy transition and digitalising core grid processes like connection requests.

4 Scope and Methodology

This paper explores how digital solutions, including the application of digital twin technologies, can improve the management of connection requests. Drawing on hands-on insights and case studies from DSOs across Europe, it identifies existing practices, common barriers, and key enablers, offering practical guidance for DSOs and stakeholders aiming to enhance their connection processes.

4.1 Scope

This **paper focuses on digitalisation efforts that enhance the efficiency, transparency, and customer satisfaction within the early phases of inquiry, assessment and approval of connection requests.** The schematic visual representation of the connection process below clarifies the scope of this analysis.

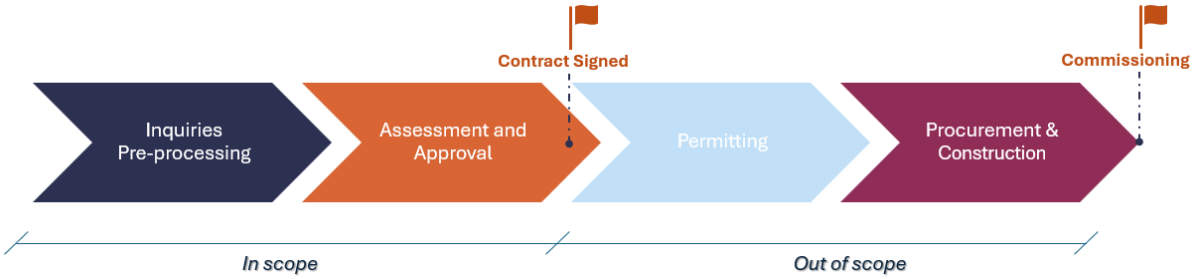

Figure - Connection Request Process | Scope Boundaries

The following issues are out of scope:

- **Technical Regulations:** This report does not address compliance with the Network Code on Requirements for Generators (NC RfG) and the Demand Connection Code (DCC).
- **Grid Hosting Capacity (GHC):** This topic is excluded from the scope of the report, as GHC is treated independently to maintain clarity of focus.
- **Regulatory Topics:** Regulatory matters like Flexible Connection Agreement (FCA), locational price signals, and connection fees are occasionally referenced solely in relation to survey inputs received from members. While occasionally mentioned, these aspects fall outside the defined scope of the report and are therefore not explored in depth. Their inclusion serves solely to support and contextualise the survey findings.
- **National Legal Frameworks:** While comprehensive, this study does not aim to provide a mapping of the legal frameworks applicable to connections in EU countries, like for instance legal specific timeframe. In some countries, national regulations impose financial penalties on DSOs for delays in processing connection requests, even when such delays are due to factors beyond the DSO's control.

4.2 Methodology

This document is based on a qualitative analysis of information collected through a structured survey distributed to members of the DSO Entity Task Force on Digitalisation of Energy System (TF DESAP). DESAP TF started to work in January 2025. A group of experts across the EU has volunteered to address this important assignment.

The methodology involved:

- Collecting feedback from DSOs through a structured questionnaire.
- Analysing responses to identify recurring patterns, unique solutions, and common obstacles.
- Thematic categorisation of challenges and enablers to support an efficient implementation.
- Qualitative assessment based on hands-on expert experience within DSOs, complemented with bilateral discussions whenever needed.

As shown in the map below, the survey results ensure a consistent level of representativeness, as respondents come from various European countries:

Figure - Geographic Coverage - Member Respondents to Survey

This approach allowed the paper to capture a rich and representative snapshot of current practices, supplemented by illustrative use cases.

5 Challenges

The analysis of DSO responses reveals that connection request processing faces multifaceted challenges. These affect not only the timelines of the process but also the ability to scale up and digitalise operations effectively.

While some of these challenges fall beyond the sheer scope of this report, they are still reported for the sake of transparency. The challenges in handling the connection request process, including barriers hindering the potential for digitalization, can be categorized as follows:

5.1 Technical Challenges

Manual Assessment Requirements: Certain complex technical topics, such as reinforcement calculations, are deliberately kept manual to maintain quality and safety standards to ensure grid's reliability.

IT System Limitations: Several DSOs identified gaps in IT system development and difficulty integrating new digital solutions with existing legacy systems, limiting their ability to streamline connection request processing and causing additional workload.

Interoperability Issues: Ensuring seamless communication between different systems and platforms is a common challenge.

Data Quality Issues: Poor-quality data burdens staff with verification tasks, reducing overall efficiency and hinders the full benefits of automation.

Misalignment of Digital Tools: In some cases, digital tools used for grid analysis are not fully integrated into the broader workflow or adapted to actual operational needs, leading to inefficiencies and delays.

5.2 Organisational Challenges

Impact of Organisation Size: the processing capacity for connection requests might be influenced also by the size of the DSO and the scale of their distribution grid, affecting available resources for handling requests efficiently.

Cost Structure Variations: Different internal cost structures like for instance budget constraints, legacy systems. These affect the feasibility of digitalisation, particularly in the implementation of APIs and system integrations for connection request management.

Labour Shortages: Many DSOs face a shortage of qualified technical personnel, making it difficult to scale up connection processing in response to growing demand, particularly in

rooftop PV requests. Recognising this transformational challenge, DSOs support various initiatives, like for instance through EU's Net-Zero Academies to build and develop the right skills needed to deliver on the energy and digital transitions[1].

5.3 Regulatory and Legal Challenges

Permitting Constraints: Regulatory and legal differences regarding area protection rules, street types, and local authority permitting processes add complexity and disparity to the connection request process.

Concession and Land Agreement: Lengthy procedures for obtaining landowner agreements or concession permits significantly extend the timeline for processing connection requests in some countries.

Regulatory Framework: Regulatory frameworks can often distort and/or discourage DSOs from investing in digitalisation, as such investments may not be fully recognised or rewarded. When setting these frameworks, regulators need to ensure that all kinds of expenditure are properly recovered and received (i.e. opex / capex, short-term / anticipatory or traditional / innovative) the same treatment avoid distortions. A more detailed discussion about the interaction between regulatory frameworks and innovation is available in DSO Entity (2025), "Innovation for regulated companies: An initial DSO perspective"[2].

5.4 Supply-Chain Challenges

Supply Chain Disruptions: Disruption particularly affecting critical components -such as transformers, switchgear, and cables- continues to affect DSO's ability to execute connection works on schedule. These disruptions are driven by a combination of global and regional factors, including geopolitical tensions, network asset shortages, and surging global demand linked to electrification projects. Close collaboration among electricity system operators, suppliers and relevant stakeholders is crucial to address these disruptions[3].

Procurement Delays: In certain cases, delays in ordering and receiving grid components due to supplier bottlenecks contribute to longer processing times. The struggles encountered in terms of procurement go beyond the proactive solutions of distribution system operators alone. Even where DSOs have introduced mitigation measures, the structural constraints in

[1]See available: Joint Statement calls for distribution grids at the center of the European agenda
[2] See available: Innovation for Regulated Companies - An Initial DSO Perspective (DSO Entity, 2025)
[3] See available: Joint Roadmap Towards Future Proof Grids (DSO Entity, ENTSO-E, Europacable and T&D Europe, 2025)

the wider market persist. Addressing these delays will require greater coordination and support at national and EU levels.[4]

5.5 Process and Operational Design

Complex Interactions with Third Parties: Securing permissions from landowners, coordinating, consulting and negotiating with national authorities, municipalities and other stakeholders involved, remain persistent challenges that introduce unpredictable delays that are not under DSOs' control. This includes cross-coordination among different system operators that rise delays, especially in the early stages of the connection request. In many regions, the absence of collaborative systems continues to hinder progress, reinforcing the need for wider adoption of interoperable solutions and integrated processes.

Human Errors in Handling Complex Technical Assessments: Human errors can occur, particularly in cases that are less automated or involve unique, technically demanding connection requests. These situations require expert judgement and detailed analysis, where some level of human intervention is unavoidable. While such errors cannot be entirely eliminated, their occurrence remains low thanks to established review procedures and quality controls yet.

Request Type Dependency: The time and complexity involved in processing a connection request depend not only on whether the request is fast (e.g., Online Connection Checks) or binding (requiring detailed technical and regulatory assessments), but also on the type of installation. For example, household connections or standard self-consumption installations are typically more straightforward, while large industrial consumers, fast-charging EV stations, or complex mixed-use projects introduce significantly more technical and legal challenges. These may require load flow analysis, grid reinforcement studies, or tailored permitting procedures. As a result, even among binding requests, there is substantial variability in processing timelines depending on the installation's size, nature, and expected grid impact.

High Volume of Specific Request Types: A sudden surge in certain types of applications—such as residential solar PV installations, or even less mature connection projects that have stopped for various reasons—has in some instances overwhelmed processing capacity, leading to delays of several months. In parallel, a growing number of large-scale connection requests can disproportionately exhaust the available hosting capacity at specific connection points. This can result in significant bottlenecks that delay or even prevent the timely

[4] See available: Distribution System Operators and the Supply Chain Challenge (DSO Entity, 2025) for a detailed analysis of procurement constraints and proposed mitigation measures.

connection of smaller installations sharing the same infrastructure, compounding processing difficulties and raising equity concerns among applicants.

Cross-Stakeholder Interaction Gaps: Effective processing of connection requests hinges on timely and accurate information exchange between all parties involved. This includes not only the flow of information from DSOs to stakeholders but also the reverse. DSOs rely on dependable input from customers, local authorities, TSOs, and permitting bodies to plan and execute connection works efficiently. However, this essential bidirectional information exchange is sometimes lacking. Excessive bureaucracy, coupled with gaps in communication and coordination at the national level, can lead to misunderstandings and procedural delays that hinder progress. Addressing these issues requires a collaborative approach among all stakeholders to ensure that administrative processes support rather than slow down the connection request journey.

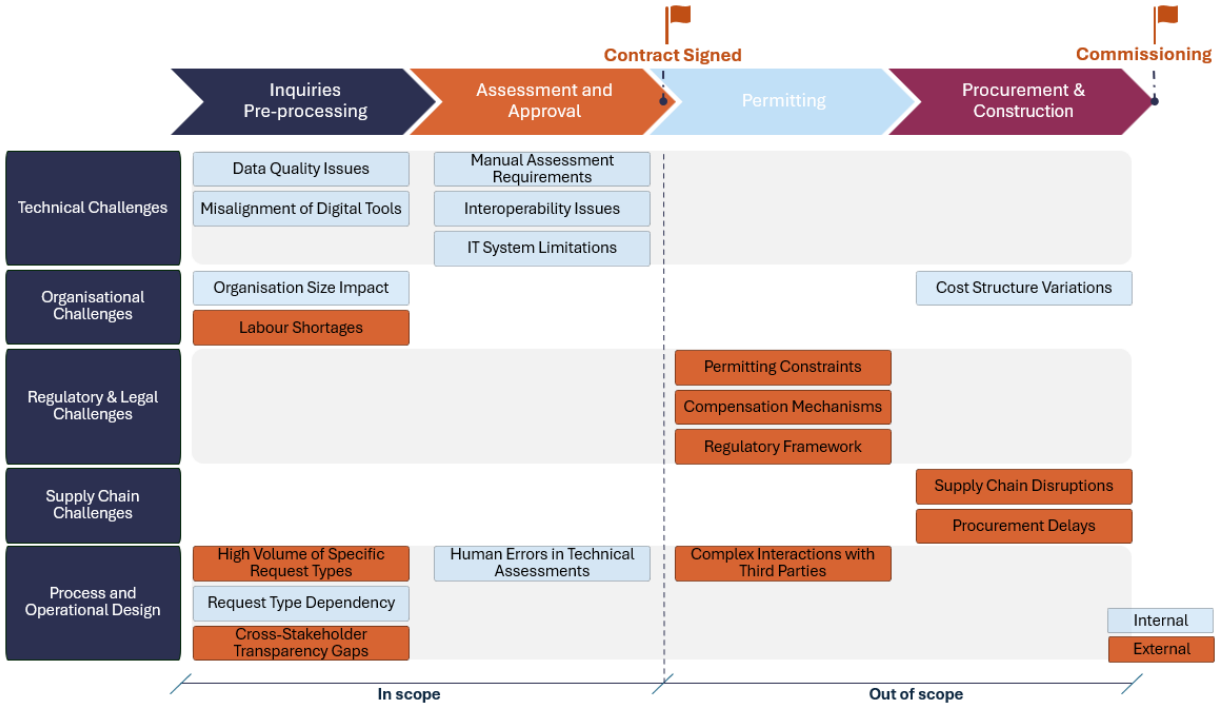

Figure - Mapping Internal and External Challenges to Grid Connection Processing

The table above depicts a structured overview of the challenges faced by Distribution System Operators when managing electricity connection requests. Challenges are first categorised according to their root cause—technical, organisational, regulatory/legal, supply chain, and process-related—and subsequently mapped across the relevant process phases: pre-processing, assessment and design, approval and permitting, and procurement and implementation. This dual-layered classification offers clarity on when and where specific bottlenecks emerge throughout the connection process. Additionally, by distinguishing each

challenge as either internal or external, the framework offers valuable insight into the respective spheres of responsibility and influence. This framework supports a more targeted approach when defining the enablers to enhance effectiveness in handling connection requests within DSOs.

In sum, delays in connection request processing are rarely due to a single factor but arise from the complex interplay of technical, organisational, regulatory, economic, and human factors Many bottlenecks and challenges faced by DSOs are not strictly occurring during the handling the connection request but rather at a later stage in the process.

6 Enablers

While section 5 was dealing with all types of challenges by DSOs in handling connection, this section focuses specifically on the contribution of digital solutions to the effectiveness and efficiency of the connection request process. While other important enablers—such as regulatory reforms or organisational adaptations, exist, these are considered out of the scope of this analysis and may be addressed in other dedicated publications.

Addressing the challenges of connection request management requires a coordinated set of digital enablers. These can be broadly categorised into three interdependent areas: **Customer Engagement and Front-End Services**, **Operational Intelligence and Efficiency**, and **System Integration and Institutional Coordination**.

6.1 Customer Engagement and Front-End Services

A growing number of digital tools now enable applicants to engage directly with the connection process, providing greater transparency, autonomy, and responsiveness. These customer-facing solutions not only support applicants in preparing higher-quality submissions but also improve the overall accessibility of the process

Customer Self-Service Portals enhance transparency and speed up data collection from applicants with the use of intelligent prompts, pre-validation, and document checks improve application completeness and quality, as per implementations seen in various countries.

Responsive Customer-facing Digital Touchpoints are increasingly used to keep applicants informed throughout the process. These interfaces may allow users to track request statuses, receive alerts, and interact with DSOs more effectively.

Multi-Channeling Approaches recognise the diverse needs and digital readiness of customers. While digital solutions are wished to become the default channel, some applicants still rely on physical or in-person support. In many countries, DSOs shall continue to offer paper-based applications, staffed customer service desks, telephone helplines, and even video consultations to ensure inclusiveness. By maintaining a balanced mix of digital and traditional channels, these approaches not only broaden accessibility but also build trust among users who may be less familiar with digital tools. It is yet very much acknowledged that multi-channeling creates complexity and increases costs for DSOs.

Updated Grid Capacity Information and Dynamic Connection Tools, empowering customers to assess feasibility in advance of applications. These tools reduce speculative or unviable requests, improving overall system efficiency.

Pre-Verification Systems and Document Validation with online forms that pre-verify the completeness of documents attached by applicants. Use of AI supports validation and analysis of documentation, reduces human errors and improves data quality.

6.2 Operational Intelligence and Efficiency

Digital transformation within DSOs is increasingly focused on improving internal processes and leveraging data to enable faster, more consistent, and technically sound decision-making. The following digital enablers have been highlighted to support this shift towards automation and operational intelligence.

Workflow Automation and End-to-End Digitalisation significantly reduce manual interventions, for both binding and non-binding connection requests, enabling faster, more consistent handling and supporting DSOs in managing growing application volumes. DSO platforms demonstrate how automation supports consistent processes and reduces turnaround times. While these tools address many internal delays, some bottlenecks remain dependent on timely coordination with external stakeholders such as permitting authorities, municipalities, and equipment suppliers.

Advanced Data Management ensures a higher data quality with the support of intelligent algorithms cleaning inconsistent data and filling data gaps in a structured, and often automated, manner.

Integrated Data Management ensures data flows seamlessly across siloed separate systems. Integrated online forms and internal IT platforms, improve traceability, forecasting, and operational efficiency. An increasing integration with GIS and ADMS platforms supports rapid and reliable feasibility studies.

Queue Management and Maturity Assessments are emerging as useful tools to improve transparency and predictability for all stakeholders in the connection process. These mechanisms help identify speculative or underprepared requests and allow DSOs to manage workload more effectively by focusing first on those applications that are ready for technical assessment. While discussions at the European level are ongoing regarding the potential for prioritisation based on public interest or social value (e.g., hospitals or schools), it is crucial that any such criteria be clearly defined and mandated by the competent regulatory authority—not by DSOs themselves. DSOs must remain neutral market facilitators, applying the rules set by legislation rather than determining the order of access. As such, digital queue management tools can support the implementation of legally prescribed prioritisation schemes, where applicable, but should not be considered enablers of prioritisation per se.

Digital Twins of Distribution Networks, as implemented in various countries, allow simulations of grid constraints and capacity and determine the corresponding connection fee per voltage level.

Differentiated Connection Management for Complex Cases is also gaining traction. Many DSOs report that specialised digital tools and coordinated teams provide tailored handling for technically or administratively complex applications. The solution of a specialised team dedicated for complex connections in some countries shows good results in reducing handling time and increasing customer satisfaction.

Modularity and Scalability of Software-based Solutions based on digital twin technology form the foundation to scale up a wide range of grid processes in planning and operations.

6.3 System Integration and Institutional Coordination

Many of the most effective digital enablers are those that improve collaboration across DSOs, permitting authorities, and national agencies. Integrated systems support process alignment, accelerate approvals, and ensure consistent access to information for all stakeholders.

Collaborative Planning Platforms with external stakeholders, like installers, municipalities and permitting authorities shorten administrative timelines by enabling data exchange and early alignment. Integrated process between DSO internal systems and national connection request platforms allow seamless two-way communication, replacing manual submissions and reducing the risk of errors. Some advanced portals also allow applicants and local authorities to initiate, monitor, and update connection requests directly. These tools foster transparency, accountability, and efficiency, supporting DSOs in managing increasing request volumes.

Centralised Connection Request Systems, as implemented in various countries could be implemented at national level and have the capacity to harmonise procedures and reduce administrative overheads. These platforms often integrate multiple access channels to serve both internal users and external applicants effectively. Decisions on centralised or decentralised architecture and related issues (in terms of data privacy, resilience, or others) should be made at the national level.

Integrated digital ecosystems, eliminate redundant manual tasks and promote transparency and coordination across business units within the same company.

Survey responses confirm that many DSOs have implemented or are developing digital tools to manage connection requests. While the maturity and scope of these platforms vary, they share common goals: to standardise processes, improve data-based decision-making,

automate the process and gain in efficiency, and deliver a more predictable and user-friendly service. Respondents also highlight the importance of tailoring solutions to reflect local, and national contexts.

Importantly, the deployment of digital platforms should be supported by proper evaluation frameworks. These include **business case** and **organisational-level impact** reviews to ensure that implementations are not driven purely by the availability of technology but by a clear understanding of expected outcomes. To this end, digitalisation should not be pursued for its own sake, but rather as a mean to achieve measurable improvements in efficiency, transparency, and service quality. The implementation of such platforms should not be mandatory; rather, **organisations should retain the flexibility to adopt digital solutions** in line with their specific operational needs, customer profiles, and national regulatory environments.

Snapshot: Customer Experience in a Digitalised Connection Request Process

Worth emphasising that customer experience and satisfaction are not merely a by-product of efficient processes—it is at the **core** of DSOs' activity. As the connection request process often represents the **first direct interaction** between a DSO and its customers, it serves as a critical moment to establish **credibility, transparency, and trust**.

Digitalisation plays a key role in modernising the customer experience. However, the objective extends beyond operational efficiency; DSOs must ensure that digital tools are **designed with the customer in mind**, accommodating a diverse range of needs, digital readiness levels, and preferences. Enhancing the connection journey must therefore be coupled with a commitment to **accessible, adaptable, and supportive interfaces**. DSOs have a duty to adapt their services to evolving customer expectations and societal needs, which include:

- Offering **clear, timely, and accurate information** to support informed customer decisions.
- Ensuring **transparency and visibility** throughout the request process.

Enabling **predictable and consistent interactions** regardless of request complexity.

Human Interaction and Multichannel Approaches - Enabling Inclusion

While digital portals and automation can certainly streamline procedures, **human interaction remains a vital enabler of customer trust**. Some customers may lack the digital literacy, infrastructure, or confidence to fully navigate online platforms—particularly in cases of complex or high-stakes connections.

As described in **Error! Reference source not found.**, various DSOs apply this principle in practice, where m aintaining a **multichannel approach** allows customers to interact via traditional channels such as phone or in-person consultation. This dual strategy recognises that **building and maintaining trust** sometimes requires

human touchpoints, particularly when dealing with customers who are not fully ready to adopt digital tools. In turn, it raises complexity and costs for DSOs.

Embedding Customer-Centric Design in Digitalisation

Survey responses from across Europe show that DSOs are increasingly embedding **customer-centric design** principles into their digitalisation strategies. Noteworthy practices include:

- **Use of virtual assistants and chatbots** to provide immediate and consistent answers.
- **AI for document analysis:** Use of AI to validate and analyse documents, reducing human error and improving data quality.
- **Integrated help functions and applications:** Ensuring process accessibility and responsiveness. And **single points of contact** for complex projects, reinforcing coordination and reducing customer burden.
- **User-guided online forms:** Assisting applicants in providing correct data.
- **Pre-verification systems:** Online forms that pre-verify the completeness of documents attached by applicants.
- **Personalised tracking systems:** Online tracking systems that allow customers to view the status of their requests.
- **Automated notifications:** Employing bots to send automatic notifications to customers.
- **Online payment systems:** Online payment systems that improve cash flow and customer convenience.

Such initiatives contribute not only to faster processing and reduced errors, but also to **higher levels of customer satisfaction and loyalty**.

In conclusion, digitalisation should be viewed not only as a technical upgrade, but as a **strategic opportunity to deepen customer engagement and trust**. As custodians of critical infrastructure, DSOs must continue to place **customer experience at the centre of their service delivery**, ensuring that all customers—regardless of digital maturity—benefit from an equitable and supportive connection process.

7 Deep-Dive: Digital Transformation – From Vision to Execution

The journey toward digital, scalable, and customer-centric connection request processes is as much about people and strategy as it is about technology. The following guiding principles are essential for DSOs looking to turn digital solutions into lasting transformation:

- **Define and Communicate a Clear Vision**
  - **Establish a well-articulated vision and strategy** that aligns with the organisation's goals. This helps navigate the complexities of digital transformation.
  - **Communication is crucial** for successful change management.
- **Secure Executive Sponsorship**
  - Strong **executive support is essential** for securing the necessary resources and driving the change across the organisation.
  - Leadership should **model the behaviours and attitudes** they wish to see in their teams.
- **Foster a Digital-First Culture**
  - Recognise **potential benefits of digital transformation**. It proves to be more efficient working with examples e.g. what could be translated into use cases, without being abstract.
  - Encourage **openness to change, innovation**, and cross-functional collaboration.
  - Promote a **digital mindset and skills** among employees through investing in continuous training and recruitment of digital talent.
- **Whenever Relevant Digitalise, and Automate**
  - Focus on these two pillars to enhance operational efficiency and innovation.
  - Select **technologies that are flexible and adaptable** to support long-term objectives. This may include leveraging cloud computing, AI, and data analytics.
  - Begin with a **comprehensive process assessment** to identify areas for optimisation, and then implement digital solutions that are, by design, secure and compliant with data privacy and cybersecurity standards.
- **Measure Progress and Learn Continuously**
  - **Define metrics** and regularly assess progress against objectives.
  - Encourage a **culture of experimentation and innovation**. Iterate based on feedback, scale successful pilots, and learn from failure.

- **Keep Customers at the Centre**
  - Continuously gather and act on **user/customer feedback** to refine digital solutions. This ensures that the transformation remains aligned with user/customer needs.
  - **Ensure accessibility and inclusiveness** by combining digital tools with traditional service channels.
- **Empower Change Agents and Build Ecosystems**
  - **Internally**, identify ambassadors in the field and empower key individuals who can drive the transformation.
  - **Externally**, form strategic alliances to leverage external expertise and resources. This can accelerate innovation.

Digital transformation is not a one-off IT deployment—it is a **continuous organisational and cultural evolution**. DSOs that combine technological innovation with strong leadership, cultural change, and stakeholder collaboration are best positioned to manage connection requests efficiently and resiliently in the years ahead.

8 Conclusions

As Europe accelerates its decarbonisation and electrification agenda, **DSOs occupy a pivotal role in enabling the energy transition,** one that directly influences how efficiently new demand and generation assets are integrated into the grid. This connection request process—often the first interaction between a customer and the grid—is no longer a back-office task. It is a strategic function that determines how efficiently new demand and generation assets are integrated into the power system, and how trust and transparency are established from the outset.

This analysis confirms that **digitalisation has been instrumental in improving processing speed, data quality, and customer engagement**. However, digital tools alone are insufficient. Their **success also depends on complementary factors** such as cross-stakeholder coordination, process simplification, regulatory support, and cultural openness to change. In particular, interactions with external stakeholders—including installers, municipalities, and permitting authorities—remain a major bottleneck. Addressing this requires not only the digitalisation of interactions, but also the removal of unnecessary bureaucracy that delays progress.

Customer experience and satisfaction are not merely by-products of process efficiency—they are central to the role of DSOs. As the connection request process often marks the first point of contact, it represents a critical opportunity to build credibility and confidence. While digitalisation enhances speed and convenience, it must be paired with customer-centric design, ensuring accessibility for users with varying levels of digital readiness. **Preserving a multichannel strategy**—with options for online, phone, and in-person interaction—remains essential to inclusivity, even if it introduces greater complexity and costs.

At the same time, it is important to recognise that certain steps in the connection process—particularly those related to grid safety and reliability—cannot be rushed. Defining timelines for procedures should not compromise the **quality of technical assessments** that ensure secure, long-term connections.

DSOs must continue to evolve by **adopting integrated, interoperable digital ecosystems** while maintaining flexibility to adapt to local conditions **with a proper evaluation and understanding** of their operational needs and conditions. Good practices, such as grid visibility and differentiated handling of complex requests, can serve as an example for future implementations.

Any configuration of the tool must strictly adhere to existing regulations. Accordingly, if **prioritisation criteria**—such as those based on public interest—are to be applied, they must be explicitly **mandated by the competent regulatory authorities**. DSOs must remain neutral facilitators.

Looking ahead, DSOs must proactively adapt—through both digital transformation and strategic planning, to ensure that the **electricity network remains a reliable, responsive, and equitable** platform for Europe's clean energy future.

9 Annex: Compilation of Use Cases Shared by Members in the Questionnaire

Use Case: E.ON

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
Intelligent Grid Platform	Germany & USA (but also used in further countries)	- Generation and consumption - More targeted connection requests are possible, for example: EV charging stations, Data Center, heat pumps, etc. - Low voltage & medium voltage requests are possible	-Request is sent via API to IGP system - Connection Request will be handled by Grid Planners within the system, or via own API processes, or e.g. through fast track (etc. -> different scenarios possible) - Request information will be afterwards provided to the customer	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Online Connection Check: 1. A customer submits a connection request through the web portal, providing details about the planned connection. 2. The Online Connection Check (OCC) automatically performs a technical grid analysis to evaluate the feasibility of the connection request. 3. Based on the OCC results, the system generates an automated assessment indicating whether the connection is possible without grid reinforcement.					

4. If the connection is technically feasible, the customer receives immediate feedback and can proceed with the connection process. If not, alternative solutions or grid reinforcement options are evaluated

Connection Request – rough process description:

1. If manual review is needed, the request gets marked for manual processing and the system notifies the user that expert evaluation is required.
2. For binding requests, approved connection variants are automatically reserved in the system to ensure grid capacity is held for the customer.
3. The system generates detailed technical reports documenting the assessment results and connection requirements.
4. Status updates and results are communicated back to the originating system (like iConnect) through APIs to keep all systems synchronized.

External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...

Only DSOs have access to the system itself.

End users, competent authorities, generation project developers, SOs, installers, have access to provided frontend (mostly frontend (Map, Forms etc.) provided by DSO.

AI capabilities / functionalities: Yes / No

N/A

What are the technological features of your digital solutions and what are the benefits from their use?

- Secure hosting in Microsoft Azure or Open Telecom Cloud environments
- High availability and redundancy through Azure cloud infrastructure
- Secure VPN connections for on-premises data sources
- Automated data synchronization with configurable intervals

- Modular architecture enabling flexible deployment and customization
- Highly scalable platform managing large portions of distribution grids
- Interoperable solution with open interfaces for system integration
- Metering technology-independent solution allowing interfaces to any metering operator
- Comprehensive documentation
- State-of-the-art security standards for grid data protection
- Automated data synchronization with regular intervals defined by grid operators

Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …).

When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).

Accelerated Processing Times:

- Medium voltage connection requests: Reduced from 8 hours to less than 30 minutes per case (>90% reduction)
- Low voltage connection requests: Reduced from 1 hour to 5 minutes per case (>90% reduction)

Enhanced Grid Model Creation:

- Initial setup time reduced from multiple person-years to 3-4 months
- Automatic updates instead of manual maintenance effort

Cost Efficiency:

- Significant lower costs compared to traditional processes in run-phase.

Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Strategic Implementation Planning: Careful planning of the integration process, including thorough testing phases and staged rollouts • Stakeholder Collaboration: Active engagement with DSOs, TSOs, and third parties to understand their specific requirements and pain points • Standardized Data Models: Development and implementation of uniform data models to ensure consistent information exchange • Automated Workflows: Implementation of automated processes to reduce manual work and streamline operations • Clear Documentation: Comprehensive documentation and training materials to support user adoption **Barriers:** • Technical Integration Challenges: Compatibility issues with existing legacy systems and diverse IT infrastructures • Data Quality and Availability: Incomplete or inaccurate grid data affecting the reliability of calculations • Grid Digitalization Gaps: Varying levels of grid digitalization across different regions and operators • Complex Regulatory Requirements: Need to comply with different regulatory frameworks while maintaining system flexibility • Change Management: Resistance to new digital processes and need for comprehensive training programs

Use Case: ESO #1

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
Grid Capacity Tool for prosumers	Lithuania	Generation connection and grid access check for existing customers	Pre-inquiry and Customer information	DSO, TSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
• Pre-inquiry: Customer enters object number to check available capacity for generation. • Feasibility check: System calculates how many kW can be fed into the grid. • Application: Customer proceeds to submit a formal request via ESO's self-service portal. • **Alternative solutions: If the customer is provided with response that currently no additional capacity is available at the selected point, the customer is provided a number of alternatives to consider (1. To install a solar PV with limited feed-in up to 0,8 kW 2. To become a remote prosumer (buy a share of a solar park) - solution under construction**					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
End Users					
AI capabilities / functionalities: Yes / No					
No					

What are the technological features of your digital solutions and what are the benefits from their use?
Technological Features: • Automated capacity calculation: Based on object number input, the system retrieves real-time grid data to determine available capacity (kW) for grid feed-in. • Integrated GIS/database lookup: Cross-references geolocation and grid infrastructure data to assess technical feasibility instantly. • User-friendly web interface: No login required for initial inquiry, enabling quick access for both residential and business customers. • API integration with ESO systems: Seamless transfer from pre-check to application submission within ESO's self-service environment. • Responsive design: Accessible from mobile and desktop devices for convenience.
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …). When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
Benefits: • Timesaving: Customers receive immediate feedback on connection potential without needing to contact customer support or submit formal documents. • Transparency: Clear visibility into technical limits helps users make informed decisions before investing in a solar power system. • Improved planning: Reduces uncertainty and helps avoid unnecessary application rejections due to grid constraints. • Encourages green energy adoption: By simplifying the connection process, more customers are encouraged to install renewable energy sources. • Reduced administrative workload: Automating the pre-check process minimizes manual assessments by ESO staff.

Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Barriers: • Data quality and availability: Accurate and up-to-date grid data is essential for reliable capacity checks. Inconsistent or outdated information can lead to incorrect results. • Legacy system integration: Connecting modern digital tools with existing internal infrastructure and databases can be technically complex and resource intensive. • Customer awareness and digital literacy: Some users may not be familiar with digital tools, leading to underutilization or misinterpretation of results. • Scalability: As user demand grows, the tool must maintain performance and availability, which can require significant backend infrastructure upgrades. **Enablers:** • Clear user interface and guidance: Grid capacity tool provides a simple and intuitive interface that lowers the barrier to entry for non-expert users. • Automated decision support: Pre-checking grid capacity helps streamline the process and reduces the number of rejected applications. • Integration with self-service portals: Seamless link between capacity check and application submission in ESO's platform improves customer experience. • Supportive internal processes: Close collaboration between IT and grid operation teams enables faster tool development and problem resolution.

Use Case: ESO #2

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
New connection, power capacity increase fee calculator	Lithuania	- New electricity connection, Power capacity increase;	Price calculation before official request	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
• The calculator on the public DSO online portal (www.eso.lt) allows customers to find out the fee for a new connection or capacity increase before registering an official connection request: https://www.eso.lt/web/elektros-ivedimo-imokos-skaiciuokle-namams-351 • In case of new connection, customers provide their object's type (flat, house, etc.), connection point physical address or points location on the map and get connection fee value. • In case of power capacity increase, customers can choose to base the calculation on their smart meter's 15-minute usage data. This allows ESO to recommend a new power capacity based on the customer's usage at the existing connection point over the past 12 months and his/her new capacity requirements.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
End Users					

AI capabilities / functionalities: Yes / No
No
What are the technological features of your digital solutions and what are the benefits from their use?
Integration with smart meters and network data
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …). When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
From the new connection perspective: • Provides an indication of the appropriate power capacity for the customer's object, • Reduces requests made solely for information purposes. • From the power capacity fee perspective: • Enables more effective usage of the existing network capacity.
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Ineffective existing network utilization, **Barriers:** • Readings hub capacity: evaluating the last 12 months of 15-minute usage data for approximately 1 million customers (for the power capacity increase task).

Use Case: Energienetze Steiermark GmbH

Use Case Description					
Name of the digital solution / online platforms "Einspeiser Portal"	**Country** Austria	**Type of Connection request process:** - Small generation (specify <100 kWp) automated assessment - Medium and large scale generation manual assessment, but will be evaluated automatically in the future	**Process stage short description** - Inquiry (Pre-inquiry and Customer information / Technical Parameters / Request Submission) - Grid Connection Concept (Request Review / Grid Calculations / Offer Grid Connection Concept) - Customer builds PV - Transmission of relevant documents - Initiate infeed	**Solutions' owners** DSO	**Maturity** In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor the whole process systematically. Furthermore, the automatic calculation of a load flow analysis to evaluate the possibility of a connection is triggered. Central point of knowledge regarding the inquiry.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
N/A					
AI capabilities / functionalities: Yes / No					

N/A
What are the technological features of your digital solutions and what are the benefits from their use?
• Front-end development as web application or portal: responsive • Surface design independent of the backend: quickly customizable • Integration in well-known software: quick adaptability of employees **Integration with other systems:** • Provision of GIS data: automatic generation of most recent network topology • Connected with load flow analysis software: automatic calculation of the load flow
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …). When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
~50% of the requests can be handled automatically
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Careful planning and integration strategy • Effective collaboration / consultation with all relevant stakeholders to understand their needs • Supportive regulatory frameworks • Competent personnel

Barriers:

- Technical limitations like interoperability issues with existing legacy systems
- Data privacy and security concerns; Data quality needs vs data quality status quo
- Lack of digital skills
- Strong interdisciplinarity is required
- Not every requirement is known beforehand, which leads to possible wrong decisions (e.g. capabilities of database, which voltage levels must be included in the calculation,

Use Case: E-REDES #1

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
Balcão Digital	Portugal	Demand connections (any type)	All stages of the process, allowing the direct interaction with the process itself	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Online platform that allows the submission of connection requests by the customer, allowing the monitoring of the process and the interaction between the customer and the process.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
Final customer, responsible technicians, DSO.					
AI capabilities / functionalities: Yes / No					
No					
What are the technological features of your digital solutions and what are the benefits from their use?					
Web portal, interface with commercial system, documentation exchange.					
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …).					

When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
Improved customer experience, more self-care information, reduction of requests by the customer.
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Simplification of submission, increase self-care, 24h-24h service, maximise information to the customer **Barriers:** • Procedural changes that imply adaptation of the platform, customer segments with low digital literacy, data availability.

Use Case: E-REDES #2

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
DGEG/ E-REDES Integration for individual self-consumption	Portugal	Self-consumption connections	Request submission and certification of facilities	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Integration between the single platform of the national authority for energy and E-REDES systems, allowing the submission of self-consumption requests and the creation of master data.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
Competent authorities, self-consumers and DSO.					
AI capabilities / functionalities: Yes / No					
No					
What are the technological features of your digital solutions and what are the benefits from their use?					

Web service, interface with commercial system and entities' systems.
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …). When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
Reduction of process duration, real-time treatment at any hour any day (automation, simplicity and more efficient procedures), handover reduction, increased customer information and satisfaction (no human errors), process traceability in IT systems (SAP) allowing daily monitoring, dematerialization, simplification and automation of the entire process. It has proved to be an enabling element that encourages self-consumption.
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Automation of stages of the procedures, online information on the process **Barriers:** • The correction of bugs and errors in the system demands a continuous monitoring of the system, and consequently, more specialized and technical personnel

Use Case: E-REDES #3

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
DGEG/ E-REDES for Energy Communities	Portugal	Renewable Energy Communities connections	Request submission and certification of facilities	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Integration between the single platform of the national authority for energy and E-REDES systems, allowing the submission of renewable energy communities requests and the creation of master data.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
Competent authorities, energy communities, DSO.					
AI capabilities / functionalities: Yes / No					
No					
What are the technological features of your digital solutions and what are the benefits from their use?					
webservice, interface with commercial system and entities' systems					

Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …). When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
Reduction of process duration, real-time treatment at any hour any day (automation, simplicity and more efficient procedures), handover reduction, increased customer information and satisfaction (no human errors), process traceability in IT systems (SAP) allowing daily monitoring, dematerialization, simplification and automation of the entire process. It has proved to be an enabling element that encourages renewable energy communities.
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Automation of stages of the procedures, online information on the process **Barriers:** • Process monitoring and error correction; solution doesn't yet include changes to the community (e.g., change of ownership, addition of new members…); pronunciation of the system operator to identify whether the energy community uses the public service electricity network is still done manually.

Use Case: E-REDES #4

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
GPLIC	Portugal	For every demand and generation connection	Submission of requests for authorisation by third parties	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Single application centralizing the entire permitting process, allowing the effective management and visibility over the entire process, automation of certain steps and communication between teams that handle the permitting process and technical teams.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
DSO, competent authorities					
AI capabilities / functionalities: Yes / No					
No					
What are the technological features of your digital solutions and what are the benefits from their use?					
Interface with commercial system and entities' systems					
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …).					

When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
Improved customer experience, reduction in submission and response times, operational efficiency, process automation (notification, process creation, status update)
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Integration with third parties, works planning. **Barriers:** • Diversity of third parties and submission method for each one, lack of capacity from competent authorities to implement the integration.

Use Case: E-REDES #5

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
AI algorithm for documentation validation	Portugal	For demand connections at LV level	Validation of documents and data consistency	DSO	In Operations
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Validation of documents and data consistency in requests submitted through the "Balcão Digital".					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
DSO					
AI capabilities / functionalities: Yes / No					
Yes, AI algorithm for documentation validation.					
What are the technological features of your digital solutions and what are the benefits from their use?					
Interface with commercial system					
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …).					

When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
Reduction of validation errors and of manual activities.
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Normalization, not subject to distinct interpretations. **Barriers:** • Technical and development limitations; Changes on necessary procedures/validations implying the adaptation of the algorithm.

Use Case: E-Distribution

Use Case Description					
Name of the digital solution / online platforms Requests Tracking	**Country** Spain	**Type of Connection request process:** Any type of connection request: - Generation - Consumption (EV charging stations, Data Centers included)	**Process stage short description** All the phases of the request	**Solutions' owners** DSO	**Maturity** In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
The customer, for all types of connection requests, can view the status of the request by login to the reserved area in the web portal. Thus, an E2E tracking of the request is available, allowing the customer to be constantly informed.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
All Web users (private area) can see the history of connection requests they have handled (as applicants or as representatives of a third party)					
AI capabilities / functionalities: Yes / No					
No					
What are the technological features of your digital solutions and what are the benefits from their use?					
• Responsive • Integration with other systems:					

- Provision of GIS data
- Connection to ERP, document management and CRM
- Interface with Order management for construction work and other external services

Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …).

When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).

- Customers can view the status of their request on the website at any time, regardless of the channel through which they have requested it.
- They can view/download all the relevant documentation: connection request, technical-economic offer, invoices...
- They can also do actions in the status when the request is pending: make digital payment, upload technical documentation, request inspections, ask for consultations...

Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?

Enablers:

- Effective collaboration / consultation with external stakeholders to understand their needs
- Supportive regulatory frameworks

Barriers:

- Technical limitations like interoperability issues with existing systems

Use Case: E-Distribuzione

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
Producer Web Portal, Smart Quotation	Italy	Distribution Generation	Request Submission, Request Check, Grid Calculations, Quotation Submission	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Customers can submit the connection request with the necessary documentations only from web producer portal after authentication, artificial intelligence analyses documents uploaded by the client: 56% of documents are validated by AI, 46% are analysed but not validated, the remaining percentage and the 46%analyzed but not validated are manually analysed in the back office; after that they proceed to the quotation phase. For all requests <50kW Prosumers the smart quotation is made, network calculations are performed automatically, and the technical solution is processed without operator intervention with an about 65% success rate, finally, the quotation is automatically sent to the customer without the need for a signature from the commercial.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
All producers' clients, Enel employees, Enel technical staff.					
AI capabilities / functionalities: Yes / No					
Yes, "Data and document analysis".					

Artificial intelligence analyses and verifies the documents (data, information, signature…) uploaded by the client based on the specific training model used.

What are the technological features of your digital solutions and what are the benefits from their use?

- Front-end development as web application or portal
- Real time response from web portal for preliminary checks
- AI automatic controls
- Automatic quotation without manual operations by back office staff
- System integration with electric calculations tool

Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …).

When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).

The solution have increased customer satisfaction due to a faster and more effective way to upload the request and to obtain a quotation. Furthermore, the solution made it possible to automate some manual tasks that were being performed by Enel operators. Some data:

- About 30% of requests automatically pass controls.
- About 65% of requests get automatic quotation without technician intervention.

Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?

Enablers:

- Strong support and buy-in from local permitting authorities
- Careful planning and integration strategy

Barriers:

- Technical limitations like interoperability issues with existing legacy systems
- Data privacy and security concerns
- Supportive regulatory framework

Use Case: TAURON Dystrybucja S.A. #1

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
Online form (OF)	Poland	Low and medium voltage grid connection requests	Request Submission	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Online form for submitting requests for connection to the low and medium voltage grid. The applicant can choose an option that will allow the case to be handled fully electronically from the submission of the application to the issue of the connection conditions and the transmission of the draft connection agreement.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
The online forms can be accessed by all customers who wish to submit a request for connection to the low and medium voltage grid. The forms are available on our website at: https://www.tauron-dystrybucja.pl/przylaczenie-do-sieci/formularze-online					
AI capabilities / functionalities: Yes / No					
N/A					
What are the technological features of your digital solutions and what are the benefits from their use?					

N/A

Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …).

When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).

- Easy access to applications,
- The possibility of submitting an application without leaving home,
- Fewer mistakes in applications,
- Fewer letters sent to customers asking them to fill in the blanks in the application.

Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?

Enablers:

- Strong support and commitment from employees and the Executive Council,
- Careful planning and integration strategy,
- Effective collaboration/consultation with external stakeholders to understand their needs,
- Supportive regulatory framework.

Barriers:

- Resistance from stakeholders,
- Technical constraints, such as integration issues with existing legacy systems,
- Concerns about privacy and data security,
- Lack of digital skills.

Use Case: TAURON Dystrybucja S.A. #2

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
SOPP	Poland	Support for a more complete grid connection process	Supports employees in handling the grid connection process from the moment a request for connection is received, through the issue of the connection conditions, the conclusion of the connection agreement, the financial settlement of the agreement and the completion of the connection process.	DSO	In Operation
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
SOPP supports our employees in handling the grid connection process from the moment a request for connection is received, through the issue of the connection conditions, the conclusion of the connection agreement, the financial settlement of the agreement and the completion of the connection process.					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
SOPP is an internal programme for employees who handle the connection process.					
AI capabilities / functionalities: Yes / No					
No					
What are the technological features of your digital solutions and what are the benefits from their use?					

N/A
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …). When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
• Uniform implementation of the connection process throughout the company (11 Branches), • Unified standard of customer service, • Easy access to documents and information about the connection process.
Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • Strong support and commitment from employees and the Executive Council, • Careful planning and integration strategy, • Effective collaboration/consultation with external stakeholders to understand their needs, • Supportive regulatory framework. **Barriers:** • Resistance from stakeholders, • Technical constraints, such as integration issues with existing legacy systems, • Concerns about privacy and data security, • - Lack of digital skills.

Use Case: Elvia

Use Case Description					
Name of the digital solution / online platforms	**Country**	**Type of Connection request process:**	**Process stage short description**	**Solutions' owners**	**Maturity**
Tilko	Norway	- Both generation and consumption - Medium and large scale (> 1MW)	-Inquiry (Pre-inquiry and Customer information / Request Review - Fast and early answers - Maturity assessment - Common capacity status for the grid owners and customer	DSOs, TSOs, competent authorities	Tilko has been tested in small scale and will be taken in to use around June by Elvia. In April it was implemented by a smaller Northeastern DSO, with two larger DSOs following in May.
Short presentation: Include a general description of the solution. Example: "Online portal to allow the submission of the requests, upload the necessary information and project, approve necessities by competent entities and monitor systematically the whole process, combined with Digital platform for licensing connection infrastructure to the public service network."					
Tilko shall deliver a national portal for grid connection requests over > 1 MW. The product will track the flow of information from and to the customer and share it across the relevant grid levels. All grid connection requests containing a requested demand equal to or above one megawatt (1 MW to regional, 5MW to transmission) of power must be assessed at three grid levels (local, regional, and transmission).					
External interfaces: Please describe the different roles which have access to the system: end users, competent authorities, generation project developers, SOs, installers, others, ...					
Clients interacts via a customer portal with their own access rights.					

A Grid company admin role can edit users and user roles through a dedicated admin GUI for this purpose. The person needs to be pre authorized in the org.register master (Brreg) Down the road, aggregated and meta data can be taken out of the system by the NRA, in addition to other relevant authorities, stakeholders and researchers.
AI capabilities / functionalities: Yes / No
No
What are the technological features of your digital solutions and what are the benefits from their use?
• Responsive web portal • Event driven architecture • Azure infrastructure (Elbits tenant) • OpenAPI specification on Swagger • National Grid Model integration (Nemo/FNN) • Map service (kartverket)
Benefits: Please describe the benefits gained from the introduction / implementation of the digital solution (ex: increased user experience, …). When possible, provide also quantitative benefits (ex. processing time - x%; increased user satisfaction x2, an increase of processed request: +x%,...).
• Projects over 5 MW: In daily use – around 2 hours per case (due to coordination between BSO/TSO ect.) • Savings due to making a better system on our own • Better customer experiance

Barriers and enablers: From your specific experience with this digital solution / platform, what are the main challenges foreseen when implementing digital tool solutions in the connection process and what helps?
Enablers: • A mature product fit for purpose • An ASIS – TOBE analysis that gives a defined business system before and after implementation • A structured plan for organizational implementation (training and migration) **Barriers:** • Timeline for technical implementation tasks. • Actual buy in from other grid companies in the grid development coordination area (NUK) • Possible, unknown compliance issues