EU wide implementation challenges of **interoperable platforms**

PUBLIC CONSULTATION OneNet Roadmap (PART 2)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

1 Introduction

In pursuit of fostering a more efficient, sustainable, and resilient energy market, the OneNet project has undertaken a thorough examination of solutions and recommendations designed to propel us towards a common market design and interoperable IT architecture. Through large demonstrators, we aim to verify the feasibility and effectiveness of the proposed solutions in real-world field tests.

Our systematic assessment has categorized the OneNet solutions into four objectives or thematic areas, each accompanied by a brief key message outlining the proposed steps forward. Through a thorough analysis, we have identified key enablers and barriers tied to each set of solutions, taking into account regulatory, economic, and technical considerations. Furthermore, we identified the level of impact or appropriate level of intervention for each barrier and enabler.

As we progress in this exercise, it is imperative to engage with a diverse array of stakeholders to validate our assessments and ensure the inclusivity and robustness of our findings. To this end, we have crafted a comprehensive consultation document, aimed at eliciting valuable insights and perspectives from various stakeholders.

This consultation document serves as a platform for all stakeholders to provide valuable feedback on the following key questions:

- What is the top solution within each objective that you believe should be prioritized on policy agendas?
- In your view, what are the main barriers and enablers for these solutions?
- What recommendations do you propose for further policy development in these areas?
- Are there any gaps or topics currently not addressed that you deem important for achieving an interoperable IT architecture?

Your participation in this consultation process is important to shaping future policies and initiatives aimed at fostering a more interoperable IT architecture to support future energy markets. We welcome your insights and contributions to this important undertaking.

➔ Answers could be provided to: Madalena Lacerda (madalena.lacerda@e-redes.pt) , Carlos Damas Silva (carlos.damassilva@e-redes.pt) **until 12/03/2024**

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2 Interoperability

With the development of new flexibility markets and introduction of new market parties and roles, there is the increasing need to guarantee a seamless communication between different systems that currently meet different standards and are not interoperable. Hence, expanding interoperable solutions across borders would promote the establishment of a common and coordinated market for flexibility services. OneNet makes a strong effort in the promotion of interoperable and replicable solutions, aiming to reach the following objectives for increased interoperability:

1. Process standardization: Establishing uniform procedures and protocols to streamline operations and enhance compatibility across different systems.
2. Cybersecurity and privacy: Implementing robust security measures and privacy policies to protect sensitive data and systems from cyber threats and ensure user confidentiality.
3. Technological enablement and exploitation: Ensure the necessary scalability and replicability of the solutions developed, so that they are easily and effectively implemented and scaled up within and across different countries.
4. Stakeholder participation and coordination: Facilitating collaboration and communication among all market participants, including providers, consumers, and regulators, ensuring a smooth information exchange between them.

The following sections will explore the main solutions developed within the OneNet project to promote the achievement of these objectives, exploring the different enablers and barriers that can exist for the effective implementation of these solutions, the level of intervention for these enablers and barriers required and concludes with a series of recommendations for an effective roll-out of interoperable solutions.

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2.1 Process Standardization

KEY MESSAGE:

The OneNet project contributes significantly to process standardization within the energy sector by tackling interoperability, scalability, and data ownership. It incorporates recommendations from widely recognized initiatives such as IDS and FIWARE, uses standards such as CIM, and it developed a set ofcross-platform services. This approach facilitates the integration and cooperation among OneNet participants through the OneNet system, ensuring that diverse platforms can interact seamlessly. It also proposed the OneNet Information Model that adopts the NGSI-LD standard, promoting a high level of standardization and reuse, which is crucial for the scalable and interoperable implementation of decentralized middleware and connectors.

Solutions

OneNet Decentralized Middleware and Connector

The OneNet Decentralized Middleware is a key part of the OneNet system, designed with a decentralized architecture using widely recognized standards like IDS and FIWARE. This approach promotes the integration and cooperation among OneNet participants, supporting cross-platform market and network activities. It emphasizes scalability, interoperability, and data ownership. The OneNet Connector, designed for easy deployment and integration with existing platforms, provides user-friendly REST APIs and GUIs for data exchange. It also includes a predefined list of Cross Platform Services, Business Objects, and Data Profiles to facilitate semantic and data interoperability.

Business Object List

Business Object List defined to tackle the multiple cross-platform services of OneNet, which provide their semantic definition on standard profiles such as CIM and CGMES.

OneNet defined 43 business objects, and throgh an analysis of the semantic description of business objects, it was concluded so far that they can be generally addressed by IEC profiles such as IEC 62325 (ESMP), IEC 61970 (CGMES), IEC 61968 (CDPSM) and potentially by their subsequent enhancements.

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NGSI-LD information model that raises a hybrid solution using both standard models for implementing the OneNet Decentralized middleware and the OneNet Connector. The usage of IDS Connector and FIWARE Context Broker was identified as the best solution to be adopted for ensuring a high level of standardization, interoperability, scalability and reuse of OneNet solution.

Enablers & Barriers

Table 1. Table of Enablers and Barriers for the above Macro Solution. Topics are grouped into Economic (E), Regulatory (R), and Technical (T) topics.

	Enablers		Barriers	
	Topic	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*	**Topic**	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*
E	Cloud services for individual energy data measurements and possibly aggregation that could be used by a FSP through an API	L S / C **M** / **E** L	Implementation of proprietary solutions for data exchange	L S / **C M** / E L
E	Definition of standards/ontologies that are easily applied between DSOs, TSOs and other market parties that allow an adequate degree of flexibility for adaptation	L S / **C M** / **E** L	Non-existent interoperability between standards for certain operations	L S / **C M** / **E** L
E	Promote the uptake of the dataspace concept, particularly the energy data space	L S / C **M** / **E** L	Complexity of existing standards	L S / **C M** / **E** L
E			The shift to other SO interoperable solutions may require several adaptations to their internal processes/systems/tools	**L** S / **C M** / E L
R	Lower costs for new players to participate in existing/new markets	L S / **C M** / E L	Technical and budget limitations by some parties (e.g., smaller DSOs that operate in LV grids only)	L S / **C M** / **E** L
R	Usage of open-source solutions	L **S** / **C M** / E L	Cost to adapt existing systems may be high and difficult to retrieve from tariffs	L S / **C M** / **E** L
R			Cost splitting of interconnecting the trans-national systems	L S / C **M** / **E** L
T	Harmonized schedules for data exchange in the market process and structured processes	L S / **C M** / **E** L		
T	Use of smart contracts, streamline of settlement and activation processes	L S / **C M** / E L	Missing governance for pan-European data exchange, including reference models	L S / C **M** / **E** L
T	Establishment of harmonized reference processes	L S / **C M** / **E** L	Missing submetering regulation	L S / **C M** / **E** L
T	Clear integration guides for user about how to connect to a data space like system	L S / C **M** / **E** L	Access to standards is not free	L S / C **M** / **E** L
T	Promote the use of open-source standards	L **S** / **C M** / **E** L	Missing governance models	L S / **C M** / E L

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Recommendations

- Promotion of CIM and HEMRM (NORTHERN)
- Integration with data spaces like OneNet framework should be seamless for market parties (NORTHERN)
- Standardize workflows and data exchange information models between stakeholders to ensure consistency and efficiency across different operations. (WES-PT)
- Define data standards/ data models between different stakeholders and protocols for data exchange, storage, and analysis to maintain data integrity and reliability. (WES-PT)
- Adopt modular and flexible architectures (ex: TDEP and DDEP for PT demo) that allow for easy integration of new systems and services as needed. (WES-PT)
- Participate in relevant standardization bodies and industry consortia to contribute to the development of interoperability standards and guidelines to increase processes standardization measures (WES-PT)

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2.2 Cybersecurity & Privacy

KEY MESSAGE:

The OneNet project places a significant emphasis on cybersecurity and privacy, recognizing these aspects as crucial to the integrity and resilience of the data exchange tools and infrastructure. Through its various initiatives, OneNet aims to address the growing concerns around cybersecurity threats and the need for robust privacy measures in the energy sector. The strategies and tools developed under OneNet offer a comprehensive approach to enhancing cybersecurity and privacy protections, but providing a set of recommendations, tools and frameworks.

Solutions

OneNet Cybersecurity Recommendations

A comprehensive framework designed to enhance the security posture of grid operators within the smart grid ecosystem. These guidelines encompass a broad spectrum of security measures, including access control, system and communication protection, incident response, and risk management. Tailored to align with the NISTIR 7628 Smart Grid Cyber Security standards, they emphasize the importance of maintaining the confidentiality, integrity, and availability of the network infrastructure. By integrating these recommendations, grid operators can proactively address cybersecurity threats, ensuring a resilient and secure smart grid environment.

OneNet Monitoring and Analytics Dashboard

The OneNet Monitoring and Analytics Dashboard is designed to enhance cybersecurity within the OneNet infrastructure. It integrates features for real-time and historical data monitoring, employing machine learning algorithms for anomaly detection. Through its comprehensive logging and analysis capabilities, the dashboard supports the secure and efficient operation of the grid, highlighting the critical intersection between operational technology and cybersecurity in modern energy systems.

Energy Sector Security Framework

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OneNet D4.4 provide the Energy Sector Security Framework, detailing the integration of cybersecurity measures within the European energy sector. It covers the implementation of cybersecurity network codes, adherence to the NIS 2 Directive, and the application of cybersecurity standards. It serves as a guideline for ensuring cybersecurity resilience, offering a structured approach for the sector's stakeholders to protect infrastructure and data against cyber threats, in alignment with current regulations and standards.

Enablers & Barriers

Table 2. Table of Enablers and Barriers for the above Macro Solution. Topics are grouped into Economic (E), Regulatory (R), and Technical (T) topics.

	Enablers				**Barriers**			
	Topic	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*			**Topic**	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*		
E	R&D Investment	L **S**	C **M**	**E** L	System Integration Challenges	**L** **S**	**C** **M**	E L
E	Continuously pen-test existing and new systems	L **S**	**C** **M**	**E** L	Intellectual Property Concerns	L S	**C** **M**	E L
E	Develop and adopt data sovereignty tools	L S	**C** **M**	**E** L	Lack of interoperability in existing systems	L **S**	**C** **M**	**E** L
E	Economies of Scale	L S	C **M**	**E** L	Supply Chain Risks	L S	C **M**	**E** L
E	Build upon industry de facto standards	L S	**C** **M**	**E** L				
R	Investment in Advanced Technology	L **S**	**C** **M**	E L	High Costs of Implementation	L S	**C** **M**	**E** L
R	Cyber Insurance	L S	**C** **M**	E L	Limited Return on Investment	L S	**C** **M**	E L
R	Information being exchange in a secure way generate new business opportunities	L S	**C** **M**	**E** L	Budget Constraints	L S	C **M**	E L
R	Cost-Benefit Analysis for Security Measures	L **S**	**C** **M**	**E** L	[NORTH] Awareness of end-customers and small FSPs about GDPR requirements	L **S**	**C** M	**E** L
R	Create smooth tools and processes enabling FSPs to comply with GDPR requirements	L **S**	**C** **M**	**E** L				
T	Financial Incentives and Subsidies, including Compliance and Audits	L **S**	**C** **M**	**E** L	Regulatory Lag incompatible with risks and threats	L S	**C** **M**	E L
T	Funding for Compliance and Audits	L S	**C** **M**	**E** L	Enforcement Challenges	L S	**C** **M**	E L
T	Separation of duties, establishment of data sharing reference process	L S	**C** **M**	**E** L	Diverse set of available Standards	L S	**C** **M**	**E** L
T	Stabilization of regulation	L **S**	**C** **M**	**E** L	Lack of trusted entity, or set of entities, for decision making and monitoring	L S	**C** **M**	**E** L

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Recommendations

- Compromise between actors' security requirements and implementation costs (WES-FR)
- Due to increasing amount of private data, including from sub-meters, pay attention on proper consent management (NORTHERN)
- Conduct regular security test to the existing tools/platforms and integrated systems to identify and mitigate potential vulnerabilities. (WES-PT)
- Regularly update and patch software components to address known vulnerabilities and protect against emerging cyber threats. (WES-PT)
- Encrypt sensitive data to protect it from unauthorized access or interception. (WES-PT)
- OneNet Connector by some parties in the Portuguese Demo was blocked by the cybersecurity measures that were needed, like the required exposure of public static IP. The recommendation is to find an alternative to that for regulated domains, in the Portuguese case deployment in cloud environment was the solution. (WES-PT)

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2.3 Technological Enablement & Exploitation

KEY MESSAGE:

OneNet puts a strong effort on the scalability and replicability of the solutions developed, aiming to increase the technology enablement and exploitation. It achieves this through the implementation of open standards and development solutions based on a decentralized Data Space Concept, which is the case of the OneNet system, that allows integration across multiple stakeholders and countries. As main recommendations to these solutions are the prioritization of standardised data models and the investment in scalable and adaptive IT infrastructure.

Solutions

Adopt a decentralized Data Space Concept through the OneNet System

This is done through the implementation of the OneNet Framework developed, which seamlessly connects different flexibility platforms and energy stakeholders, allowing various stakeholders to exchange reliable and trusted data with one another through a secure and smooth process. OneNet relies on a decentralized data interoperability mechanism that serves the purpose of facilitating data exchange and allowing to achieve scalability and real-time data integration across multiple stakeholders and countries.

Implement industry-standard protocols and utilize open standards

It will allow to ensure system-wide compatibility and integration through industry-standard protocols between different systems and devices, while also facilitating the integration of new technologies and systems from various vendors through the usage of open standards.

Enablers & Barriers

Table 3. Table of Enablers and Barriers for the above Macro Solution. Topics are grouped into Economic (E), Regulatory (R), and Technical (T) topics.

	Enablers		Barriers	
	Topic	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*	**Topic**	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*
E	**Cost and Economic Viability:** a) clear and attributable division of costs; b) targeted funding and grants.	L **S** **C** **M** **E** L	**Cost and Economic Viability:** a) Profitability of business model (high initial costs for infrastructure and device upgrades risks of high R&D	L S **C** **M** E L

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					expenditure); d) Complexities in quantifying benefits and balancing regulatory cost implications			
E	**Data Space Utilization:** a) Quantify value for stakeholders; b) Definition of UCs.	L S	**C** **M**	**E** L	**Technical and Resource Limitations:** a) Technical and budget limitations, particularly for smaller players	L S	**C** **M**	E L
E	**Market Access and Innovation:** a) Access to new markets and business models	L S	**C** **M**	**E** L	**Market Dynamics and Risk Management:** a) Risk aversion towards new solutions; b) Interest in maintaining market share and control over data use	L S	**C** **M**	E L
R	**Regulatory Innovation and Flexibility:** a) Performance-based regulation; b) Regulatory experimentation; c) Regulatory support for advanced management and response tools.	L S	**C** **M**	**E** L	**Regulatory Knowledge and Framework Limitations:** a) Regulators' limited technological knowledge; b) Regulatory framework not supportive of riskier investments; c) Lack of an overarching EU regulatory body to harmonize standards and practices across MS	L S	**C** **M**	**E** L
R	**Standards and Compliance for Expansion and Security:** a) Promote the adoption of open standards; b) Compliance with national and international standards; c) Set industry-wide standards that promote consistency and security	L S	**C** **M**	**E** L	**Regulatory Divergence and Complexity:** a) Diverging regulatory frameworks between MS; b) Navigating diverse and changing regulatory environments across different markets is complex and resource intensive	L S	**C** **M**	**E** L
R	**Stakeholder Collaboration and Market Fairness:** a) Stakeholder engagement and exchange of best practices; b) Regulations ensuring consumer data privacy and security	L S	**C** **M**	**E** L	**Standards, Compliance, and Consumer Awareness:** a) Compliance with complex and varying standards and protocols; b) Lack of understanding or awareness among consumers regarding their rights and protections	L S	**C** **M**	E L
T	**Standardization and Efficiency:** a) Standardized interfaces and data models; b) Adopt plug-and-play solutions for easy integration	L S	**C** **M**	**E** L	**System Compatibility and Integration:** a) Integrating legacy systems with new, interoperable technologies (existing ones are tailor made and with high security standards); b) Developing universally compatible and scalable solutions that can adapt to various operational needs	L S	**C** **M**	E L
T	**Support and Scalability for Market Participants:** a) Technical assistance and capacity building for smaller market parties; b) Modular and scalable system designs	L S	**C** **M**	E L	**Technical and Financial Constraints:** a) Existing technical and budget limitations faced by smaller parties	L **S**	**C** **M**	**E** L
T	**Real-time Data and Grid Management:** a) Access to real-time data and ability to participate in DR programs; b) Enhanced capabilities for monitoring, control real-time response.	L S	**C** **M**	E L	**Operational and Regulatory Adaptation:** a) The necessity for several adaptations to internal processes, systems, and tools when shifting to interoperable solutions; b) Challenges in understanding and interacting with advanced energy management systems	**L** S	**C** **M**	E L

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Recommendations

Prioritize Standardized Data Models for Seamless Technological Integration: The adoption of standardized data models is crucial for enabling a smooth and seamless technological integration. Emphasizing data-driven services, such as data harmonization and data quality, will further facilitate the agnostic integration of pre-existing components. This approach is key to achieving efficient interoperability across various systems and platforms. The need for standardized approaches isn't restricted to data models, with the introduction of new market players, it is increasingly important to define harmonized role models (e.g., HEMRM) to promote scalability and replicability.

Conduct a Comprehensive Trade-Off Analysis for Flexibility Solutions: Grid operators are advised to undertake a thorough trade-off analysis to evaluate the benefits and drawbacks of advanced, potentially more economically efficient flexibility solutions that rely on advanced monitoring technologies, compared to other alternatives like traffic-light systems. This analysis should encompass various critical factors such as cost-effectiveness, scalability, deployment speed, and long-term benefits. Such a comprehensive assessment will enable grid operators to make well-informed decisions that balance immediate needs with long-term strategic goals.

Invest in Scalable and Adaptive Infrastructure: Infrastructure investment decisions must prioritize scalability and flexibility to ensure that systems can grow and adapt with evolving technological landscapes and market demands. This means choosing solutions that are modular, scalable and can be easily upgraded or expanded, for example, through the implementation of middleware solutions, such as the OneNet system and APIs, to enable interoperability and communication between different systems and platforms. It also means building in the capability to integrate emerging technologies, such as renewable energy sources, energy storage, and electric vehicles, without extensive overhauls. A forward-looking infrastructure strategy considers not just current needs but also anticipates future developments.

Utilize Advanced Data Analytics for Informed Decision-Making: Advanced data analytics tools are vital in managing the increasingly complex and voluminous data generated by modern grids. These tools should be capable of integrating data from disparate sources to provide a holistic view of the grid's operations. By applying sophisticated algorithms and machine learning techniques, operators can extract valuable insights for more informed decision-making. These insights can lead to improvements in operational efficiency, more precise demand forecasting, and better customer service.

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Forge Synergistic Partnerships for Shared Success: Collaboration with technology providers, other utilities, and stakeholders is key to leveraging collective expertise and achieving economies of scale. Partnerships can take various forms, from joint ventures to research collaborations, and should be aimed at sharing risks and rewards equitably. By pooling resources and knowledge, organizations can accelerate the development of interoperability solutions and drive innovation. Collaborative efforts also provide a platform for setting industry benchmarks and best practices.

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2.4 Stakeholder Participation/Coordination

KEY MESSAGE:

For an increased stakeholder participation in new flexibility markets and to allow coordination between them, it is imperative to ensure interoperability between the different systems, through implementation of standards and by reinforcing the transparency of the data collected and used by the market parties. As main recommendations, OneNet proposes to have clear role definitions and duty separation and to adopt scalable, adaptable and user-friendly architectures and interfaces for easy integration of new market parties.

Solutions

Extension of the CIM Model

This extension should include consumer aspects, allowing their seamless participation in the several energy markets. To ensure this, the CIM data model should incorporate a more extensive set of standardized data exchange models tailored to both large and small FSPs, facilitating seamless communication across diverse energy systems.

Transparency in Data Collection and Usage

Articulate and publicize the types of data collected from consumers and FSPs, detailing how this data contributes to grid optimization and individual benefits. Specific access rights need to be defined for different stakeholders, including utilities, aggregators, and consumers, while implementing robust privacy measures to protect sensitive information. Finally, provide comprehensive disclosures regarding the purposes for which data is used, including system management, market operations, and personalized services, ensuring consumers are fully informed.

Enablers & Barriers

Table 4. Table of Enablers and Barriers for the above Macro Solution. Topics are grouped into Economic (E), Regulatory (R), and Technical (T) topics.

	Enablers				Barriers			
	Topic	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*			**Topic**	**Level of Intervention** *(L - Local, C - Country, E - European) (S – Short, M – Medium, L – Long)*		
E	**Economic Incentivization:** a) Developing incentive schemes to encourage participation and	L S	**C** **M**	E L	**Economic Disparities and Integration Costs:** a) Cost of integration can be high and the impact can be "experienced"	L **S**	**C** **M**	**E** L

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	investment; b) Remunerating stakeholders for data access.			differently amongst different stakeholders; b) varying economic capacities among stakeholders.	
E	**Benefit Distribution:** a) Implementing value sharing mechanisms to ensure equitable distribution of economic benefits.	L S	**C M**	E L	**Valuing Non-Quantifiable Benefits:** Economic difficulty in quantifying certain benefits of interoperability.	L S	**C M**	E L
E					**Mismatch Between Business Models and Market Demand:** Service acquisition business models do not align with the actual needs and preferences of the customers.	L S	**C M**	E L
E					**Economic Risks of Data Sharing:** Data provision may be a risk especially for companies.	L **S**	**C M**	E L
R	**Technological Advancements and adoption of open solutions**: a) Speed up the introduction of smart meters across Europe; b) Remove vendor lock-in solutions and shift towards open solutions.	L **S**	**C M**	E L	**Regulatory Harmonization and Data Governance:** a) Missing governance for pan-European data exchange; b) Diverging and divergent regulatory frameworks and standards across MS; c) Missing regulation concerning customer data ownership and access.	L **S**	**C M**	**E** L
R	**Transparency and Enhanced Communication:** a) Transparency and reporting requirements, making operations more understandable and trustworthy; b) Raising customer awareness about business parties, data access rights, and the implications of the electricity market.	L S	**C M**	E L	**Technical Integration and Financial Allocation Challenges:** a) Communication requirements and the associated high costs for smart FSPs to connect with other market players; b) Challenge of how to distribute ICT costs due to its interrelation with regulatory aspects	L S	**C M**	E L
R	**Harmonization and Standardization Initiatives:** a) Data exchange harmonization on EU level; b) Harmonization of rules, roles and processes.	L S	C **M**	**E** L	**Customer Engagement and Market Literacy:** a) Customer unwillingness to understand or engage with electricity market implications.	L S	**C M**	**E** L
T	**Standardization and Data Integration:** a) Implementation of a Common European Data Space for Energy; b) Standardization of data exchange protocols and adoption of standardized data models such as the CIM, including its extension to customer and small FSP aspects; c) Development of standardized interfaces and data models.	L S	**C M**	**E** L	**Data Access and Privacy:** a) Limited availability of grid data from SOs; b) Data security and privacy concerns.	L **S**	**C M**	E L
T	**Knowledge Exchange and Best Practices:** a) Encouragement of knowledge sharing and the exchange of best practices.	L S	**C M**	**E** L	**Technological and Infrastructural Challenges:** a) Technological heterogeneity across stakeholders; b) Technical complexity of tools and platforms; c) Lack of standardization in data exchange and the slow adoption of standardized data models like CIM.	L **S**	**C M**	**E** L
T	**Technical Simplification and User Experience:** a) Automation of processes to address the technical complexity of tools and platforms; b)	L S	**C M**	E L	**Market Participation and Aggregation Issues:** a) FSP aggregation primarily focused on industrial FSPs; b) Restrictive market participation conditions	L S	**C M**	E L

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	Design and implementation of user-friendly interfaces.		for residential load aggregators (consumers), such as the requirement for a minimum bid of 1 MW.	
T			**Expertise and Knowledge Gaps:** a) Lack of technical expertise among varied stakeholders.	L S C M E L

Recommendations

Implement Structured Role Definitions and Duty Separation: It's recommended to rigorously define roles and responsibilities within the operational framework. This step involves establishing clear, distinct job descriptions and a separation of duties, aimed at eliminating conflicts of interest and ensuring operational integrity. This approach not only promotes accountability and efficiency but also aligns with best practices for interoperability by clarifying interfaces and interactions among different roles. Such structured role clarity is vital for maintaining streamlined, conflict-free processes, essential for achieving optimal interoperability in complex operational environments.

Adequate regulation of Smaller Residential FSPs: Create the necessary regulatory framework for the operation and aggregation of smaller residential FSPs to ensure their effective participation in the energy market without compromising system stability or market fairness.

Stakeholder involvement and knowledge exchange: Promote workshops and initiatives to create consumer awareness about the importance of their participation in the existing/upcoming flexibility markets and empower stakeholders to effectively utilize and integrate technological components, maximizing the benefits of interoperability. The involvement of stakeholders should also be extended to the aim of defining data models and data exchange protocols adequate to the several market parties.

Adoption of adaptable and user-friendly architectures and interfaces for easy integration: Adopt modular and flexible architectures that allow for easy integration of new stakeholders, facilitating integration of systems and applications used by different stakeholders. Use of a GUI to show up the analysis and data gathered for the different UCs, to give visibility to the different stakeholders involved.

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