



## Publishable Summary for 18NET03 SEG-net Support for a European Metrology Network on smart electricity grids

### Overview

Electricity grids are a key enabler of the “**Energy Transition**” towards a sustainable energy system, but face huge challenges due to, for example, the desired uptake of renewable energy sources and electric vehicles. So far, over 20 joint research projects (JRPs) have provided crucial metrology support for the development of (smart) electricity grids, but their impact has been hampered by a lack of higher-level coordination. This project will accelerate the full establishment of a European Metrology Network on Smart Electricity Grids (EMN SEG) to realise a coherent National Metrology Institute (NMI) response to smart electricity grid measurement challenges, to provide a single point of contact for stakeholders, and to maximise the impact of R&D activities.

### Need

The European Commission’s Energy Union strategy to “build a low-carbon, climate resilient future” via “secure, clean and efficient energy”, has a profound impact on electricity grids – the backbone of our modern society. Grid stability and quality of supply is negatively affected by the significant uptake of renewable energy sources (RES) and grid energy losses need to be reduced in order to meet EU climate targets. Over 20 joint research projects under the iMERA-Plus, EMRP and EMPIR programmes have so far provided crucial metrology and normative support to the development of smart electricity grids, with extensive stakeholder interaction and support. However, there is a significant need for more coordination in electricity grid metrology focussing on stakeholders’ technological and strategic objectives.

Stakeholders need long-term commitment and a coherent, well-considered joint R&D agenda to ensure that all their metrology needs are adequately addressed, and that measurement solutions are available when they need them. The metrology community can only meet these challenges by agreeing, well in advance with all relevant stakeholders, what metrology is needed and when, and by carefully coordinating national programmes within the framework of a European joint Strategic Research Agenda (SRA). Once R&D results are available, the stakeholders will need easy access to these results. They do not want to navigate a plethora of individual project websites but instead need a simple, comprehensive platform that provides all information and answers across the full range of their needs. Next to easy access to R&D results, there is a need for practical knowledge transfer. Whilst utility engineers, manufacturers, and companies lack the particular metrological knowledge required to fully implement the smart electricity grid, there is no systematic programme satisfying the full metrology training needs of this stakeholder community.

The stakeholder needs in smart electricity grid metrology are extensive and call for major investments in an adequate European metrology infrastructure. Given these investments, a complete and comprehensive European metrology infrastructure can only be sustained by smart specialisation, where each country focusses its activities and investments based on its (unique) expertise and the national stakeholder needs. At the same time the complete range of NMI capabilities in Europe will optimally cover the needs of all EU stakeholders.

For measurement issues related to the energy transition and smart electricity grids, European stakeholder organisations want to move away from the present ad-hoc and project-based contacts with individual NMIs, to a more systematic contact with a recognisable entity that represents the metrology community. On the NMI side, there is an increased need to become more visible as utilities and industry are all too often unaware of the significant added value that metrology research can provide. EURAMET has recently decided to initiate a European Metrology Network on Smart Electricity Grids to optimise the use of limited NMI/DI resources in meeting smart electricity grid industry and standardisation challenges. Given the urgency to achieve this aim, there is a need to support and accelerate the full implementation of the EMN.



### Objectives

The overall aim of this project is to support the European Metrology Network on Smart Electricity Grids and to accelerate its full implementation via the achievement of the following objectives:

1. To establish systems within the EMN to coordinate and align national R&D strategies, including:
  - Developing a European joint strategic research agenda together with all relevant stakeholders, describing current and future stakeholder metrology needs related to smart electricity grids.
  - Defining roadmaps and strategies to meet these needs. To discuss prioritisation of national R&D strategies with the aim of preventing unnecessary duplication and optimising the use of precious resources.
  - Liaising with instrument manufacturers and other relevant stakeholders to ensure that early take-up of future metrology R&D is incorporated into the defined strategies.
2. To significantly enhance exploitation and uptake of research results from multiple EMRP and EMPIR joint research projects and national research activities through the realisation of a virtual knowledge hub, which will serve as a single point of contact to stakeholders, providing easy access to the full range of smart electricity grid metrology research results, relevant NMI calibration services, and a help desk to submit metrology needs and/or request further information.
3. To develop a plan for a joint sustainable European metrology infrastructure for Smart Electricity Grids by stimulating smart specialisation of European NMI facilities and services, including:
  - Producing a comprehensive overview of existing facilities and services across Europe and identifying deficiencies.
  - Promoting alignment of national R&D priorities with these deficiencies and with the future needs of stakeholders.
  - Stimulating sharing and use of existing large grid-metrology infrastructure by all participants in the network and by the wider stakeholder community.
4. To create a widely visible identity as the voice of the European electricity grid metrology community (including logo, flyers, newsletters, etc) and to establish liaisons with relevant European stakeholder organisations such as ENTSO-E, CENELEC, WELMEC, EURELECTRIC, TD Europe, ESMIG and similar organisations worldwide such as IEC, OIML, CIGRÉ, with the European JRC on Smart Electricity Systems and Interoperability, and with related European H2020 research projects.
5. To set up an extensive knowledge transfer programme for the associated EMN consisting of training courses, webinars, best practice guides, and other materials such as publications, events and R&D activities with a significant training component, and a web-based platform to attract and stimulate exchange of metrology R&D researchers.

### Results

*Strategic research agenda for smart electricity grid metrology and technical implementation roadmap (Objective 1)*

A first version of the Strategic Research Agenda (SRA) has been drafted based on the extensive stakeholder information that the EMN SEG member and partners have acquired in the past decade. The SRA includes: a short introduction on EURAMET and the EMN concept, an overview of Smart Electrical Grids in the framework of the European Green Deal, and several generic grid challenges and a description of the related measurement infrastructure. The main chapter of the SRA covers the measurement challenges in electricity grids, divided over 9 themes: revenue metering, power quality, digital substations, instrument transformers and sensors, grid monitoring and data analytics, efficiency, high-voltage testing, DC grids and applications and grid integration.

The draft SRA has been shared with the EMN SEG stakeholder community, together with an extensive survey soliciting for comments. In total 80 stakeholders from 15 countries and several pan-European organisations have participated in the survey. Further stakeholder feedback on the SRA will be sought via site visits, and three (web) workshops. The results of these stakeholder consultations will be used to prepare a final version of the SRA early 2022.



In addition, the project is continuing its efforts to extensively document and review the process of stakeholder consultation in developing the SRA, so that future revisions of the SRA by the EMN will profit from the lessons learned from the initial exercise.

The draft SRA with the collection of the stakeholder needs has already been very successful in steering new project proposals of the EMN SEG community as part of the EMPIR 2019 Energy Call, and more recently of the 2021 Green Deal and Normative calls of the European Partnership on Metrology. At present, three [EMPIR 2019 projects](#) (19ENG02 FutureEnergy, 19NRM05 IT4PQ, and 19NRM07 HV-com<sup>2</sup>) have started their R&D activities and six new proposals are presently being prepared as part of the 2021 Green Deal and Normative calls.

### *EMN virtual knowledge hub (Objective 2)*

An extensive functional specification is being developed for the EMN SEG virtual knowledge hub, together with “wireframe” prototypes of the webpages. In this development, smart grid experts worked closely with a professional web developer in multiple iterations for achieve the desired result. The specification has been verified with coordinators of previous and running smart grid metrology projects, and with stakeholders from key stakeholder groups. The functional specification and the wireframes have been implemented by EURAMETs web contractor as a first implementation on the live platform. Thereafter the project will provide a handbook on the development and maintenance of the virtual knowledge hub, including technical instructions and guidance on how to maintain consistent presentation of the contents over the years, including after this project has finished, thus enabling sustainability of the hub.

### *Smart specialisation (Objective 3)*

The project has designed an extensive survey in order produce an overview of the existing metrology landscape for electrical energy covering current measurement capabilities, national priorities, and existing large infrastructure. The enquiry has been completed by the European national metrology institutes and designated institutes active in the area of smart electricity grids, and an overview report is presently being finalised. Based on this report, an analysis will be made of the gaps and overlaps in order to optimise the limited national resources in tackling stakeholder challenges. Following this analysis, a strategy will be developed to achieve an adequate and sustainable metrology infrastructure via smart specialisation within the framework of the EMN SEG. This strategy will ensure that, as far as possible, all stakeholder needs are covered, whilst countries still have a final decision on where they become active and focus their activities.

### *EMN identity and liaisons (Objective 4)*

A strong EMN identity is essential for its recognition, visibility and influence with stakeholders, research funders, regulators and governments. It will also be crucial for establishing international leadership through a single recognisable entity that represents the metrology community in discussions on measurement issues related to the energy transition and smart electricity grids. The project has collaborated closely with EURAMET in the production of specific material to promote the EMN and to present the EMN at stakeholder events in a form that follows the EURAMET style guide for EMNs. A logo has been developed for the EMN, as well as for the nine main themes in the EMN. Presently work is underway to produce the required templates for presentations, posters, newsletters, etc.

To enhance the interaction of the smart electricity grid metrology community with strategic stakeholders, the project has produced an overview of the wider (smart) electricity grid community in Europe and will subsequently realise liaisons on behalf of EMN SEG with at least 5 high-level stakeholder organisations. The overview covers the complete range of stakeholder communities: utilities, industry associations, manufacturers, standard organisations, and universities. An “EMN SEG strategic liaison plan” has been developed and formal liaisons have been initiated with CEN-CENELEC TC38 “Instrument Transformers” and IEC TC42 “High voltage and high current technology”. Both TC’s have responded very positively to the request for liaison, and presently the last actions are being taken to formalise these liaisons.

### *Knowledge Transfer programme (Objective 5)*

To improve the dissemination of the knowledge resulting from the smart electricity grid metrology joint research projects, the project has developed an enquiry, where all EMN SEG members and partners have provided



information on their present and planned training and other KT activities. The resulting overview is presently being used to identify opportunities for (joint) development of new training courses. Furthermore, preparations have already started for the organisation of a PhD Summer School on smart grid metrology in 2022.

Together with the development team of the virtual knowledge hub it has been discussed how information about the training programme will be made accessible via a dissemination and training section of the virtual knowledge hub. Furthermore, a web-based platform will be set up on the virtual knowledge hub with details of guest researcher opportunities, MSc / PhD positions, and student internships. The EMN SEG has already received the first requests for PhD positions within the network via the present EMN SEG page on the general EURAMET website.

### Impact

The project partners presented EMN SEG at 12 International and European conferences, including EURAMET events. 3 additional presentations have been given to key IEC and CEN-CENELEC technical committees. In addition, the project together with the EMN SEG and EMN EG presented the results and activities during a stakeholder event at the European Parliament which was held on 4 February 2020. This event was part of the “11<sup>th</sup> European Innovation Summit” organised by the Knowledge for Innovation (K4I) platform, to advocate the role of metrology in achieving the EU Green Deal aims. With two Members of Parliament hosting the event, and more than 60 attendees, the fully booked event was highly successful in promoting the relevance of the EMN SEG and EMN EG in realising the EU Green Deal objectives.

For stakeholders, this project and its associated EMN will greatly reduce the present ad hoc approach to meeting their smart electricity grid metrology needs. Increased specialisation of NMIs will enable more efficient use of resources, thus allowing stakeholders’ needs to be covered more effectively. Aligning and focussing R&D activities via the strategies for implementing the joint SRA developed in the project will increase the scientific output, stimulate scientific cooperation between NMIs and with universities and other organisations, and most of all, it will ensure that the needs of all stakeholders will be met more consistently. Impact studies have proven that such consistent metrology support enhances the competitiveness of companies and that it results in more jobs.

Furthermore, the realisation of the virtual knowledge hub will significantly increase the exploitation and uptake of electrical grid metrology R&D. Allowing stakeholders to access R&D results by topic rather than by project alone will greatly increase the accessibility of the project’s results. The concise knowledge transfer programme developed in this project and implemented within EMN SEG will further enhance the dissemination of the acquired metrology knowledge to the stakeholder community. In terms of long-lasting impact, the project’s outputs will lay the foundations for the realisation of a ‘natural metrology partner’ for stakeholder organisations, as a single voice of the European smart electricity grid metrology community, and which will greatly enhance the formal interaction with stakeholder organisations. The impact of this cannot be over-estimated, as one of the major deficiencies encountered by all NMIs active in the area is the low visibility of metrology and the lack of awareness of what metrology can contribute to solving stakeholders’ business challenges.

The SRA and smart specialisation strategy developed by the project will allow NMIs to use their scarce resources in a more effective and complementary way, and this will lead to a more structured approach in national R&D programmes. Easy access to large and expensive facilities in other countries will enlarge the service portfolio that NMIs can offer to national customers. As such, the increased visibility realised by the project and its associated EMN via a recognisable identity and high-level liaisons will be a major asset to NMIs for increasing general awareness and recognition of the metrology contribution to the realisation of smart electricity grids. More involvement in solving stakeholder problems will not only generate new income, but also prove the impact and added value of metrology to society.

Moreover, the enhanced visibility and the dedicated training programme developed by the project aims to attract students, young researchers and electrical engineers to the area of smart electricity grid metrology, increasing their skills and providing them with a specific and deep metrology background. This will help alleviate a significant problem that is encountered by NMIs i.e. in hiring staff that are both interested and adequately trained in smart electricity grid metrology. During the first year of this project, early requests for student opportunities within the EMN have already been received.

The SRA, including the prioritisation and implementation plan, as realised by the project will be crucial to ensure that the challenges with the largest economic impacts will be covered in the subsequent metrology research. The cooperation and smart specialisation stimulated by the EMN will help to ensure that the



metrology efforts will lead to a larger portfolio of facilities, covering a wider range of stakeholder needs than without EMN coordination. This increased and more effective metrology support to stakeholders will further improve the already strong competitive position of European manufacturers. Indeed, early impact was already achieved in the first two project years: as already mentioned above, based on the early draft of the SRA, twelve new project proposals have been submitted in the EMPIR 2019 Energy Call and the 2021 Green Deal and Normative calls of the European Partnership on Metrology, to cover the most urgent needs identified in the SRA.

The CEN-CENELEC market perspective and innovation director has already testified that metrology makes an important contribution to standardisation for smart electricity grids. This has been confirmed by several national standardisation committees and by the strong standardisation component in the over 20 smart electricity grid-related JRP, 6 of which are fully dedicated to standardisation support. The regular interaction between CENELEC and the smart electricity grid metrology community, realised via this project and its associated EMN, will help to identify standardisation R&D needs at an earlier stage and will result in better coverage of these needs by research projects. In this way, the project and its associated EMN will give impetus to the development of pan-European documentary standards and grid codes that are vital to ensure that equipment from different smart electricity grid vendors can be used inter-changeably and that common grid limits and constraints are applied, based on reliable measurements. This added value is recognised by key technical committees of IEC and CEN-CENELEC and has led to the initiation of formal liaisons with CEN-CENELEC TC38 “Instrument Transformers” and IEC TC42 “High voltage and high current technology”.

The most significant social impact of the associated EMN lies in its contribution to a more reliable and more efficient electricity grid as the key enabler of the “Energy Transition”: they are essential for the reliable integration of sufficient renewable energy sources to meet the EU 2050 target of 50 % renewable energy supplies. Improved metrology support to a stable and high-quality electricity supply, based on sustainable energy sources such as wind and solar, is at the heart of the EMN on Smart Electricity Grids. This project and its associated EMN are improving the coordination and organisation beyond individual research projects, thus reducing the risk of key metrology not being ready when needed and avoiding potentially delaying the successful implementation of EU energy policies. The coherent, pan-European approach to smart electricity grid metrology, as presently realised by this project, will thus have a profound impact on society. Finally, this project and the EMN will ensure reduced emissions of carbon dioxide and greenhouse gases in two ways: firstly, via support to the increased uptake of renewable energy sources (RES) to the EU energy mix and secondly via support to the implementation of more efficient electricity grids. In this wider sense, this project and the EMN for Smart Electricity Grids will thus help to address the requirements of the Paris agreement by tackling climate change.

Project start date and duration:		1 May 2019, 48 months
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Internal Funded Partners:	External Funded Partners:	Unfunded Partners:
1. VSL, Netherlands		5. METAS, Switzerland
2. INRIM, Italy		6. PTB, Germany
3. LNE, France		
4. NPL, UK		