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International Smart Grid Action Network (ISGAN)

Brochure



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Preface

The International Energy Agency (IEA) is an intergovernmental organisation that works to shape a secure and sustainable future for all, through their focus on all fuels and all technologies, and the analysis and policy advice to governments and industry around the world.

The Technology Collaboration Programme is a multilateral mechanism established by the IEA with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of thousands of experts across government, academia and industry in 55 countries dedicated to advancing common research and the application of specific energy technologies.

The Clean Energy Ministerial is a high-level, global forum striving to promote policies and programmes that advance clean energy technology, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy. Initiatives are based on areas of common interest among participating governments and other stakeholders. ISGAN, the International Smart Grid Action Network, is a Technology Collaboration Programme (TCP) of the International Energy Agency (IEA). The co-operative programme was formally established in 2011 and is also an initiative of the Clean Energy Ministerial (CEM).

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1. ISGAN overview

1.1. What is ISGAN?

ISGAN is an IEA Technology Collaboration Programme, and as such seeks to support governments and industry with insight and recommendations to high-level decision-makers. In addition, ISGAN closely co-operates with Mission Innovation, a global initiative that promotes the acceleration of the clean energy transition.

Operating as both an IEA TCP and a CEM Initiative, ISGAN is an international platform for the development and exchange of knowledge and expertise on smarter, cleaner, and more flexible electricity grids ("Smart Grids"). ISGAN provides an important channel for the communication of experience, trends, lessons learned, and visions in support of global, national and regional clean energy objectives as well as new flexible and resilient solutions for Smart Grids.



▲ Schematic view of a modern electricity grid: Smart Grid

ISGAN seeks to improve global understanding of the benefits and opportunities of Smart Grids, to accelerate their development and deployment through furthering knowledge, frameworks, and tools. ISGAN's Contracting Parties can then apply these within their own national, sub-national, or regional contexts. The network's impact relies on the development of publications and organization of mutual learning processes and events that will enable smarter investment and better policy but is also heavily dependent on the implementation by authorities in sovereign nations.

ISGAN creates a strategic platform to support high-level government attention and action for the accelerated development and deployment of smarter, cleaner electricity grids around the world.

ISGAN **emphasizes knowledge-sharing by design** and seeks to identify and implement effective communication mechanisms to ensure that results are useful for decision-makers.

ISGAN recognizes that robust, resilient, and smart electric grids play a key role in enabling greenhouse gas (GHG) emission reductions. This is achieved through:

- Management of electricity demand
- Integration of growing supply from both utility-scale and distributed small-scale renewable energy systems
- Accommodation of an increasing number of electric and plug-in hybrid electric vehicles,
- Improvement of operational grid efficiency
- Application of energy-efficient technologies at their full potential

Smart Grids also enable better utilization of existing electricity generation assets. In coordination with the IEA and CEM, ISGAN strives to improve the potential of Smart Grid technologies at global, national and regional level. Another important motivation for Smart Grids is to ensure a resilient and secure energy system.

Investment in Smart Grid technologies and approaches, including Smart Meter deployment, has grown rapidly in recent years around the world. Smart Grids are playing an increasingly critical role towards the affordable and reliable integration of clean energy technologies. To ensure that Smart Grids can continue to meet current and future power system challenges, there is an increasing need for more adaptive regulatory frameworks and market designs that enable the development of innovative business models and accelerate market uptake.

Challenges that Smart Grids are expected to manage in parallel include:

- Integration and interaction among an increasingly complex and diverse set of clean energy technologies, including sector coupling across electricity, space heating/cooling, transport, etc.
- Accommodation and coordination of all available sources of flexibility with the ability to improve system efficiency, maintain system reliability and resiliency, and cost management
- Increased use of local energy systems and microgrids including storage, where appropriate
- Engagement of a growing variety of power systems stakeholders and roles in an increasingly connected society, taking advantage of new digital tools and business models focused on delivery of data-driven energy services

To highlight some of the core objectives and means for achieving smarter, cleaner electricity systems, ISGAN in 2016 appointed its primary theme as (power system) flexibility and a secondary theme, digitalization. In 2017, ISGAN added another secondary theme, namely, resiliency. In 2019, interoperability was added as second side-theme to emphasize its importance in ISGAN's work.

1.2. Vision

ISGAN's vision is to **accelerate progress on key aspects of Smart Grid policy, technology, and investment** through voluntary participation of governments and their designees in specific projects and programmes. Its activities centre foremost on those aspects of Smart Grids where governments have regulatory authority, expertise, convening power, or other leverage, focusing on five principal areas:

- Policy standards and regulation
- Finance and business models
- Technology system development
- Workforce skills and knowledge
- User and consumer engagement

1.3. Activities and Deliverables

ISGAN facilitates dynamic knowledge-sharing, technical assistance, peer review and, where appropriate, project coordination among its Contracting Parties. The active ISGAN community produces a variety of deliverables each year which can be categorized as shown below:



Webinars

Workshops & Knowledge Transfer





1.4. History

ISGAN was launched in Washington, D.C., USA, in July 2010, at the first Clean Energy Ministerial meeting (CEM1), a forum for energy and environment ministers and stakeholders from 23 countries and the European Union. ISGAN was formally established at their second meeting, CEM2 in Abu Dhabi, in April 2011, as an Implementing Agreement for a Co-operative Programme on Smart Grids, operating under the IEA Framework for International Energy Technology Cooperation. After the end of its first five-year period, an extension for ISGAN was requested and approved by the IEA in February 2017.

1.5. ISGAN's strengths

Broad International Expert Network

ISGAN leverages expertise from governments, national laboratories and research institutions, transmission and distribution system operators, public utilities and others from 26 countries from five continents.

Partnerships with Thought Leaders

ISGAN engages leading private sector Smart Grid initiatives, the IEA Energy Technology Network, and other Clean Energy Ministerial initiatives to advance systems perspectives on power grids and grid integration.

Diverse Portfolio

ISGAN implements a range of activities to support a better global understanding of Smart Grids and the value they offer, address gaps in knowledge and tools, enhance peer-to-peer exchange, and otherwise improve international coordination.

1.6. ISGAN's organizational structure

ISGAN is a Technology Cooperation Programme (TCP) with currently 26 Contracting Parties. Their nominated representatives form the Executive Committee which is headed by the Presidium and assisted by the Co-Secretariats and the Operating Agent of ISGAN. The activities of ISGAN are organized in nine Annexes, which are standing working groups, defining new tasks each year. Each Annex consists of national experts from Contracting Parties and is led by the Annex' Operating Agent and supported by a technical Lead. Annex 1 has already been completed, with some of its remaining tasks moved to Annex 2.

Five of the Annexes are topic-oriented (Annex 3: Cost-Benefit Analyses; Annex 5: Smart Grids testing; Annex 6: Future T&D system needs; Annex 7: Smart Grids Transitions – on Institutional Change, Annex 9: Flexibility Markets development and implementation), while three Annexes constitute platforms for dissemination and deployment of Smart Grid practices focused on specific products and methodologies (Annex 2 and Annex 4 comprise Knowledge Transfer Projects (KTP), Casebooks, and policy insight; Annex 8: Webinar-based virtual training and strategic communication to decision-makers).

1.6.1. The Executive Committee

Each Contracting Party appoints a delegate and an alternate to the Executive Committee. This is the decision-making body of ISGAN and convenes twice a year. Its main aims are to discuss new developments, identify knowledge gaps and implementation barriers, and shape ISGAN's Programme of Work accordingly.



1.6.2. The Presidium

The Executive Committee is led by the Chair and three Vice Chairs. Together they form the Presidium. Each member of the Presidium is elected for a period of two years, with possible re-election. The first Presidium was elected at the inaugural meeting in Seoul, Korea, in June 2011. Owing to the complexity of ISGAN's activities, having three Vice-Chairs was deemed appropriate.



▲ ISGAN Presidium

1.6.3. Contracting Parties

Under the IEA Framework for International Energy Technology Co-Operation, ISGAN is open to all governments, yet only upon invitation from the ISGAN Executive Committee. Although ISGAN is primarily focused on government-to-government cooperation, it is also open to entities designated by the participating governments, including academic institutions, select private sector and industry associations as well as international organizations.



List of ISGAN Contracting Parties (as of February 2021):

	Australia	
	Belgium	
(China	
\bigcirc	European Commission	
	France	
	India	
	Italy	
	Korea	
	The Netherlands	Ę
	Russian Federation	Č
	South Africa	
	Sweden	
	United States of America	è

	Austria
()	Canada
	Denmark
Ð	Finland
	Germany
	Ireland
	Japan
	Mexico
	Norway
	Singapore
	Spain
0	Switzerland
	United Kingdom

1.6.4. Secretariat and Operating Agent

The Operating Agent (OA) is the legal representative of ISGAN. AIT Austrian Institute of Technology has been holding the position of ISGAN OA since June 2017.

• Mihai Calin, Operating Agent of ISGAN, Mihai.Calin@ait.ac.at

ISGAN is supported by two Co-Secretariats: the Co-Secretariat at AIT is responsible for the management of ISGAN, organization of the meetings and communication matters as well as the administration of the common fund and reporting to the IEA:

• Head of the Co-Secreatariat: Susanne Windischberger, Susanne.Windischberger@ait.ac.at

The Co-Secretariat at KSGI is responsible for the support of ISGAN deliverables to the Clean Energy Ministerial, the ISGAN Award of Excellence and coordination and contact activities within Asia:

• Chloe Yoon, ysj@smartgrid.or.kr

2. ISGAN Annexes

The activities of ISGAN are organized in Annexes. In contrast to other IEA TCPs, these Annexes are standing working groups that continuously work on Smart Grids related topics and regularly update their plans and objectives for the upcoming year at the spring meetings of the Executive Committee. Annex 1 "Smart Grid Inventories" which delivered a general picture of on-going Smart Grid project deployment has already been completed. Annexes are led by Operating Agents who can also be supported by Technical Leads.

Recently, an Incubator team was established under the lead of UK with the aim to identify the gaps in ISGAN's work. This led to the creation of Annex 9 which focuses on creating flexibility markets and the enabling role of digitalisation in this transition. The first activity of the Annex was a review of existing initiatives and literature.

Annex	Title	Operating Agent	Country
Annex 1	Smart Grid Inventories	completed	
Annex 2	Smart Grid Case Studies	Korea Smart Grid Institute – KSGI	Korea
Annex 3	Cost-Benefit Analyses	University of Cagliari	Italy
Annex 4	Synthesis of Insights for Decision Makers	Korea Smart Grid Institute – KSGI	Korea
Annex 5	Smart Grid International Research Facility Network (SIRFN)	DERLab	Germany
Annex 6	Transmission and Distribution Power Systems	Research Institutes of Sweden, RISE	Sweden
Annex 7	Smart Grids transitions	AIT Austrian Institute of Technology	Austria
Annex 8	ISGAN Academy on Smart Grids	Institute for Research in Technology IIT, Universidad Pontificia Comillas	Spain
Annex 9	Flexibility Markets- development and implementation	Department for Business, Energy & Industrial Strategy	UK

Annexes and their Operating Agents are listed in the below table:

2.1. Annex 2: Smart Grid Case Studies

The overarching aim is to collect information on case studies from around the world and to extract lessons learned and best practices as well as foster future collaboration among participating countries. Through the organization of Knowledge Transfer Workshops, Annex 2 promotes cross-organizational dialogue inspired by experiences and results achieved and creates a forum for peer-to-peer learning where all participants can contribute to and benefit from the collective thinking process. ISGAN participants contributing to this Annex actively shape the analyses of, and methodological framework for, Smart Grid-related case studies, as well as the selection of topics and projects for new case studies.

Recent activities:

All case studies are documented in Casebooks which allow for comparison of policies and technologies adopted in different regulatory, legislative, technical, and natural environments. To date the following Casebooks have been published:

- Advance Metering Infrastructure (AMI)
- Demand Side Management (DSM)
- Consumer Engagement & Empowerment
- Casebook Energy Storage Systems
- Casebook on Innovative Regulatory Approaches with Focus on Experimental Sandboxes

The Casebooks are available for download on ISGAN's website.

2.2. Annex 3: Cost-Benefit Analyses and Toolkits

Annex 3 deals with methods aimed at guiding stakeholders' investment decisions related to Smart Grid technologies by considering economic and social welfare aspects. The scope of this Annex spans the development of tools for analysts, regulators, utilities and other actors to define system needs and decide on priorities for Smart Grid system investments along with necessary regulatory changes. Annex 3 develops a global framework and related toolkits, which provide a way of identifying the benefits of demonstrating and deploying Smart Grids technologies in a standardized way. Annex 3 also puts the achieved benefits in relation to their costs.

Recent activities:

In this Annex a web-based tool using a combination of Cost-Benefit Analysis (CBA) and multi-criteria analysis was developed. A deep analysis of socioeconomic benefits of smart grids and regulatory implications has been accomplished that dealt with the following topics:

- Inclusion of socioeconomic factors into CBA on Smart Grid
- Asymmetric benefits of Smart Grids
- Combined MC-CBA methodology for decision making on Smart Grid

2.3. Annex 4: Synthesis of Insights for Decision-Makers

The core objectives of Annex 4 are to organize knowledge, identify key issues and important themes, and provide insightful analysis for decision-makers. Another responsibility of Annex 4 consists of consolidating and disseminating the efforts of other ISGAN Annexes, as well as, when appropriate, Smart Grid efforts beyond ISGAN in support of greater outreach and impact.

Annex 4 ultimately provides communication tools, products, and platforms that foster international understanding of Smart Grids, while recognizing the diversity of drivers and approaches among related technologies, policies, practices, and systems.

Recent activities:

- Organisation of a Knowledge Sharing Seminar on Smart Grid Policies and Technologies in Asia
 - To share practical cases of SG projects and researches and to establish a cooperative network among Asian countries, and to introduce ISGAN and its activities

2.4. Annex 5: Smart Grid International Research Facility Network (SIRFN)

Annex 5 enables participating countries to evaluate pre-competitive technologies and systems in a wide range of Smart Grid use cases and geographies using common testing procedures. Research testbeds were selected based on their complementary capabilities to conduct specialized, controlled laboratory evaluations of integrated Smart Grid technologies. These include cyber security, plug-in hybrid integration, load management, automated metering infrastructure, protection, network sensing, energy management, renewable energy integration and similar applications. In this way, researchers in each individual participating country can benefit from the unique capabilities and environments of the other partner nations. Research data is made available to all SIRFN participants to accelerate the development of Smart Grid technologies and systems and enable appropriate supporting policies.

The Annex consists of a strong, active community of researchers engaging in applied research and impactful work on Smart Grids testing including smart inverters, BESS, DER, ALTM, power systems, microgrids and many more. Open source software tools, test cases and procedures to be used by DER vendors, universities, research institutions, certification laboratories are developed and input for standards organizations is provided.

Recent activities:

In 2020, Annex 5 organized a Webinar on "Testing Methods and Certification Protocols" and published five scientific articles in renowned journals.

2.5. Annex 6: Power Transmission and Distribution Systems

Power systems around the world are faced with a wide range of challenges in order to realize the objective to integrate an increased amount of renewable energy sources in the modern electricity grids. The consequences affect the daily operation and long-term planning of transmission and distribution systems, and the network owners and operators ability to ensure continuous, reliable and high quality of supply to the customers. The needs of each actor within the electrical supply chain provide drivers for revision of current practices and promotes future adaptions of functional components and systems, economic and regulatory areas.

Recent activities:

In the last working period the work of Annex 6 has been supported by its 4 focus areas (Technology Trends & Deployment, Expansion Planning & Market Analysis, System Operation & Security and Transmission & Distribution System Interaction) to identify the drivers for change regarding generation, demand, and grid, the resulting consequences this has on operation and planning of the power transmission and distribution systems, and finally the needs to ensure sustainability & security of supply from the technology, market and policy perspectives. This work was based on an extensive list of annex activities, papers, networking activities and policy recommendations. The focus of annex 6, which is on system-related challenges with emphasis on technologies, market solutions, and policies which contribute to the development of system solutions, remains important for the next working period. Electricity networks will be even more pivotal for other sectors, both at transmission level (One System Vision) and distribution level (empowering consumers). Different relevant topics for future work (e.g. 'Flexibility for Resilience' and 'Flexibility harvesting from renewable energy sources and its impact on TSO-DSO interaction' have already been identified.

2.6. Annex 7: Smart Grid Transitions and Institutional Change

The ongoing transition of energy systems describes the process of replacing a comparatively simple regime of just-in-time electricity production characterized by unidirectional trickle-down distribution, with complex, responsive, multidirectional systems. As a result, the electricity sector is undergoing a transformation towards an industry providing energy logistics services to match demand with volatile energy supply. Smart Grids will become the backbone of smart energy logistics. This requires new institutional structures and governance processes, as well as shared views on socio-technical transition pathways. How this institutional change shall be orchestrated, is the key topic of Annex 7 and a key policy issue for the IEA and the Clean Energy Ministerial. The scope of this Annex is to co-ordinate applied social sciences and socio-technical change processes related to this transition towards a sustainable electricity system as well as to collect results and inform policymakers.

The Annex aims at establishing a network of researchers and practitioners sparking off an international, coordinated, interdisciplinary research activity in the social sciences supporting and complementing technology-oriented Smart Grid activities. In short, Annex 7 accumulates information and knowledge from innovation studies, political sciences, institutional economics, sociology and energy law, and makes this information palpable for policy makers and other stakeholders at multiple administrative levels. This includes supporting policy development in the field of Smart Grid-related research, technology development and innovation.

Recent activities:

Regulatory Experimenting – Regulatory Sandboxes

Many countries are facing the problem of innovation not bridging the valley of death from innovative technological development to real world deployment. Regulatory and other institutional barriers are amongst the trickiest challenges we are facing in the process of speeding up energy transition. Therefore Annex 7 has taken up the task to investigate, better understand and support policy makers in developing and implementing new transformative policy instruments. Regulatory experimenting is considered as promising for Smart Grid Transitions.

Experimental Sandboxes are such a policy instrument. It provides a framework for innovation-projects to be performed under experimental condition. By opening-up rules and regulations, innovators are provided with experimental space for implementing and replicating new solutions and business model development. Annex 7 analysed country cases and activities in cooperation with other ISGAN Annexes in the form of webinars and KTP workshops.

2.7. Annex 8: ISGAN Academy on Smart Grids

The ISGAN Academy offers the ISGAN community a possibility to share knowledge and engage with experts in the field of Smart Grids through an e-learning platform. The platform offers webinars on topics ranging from power system fundamentals to more specialized seminars on breakthrough Smart Grids solutions. The information includes recent developments, best practices, interesting methodologies, Smart Grids theory, applications and deployment. Fundamentals and further reading material are provided as complementary appendices to the critical learning path.

By attending the webinars developed by Annex 8, stakeholders obtain a means to stay updated on recent developments, pilot projects, demonstrations, software tools and case studies. By nominating a representative to the Academic Committee, supporters of the Annex can contribute to the evaluation of the quality of the content and the relevance of the selected topics.

Recent activities:

Between 5 and 10 webinars are organized by this Annex each year. They can be attended live, but are also available on YouTube. The ISGAN Academy webinars are divided in five different areas:

- Novel Smart Grids tools
- ISGAN Award of Excellence
- Flexibility in Power Systems
- ISGAN Knowledge Transfer Projects
- New Challenges in Smart Grids

2.8. Annex 9: Flexibility Markets development and implementation

The newest ISGAN Annex was officially approved on 26th of January 2021 and kicked off on 1st of February with the aim to:

- Enrich and disseminate participant's understanding of flexibility market design
- Create and curate an evidence base all can draw upon to support decision making in the flexibility market space
- Further the debate on best practice in market design

The scope of this Annex is all aspects of market design for power system flexibility. This includes: the whole range of market timescales, from long term investment signals to second-to-second balancing and response; the whole physical system from large centralized generation to behind the meter sources of flexibility within domestic settings and interfaces with other vectors; all sources of value that flexibility conceivably could capture, going beyond MWh to include character-istics like voltage control, repeatability, inertia, locational constraint alleviation; and aspects of the market that go beyond the trading rules such as consumer support, or how obligations (such as with respect to grid stability) are understood and checked.

In 2021, the work of the annex will concentrate on three topic areas, namely

- Flexibility characteristics (Task 1)
- Consumer focused flexibility (Task 2)
- Interoperable markets (Task 3)

3. ISGAN Award of Excellence

Each year, in partnership with the Global Smart Grid Federation (GSGF), ISGAN presents the Annual ISGAN Award of Excellence (AoE) to recognize excellence in Smart Grid Projects, policies, and programs around the world. The ISGAN Award of Excellence seeks to leverage leadership and innovation in smart grids to accelerate the global exchange of best practices and promote replication or adaptation of proven concepts in other markets, countries, and regions. By providing a showcase for exemplars in the global smart grid community, the Award also draws attention to the value offered by smart grid systems.



ISGAN Award of Excellence Winner 2020

Project Title: Smart Grids and Smart Communities Demonstration Project Project Location: Slovenia Lead Organization: New Energy and Industrial Development Organization (NEDO) Partner Organisations: ELES, Hitachi

The "Smart Grids and Smart Communities Demonstration Project" being carried out by New Energy and Industrial Technology Development Organization (NEDO), ELES, d.o.o. and Hitachi, Ltd aims to highly digitalize the power distribution systems in Slovenia to contribute to solving energy issues faced by Slovenia and other European countries. This project has been run across many locations in the country. Applying the most advanced technology in pursuit of stable energy supply, this project would benefit not only grid operators but also all the consumers connected to the grid. This project has confirmed that electricity tariffs would decrease when consumers positively respond to peak-cut requests from grid operators, making it possible for grid operators to procure flexibility cost-effectively. Those outcomes have presented the possibility of creating a virtuous circle between consumers and grid operators.

4. Collaboration and Co-operation

One of ISGAN's key activities revolves around reaching out to and cooperating with outside stakeholders, clean energy initiatives and similar target groups. In 2020, ISGAN's main cooperation partners and activities were as follows:

- Engagement with **Mission Innovation**, IC1 on Smart Grids and its follow-up organizations Mission Innovation Phase 2; Power Mission
- The long-lasting partnership between ISGAN and the Global Smart Energy Federation (GSEF)
- ISGAN became an Associated Partner of ERA-Net Smart Energy Systems in March 2019
- ISGAN supports knowledge-sharing within the IEA Technology Collaboration Program (IEA TCP) and appointed dedicated liaison persons for an active exchange with the collaborations on Hydrogen, Photovoltaic Power Systems (PVPS) and Industrial Energy-Related Technologies and Systems (IETS)
- ISGAN plans to enhance its cooperation with several other initiatives including the **Global Power System Transforma**tion Consortium (G-PST)
- In 2020, ISGAN and the European Technology and Innovation Platform Smart Networks for Energy Transition (ETIP SNET) signed a Memorandum of Understanding to cooperate on common fields of research and innovation areas related to smarter, cleaner electricity grids around the world.
- ISGAN will also be engaged in dialogues and activities of the Digital Demand-Driven Electricity Networks (3DEN), which is a four-year cross-agency initiative launched by the IEA, working to accelerate progress on power system modernisation and effective utilisation of distributed energy resources through policy, regulation, technology and investment guidance.



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