Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Department of the Environment,
Transport, Energy and Communication DETEC

Swiss Federal Office of Energy SFOE
Energy Research

Annual report from 28. November 2023

IEA ISGAN TCP

Schweizer Beteiligung

Date: 28. November 2023

Place: Bern

Publisher:
Swiss Federal Office of Energy SFOE
Research Programme Grids
CH-3003 Bern
www.bfe.admin.ch
energieforschung@bfe.admin.ch

Agent:
ETH Zürich
Forschungsstelle Energienetze
Sonneggstrasse 28
CH-8006 Zurich

Author:
Cansin Yaman Evrenosoglu, Forschungsstelle Energienetze - ETH Zürich, evrenos@fen.ethz.ch
Alexander Fuchs, Forschungsstelle Energienetze - ETH Zürich, fuchs@fen.ethz.ch
Adamantios Marinakis, Forschungsstelle Energienetze - ETH Zürich, marinakis@fen.ethz.ch
Turhan Demiray, Forschungsstelle Energienetze - ETH Zürich, demirayt@fen.ethz.ch

SFOE head of domain: Dr. Michael Moser, michael.moser@bfe.admin.ch
SFOE programme manager: Dr. Michael Moser, michael.moser@bfe.admin.ch
SFOE contract number: SI/502199-01

Contents

1 Introduction

The International Smart Grid Action Network (ISGAN) strives for the accelerated development and deployment around the world of smarter, cleaner electricity grids—as in **smart grids**. ISGAN's national experts come from 26 countries and the European Commission and include engineers, analysts, academics, industry executives, government officials, project managers, policymakers, technology providers, and utility planners. In coordination with the International Energy Agency (IEA), Clean Energy Ministerial (CEM), and other strategic partners, ISGAN is committed to identifying emerging advances, sharing best practices, and raising high-level government awareness on the value and impact of smarter grids.

ISGAN facilitates dynamic knowledge exchange, technical assistance, peer review, and activity coordination among its participants and stakeholders. Policy analysis and recommendations are a top priority for ISGAN. Unbiased technical expertise and direct interaction with policymakers are two major assets on which ISGAN can base its leadership.

1.1 Background of ISGAN

2010, ISGAN is launched in Washington D.C. at the first Clean Energy Ministerial (CEM) meeting. The initiative evolves from CEM's commitment to policies and programs that accelerate the global transition to clean energy.

2011, ISGAN is formally established as the International Energy Agency (IEA) Implementing Agreement for a Co-operative Programme on Smart Grids, operating as a "Technology Collaboration Programme" under the IEA Framework for International Energy Technology Co-operation.

2013, ISGAN membership expands across five continents and includes 24 participating countries and the European Commission.

2014, ISGAN expands to include Annex 5: Smart Grid International Research Facility Network (SIRFN), bringing together a diverse array of research and testing facilities.

2015, The first annual ISGAN Award of Excellence is launched to celebrate exemplars in smart grid projects and promote the adaptation of their proven best practices in other countries and jurisdictions.

2016, Launch of the ISGAN Knowledge Transfer Platform (KTP). The KTPs offer dynamic spaces where interdisciplinary groups of participants with complementary competencies contribute to the development of joint ISGAN knowledge products, policy messages, and targeted technical assistance. ISGAN will complete its 9th KTP project in 2023.

2016, Beginning of ISGAN Virtual Learning webinars. Every year, ISGAN hosts dozens of webinars where participants from academia, government, non-profits, and industry gather to demonstrate and share best practices and the latest smart grid research.

2018, ISGAN continues to expand its international reach and to serve as a partner for domestic and international efforts including the Global Smart Energy Federation, and the India Smart Grid Forum.

2019, ISGAN Annex 3 releases the smart grid evaluation toolkit, which integrates Cost-Benefit Analysis (CBA) within a Multi-Criteria Analysis (MCA) framework.

2021, The Annexes are transformed into Working Groups (WGs) with WG 3-Cost Benefit Analysis Toolkit, WG 5-International Research Network-SIRFN, WG 6-Power T&D Systems, WG 7-Smart Grid Transitions, WG 9-Flexibility Markets, and a cross-cutting Communications Working Group (focused also on deep knowledge exchange).

2022, ISGAN signs a Memorandum of Understanding with the Global Smart Energy Federation and a letter of intent with the Mission Innovation: Green Powered Future Mission at the Global Clean Energy Action Forum in Pittsburgh, Pennsylvania.

2022, A new strategy and structure process is completed, and Request for Extension (RfE) is finalized.

2 Goal of Project

According to the Energy Act of January 2018 and the Swiss Federal Council decision of August 2019, the general goals for the Swiss energy system is to phase-out the nuclear power and reach zero net greenhouse gas (GHG) emissions by 2050. According to the energy perspectives of the Swiss Federal Office of Energy (SFOE), this will be achieved by increasing the share of renewable energy generation sources and electrification of heating and mobility, while increasing the energy efficiency.

The implementation of this strategy drives the following trends: (i) increasing proliferation of variable renewable energy sources (VRES), such as wind farms and solar PVs, mainly in a distributed fashion, (ii) increasing electrification of energy demand, i.e., heating and transportation, which leads to a significant increase in both peak demand and total electricity demand, and (iii) as a result of (i) and (ii), increasing need in techno-economically feasible ways to utilize the available sources of flexibility so that the costs of the energy supply as well as infrastructure investments are optimized.

These developments introduce tremendous stress on the energy suppliers and system operators that are responsible for balancing the supply and the demand and this phenomena are unprecedented. As such, they require massive and costly adaptations to the energy infrastructure. The transition also brings along the need for new planning, operation, market and ownership models, as well as the need for new regulations to facilitate these complex models.

FEN, acting as a bridge between academia and the industry, has been performing several research activities in this direction. Some of these activities have been performed as an integral part of Swiss participation in the ISGAN activities in the period of 2022-present. FEN represented the SFOE actively in the following working groups that are focusing on the activities of interest:

- **Working Group 3** on **Cost-Benefit Analysis and Toolkits** (link)
- **Working Group 6** on **Power Transmission & Distribution Systems** (link)
- **Working Group 9** on **Flexibility Markets** (link)

By exploiting international experiences and insights, the results of the participation in these working groups and the associated activities will continue to provide useful insights to Swiss policymakers and energy stakeholders for (i) devising future grid investment and operational strategies leveraging the value of flexibility, (ii) decreasing the cost of the ownership of distributed energy resources as a result of new potentials of revenue streams by providing flexibility services, and (iii) devising appropriate (intermediate) targets and regulations towards achieving the targets of the Energy Strategy 2050 in the most economic and environmentally friendly manner.

3 Summary of Work Performed in 2023 and Achieved Results

3.1 Working Group 3: Cost-Benefit Analysis and Toolkits

The primary objective of Working Group 3 (WG3) is to develop a global framework and related analyses that can identify, define, and quantify in a standardized way the benefits that can be realized from the demonstration and deployment of smart grid technologies and practices in an electricity system. More specifically, WG3 develops tools used by analysts, regulators, utilities, and other electricity system stakeholders. These tools help define and decide on system needs and priorities for smart grid system investment and regulatory changes. Results help develop specific business cases, considering specific regulatory and market structures, current system status, demand profiles, and available generation assets and resources. In their analysis, different ISGAN countries are likely to prioritize distinct domains within the power sector. Therefore, in developing methodological frameworks and tools, a broad definition of smart grid is adopted to encompass the full range of technologies and activities from centralized power generation to transmission and distribution networks end uses and distributed generation, and different energy vectors. The CBA-MCA tool is also used for sector coupling and evaluating various integrated energy systems. WG 3 continues to leverage existing knowledge and experience gained in different participating countries, as well as current international efforts underway and cooperation among major smart grids stakeholders globally. Two tasks are identified to achieve the objectives: (1) online tool improvement and dissemination and (2) identification of suitable regulatory frameworks to foster flexibility.

3.1.1 Participation in meetings and contributions to the activities

At ISGAN's 25th Executive Committee meeting (ExCo25, March 2023), Participants agreed to organize a high-level project or coordinated set of projects on a unified topic or theme to be decided at ExCo26 in September 2023. This project and theme are meant to serve as a **lighthouse** for ISGAN's several Working Groups (WGs) and activities to drive them toward more unified outcomes and hopefully greater impact overall, including the possible creation of a high-level Clean Energy Ministerial (CEM) campaign in time for CEM15 in Brazil (likely in September 2024).

Building on ISGAN's successful Knowledge Sharing Project (KSP) on Network Planning Under Uncertainty, and based on an informal assessment by the ISGAN Presidium members present at CEM14 in Goa, India in July 2023, the Presidium proposes that the inaugural ISGAN Lighthouse project center on distribution-level grid planning and implementation, including its interrelation with transmission-level planning and implementation, and the rapidly accelerating electrification of other coupled sectors.

As part of the WG3 activities, ETHZ-FEN has committed to actively support this lighthouse project on **Electricity Network Planning and Implementation under Uncertainty for the Clean Energy Transition: The Roles of Smart Distribution Grids in Energy Systems** by providing its know-how on the topic based on its past and ongoing activities in industrial and academic projects. ETHZ-FEN has been attending the regular meetings and contributing to the following discussion points:

- Focus attention on planning tools that already deal with uncertainty or propose a general framework/procedure for dealing with uncertainty
- Scenario identification
- Defining a general framework for dealing with uncertainty in planning and then deliver an infographic/position paper

3.2 Working Group 6: Power Transmission and Distribution Systems

The main objective of Working Group 6 is to establish long-term visions for the development of the future sustainable power systems. To create and project such visions, WG6 clarifies system-related challenges, with emphasis on the technologies, market solutions, and policies which contribute to the development of system solutions. WG6 facilitates knowledge sharing related to the application of advanced technologies for power grids and their contributions to clean energy, climate goals, and sustainable energy access for all. WG6's results are disseminated at different strategic levels. WG6 maintains a critical view on evolutions for smarter, cleaner power transmission and distribution systems based on four Focus Areas. While WG6's annual Program of Work includes more defined activities and tasks, the Focus Areas below illustrate and support the continuity and long-term plans of the Working Group. There are four focus areas: (1) expansion planning and market analysis, (2) technology trends and deployment, (3) system operation and security, and (4) transmission and distribution system interaction.

3.2.1 Participation in meetings and contributions to the activities

In general ETHZ-FEN contributed to the discussions, collected information for ongoing projects and forwarded ideas, concepts and interesting project reports to other project partners within Switzerland.

The range of topics in these meetings with significant interactions has the following highlights:

- Monthly coordination calls. In general ETHZ-FEN aims to play an active role, whereever suitable by
  - contributing to surveys for ISGAN
  - reviewing ISGAN reports and white papers
  - establishing contacts with experts from the Swiss transmission and distribution industry
- Contribution to the survey *Interaction between power system stakeholders- Insights from pilot projects*. We established contacts with about 10 experts (including Swissgrid) contributing to the survey from the Swiss perspective.
- Reviewer of the discussion paper *Aggregator in Digitalised Power System*. The paper, authored by OFFIS, was presented in the ISGAN working group. ETHZ-FEN volunteered to perform an in-depth review of the paper, which was well received by the authors. The topic also proved very interesting for several recent and ongoing Swiss projects regarding flexibility at the interface between TSO and DSOs.
- Participation in the workshop series *Flexibility mechanisms for DSOs and their trade off with investments*. ETHZ-FEN contributes the Swiss perspective, collected from past projects such as TDFLEX. This overview workshops are also directly relevant to one of Swissgrid's development projects on flexibility markets, for which ETHZ-FEN is supporting Swissgrid. ETHZ-FEN collects information from European partners and establishes information exchanges to narrow down flexibility market concepts developed by Swissgrid. The long-term goal is, to also bring in lessons learned from the Swiss perspective.
- ETHZ-FEN actively contributed to the discussion paper on **Flexibility harvesting and its impact on stakeholders interaction** (link), published in December 2022. FEN acted as the coordinator for Chapter 5, which summarizes the benefits of utilizing aggregated flexibility of the distributed energy resources within the context of two projects, TDFlex and FlexPlan (H2020), and addresses the topic from the following perspectives: technical, economic, and ICT, regulatory. TDFlex project was selected to demonstrate the benefits for ancillary services and energy dispatch while FlexPlan was

selected to demonstrate the benefits of integrated transmission and distribution grid infrastructure planning.

3.3 Working Group 9: Flexibility Markets

Working Group 9 (WG9) addresses 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. It also extends to cover the whole physical system from large centralised generation to behind the meter sources of flexibility within domestic settings and interfaces. WG9 considers all sources of value that flexibility conceivably could capture, going beyond MWh to include physical grid characteristics like voltage control, repeatability, inertia, locational constraint alleviation, in addition to various aspects of the market that goes beyond the trading rules such as consumer support, or how obligations (such as with respect to grid stability) are understood and checked. The objective of the combined impact of the Working Group's activities will be (i) to enrich and disseminate participant's understanding of flexibility market design, (ii) to create and curate an evidence base all can draw upon to support decision making in the flexibility market space, and (iii) to further the debate on best practice in market design. Three tasks/activities were identified for 2023-2024: (1) end-use flexibility characterisation and grid utilisation, (2) interoperability, and (3) operational and long-term planning.

3.3.1 Participation in meetings and contributions to the activities

FEN participates in the regular WG9 monthly meetings, as well as in ad-hoc meetings to synchronize the WG activities. FEN contributed to the **development of WP9's Program of Work (PoW)** for the year 2023-2024. Within the PoW, FEN is actively engaged in Task 3 "Operational and Long-term Planning", where it **leads Subtask 3.3 "Consideration of flexibility in long-term distribution network planning"**.

As part of the interactions and exchange performed within WG9, FEN has been actively sharing information from the **AISOP** and **PATHFDNR** projects, which are extremely relevant to the scope of WG9, as these projects cover topics such as "dynamic network tariffs", "design of local flexibility markets" and "flexibility-aware distribution grid planning".

In addition, FEN is currently (Nov-Dec 2023) actively participating in the setting up of a set of **Lighthouse projects**, i.e., activities that will combine work performed in the various WGs with the objective to address a specific topic. The selected lighthouse projects are planned to be kicked-off in 2024.

4 Collaboration

4.1 National Collaboration

ETHZ-FEN increasingly and actively collaborates with Swissgrid on the topic of TSO-DSO interactions and integrated market modeling. Swissgrid participated in the survey on the practical experiences on TSO-DSO interaction. Various ways of remunerating and pricing flexibility from distributed resources are of interest to Swissgrid as well and ETHZ-FEN is sharing its know-how and the international experiences (via ISGAN activities) on the topics with Swissgrid.

4.2 International Collaboration

As a by-product of the activities and networking at ISGAN, ETHZ-FEN was invited to be a partner in a European consortium led by the University of Comillas in Spain. Multiple members of the team at the University of Comillas is representing Spain in ISGAN activities. The proposal was submitted to Horizon call in October 2023 and titled **TRAIPLAN**: *Transport electrification through artificial intelligence and network planning*. ETHZ-FEN's responsibility is developing an uncertainty-aware grid planning framework for EV proliferation. Other Swiss partners are as follows: BKW, EBP, EMPA-UES. Eight (8) countries (Spain, Italy, Norway, Portugal, Belgium, Germany, Slovenia, Serbia) in addition to Switzerland are represented by 28 teams in the consortium, in addition to the Swiss partners.

Additionally, ETHZ-FEN is currently participating in a proposal for a Horizon call on conversion from HVAC to HVDC lines, titled AC2DC, to be submitted early 2024. Swissgrid invited ETHZ-FEN to the consortium as the research group in Switzerland for grid modeling and dynamic simulations. Several ISGAN countries (Austria, Croatia, France, Germany, Italy, Slovenia, Switzerland) are also present in the consortium.

5 Publications

B. Herndler, C.Y. Evrenosoglu, G. Migliavacca, H. Gerard, I. Vilgan, JP Chaves Avila, K. Kessels, M. Rossi, P. Lo, S. Wong, *Flexibility harvesting and its impact on stakeholders interaction*, ISGAN Working Group 6 Power Transmission and Distribution Systems Discussion paper, 2022.