

# **IERE Activities 2014–2024**

## Highlights

December 2024

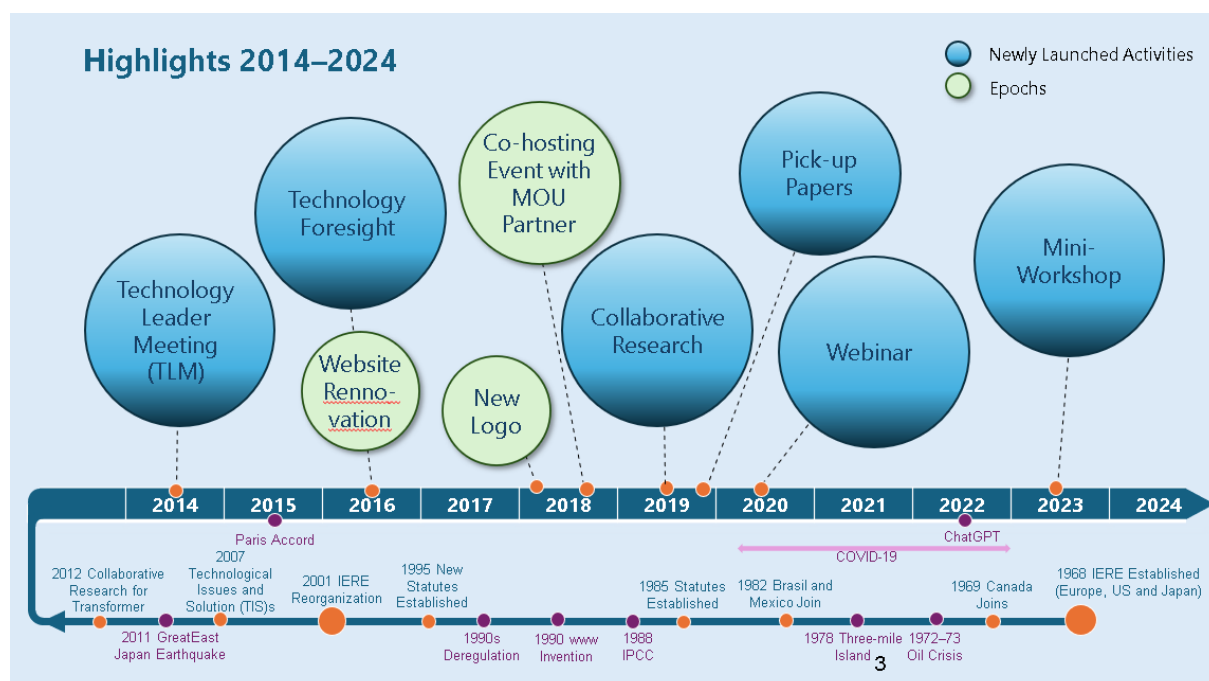
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## Introduction

It has been nearly 60 years since IERE was established. During this time, the social landscape has undergone significant changes, and IERE has accordingly adapted its modes of activity with flexibility. The most significant turning point among these was the transition to a new organizational structure in 2001. In the 1990s, **deregulation** in the electric power sectors of Europe and the United States brought a fundamental shift in the business models of electric utilities, leading to reductions in R&D budgets. This shift also compelled IERE to implement substantial reforms. Another major factor has been the advancement of IT technologies. The development of the **Internet** has transformed the way information is gathered and exchanged, significantly altering how IERE members collaborate and share knowledge. Along with changes in the format of activities, the themes of information exchange and technology development addressed by IERE have also evolved. More recently, the focus of IERE's activities has increasingly shifted toward **decarbonization**-related issues.

This report follows the 2014 publication “*Summary of IERE Activities after Reorganization (January 2001–December 2013)*” and reviews the organization's progress over the past decade. One of the most significant societal changes during the period in question was the global outbreak of **COVID-19**, which led to a sharp increase in **online meetings**, along with the rapid advancement of **artificial intelligence (AI) technologies**—all of which significantly impacted IERE's operations. This report highlights the most notable activities during this transformative decade.



## Technology Leader Meeting—Newly Launched Activity 1 (2014–2015)

A total of four meetings were held in 2014–2015 with the aim of exploring new directions for IERE through expert discussions with a limited number of participants.

The impetus for these meetings originated from the 23rd Board Meeting (November 2012), where Chairman DUDZINSKI emphasized the growing importance of *technology management* as distinct from *technology development*. He noted that while IERE had traditionally focused on the latter, the former would become increasingly vital moving forward—thus proposing a new strategic direction for IERE.



In response to this, at the 24th Board of Directors meeting (April 2013), discussions were limited to (1) the theme and (2) how to proceed. As a result, it was decided to establish a *Technology Leader Meeting (TLM)*, restricting participation to Senior Technical Executives in the R&D departments of Executive members or those in an equivalent position. Further considerations were given to the selection of themes and the method of facilitation.

At the 25th Board Meeting (December 2013), it was confirmed that prior coordination of submitted materials would be required to ensure the quality of discussions. Additionally, it was agreed that outcomes would be shared with those unable to attend, through Executive Reports and similar documentation. The Central Office also raised a concern that the exclusive nature of the meetings could potentially conflict with the Bylaws (Articles 1 and 10), which guarantee equal participation rights to all members. However, this concern was addressed by implementing the TLMs on a trial basis.

Ultimately, four TLMs were conducted, including two trial sessions. To foster open and candid discussions, each was limited to approximately 30 participants referring to the “Chatham House Rule,” which does not specify participants or speakers.

- **1st Brussels TLM (June 2014)**

**Theme: Intermittency Management—Integrating Intermittent Renewables in the Power System**

The discussion focused on the intermittency management in the grid due to the introduction of renewable energy sources, highlighting the importance of improving forecast accuracy, strengthening the power grid, and enhancing demand-side management (DSM), among other measures.

- **2nd North American TLM (November 2014)**

**Theme: Transmission Asset Management**

This meeting primarily focused on online transformer monitoring and the reliability of dissolved gas analysis (DGA) in insulating oil, highlighting these as the central topics of discussion.

- **3rd East Asia TLM (May 2015)**

**Theme: Asset Management and Flexible Operation of Power Plants**

Case studies were presented on several thermal power plants where efficiency and operational flexibility had been improved through retrofitting measures. The discussion also addressed challenges related to performance evaluation and life extension of equipment as means of cost containment.

- **4th Berlin TLM (November 2015)**

**Theme: Technologies as an Enable for Energy Transition—a Cross-Country Comparison**

The meeting examined technologies commonly regarded as important—such as photovoltaic (PV) systems and smart grids—as well as those whose priorities vary by country, including hydro, nuclear, wind, geothermal, electric vehicles (EVs), energy-efficient buildings, alternative fuels, and energy storage. A comparative discussion was held on the differing national priorities regarding these technologies in the context of energy transition. Furthermore, as a follow-up to these discussions, an analysis was conducted to investigate the correlation between national technology priorities and the structural characteristics of each country's electricity system. These characteristics—referred to as “electricity indicators”—included factors such as electricity demand growth, energy efficiency, and the extent of decarbonization.

The outcomes of these TLMs were later disseminated to IERE members via the IERE website.

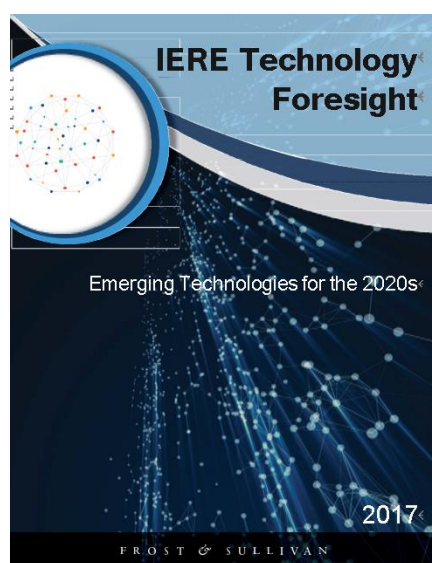
## **Technology Foresight—Newly Launched Activity 2 (2016–)**

This ongoing project aims to identify key technologies with the potential to significantly impact the future of the electric power industry. It investigates their current status, feasibility, and prospects. Initiated in 2016, it has so far produced three major reports (each approximately 100–200 pages), made available to members through the IERE website.

The impetus for this activity was the proposal at the 29th Board Meeting (November 2015) to provide technical information using paid information services as a new member service. Subsequently, a Technology Foresight(TF) Sub-committee was established to prepare for the initiative. At the 30th Board Meeting (May 2016), CHENG of CLP, a member of the Sub-committee, proposed the formal implementation of the Technology Foresight Project. The project was approved as a collaborative effort among IERE members to research and analyze emerging technologies and share findings within the organization. In addition, since the purpose of the activities was common, the follow-up activities of the Berlin TLM proposed by SCHULTE and TOSEN, Board members, at the 29 Board Meeting were integrated into this project.

- **Technology Foresight Activities 2017**

Given the tight schedule for producing results, it was agreed that IERE would finance the effort and commission an external research organization. The Steering Committee was tasked with drawing up a Terms of Reference (TOR) and preparing the member questionnaire. Based on the survey results in June 2016, 20 emerging technologies and 5 fringe technologies were identified, emphasizing technologies of particular interest to members. The report (*TF2017*), was completed in May 2017 following an investigation by a consultancy firm.

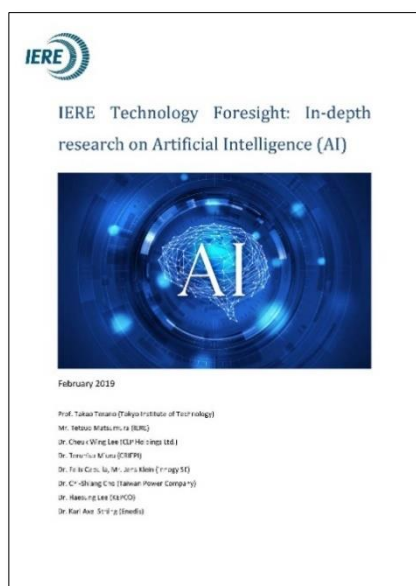


### **In-depth Research**

Subsequent developments were discussed by the Board based on the results of the member survey. First, **AI**, one of the fringe technologies (so-called dark horse technologies), was selected, and several young engineers recommended by the members conducted in-depth research. The research results were compiled and distributed to members in a report in March 2019.

In May 2019, a follow-up survey was conducted to select the next in-depth research themes. The survey revealed strong member interests in energy storage and hydrogen. Consequently, RWE TI assumed the

lead role in a **hydrogen**-related project. Fourteen members participated from late September 2019, carrying out a preliminary survey focused on the development trends of hydrogen technologies within their respective countries. The project was completed in March 2020, and the results were presented in a webinar held in September of the same year.



Regarding energy storage, it was decided to launch it as a collaborative research project.

## • Technology Foresight Activities 2021

At the 38th Board Meeting (June 2020), the need to periodically update the *TF2017* report was pointed out, and the decision was made to update it. The work was mainly carried out by the Central Office.

The process began with the identification of ten trend keywords associated with emerging technologies. Based on these keywords, the electric power industry was classified into three business sectors: “Power Generation,” “Transmission, Distribution and Retail,” and “Strategic Management.” A questionnaire survey was conducted among IERE members to gather data on the prioritization of relevant technologies in each business sector, the status of their implementation and planning, and the specific technological concerns members considered important. Notably, this survey was conducted in 2020, during a period when the COVID-19 pandemic was affecting all aspects of society. As such, the questionnaire was unique in that it also addressed the impact of the pandemic on technological development and strategic priorities.

Based on the survey results, key trend keywords were organized for each of the three business sectors, and technologies of high relevance and concern were identified to guide future technology development policies. To present these contents, an online interim report meeting was held in March 2021 for the members who had responded to the survey.

The final report, *TF2021*, was completed in October 2021 and subsequently distributed to IERE members.



### • **Technology Foresight Activities 2023**

At the suggestion of Chair NG, the TF Committee launched an initiative to conduct an in-depth survey on innovative technologies that could be realized in the 2030s. The committee met four times between November 2021 and May 2022 to discuss potential survey topics, methodologies, and scope. With the approval of the Board, the survey work was then subcontracted to a consultancy firm selected through a request for proposal.

As a first step (Part 0), the firm reviewed the technology development projections—covering R&D, demonstration, and commercialization stages—made in the *TF2017* report to evaluate their accuracy. Next, based on the member questionnaire, IERE selected 100 of about 200 potential technologies in the 2030s. The consultancy firm then created file cards summarizing each of these 100 technologies (Part 1).

Each file card included an overview of the technology, its economics, regional aspect, impacts on the electric power business and society, and future outlook. The report also shows the impact score of each item, technology readiness level, and human readiness level, as assessed by the consultancy firm. In addition, it also specifies the development entity and major projects.

In Part 2, a detailed survey was conducted for the top 20 technologies. First, the consultancy firm conducted two rounds of member surveys, and selected technologies to be targeted in Part 2 from the 100 technologies in Part 1, and created a ranking list of 100 technologies. Based on the list, the TF committee renamed and merged some of the technologies to make the 20 technologies to be studied in detail more



attractive. In addition, five technologies that did not make the top 20 on the list but were recognized as particularly “disruptive” were adopted as TF committee quotas, and the top 20 technologies were finalized.

The results of the detailed survey of the top 20 technologies submitted by the consultancy firms were discussed by the committee and some revisions were requested. For each technology, the views of experts belonging to IERE member companies were also sought, and their comments are one of the features of the report.

The final report (*TF2023*) was completed in October 2023 and published on the IERE website. A public presentation by the consultancy firm was also delivered as one of the IERE activities at the IERE General Meeting held in conjunction with the Singapore Forum in November 2023.



### **Collaborative Research—Newly Launched Activity 3 (2019–)**

The R&D Collaborative Project of IERE members was officially approved by the Board at the 21st Board Meeting (November 2011). The specific framework of the project was discussed by the R&D Working Group (WG) prior to this meeting, where members wishing to collaborate proposed a plan of action, and those who agreed with the plan participated in the project. Proposals were discussed by the WG, and only those that were approved were to be implemented as the IERE Project.

In 2011, five proposals were submitted, of which three were approved. However, only one—Hydro-Québec’s project (2012–2015) on transformer life diagnostics—resulted in a final report.



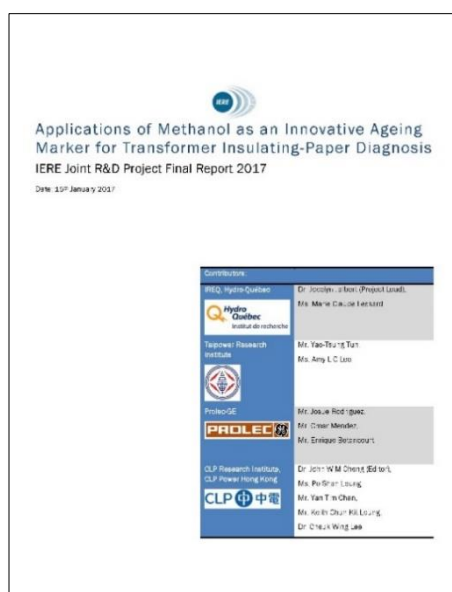
Subsequently, no collaborative research projects were conducted for a period of time. However, in 2019, a technology scouting study on hydrogen (in-depth research) was carried out, with RWE TI serving as the project leader. This project served as a model, leading to the launch of several new collaborative research projects thereafter.

Below is an overview of collaborative projects implemented since 2019.

- **Transformer Life Diagnosis (Methanol Marker) project**

**Phase 1 (2012–2015, leader: Hydro-Québec)**

This study focused on the degradation diagnosis of oil-immersed transformers. It examined a method to assess the deterioration condition of transformers by using methanol concentration as an indicator, based on the observation that insulating paper reacts with insulating oil over long-term operation to produce methanol. Although the project initially had six participating members and eventually concluded with four, it demonstrated that methanol could serve as an effective indicator. The final report was distributed to members in 2017.



**Phase 2 (2019–2024, Leader: ENGIE)**

Building on the results of the first phase, this project aimed to clarify the correlation between methanol concentration and the degree of polymerization of insulating paper (a degradation indicator), with the goal of developing a transformer degradation model. Initially, Hydro-Québec was asked to take the lead, but this did not come to fruition, and ENGIE ultimately took on the role of leader.

Participating members provided samples from dismantled transformers, which ENGIE analyzed to construct the model. Nine members participated, signing individual MOUs and covering analysis fees. Non-members were allowed to join for a roughly 30% premium, although none did.

By May 2023, 20 transformers had been dismantled. Originally planned to conclude in 2022, the project has been extended three times to early 2025 to enhance model accuracy by incorporating additional case studies.

Progress report meetings were conducted almost entirely online due to the impact of the COVID-19 pandemic; however, the kickoff meeting in May 2019 and an in-person meeting in Tokyo in October 2023, following the subsiding of the pandemic, were held face-to-face.

- **AI Project**

- Round 1 (2020–2022, Leader: CLP; Deputy Leader: E.ON)**

- In this project format, members aiming to solve specific problems provided relevant data as Data Providers (DPs), while those interested in AI development participated as Application Developers (ADs) to create AI solutions. The project launched with the participation of 11 members, and eventually, four teams were formed from eight members. The teams tackled each task by August 2021. The results were shared in November of the same year, and in March 2022, a webinar open to IERE non-members was held.

- Round 2 (2022–2024, Leader: E.ON; Deputy Leader: CLP)**

- Using the same framework, Round 2 involved eight members. A kickoff meeting was held in July 2022, and teams were again organized to tackle different tasks. Results were shared internally in October 2023 and publicly presented by E.ON and Chubu Electric Power at the Singapore Forum in November 2023. A follow-up webinar for all IERE members was held in March 2024.

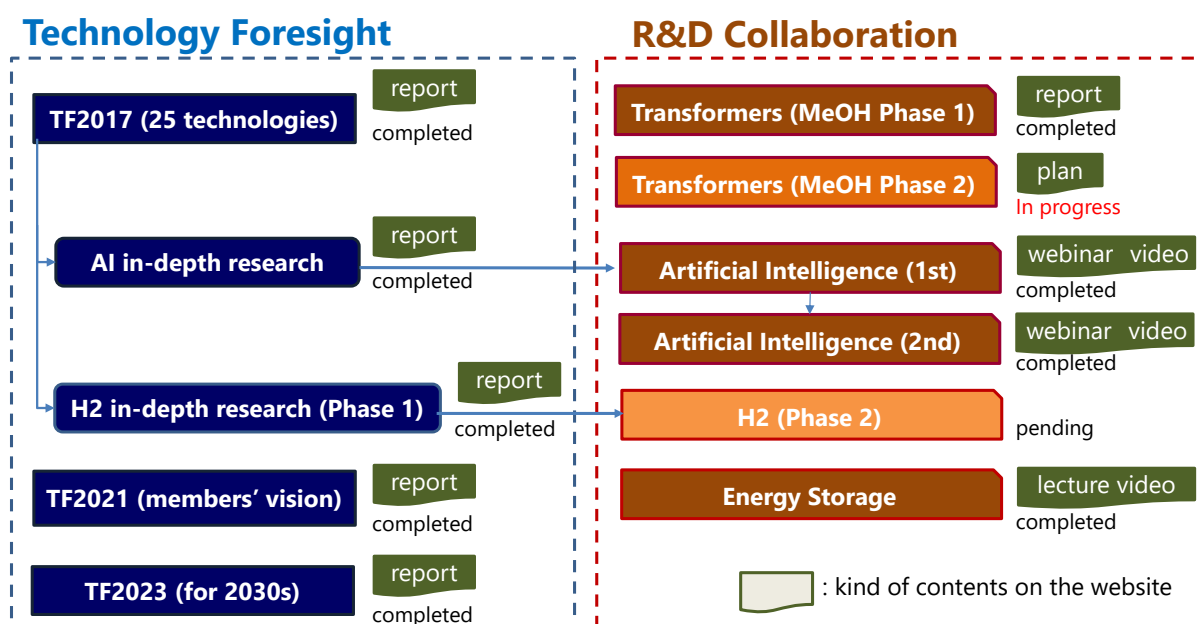
- **Energy Storage Project (2021–2023, Leader: SwRI)**

- Launched in April 2021 for an 18-month term, this project involved seven members. Its objective was to develop a battery degradation model and evaluate the risks of ignition and rupture. SwRI conducted modeling using standardized batteries and refined it with field data provided by participating members. A final report meeting was held for participating members in March 2023. SwRI continued testing independently to improve the model's accuracy and presented an overview of its findings at the San Antonio workshop in May 2024 as a special lecture.

The table below provides a summary of the collaborative research projects—including those involving in-depth researches originating from Technology Foresight initiatives—that have been initiated or conducted since the establishment of the R&D Working Group framework in 2011.

Project Name (Leader)	Period	Overview
Transformer Life Diagnostics Phase 1 (Hydro-Québec)	2012–2015	Validated methanol as a diagnostic marker for transformer degradation
In-depth Research on AI Technology (Tokyo Institute of Technology)	2018–2019	Surveyed AI tools, challenges, and practical recommendations
In-depth Study of Hydrogen-Related Technologies (RWE TI)	2019–2020	Conducted technology scouting on hydrogen over countries
Transformer Life Diagnostics Phase 2 (ENGIE)	2019–2024*	Developed correlation model between methanol concentration and insulation paper degradation
AI Round 1 (CLP)	2020–2022	Team-based development of AI solutions using operational data
AI Round 2 (E.ON)	2022–2024	Continued team-based AI development using operational data
Energy Storage (SwRI)	2021–2023	Modeled battery degradation and risk; post-project testing continued

\* Originally scheduled to conclude in 2022, Phase 2 was extended to early 2025 to gather additional data and improve model accuracy.



**General Picture of IERE Projects** as of December 2024

### Pick-Up Papers—Newly Launched Activity 4 (2019)

Beginning in December 2019, IERE launched a “Pickup Paper” service that compiles thematically curated selections of presentation materials from past forums and workshops. This service selects relevant materials from approximately the most recent three years of presentations, categorizes them by topic, and makes them accessible via the IERE website. Initial themes included “Hydrogen,” “Big Data, IoT, AI, and Blockchain,” “Thermal Power Generation,” “Energy Storage and Batteries,” and “Asset Management and Maintenance.” Furthermore, a new paper on “Carbon Neutrality” was published in November 2021.

## Webinars—Newly Launched Activity 5 (2020–)

In response to the challenges of holding in-person events due to the COVID-19 pandemic, IERE began conducting webinars using information technology in 2020 as an alternative format for conferences and seminars.

A total of eight webinars have been held through 2024, starting with the first report on the technology scouting conducted for the hydrogen collaboration, followed by three reports on the results of the collaboration, two reports on new technologies and technology trends, and three webinars dealing with technology topics requested by the board and members. Some webinars are open to non-members with the opportunity to participate in order to stimulate interest in IERE. The webinars were generally well received, drawing approximately 100 registrants per session, and in some cases nearly 200, thereby creating opportunities for participation by individuals who might face budgetary or scheduling constraints that prevent them from attending in-person events.

Several of these webinars were held in conjunction with IERE General Meetings during the COVID-19 pandemic. Even after the pandemic, the webinars have continued to be held to take advantage of the convenience and ease of participation of online participants.

Webinars Held in the Past

Event Date	Theme (Lecturer)	Note
Sept. 2020	Technology Scouting Project on Hydrogen (RWE TI)	Held with General Meeting Members Only
Nov. 2020	Sustainable Emerging Technologies 2020 (ENGIE)	Open to non-members
Oct. 2021	Key Technologies in the Next Chapter of the Energy Transition (Lux Research)	Held with General Meeting Members Only
Nov. 2021	Towards a Carbon Neutral Energy Future (ENGIE, SwRI, CSIRO, CRIEPI)	Open to Non-Members
Mar. 2022	Webinar on AI Collaboration Project (CLP-EPRI, CRIEPI - Shikoku EPCO, NARI-PLN, Chubu EPCO - Chugoku EPCO)	Members Only
Nov. 2022	Toward Enhanced Resilience for Electric Power Systems (EPRI, CEPRI, Prolec GE, Powertech Labs)	Held with General Meeting Members Only
Mar. 2024	Webinar on AI Collaboration Project (2nd Round) (Chubu EPCO - Chugoku EPCO, CLP-EPRI, CRIEPI - K-Electric, NARI - K-Electric)	Members Only
July 2024	Advanced Metering Infrastructure (AMI) (Waseda Univ., Nmi, CEPRI, K-Electric)	Open to Non-Members

## **Mini-Workshops—Newly Launched Activity 6 (2023–)**

IERE has been exploring various possibilities for collaborative research and, as a preliminary step, has provided opportunities for members with shared interests in specific themes to exchange information in advance. Some of these efforts are referred to as “Mini-Workshop,” conducted on a give-and-take basis, where only members who provide information may participate and mutually share insights.

- **Information Exchange on Hydrogen (December 6 and 8, 2021)**

In preparation for launching the second phase of the hydrogen collaborative research project, the Central Office carried out extensive coordination. As part of these efforts, an online meeting was held with members who expressed interest in participating in Hydrogen Phase 2. The purpose was to provide a platform for members to introduce their ongoing research and available experimental facilities to one another, laying the groundwork for building the second phase.

Given the time zone differences among participants, two sessions were held on December 6 and 8, facilitated by ENGIE, a candidate for the project leadership. Recordings were provided for those unable to attend both sessions.

Following the meetings, a questionnaire was distributed to collect feedback on topics of interest and potential research themes; however, a concrete joint research project was not realized.

Although this meeting was not initially labeled as a “Mini-Workshop,” it is included in this section as its purpose and format were consistent with the concept of a Mini-Workshop.

- **Mini-Workshop on Power Distribution Equipment Failure Cases and Countermeasures (April 24, 2024)**

A Mini-Workshop was held to exchange information online about power distribution equipment failures and related countermeasures. The workshop featured 10 presentations from 9 members, mainly from the Asia region, with around 100 participants including the presenters.

This initiative originated from a consultation in 2022, when the Central Office visited members in the Asia region and one member proposed the idea of building a database compiling failure cases of distribution equipment. The Central Office engaged in discussions with the proposing member regarding the feasibility of such a database. However, due to the challenges involved in collecting data from multiple members, a concrete approach to development could not be identified. Later, during visits to several Asian members in 2023, the Central Office shifted the proposal from building a database to sharing failure information instead. This alternative approach gained support from multiple members, ultimately leading to the organization of a Mini-Workshop.

Presentations covered a wide range of topics, including failure cases, maintenance and diagnostic techniques for overhead lines, cables and joints, transformers, switchgear, surge arresters, and other distribution equipment. The session was facilitated by CRIEPI. Despite time limitations that required presentations to be shortened, there was active discussion and information exchange.

A post-event questionnaire was conducted to assess member interest in device categories, failure causes, and related technologies, though no specific joint research theme emerged.

This meeting was the first to be officially held under the name “Mini Workshop.”

### **Website Renovation—Epoch 1 (2016)**

The IERE website was renovated in 2017, and a new operational system was launched. The previous website had separate structures for members and non-members, and accessing the members-only pages required using an ID and password distributed in advance by the Central Office. This complexity in operation had been recognized as a challenge

At the time, actual usage was presumed to be limited to viewing event information and past presentation slides, and the website had not become an active platform for member interaction. Against this backdrop, it was hoped that sharing information about each member’s R&D activities on the website would stimulate interest and promote engagement among members.

In response, discussions on website renovation progressed, and the new website was launched in early 2017. Key structural features of the new site included the elimination of the division between member and non-member pages, allowing each member to set their own ID and password using an email address containing their organization’s domain, and the simplification and reorganization of the previously complex top page. These changes improved both convenience and usability.

In addition, with a focus on information exchange among members, a “Community” page was introduced. In 2018, based on the results of the *TF2017* survey, a “Collaboration Map” was added to the “Members Information” page. This initiative aimed to address the difficulty members faced in understanding each other’s areas of interest in research and emerging technologies by visualizing these interests and the willingness to share information online, thereby facilitating the identification of partners for information exchange and collaborative research.

This function enables the mapping of each member company’s technical information and provides a reverse-search capability to identify companies interested in specific technological fields.

## **New Logo—Epoch 2 (2016)**

IERE's early logo, which had been in use for years, were said by members to be small and unrecognizable. In response, the Central Office proposed a logo revision at the 32nd Board Meeting (May 2017). This proposal was approved, and a design firm was commissioned to create a new logo. At the 33rd Board Meeting (November 2017), a final design was selected through a board vote from several candidates. The new logo was officially adopted and put into use in 2018.

The updated logo retains the basic design elements of the original but incorporates enhancements to emphasize dynamism and communication. The italicized “IERE” lettering symbolizes active motion, while the dual-radius outer lines represent the expansion of IERE’s scope and influence.



## **Co-hosting Event with MOU Partner—Epoch 3 (2018)**

IERE has concluded Memoranda of Understanding (MOUs) with several external organizations for cooperation in information exchange and co-hosting events. A notable example of utilizing such agreements was the joint hosting of the VGB (now vgbe) annual Congress and an IERE Workshop in 2018

This event was planned as a result of ongoing information exchange between the Central Office and VGB, during which both parties explored new possibilities for collaboration. As both are membership-based organizations with significant overlap in their technical focus areas, the event was held with the aim of deepening interaction among members and facilitating broader exchange of technical information through co-hosting.

For this co-hosted event, a format was adopted that allowed participants of both events to move freely between sessions. The venue was set in Munich, Germany, where VGB had planned to hold its annual Congress, and RWE TI, a German member of IERE, served as the local host. Several challenges arose in the planning process, including differences in participation fee structures, variations in membership categories between the two organizations, and the need to design a program that allowed unrestricted movement between sessions. However, these issues were successfully resolved through careful coordination in advance.

Discussions are currently in progress with vgbe to explore potential avenues for collaboration in 2025.