

The background of the cover is a composite image. The top left shows a blurred high-voltage power transmission tower against a blue sky. The right side features a vertical stack of server racks with glowing blue lights. The bottom right corner shows a close-up of a computer monitor displaying several data charts and graphs with orange and red lines. The overall color palette is dominated by blues and oranges.

LF ENERGY

LF Energy

2024 Annual Report

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The Challenge

The Challenge

Digital transformation of the global energy sector is necessary to meet the challenges of the rapidly accelerating energy transition. Load growth from electrification of buildings and vehicles, data center expansion, and the rise of variable energy generation from renewables create unprecedented complexity for an industry that has not experienced such radical transformation since its inception.

Significant change on a global scale is never easy or quick. Therefore, innovation and new ways of thinking are critical. But this also brings its own challenges, as traditional players in the energy sectors, such as utilities, technology vendors, and policymakers, face problems they've never encountered before and often aren't able to solve. The energy industry workforce also suffers from a skills gap, lacking the necessary combination of energy know-how and required ICT skills to make the transition.

Forging collaboration and tangible progress in critical areas such as artificial intelligence (AI), interoperability, and security, LF Energy is accelerating digital transformation across the global energy industry and enabling energy sector decarbonization.

The time is now. Join us.

Message From Executive Director

Message from Alex Thornton, Executive Director

For those of us living at the intersection of energy, technology, and open source, it is the most exciting and dynamic of times. As I write this, the announcement of an open source AI model that delivers vast improvements in performance and efficiency has rocked the world. This milestone concretely demonstrates a few things that validate the premise of LF Energy.

First, there is a tight connection between energy and AI. Load growth forecasts have exploded over the past 18 months due to overall electrification and AI-driven data center growth. With incredible efficiency improvements demonstrated, there is doubt surrounding those load growth forecasts. Second, open source wins. Closed, proprietary solutions cannot match the innovative power of collaboration through open source. Open source AI solutions lead the pack in energy efficiency, reasoning performance, cost, transparency, and trust.

LF Energy exists to navigate these dynamic, ever-changing times. The energy sector is rapidly digitizing in terms of infrastructure and workforce. Our community is at the intersection of digital transformation and energy transition and is rising to meet the challenge. We are the place for software engineers, data scientists, and other digital experts to tackle the unique problems of our industry, building up an invaluable repository of open technology and shared knowledge.

As this report details, I'm proud of this community's progress in 2024. Much work remains to deliver on the energy transition's promise of affordable, reliable, safe, and clean energy. LF Energy is and will become an even more indispensable part of that transition. I'm thrilled to be working on it with you all and look forward to meeting the next challenges together.

New Partnerships

New Partnerships

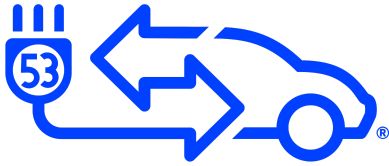


CRESYM Collaborative Research for Energy SYstem Modelling

[Collaborative Research for Energy SYstem Modelling \(CRESYM\)](#) is a nonprofit association based in Brussels, Belgium, made up of industrial and academic research organizations aimed at solving upcoming challenges for the fast-evolving European energy system.

In 2024, LF Energy and CRESYM signed a Memorandum of Understanding to increase collaboration in support of energy sector open source projects to enhance the digitalization of energy systems. Building on the strengths of both organizations, CRESYM will continue to focus on the creation of new, innovative research projects to drive digital transformation in the energy sector. Providing research communities with resources for ongoing project maintenance and support after initial development allows CRESYM to focus on research and development.

LF Energy will leverage its expertise in building sustainable open source projects and host CRESYM's research projects once they reach an appropriate stage. Support from LF Energy's Technical Advisory Council (TAC) will enhance project technology readiness and foster open source tooling development. LF Energy will also promote CRESYM's research road map to LF Energy members seeking synergies, triggering new research projects, and inviting members to join early-stage projects.



Task 53 from the International Energy Agency

The International Energy Agency (IEA) is an autonomous intergovernmental organization based in Paris that provides policy recommendations, analysis, and data on the global energy sector. The IEA's Hybrid and Electric Vehicle Technology Collaboration Programme (HEV TCP) launched Task 53 to help improve the interoperability of bidirectional charging, which plays an essential role in the decarbonization of the electricity sector.

It is commonplace in today's marketplace for each car or charging station manufacturer to develop their own proprietary solutions, and the inevitable result is market fragmentation. There also exist different standards in different regions around the globe, which increases complexity. This lack of standardization has negative effects not only on companies looking for market share but the entire ecosystem.

In 2024, LF Energy announced a partnership with Task 53 to test the conformance of the upcoming ISO amendments (ISO15118-2X) for bidirectional charging at car-charging stations. In this collaboration, LF Energy's [EVerest](#) project provides expertise in establishing universal open source charger firmware supporting all relevant industry standards and variations. This allows Task 53 to focus on and organize cross-system interoperability testing.

The partnership will help ensure interoperability between bidirectional charging stations, vehicles, and distribution grids.

Board of Directors

Board of Directors



PROFESSOR AT RWTH AACHEN UNIVERSITY
Antonello Monti



TREASURER
VALUE STREAM LEAD AT ALLIANDER
Arjan Stam



SENIOR DIRECTOR, ENERGY STRATEGY AT
MICROSOFT CORPORATION
Audrey Lee



CHIEF DIGITAL TECHNOLOGY ADVISOR AT SHELL
INTERNATIONAL EXPLORATION & PRODUCTION,
INC.
Bryce Bartmann



EXECUTIVE VICE PRESIDENT AT SAVOIR-FAIRE
LINX
Christophe VILLEMER



SENIOR SOFTWARE ENGINEER AT APPLE INC.
Jordan Hughes



CHAIR
OPEN SOURCE PROGRAM DIRECTOR AT RTE
(RESEAU DE TRANSPORT ELECTRICITE)
Lucian Balea



CEO AT PIONIX GMBH
Marco Möller



DATA AND SOFTWARE CLIMATE SOLUTIONS AT
GOOGLE LLC
Savannah Goodman

Message from Lucian Balea, Board Chair

What a year for the LF Energy community!

The emblematic image that I remember from 2024 is that of the LF Energy Summit held in Brussels in September: a wealth of opportunities for collaboration, a wide range of innovative projects moving forward, and above all, an energetically committed community. The event was sold out for a reason!

In 2024, we were delighted to welcome the three first North American utilities and grid operators alongside the six European grid operators already involved. Not only have they become members, but they are already committing to emerging projects! Such involvement is essential, as it is through participation that the full value of open source collaboration becomes apparent.

Whether we're talking about EV charging, digital substations, or grid simulation and modeling, the industrial and commercial prospects for LF Energy's projects are growing. This is no accident but the result of ongoing efforts to help communities achieve high industrial-grade, cyber-resilient software standards.

Looking ahead to 2025, our direction remains as clear as ever—to bring together a leading-edge ecosystem and provide the most appropriate framework and tools for collaboration on open source technologies and standards. This will serve as the trustworthy digital foundation for energy decarbonization, grid modernization, and modern energy services.

On behalf of the Board of Directors, I would like to extend my warmest thanks to the entire community for your commitment to this collective endeavor.

Spotlight: Artificial Intelligence

LF Energy Spotlight: Artificial Intelligence

While AI is rapidly transforming almost every global industry, its own energy demands are becoming a significant consideration. The training and operation of AI models require substantial computing power, translating to high electricity consumption for running the processors and maintaining cooling systems. As AI's overall energy footprint continues to grow, efficient AI development and operations are crucial.

At the same time, AI offers immense potential for improving energy efficiency and optimizing energy systems. By analyzing vast amounts of data from various sources, AI can identify patterns and insights that can lead to more accurate forecasting of energy demand, better management of renewable energy sources such as solar and wind, and optimized control of energy grids. AI-powered systems can also predict equipment failures, enabling proactive maintenance and reducing downtime. All of this helps the energy sector to become more efficient, reliable, and sustainable, ideally offsetting the energy consumption of AI itself and accelerating the decarbonization of the grid.

LF Energy is building open source solutions for key AI use cases and has launched (or is setting up) projects for six priority AI application areas in power systems:

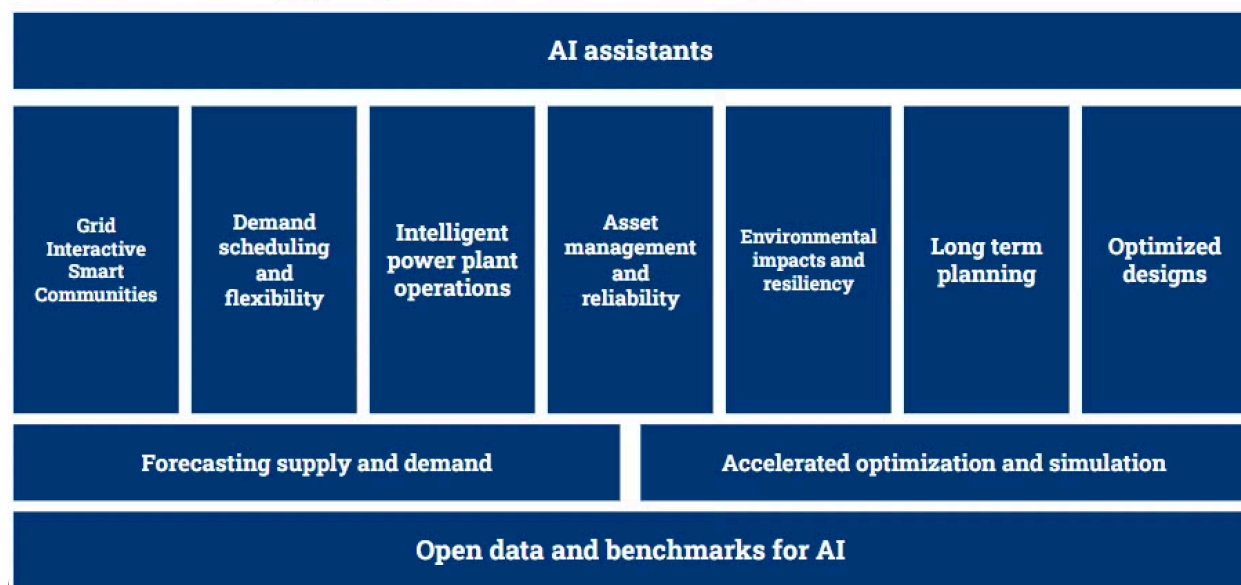
- **Forecasting:** Enhancing short-term load forecasting
- **Accelerated Simulation and Optimization:** Speeding up operational decision making by leveraging AI in simulation and optimization tools
- **Asset Management:** Optimizing maintenance and reducing failures by supplementing predictive analytics with AI models
- **Long-Term Planning:** Developing optimal decision-making tools for long-term infrastructure investment while tackling uncertainty and the changing climate
- **AI Assistants:** Supporting AI-powered decision making in operations
- **Grid-Interactive Smart Communities:** Enabling flexible, decentralized energy management at the grid edge

Other projects focus on horizontal needs such as foundational models, digital twins, and synthetic smart meter data.

Through LF Energy, energy stakeholders can join forces to develop industry-grade open source AI solutions with a rich and sustainable ecosystem to support and commercialize them.

When facing a task this complex and significant, there are several challenges and open questions that require solving while disrupting the status quo in the utility sector, primarily around speed and scale, trust and compliance, and standardization.

AI for energy systems use cases



To overcome these challenges, better answer open questions, and deliver on these promises, a new collaboration model is necessary. LF Energy believes that stakeholders in the energy ecosystem must adopt a strategic approach to AI readiness by:

- Establishing robust data governance to enable AI innovation and deployment
- Investing in digital twins and data platforms based on open source shared components to support AI initiatives
- Supporting open, realistic datasets to fuel AI model development with third-party innovators and researchers
- Promoting AI literacy in the organization and workforce to help power systems make the most of AI tools and technologies and support AI experts in navigating and understanding energy-specific knowledge and challenges

LF Energy launched an [AI Special Interest Group \(SIG\)](#) in 2024 to help spearhead this collaborative effort. The SIG provides a venue for open innovation and collaboration; co-develops techniques for addressing privacy, confidentiality, cybersecurity, and critical infrastructure protection issues; provides high-value, high-quality open benchmark datasets; and fosters open, use case-driven, peer-reviewed collaborative research and innovation.

Open source AI-focused projects hosted by LF Energy include [GridFM](#), [OpenSynth](#), and [OpenSTEF](#).

LF Energy AI in Action

- The OpenSTEF project provides a foundation for forecasting use cases by offering automated, open source machine learning (ML) pipelines for accurate short-term load forecasting. Building on OpenSTEF, stakeholders can collaborate to advance the use of AI/ML techniques and improve forecasting in power systems. [Alliander uses OpenSTEF for congestion management](#) and to prohibit the exceedance of grid limitations, while other possible use cases include forecasting peak shaving on solar farms, forecasting as a service, and energy traders maximizing returns on a specific market. RTE, RTE International, and Shell also participate in the community.

- The [Centre for Net Zero](#), a not-for-profit, impact-driven energy research institute, created a generative AI database with synthetic residential smart meter data using the LF Energy [OpenSynth](#) project and has now [released the model's synthetic outputs](#). It encourages raw smart meter data holders around the world to generate and share synthetic data for training and improving AI algorithms.
- IBM is working on a project in collaboration with LF Energy and [Hydro-Quebec](#) to build grid foundational models using [GridFM](#) models to address challenges emerging with the increasing complexity of grid transformation. These pre-trained models allow stakeholders to fine-tune for specific applications using proprietary data.

“Foundation model technologies are a great fit for tackling the underlying complexity of the power systems. GridFMs can capture the dependencies across all the data we find in modern grids in an AI representation and offer new possibilities.” —Juan Bernabé-Moreno, Climate and Sustainability strategy lead at IBM Research

[2024 LF Energy AI Resources, News, and Use Cases](#)

[Unlocking AI's Potential for the Energy Transition Through Open Source](#)

[Adoption of Artificial Intelligence by Electrical Utilities](#)

[Grid Foundational Models Emerging](#)

[An IBM-Led Team Is Exploring How AI Can Prepare the Electrical Grid for the Low-Carbon Era](#)

Ambassadors

LF Energy Ambassadors



Robert de Leeuw

TECHNICAL EVANGELIST, PIONIX



Dr. Marco Möller

CO-FOUNDER AND CEO, PIONIX



Dr. Kwate Kwate Rodrigues

SOLUTION ARCHITECT, HYDRO-QUÉBEC



Jonas van den Bogaard

STRATEGIC MEMBER REPRESENTATIVE, ALLIANDER



Christophe Villemer

EXECUTIVE VICE PRESIDENT, SAVOIR-FAIRE LINUX



Sachin Bhakar

OPEN SOURCE ADVISOR, SHELL

In any open source project, active participation is paramount to community and project health. Project Ambassadors represent the project in their particular geographies and industry verticals, actively contribute to the project in various forms, and lead by example. In addition to the traditional project onboarding mechanisms, Ambassadors also provide a helpful and friendly resource for community newcomers.

In 2024, LF Energy was proud to announce its first cohort of Ambassadors!

Spotlight: Security

LF Energy Spotlight: Security

Security of the power grid is of critical importance, and LF Energy recognizes that the adoption of open source in the energy sector requires attention to security practices in projects, products, communities, and the energy ecosystem as a whole.

As we move toward increasingly digital and distributed power systems, LF Energy is proactively taking measures to ensure that we build our open source projects with the most advanced and transparent security processes, tools, and best practices. As part of the Linux Foundation, LF Energy is working in tandem with security efforts and groups such as [SPDX](#), [OpenChain](#), and [OpenSSF](#) to improve security readiness throughout the open source ecosystem, implementing tools like a Software Bill of Materials (SBOMs) and initiating project audits.

Projects with effective security protocols are more likely to gain traction in enterprise and critical infrastructure sectors.

LF Energy projects comprise mission-critical software with the highest requirements for security. As part of LF Energy's commitment to making sure that open source solutions for energy systems are kept secure, it engaged [Quarkslab](#) in 2024 to carry out a holistic security audit of LF Energy's [OperatorFabric](#) project. The intention of the audit, which the [Open Source Technology Improvement Fund \(OSTIF\)](#) facilitated, was to evaluate the project's security posture, identify potential vulnerabilities, and suggest possible improvements.

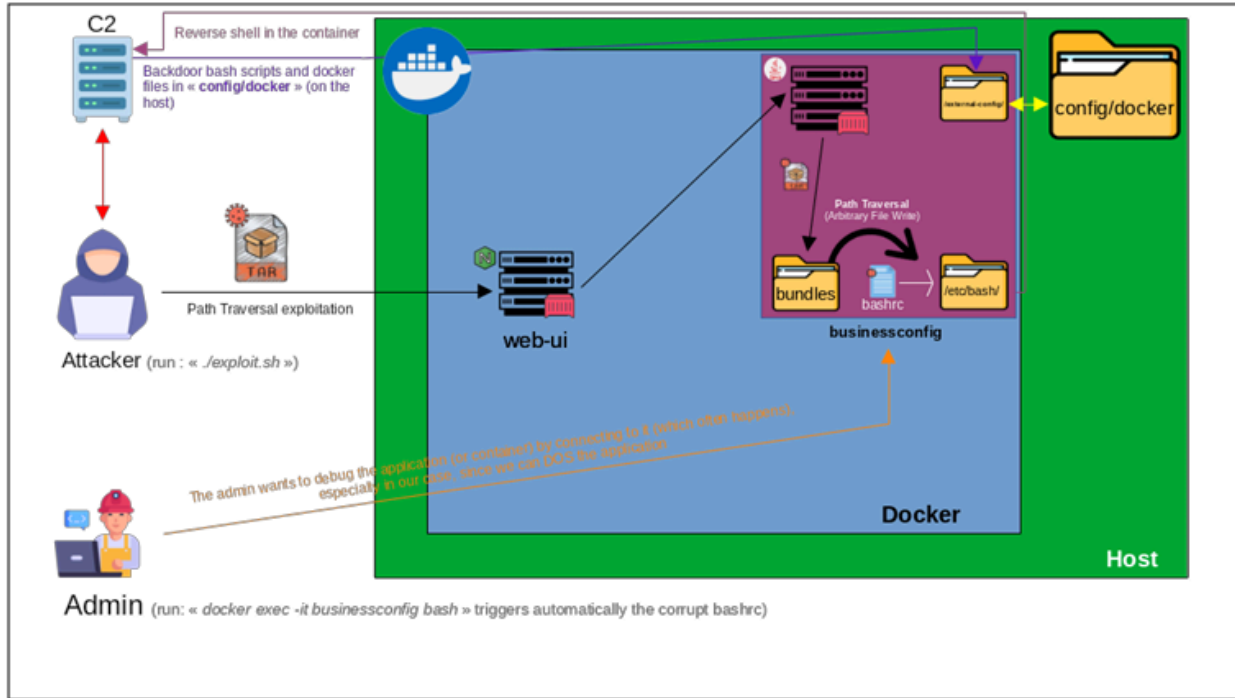


Diagram of a potential “Path traversal (Arbitrary File Write & Arbitrary File Delete) leading to RCE and docker escape” vulnerability identified and addressed through the OperatorFabric security audit.

While the audit found no vulnerabilities available to unauthorized users, the report surfaced various exploitable errors, which project maintainers immediately addressed. The audit team also noted the high quality of the OperatorFabric codebase and proactive steps around security measures. More information on the audit is available in this [blog post](#).

OSTIF next brought in [Ada Logics](#) to carry out a holistic security audit of LF Energy’s [SEAPATH](#) project. The audit formalized a threat model based on the project scope and reviewed security vulnerabilities, security practices, third-party open source dependencies, ISA/IEC-62443 security standards, and more. High-level audit results included various issues related to the SEAPATH threat model, recommendations related to ISA/IEC-62443 compliance, and a supply-chain security assessment.

Updates to project documentation and procedures occurred following the audit’s completion, including addressing identified vulnerabilities. The audit determined the SEAPATH community had also prioritized security, invested

in security hardening, and implemented security best practices. More information on the audit is available in this [blog post](#).

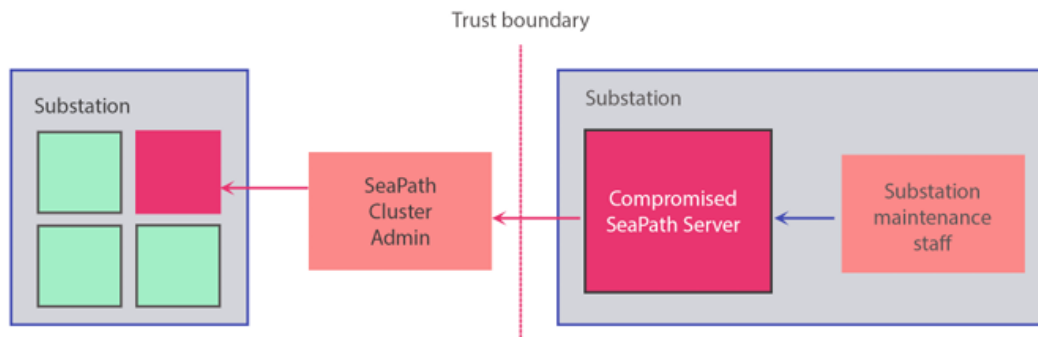


Diagram of a “SEAPATH local attacker escalation” vulnerability identified and addressed through the SEAPATH security audit.

“Having experienced open source engineering teams like Savoir-faire Linux involved ensures that SEAPATH continues to evolve with strong foundations in stability, security, and long-term viability.” —Eloi Bail, Savoir-faire Linux

[2024 LF Energy Security Resources, News, and Use Cases](#)

[LF Energy OperatorFabric Project Completes Security Audit and Threat](#)

[LF Energy SEAPATH Project Completes Security Audit and Threat Model](#)

[Linux Foundation Energy Releases v1.0 of SEAPATH, Open Source Software Hypervisor for Digitalizing Electrical Power Substation Systems](#)

[Baltic RCC’s Use of Open Source Technology To Meet Energy Transition Challenges](#)

[Announcing the Launch of the OpenSynth Model Repository: Revolutionizing Access to Energy Demand Data](#)

[OpenSynth Model’s Synthetic Outputs Now Openly Available](#)

Projects

LF Energy Projects

New Projects

The LF Energy's TAC voted to accept six new projects into the foundation in 2024.

[covXtreme](#) is a model and software for hazard risk analysis of extreme events. covXtreme estimates penalized piecewise constant covariate marginal and conditional extreme value models and allows environmental contour estimation. Shell contributed covXtreme to LF Energy.

[GEISA \(Grid Edge Interoperability & Security Alliance\)](#) creates a production-grade, secure technical foundation for a robust and open grid edge “app” ecosystem in constrained edge devices. GEISA specifies a uniform runtime environment for running applications and creates a testing program to develop an industry-wide, consistent, and interoperable approach to securely deploying grid edge applications, significantly reducing the audit burden on IT teams and accelerating the deployment of innovative solutions. Southern California Edison (SCE) supported the foundation of the project within LF Energy.

[GridFM](#) is an open source framework to enable the development of foundation models (FMs) for power grids. FMs are AI models pre-trained on massive data sets and adapted to a broad set of applications. You can apply FM technology to the electric power grid (GridFMs), and the concept is to train it on grid data. Hydro-Québec and IBM contributed GridFM to LF Energy.

[NODE \(National Open Data for Electrification\) Collective](#) commits to sourcing, structuring, and maintaining comprehensive data on every residential incentive program in the U.S. The community has amassed the most complete, well-structured, accurate set of incentive data in the U.S.

and developed the tools to enlist a broad coalition in this effort moving forward. Eli Technologies, the Building Decarbonization Coalition, Rewiring America, RMI, and the North Carolina Clean Energy Technology Center contributed the NODE Collective to LF Energy.

[OpenSynth](#) is a global open community that democratizes synthetic data and accelerates the decarbonization of global energy systems. Starting with a focus on synthetic consumption data, the community is expanding to create synthetic, privacy-preserving data sets that cover the entire electric grid. The Centre for Net Zero, powered by Octopus Energy, contributed OpenSynth to LF Energy.

[SC Decarbonisation Hub \(SCDH\)](#) creates visibility and measurability and allows for conversations around Scope 3 carbon emissions data. This visibility and measurability lead to decisions and actions that can deliver the change an organization is focusing on. Shell originated SCDH before it contributed it to LF Energy.

Special Interest Groups (SIGs):

[LF Energy Architecture Model](#): The goal of the LF Energy Architecture Model is to become the place to go for sharing reference architectures and project architectures within the LF Energy community. It aims to clarify the ecosystem of LF Energy—where you can use LF Energy projects, how they interact together, and how you can adopt them in reference architectures.

[LF Energy AI](#): The creation of LF Energy AI SIG was to drive AI for energy priorities forward. The potential of AI relies heavily on access to data, and much of the granular data in energy involves some degree of privacy, confidentiality, cybersecurity, and critical infrastructure protection issues. Open innovation and collaboration in this area will bring new solutions such as synthetic data generation based on real datasets, privacy-preserving techniques, and more.

[Digital Substations](#): Digital substations improve grid reliability, safety, and efficiency while reducing costs through automation, remote monitoring, and standardized communications. The LF Energy Digital Substations SIG addresses these challenges by optimizing substation operations through advanced data management, dynamic protection settings, and adaptive automation.

[EV Charging](#): The LF Energy EV Charging SIG is a collaborative initiative to advance open source solutions in the EV charging ecosystem. The group serves as a center of gravity for innovation, technical collaboration, and standardization efforts in EV charging, fostering cross-project synergies and identifying gaps where new open source projects can drive progress. By facilitating an open, standards-aligned, and interoperable EV charging ecosystem, the LF Energy EV Charging SIG is driving the future of sustainable mobility through open source collaboration. Projects include EVerest and CitrineOS.

[Grid Simulation and Modeling](#): Power grids are becoming increasingly complex to manage as energy resources become increasingly distributed and variable. The LF Energy Grid Simulation and Modeling SIG is a collaborative initiative to advance open source tools and methodologies for power system simulation, forecasting, and grid modeling. The group fosters innovation, cross-project collaboration, and alignment with industry standards to enhance grid planning, operation, and resilience in the energy transition. The design of the SIG supports and guides open source projects that enable accurate, scalable, and interoperable grid simulations and modeling. Projects include Arras, covXtreme, Dynawo, Grid Capacity Map, GridFM, GRIP, OpenSTEF, Power Grid Model, and PowSyBl.

Message from Antonello Monti, TAC Chair

2024 has again been a fantastic year for the technical activities within LF Energy. We continue experiencing growth and are increasingly making an impact in the industry. After a reorganization in 2023, this year the TAC is experiencing a new structure with the possibility, on the one hand, of more focused discussions in the SIGs and, on the other hand, more time for strategic thinking in the TAC.

Among all the activities, I would like to mention our new efforts in the direction of the application of AI. This is definitely an area where open cooperation is critical for solid and productive development.

It is also relevant to mention that LF Energy has been improving its worldwide presence with new relevant partners from the Americas. The exchange beyond European borders is one of the best-added values of the foundation.

We are looking forward to the new year with new projects, new members, and mostly new real-life implementations.

LF Energy Project Rollup

Data Standards and Tooling



Building sustainable open source software best practices and delivering standards for the battery industry



A data dictionary for raw data and a standard for data requirements that enable energy data access for measuring, quantifying & tracking carbon emissions from energy production and consumption



A nonprofit alliance dedicated to sourcing, structuring, and maintaining comprehensive data on every incentive program in the U.S.



An open source library that measures the impacts of demand-side programs using

historical data, predictions, models, and usage



A global, open community that democratizes synthetic data to accelerate the decarbonization of global energy systems



Provides visibility into, and the ability to manage, suppliers' Scope 3 emissions



An open source specification project focusing on a widely applicable smart meter data gateway



Accelerating the implementation of interoperable systems for the exchange of transmission facility ratings

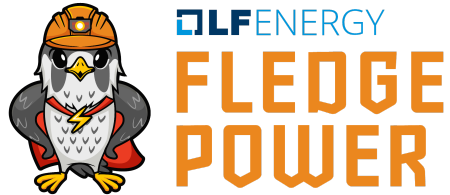
Digital Substations



Common software blocks for IEC 61850 profile configuration



Enables building a real-time virtualization industrial-grade platform based on Yocto or Debian



Flexible, lightweight, industrial-grade, open source gateway that embeds Fledge (LF EDGE)

EV Charging



Open source charger network software for rapid OCPP 2.0.1 and NEVI-compliant EV charge management



Open source modular framework for EV charging

Grid Operations



Intelligent and developer-friendly EMS to support real-time energy flexibility apps rapidly and scalably



Production-grade, secure technical foundation for a robust and open grid edge “app” ecosystem in constrained edge devices



Software platform that enables hardware monitoring and control in the public space at scale



Open source control for AC, DC, AC/DC microgrids



A friendly and compliant OpenADR implementation for Python 3



Modular, extensible platform for alert management for systems operators



Easy access to high volume, historical, and real-time process data for analytics applications, engineers, and data scientists



Implements the Universal Smart Energy Framework for flexibility forecasting, offering, ordering, and settlement processes



Microservice based architecture for distribution grid automation

Grid Simulation and Modeling



Simulation and analysis tool that models emerging smart grid energy technologies



Model and software for hazard risk analysis of extreme events



Hybrid C++/Modelica open source suite of simulation tools for power systems



Enables grid operators—and the customers they serve—to more easily see when and where connections will be most optimal



An open source framework to enable the emergence of foundation models for power grids



Software platform designed to help electric grid operators anticipate, mitigate against, and recover from the effects of extreme weather events



Automated ML pipelines to deliver accurate, self-correcting, and explainable grid load forecasts



High-performance distribution grid calculation model



Open source library dedicated to electrical grid modeling and simulation

Spotlight: Interoperability

LF Energy Spotlight: Interoperability

The energy sector is the largest contributor to greenhouse gas emissions worldwide, which makes Goal 13, Climate Action, of the UN Sustainable Development Goals so critical. In addition to needing to make its services greener and smarter, the electricity sector also faces the challenge of at least a 50% increase in demand by 2050.

The lack of interoperability between utilities and other electricity system stakeholders, such as the growing number of connected devices, is a recognized roadblock to meeting these needs due to security, data sharing, communication, and vendor lock-in issues. Open source standards and protocols have shown the greatest promise to address these interoperability issues and accelerate innovation and the energy transition. Benefits of open source for interoperability include:

- Reduced lock-in risk
- Increased visibility
- Improved integration
- Data sharing
- Future proofing

Industry groups provide a platform for collaboration and knowledge sharing among utilities, OEMs, and other stakeholders and help drive consensus and alignment on standards.

In early 2024, LF Energy partnered with the [U.S. Joint Office of Energy and Transportation \(Joint Office\)](#) to build an open source reference implementation for EV charging infrastructure. The choice was to use LF Energy's [EVerest](#) project to reduce instances of incompatibility that result from proprietary systems and make charging more reliable for EV drivers by developing an open source software stack for energy communications across charging stations, vehicles, generation resources, batteries, adjacent chargers, power grids, backend payment systems, user interfaces, and mobile devices.

Open Source and Energy Interoperability



In 2024, LF Energy announced that the EVERest Project is partnering with the [IEA's](#) Task 53 to address challenges in developing practical standards and interoperability guidelines for bidirectional EV charging. The collaboration aims to tap the EVERest project's expertise in developing open source solutions and protocols for EV charging stations and onboard chargers (OBCs) to ensure interoperability between bidirectional charging stations, vehicles, and distribution grids.

“Open source platforms can provide common tools, modules, and applications that enhance interoperability by meeting performance criteria and facilitating easier integration among diverse systems.” —Travis Lusney, Director, Power Systems at Power Advisory LLC

Several LF Energy projects have a focus on interoperability, such as [CoMPAS](#), [FledgePOWER](#), [GEISA](#), [GXF](#), [EVERest](#), and [TROLIE](#). In 2024, LF Energy also kicked off the Digital Substation SIG to optimize digital

substations through open source technology and provide a collaboration platform for projects working on digital substations. LF Energy hosts three technical projects ([CoMPAS](#), [FledgePOWER](#), and [SEAPATH](#)) focused on digital substations. The mission of this working group is to improve collaboration and interoperability between these projects.

2024 LF Energy Interoperability Resources, News, and Use Cases

- [Industry Report: Open Source and Energy Interoperability](#)
- [U.S. Joint Office of Energy and Transportation Partners With Linux Foundation Energy To Improve Reliability and Interoperability of EV Charging Nationally](#)
- [Linux Foundation Energy EVERest Project Joins Task 53 of the International Energy Agency \(IEA\)](#)
- [How French Transmission System Operator, RTE, Leverages LF Energy and LF Edge to Build Next-Gen Substation Monitoring and Controls](#)
- [Seed Studio Develops Open Source EV Charging Product Thanks to Zephyr RTOS and LF Energy EVERest](#)
- [The TROLIE Forecasting API Is Now Stable](#)
- [LF Energy TROLIE Publishes Version 1.0.0 Specification for Exchange of Power System Ratings and Limits Data](#)
- [Unleashing the Power of LF Energy's Super Advanced Meter: A Comprehensive Overview of Major Use Cases](#)
- [LF Energy Carbon Data Specification Selected for U.S. Department of Energy Grant](#)
- [CitrineOS v1.2.0 Now Available, With Improved ISO15118 Use Cases](#)
- [Rust Implementation of OpenADR 3.0 Becomes Part of OpenLEADR](#)

New Members

New Members

General:



[Hydro-Québec](#), the largest power utility in Canada, and a major player in the global hydropower industry, has joined the foundation as a general member and, significantly, is the foundation's first electrical utility member from North America.

“The energy transition involves many challenges and technological hurdles. Joining the LF Energy ecosystem will help Hydro-Québec in its innovation process to better respond to the energy transition while sharing its know-how and expertise with the energy market and helping to decarbonize it.” —Sébastien Lussier, Hydro-Québec



An *EDISON INTERNATIONAL*® Company

[Southern California Edison](#), the second-largest investor-owned utility in the U.S., has also joined as a General Member, demonstrating a commitment to building and using open source solutions to drive the energy transition forward and ensure interoperability, reliability, and security of the power grid.

Initial community contributions include founding support for the GEISA project and contributions and leadership on digital twins as foundational tools for utilities.



[Welotec](#) is a pioneering system provider specializing in automation, digitalization, and precision farming.



OPTIMIZATION SOLUTIONS

[Artelys](#) specializes in optimization, modeling, and data science, providing a decision-support software suite designed to enhance efficiency through mathematical programming and AI.

Associate:



[Eindhoven University of Technology](#) is a research university specializing in engineering science and technology.



[OwnTech](#) is a non-profit organization that changes the user experience in power electronics through an open source technology suite.

All Members

Strategic (5)



General (21)



Associate (41)



Community Events

Community Events

LF Energy Summit



LF Energy Summit came to Brussels from September 5–6, 2024, gathering a sold-out crowd of 250 stakeholders from 127 organizations in 29 countries around the globe. Attendees were electric utilities, technology vendors, policymakers, global energy companies, researchers, and more. The event featured 34 breakout sessions, five keynotes, seven lightning talks, nine live demos, seven working group and project meetups, and three interactive workshops.

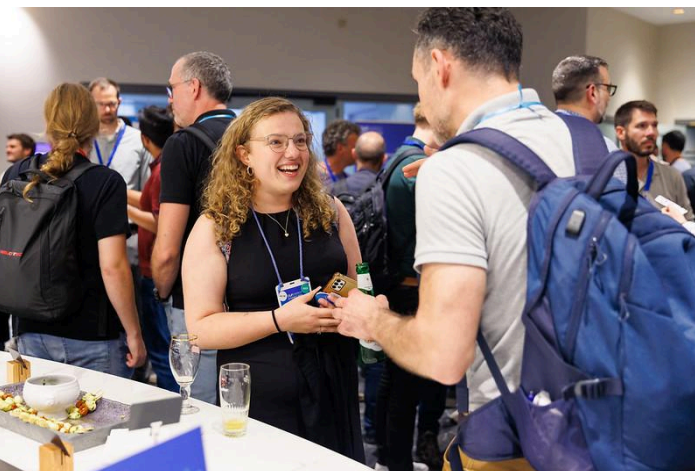
Across the keynotes and sessions at the event, several key themes emerged:

- **Industry Challenges:** Alex Thornton, ED of LF Energy, illustrated the challenges of the digital energy transition and how collaboration through open source can address them. An industry panel delved into the benefits of open source collaboration from a variety of

perspectives, including government, electrical utilities, researchers, and industry.

- **Digitalization:** Mark van Stiphout of DG Energy at the European Commission spoke on how digitalization can help the energy transition through improved operation of individual assets and a smarter operation of energy systems.
- **Digital Substations:** Digital substations were a focus, with attendees from electrical utilities and vendors exploring ways to advance technology and move the digitalization of substations forward.
- **Open Standards:** A panel of industry leaders discussed how adopting consistent standards at all levels of the energy systems tech stack is the only way to ensure interoperability and open source methods for standards development have become prominent to develop standards faster with input from a wider variety of stakeholders, which also speeds adoption. An Open Standards Meetup also gathered interested stakeholders to discuss the current state of standards in the context of open source projects, European standardization, and the IEC.
- **Other Topic Areas:** These included grid operations, data standards and tooling, and open source best practices. Subtopics included AI, security, data sharing, and developing world perspectives.

Access the full [post-event report](#) here. Presentation slides from most sessions are available by visiting the [LF Energy Summit 2024 schedule](#), clicking on the session of interest, and looking for the PDF download link. Session videos are available on the [LF Energy YouTube channel](#).



Feedback from attendees was positive, with 85% of survey respondents rating the event as “very good” or “excellent,” and 92% of survey respondents said they would recommend the event to a friend or colleague.

Other Key Events

2024 was a busy year for events overall, with the LF Energy community gathering regularly for in-person collaboration, presentations, and key discussions. Key events, among others, included:

- [Digital Substations Meetup](#), January 23–24, 2024, Paris: This event brought developers and company representatives together at the offices of RTE to focus on substation automation.
- [FOSDEM](#), Feb 3–4, Brussels, Belgium: Members of the LF Energy community from Alliander, RTE, Open Climate Fix, PIONIX, and Seita volunteered as managers of the Energy Devroom, featuring 20+ presentations covering open source projects from across the energy sector.



- [Open Sustainability Policy Summit](#), May 2–3, 2024, Washington, DC: This brand new event hosted at [Johns Hopkins University Bloomberg Center](#) gathered a plethora of energy industry stakeholders to discuss the challenges and opportunities for building technology and standards to accelerate the energy transition using open source models.

- [The Open EV Charging Summit](#), May 15-16, Dallas, TX: LF Energy and Texas Instruments hosted an event on the TI campus

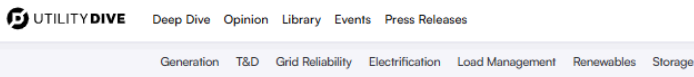
to explore open source technology as a solution for EV charging reliability, efficiency, and interoperability.

Visibility

Visibility

Awareness of LF Energy continued to grow in 2024, with media coverage of the foundation and its projects increasing by 37% compared to 2023. Engagement across owned channels also saw a significant increase, with a 141% increase in views of LF Energy videos on YouTube, 32% increase in LinkedIn impressions, and 130% increase in website visits. The increase in engagement with LF Energy channels, in addition to mentions in third-party media, demonstrates the spread of LF Energy's message to a broader audience.

Media Highlights



OPINION

Accelerating grid modernization with open technology and standards

As the power and utility industry digitizes, it can look to the tech industry for inspiration on how to innovate.

Published Dec. 12, 2024

By Alex Thornton



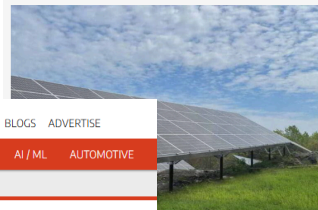
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Digitalisation

Tech Talk | Open source – how it can benefit the energy transition

Jonathan Spencer Jones • Sep 10, 2024

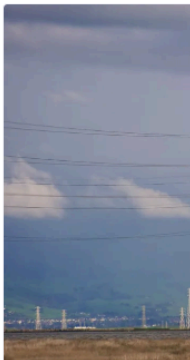
Share



Open source technology in the energy sector represents a transformative opportunity to achieve the UN SDGs, particularly in addressing climate action, LF Research suggests.

In a study for Natural Resources Canada, LF Research – the research arm of the Linux Foundation – investigates the role of open source in the context of the Canadian energy grid and its increasing digitalisation.

If there is one basic need in the energy sector, and of ever increasing importance as the number of connected devices grow, it is 'interoperability' – interoperability of hardware and of software and ultimately between utilities and other stakeholders.



*Rainbow and Power Lines at the Palo Alto

Initiative Promises to Speed Up EV/Charger/Grid Interoperability

Dec. 4, 2024

Can the Linux Foundation's Energy Initiative help untangle the fractured patchwork of protocols and grid codes that make vehicle-to-grid systems so difficult to standardize?

Lee Goldberg

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Why LF Energy

Why LF Energy

The power grid is undergoing its greatest transformation since its inception, with new challenges imposing problems that our grid is not able to handle. Historically, we would solve problems by building infrastructure to handle the worst-case scenario. This has proven to be too slow and too expensive. We can't build our way out of this problem. Instead, as former FERC Chairman Glick stated, "We need to squeeze everything out of our existing grid." To do so, we need to rapidly adopt data-driven, digital optimization of our physical assets, building only what we need.

Open source is a way of collaborating on digital research and development, and it is the de facto building block of modern technology. These open building blocks solve the most common challenges. We assemble them much like Legos and then customize them as needed for a specific problem.

But open source is so much more.

- It's a **procurement strategy**, a low-friction way for customers to collaborate with their vendors, arriving more quickly at product requirements, building minimum-viable products together, and avoiding stranded assets.
- It's a **product strategy**, a way to surface the "precompetitive" areas of a technology stack and commoditize it, benefiting the entire ecosystem and allowing organizations to focus on areas of strategic innovation, IP generation, and commercialization.
- It's a **community** of fellow travelers in the energy ecosystem who both cooperate and compete, learning from and inspiring each other, evolving standards and best practices together, forging new partnerships, and breaking down barriers.

LF Energy provides a precompetitive platform to build the energy systems of the future. It connects members with technical projects, innovative utilities, customer-centric suppliers, and developer communities that are

transforming the energy sector. LF Energy enables you to reduce costs, speed innovation, and deliver greater value.

Get Involved

LF Energy is the premier community for collaboration on open industrial-grade technology platforms and agile standards for the digital energy transition. To be successful, we need the global energy ecosystem to get involved, contribute code, and help spread the word. We encourage you to learn more, sign up for a mailing list, join a committee, participate in discussions, attend an event, contribute to a project, and stay informed about LF Energy news and events.

<https://lfenergy.org/about/get-started/>

Benefits of Membership

As a member-funded nonprofit, our contributing members provide critical financial support to ensure that our ecosystem is sustainable for decades to come. In addition, members get access to certain members-only benefits such as:

- **Access and Networking:** Access thought leaders and peers through discounted access and members-only events.
- **Governance and Legal:** Leverage LF Energy governance and legal support to enable highly regulated entities to safely collaborate in the open.
- **Marketing:** Leverage our community and platform to amplify your reach, connecting with customers and collaborators.
- **Advising:** Receive white glove partnership from LF Energy staff to reach your digital goals through open source.

<https://lfenergy.org/become-a-member/>

The time is now. Join us!



www.lfenergy.org



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