OPERATORFABRIC CASE STUDY

How RTE international Built a Pan-European Energy Data Platform on Open Source

EXECUTIVE SUMMARY

RTE international built PEMMDB, a pan-European data collection platform for ENTSO-E, on OperatorFabric — the open source control room coordination platform hosted at LF Energy. The platform now serves 40 transmission system operators across 36 countries, replacing a manual Excel-and-shared-folder workflow that required months of preparation per data collection, produced error-prone outputs, and had become a critical bottleneck in ENTSO-E carrying out energy planning studies required under European legislation. Since deployment, ENTSO-E runs significantly more data collections per year — around 10 per year, on top of update cycles and continuous updates of boundary data — with higher data quality, and full real-time visibility across all 40 TSOs. Thanks to the success of PEMMDB, ENTSO-E is now rolling it out for other projects and use cases.

40	36	~10	5
transmission system operators on one platform	countries	data collections per year	quality control checks on every submission

The Challenge: Fragile Data at the Heart of Europe's Energy Planning

Almost every major decision about Europe's energy future rests on one resource: the data that 40 transmission system operators (TSOs) across 36 countries submit to ENTSO-E, the European Network of Transmission System Operators for Electricity. ENTSO-E turns this data into the strategic planning studies that inform grid investment, supply security, and EU policy.

Those studies, including ERAA, TYNDP and Seasonal Outlook, are not advisory. They are legally mandated, and they directly inform EU decision-making on the allocation of European energy funding. The data underpinning them – demand forecasts, supply scenarios, network parameters, generation capacity – must arrive from 40 organisations, on time, in a consistent format, and error-free.

Each data collection cycle began with ENTSO-E staff manually building Excel templates, then duplicating them across every TSO using custom Python scripts, organised into per-country folders on SharePoint or ShareFile.

Carrying data forward from one collection to the next required another script, which was necessary because templates changed significantly between cycles, creating inefficiencies for TSOs.

During the collection itself, correspondents would download their template, fill it in, and upload it, and any user could overwrite any other TSO's data. Errors only surfaced at the end of the cycle, when yet another Python script ran a batch check. Many of those errors were formatting problems rather than substantive data issues, which meant ENTSO-E staff had to fix them directly. If a corrected file was then re-uploaded by the correspondent, the same mistakes could reappear. When ENTSO-E needed to run a mid-cycle update to a specific dataset, they had almost no way to distinguish what they had changed from what the TSO had changed.

With three data collections a year, each updated one or two times, the process consumed months of staff time in preparation and post-processing and required external consultant support to run. It was a critical bottleneck across everything ENTSO-E's planning teams worked on, and the data it produced still required significant correction.

The stakes were clear. ENTSO-E needed a single, secure, validated data collection system, one that could serve 40 organisations operating across different systems and time zones, with the reliability that Europe's energy infrastructure demands.

Why Open Source, and Why OperatorFabric

RTE international, the consulting and engineering services subsidiary of RTE (the French transmission system operator), was chosen by ENTSO-E to design and build the solution, working with technical partner Aprico Consultants.

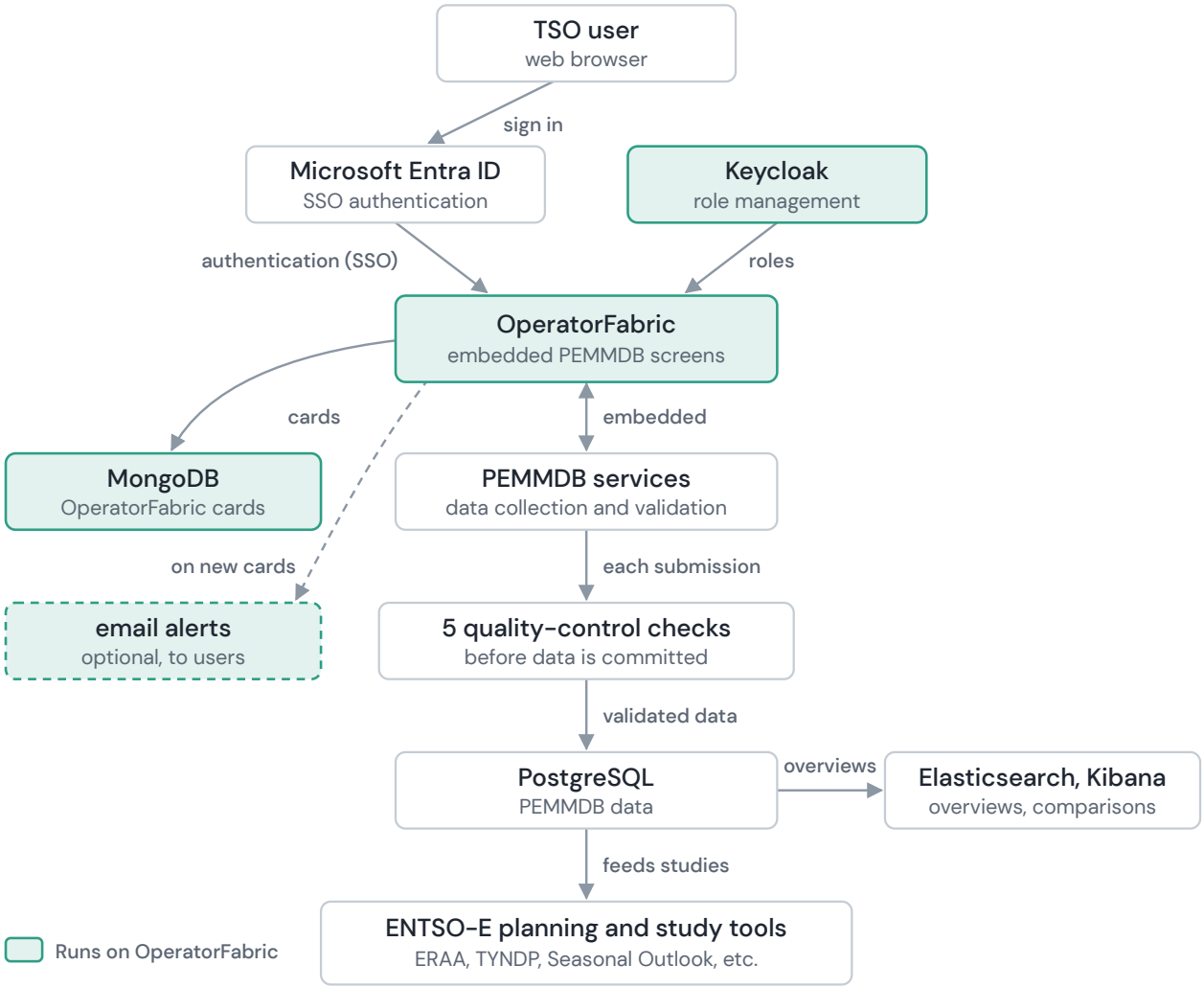
The team chose to extend OperatorFabric, the open source operations notification and coordination platform hosted by LF Energy, that RTE had already contributed to and deployed in production across its own eight control centres. OperatorFabric is not a replacement for SCADA or EMS systems; it is a coordination and notification layer designed to sit above and alongside operational tools, connecting users and processes through a structured, event-driven interface.

> **"Every project we deliver on the platform moves it forward."**
>
> Gabin Garrot, Project Manager, RTE international

That architecture was exactly what PEMMDB (Pan-European Market Modelling Database) needed, meeting technical requirements including event-driven architecture, extensibility, and modularity. Rather than adding a separate tool that users would need to navigate independently, RTE international embedded PEMMDB's data collection, validation, and coordination workflows directly within OperatorFabric. The result is a single, seamless application, not an integration of two separate products.

The choice also reflected a broader conviction. OperatorFabric was originally developed by RTE, and RTE international maintains a close working relationship with the people who build and maintain it. "Every project we deliver on the platform moves it forward," explains Gabin Garrot, Project Manager at RTE international. "The improvements we make for ENTSO-E return to the open source community, so what we build for one client strengthens the whole ecosystem."

How PEMMDB Works



PEMMDB architecture on OperatorFabric

Every TSO accessing PEMMDB signs in through single sign-on via Keycloak, then works inside a familiar OperatorFabric interface. PEMMDB's own screens are embedded within the OperatorFabric menu, so users never need to leave the application.

At the heart of the system is a live card that tracks the status of each data collection in real time. As soon as anything changes, a submission arrives, a check fails, a correction is made, etc., the card reflects it. TSOs can see at a glance which submissions are valid, which are still outstanding, and which have flagged anomalies. As a closing deadline approaches, this visibility becomes critical.

Every submission passes through five successive quality control checks for schema validation, completeness, business rules, consistency, etc. Any anomaly triggers an alert before the data is validated and committed to the database. ENTSO-E administrators can direct each data collection to the appropriate operators and supervise the entire process in real time. Users who prefer not to stay logged in can elect to receive notifications by email, staying informed without remaining connected to the application.

What was once a manual, fragile exchange through shared folders has become a controlled, traceable, and auditable process.

Results: European-Scale Impact

Scale	A single platform now serving 40 TSOs across 36 countries
Volume	ENTSO-E now runs approximately 10 data collections per year, significantly more than the previous three years, each updated multiple times by multiple contributors throughout the year — a volume that would have been operationally impossible under the old workflow. This is in addition to update cycles and continuous updates of boundary point data
Data integrity	Five successive quality control checks catch anomalies at submission, before they reach the planning models — replacing a batch validation process that ran only at the end of each cycle and still produced outputs requiring significant manual correction
Integration	Elastic/Kibana is integrated within the PEMMDB, enabling users who submit data to see overviews and comparisons with their previous submissions, and acting as another quality check
Accountability	ENTSO-E can now see in real time exactly which TSOs have and have not submitted updated data, eliminating the opacity that made mid-cycle corrections so difficult to manage
Security	Per-TSO access controls replace an environment where any user could overwrite any other organisation's data
Efficiency	The time now required to run more collections has been reduced, with no external consultant dependency and dramatically less post-processing work
Trajectory	ENTSO-E is now expanding PEMMDB to support additional data collection processes

> **PEMMDB demonstrates what is possible when you build on open source with a long-term community mindset. We didn't just deliver a tool for ENTSO-E, we advanced a platform that the whole energy sector can use.**
>
> Gabin Garrot, RTE international

Building on the Foundation

PEMMDB is one of several projects RTE international has built on OperatorFabric, and the team has more in development. The platform is also drawing interest from other organisations in the energy sector, including several TSO associations beyond Europe who have already expressed interest in an equivalent solution. These organisations have reported being attracted to an open, reliable and highly customisable platform for building operational coordination tools, valued for its technical capabilities, interoperability, open source model, and neutral governance under LF Energy.

For organisations responsible for critical data exchange across distributed networks, PEMMDB shows what open source can deliver when the platform, the team, and the community are aligned.

> **RTE international embraced open source as early as 2020, and PEMMDB is a concrete demonstration of its value applied to critical energy infrastructure. This approach delivers robustness and reliability, while remaining transposable to other players in the sector and continuously enriching the wider ecosystem.**
>
> Aurélien Watare, Director of Digital Solutions, RTE international

FAQ

Which organisations are currently using PEMMDB?

PEMMDB serves 40 transmission system operators across 36 European countries, coordinated through ENTSO-E. All participating TSOs submit data through the platform, which replaced a shared-folder workflow with no automated validation.

Why does data quality matter so much in this context?

ENTSO-E's planning studies are legally mandated and directly inform EU decision-making on the allocation of European energy funding. Under the previous workflow, errors were only detected at the end of each collection cycle, by which point ENTSO-E staff had to fix formatting mistakes manually, and corrected files could be re-uploaded by correspondents with the same errors reintroduced.

What did the old workflow actually look like in practice?

Each collection cycle began with ENTSO-E staff manually building Excel templates, then scripting their duplication across 40 TSOs organised into per-country folders on SharePoint or ShareFile. Data carry-forward from previous cycles required additional scripting. During the collection, there was no access management, no upload-time validation, and no way to track who had changed what. Batch error-checking ran only at the end, and many errors required ENTSO-E to fix files directly. The process consumed months of staff time per cycle and required the support of external consultants.

What is OperatorFabric and how does it relate to PEMMDB?

OperatorFabric is an open source notification and coordination platform for utility control room operators, developed by RTE and hosted at LF Energy. Its architecture includes event-driven messaging, notification cards, and workflow orchestration. PEMMDB is built on OperatorFabric; its data collection and validation workflows are embedded directly within the OperatorFabric interface rather than deployed as a separate application.

How does this approach reduce dependency on proprietary tools?

By building on OperatorFabric, ENTSO-E and its member TSOs avoided a standalone custom application that would require independent maintenance and integration work and leave them reliant on a single supplier. Improvements made for ENTSO-E return to the open source community, reducing long-term development cost for all users of the platform through community development, and providing easier integration.

What does ENTSO-E's continued investment in PEMMDB signal about the platform's maturity?

ENTSO-E has incorporated the PEMMDB app into more System Development studies, including the collection and validation of network models, which will allow ENTSO-E to decommission a costly legacy tool.

Two development cycles have been delivered since 2022. The decision to anchor future infrastructure to an open source platform reflects a broader shift among European TSOs toward shared digital foundations.

How do TSOs access PEMMDB and what does the workflow look like?

TSOs authenticate via single sign-on and work within the standard OperatorFabric interface. Every data submission passes through five successive quality control checks before validation. Real-time status cards give each TSO and ENTSO-E administrators full visibility of submission status at any point in the collection cycle.

Learn more about OperatorFabric at lfenergy.org/projects/operatorfabric or explore the RTE international article on PEMMDB at rte-international.com/en/open-source-solution-entsoe-data-collection

ABOUT OPERATORFABRIC

OperatorFabric is an open source platform that gives grid operators one screen for real-time events from across their operational applications and a structured way to coordinate between control centers.

ABOUT RTE INTERNATIONAL

Founded in 2006, RTE international is a leading European consulting and engineering firm specialising in power systems and critical infrastructure. As a subsidiary of RTE, the largest electricity transmission system operator in Europe, the company offers tailor-made solutions for the development, operation and maintenance of power systems worldwide. In 2025, it joined forces with MAI Group. This partnership combines deep technical expertise with strong strategic and managerial capabilities in environmental services and grid management. Through this integrated approach, RTEi Group is now uniquely positioned to support clients throughout the full lifecycle of their energy and environment projects.

Beyond OperatorFabric, RTE international's digital expertise spans three core areas: services for Regional Coordination Centres, including grid modelling and power system simulation with PowSyBl; energy market studies with Antares and GEMS; and digital substations with SEAPATH, supported by an in-house pre-integration and test platform. All three build on proven expertise in open-source energy technologies.

Find out more: Website - LinkedIn

ABOUT LF ENERGY

LF Energy is the Linux Foundation's neutral home to build the digital foundation for energy together. We host more than three dozen open source projects used to plan, operate, and modernise energy systems. The portfolio spans from transmission system modeling to substation virtualization, smart meter integration to EV charging. We provide the trust layer: neutral governance, legal frameworks, security practices, and community of practitioners that turn open source software, standards, and data into infrastructure the industry can depend on for decades. Members include utilities, energy companies, vendors, researchers, and technology providers, aligned to deliver affordable, reliable, safe, and clean energy. For more information, please visit lfenergy.org.