The energy data space

The path to a European approach for energy

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1 Mission and goals of the energy data space

The goals of the energy data space are:

- To support and accelerate the energy transition in Europe;
- To develop businesses at European and worldwide scales;
- To provide new services to European citizens, taking advantage of GAIA-X infrastructure, data protection services and associated value allowed by these services.

The GAIA-X contribution to the Energy Domain

Energy European stakeholders expect strong business benefits and joint tangible outcomes from the creation of the GAIA-X ecosystem. We actively support the emergence of federated services and data platforms that create value and opportunities for all businesses – and ultimately for European citizens.

Through the GAIA-X initiative, we – at last – foresee a tangible and close way forward to easily build, assemble and use trusted and value-creating cloud services, as well as create new products/services and foster new business models that are compliant "by design" with European regulations and values. For that reason, it is not only about the data but also the opportunity to build a strong European digital system layer on top of the existing energy system layer which should be seamlessly coupled.

Added value to the whole energy value chain

Thanks to data-driven solutions, the energy data space aims to help manage the transition towards decarbonized energy and carbon neutrality. Other objectives are to enable energy efficiency and sector coupling (green energy fluids, integration of mobility and building/heating systems...), and also enable more flexibility and renewable energy integration into the European electric system. Within GAIA-X, energy stakeholders will foster European energy system optimization and competitiveness. The European ecosystem is being identified and organized to design relevant use cases on national and cross-border scales: the governance within this ecosystem needs to be clear to ease and accelerate the energy sector digitalization and its adoption. Thanks to data-sharing possibilities between stakeholders, valuable use cases will be addressed so that new services for European citizens and companies can be deployed.

2 Challenges addressed for the energy data space in context of GAIA-X

Addressing these use cases requires cross-border common data knowledge representations, semantic data models, data collection and sharing data capabilities. Accessing data in trusted and collaborative cloud infrastructures is compulsory to provide comprehensive offerings under high security standards. The GAIA-X strategy of enabling access to aggregated, federated and interoperable trusted cloud services and AI services through the setting of common policy rules will ensure data, data knowledge representation and services protection, but also interoperability and portability. These are crucial to reinforce trust and transparency in order to scale, digitalize and provide new services at a European level. Moreover, there is a need to have real-time data exchange in order to improve the system flexibility and leverage the electrification of the system.

Since highly secured data will be processed in the energy data space, dataspace stakeholders will be very sensitive to providers with highly secured standards: labelled GAIA-X.

The challenge is also on governance and organization. Big energy companies – some of them being great competitors – are joining their efforts to provide to their national and cross-border customers new services that will help business growth, social improvement and carbon neutrality reach.

Large amounts of heterogeneous data can be gathered to address the most valuable use cases, therefore, the whole value chain must participate to this joint effort:

- Energy providers: for the production and storage of energy for all the different kinds of decarbonized energies, energy efficiency and new services;
- Contractors, partners and engineering service providers: all companies and partners to improve energy production and engineering;
- Gas, power and heat network operators (DSO/TSO/Stadtwerke (engl. Municipal utilities in Germany): with energy transportation and distribution data;
- Aggregators: collecting and packaging data to provide it to consumers;
- Energy consumers, as households, local collectivities, industrials (smart metering data...);
- EV station managers: with vehicle and charging stations data;
- Safety and certification bodies: with safety and certification data;
- Open services: with public maps, meteorological, city or transport data.

3 Solution: Data space description in a holistic view – detailed view on the endeavor

3.1 Partners of the ecosystem

There is already a broad representation of Energy Companies in the data space, from all around Europe, especially from Germany, Belgium and France. These companies represent all segments of the energy value chain. They are already able to develop Smart Services (AI, IOT, Machin Learning, Blockchain…) and to integrate suppliers to develop these services. And they are supported by academic and technological partners.

3.2 Description Use Cases renewables

3.2.1 Renewables – Wind and solar asset description model

Solution

The wind and solar description model is the digital backbone to federate all the businesses and its ecosystem around one single source of truth from "DESIGN, MODIFICATION to others REFRESHMENT". This structured, agnostic asset management description support business process orchestration in a context of new business model refocused on growth of decentralized and distributed energy and carbon neutrality "as a service".

Asset Data Management and valorization lay on a change in paradigm which needs to consider specificities of the data and the complexities of the life-cycle management:

- different technologies offered by equipment manufacturers: Vestas, Siemens, etc.,
- diversity of contracts with equipment manufacturers, data providers,
- strong commitment to third parties on the performance rate of turbines,
- large volume of data, inconsistency making it impossible to share the results and use them (interoperability),

- difficulties accessing data from some farms, …

The theorical modeling of assets is a new paradigm all along their lifecycle, enabling to link the two "worlds" as build and operate. Take some following examples to support this new paradigm:

- The development of the renewable assets should define precisely and realistically the layout from trusted and updated technical information. With such asset configuration management, scenario can be defined, simulated by modifying, combining design parameters, analyzing components and their assembly to understand and assess the impact of any exogenous effect implied by layout constraints and changes to any layout.
- Thus, it is easier to consider the as-built model and update the final implementation file (Dossiers Ouvrages Executés, DOE), including underground networks and turbines.
- This asset modeling is key to compare the asset production between sites.
- This framework enables to understand how farms are operated and the root cause of observed discrepancies.
- This framework enables to calibrate the operational team on site to better regulate and organize technicians 'activities according to travel times.

This framework is a new asset centric form of shared master data. Each equipment is linked to a model (technical description of the assets included components, physical model, localisation… as metadata) to ensure coherence and value of data with a "single point of truth" access.

It lays foundations for a Virtual Plant, ensuring continuity of data all along the lifecycle and sharing in ecosystems to drive both traditional and disruptive new business models.

Problem solved

When it comes to manage efficiently and effectively the renewable assets and all the O&M actions for the different actors (Manufacturers, Owners, Developers, Operators, ...), the difficulties to access to data exploitable in a cross functional way by these different profiles of actors and the different digital systems mobilized represents a real challenge.

Being able to share this same abstract representation of data for the Wind and Solar domain would allow a better understanding of the associated operations (asset management, RCA, Structural Analysis, Visual Inspection, monitoring ...) and an obvious improvement of the processes that mobilize the processing of this information.

The availability of standards (IEC 61400-25, etc.) provides a solid reference framework, but these are not transposed into semantic paradigms (ontology based), even if some initiatives exist in this transposition. (1)

Concrete benefits

The asset description model is an opportunity to build comprehensive models, analytics frameworks and improve multiparty collaboration capabilities needed to support digital ecosystems. It is a backbone for renewables operator to ensure continuity of technical data all along the life cycle.

This "single point of truth" is a real accelerator for Greenfields and brownfields assets to deliver more safely, more quickly more efficiently (right the first time) and with a lower Total Cost of Ownership. It lays foundations of virtual plants with the following objectives:

- Projects designed right the 1st time, based on reliable & available data
- Projects delivered for operations, in compliance with specifications
- Enhanced preparation of interventions, using as operated configuration
- Break organization and information systems silos. Each business receives accurate information across the world, which makes it easier to achieve the ambition. Ex: issuing an alert when a design change made in one area may have implications in another.

3.2.2 Renewables – Works risk prevention

Within the domain of safety management, it is common experience that the aim to provide a safe working environment for everyone who enters it, becomes more complex when different actors, belonging to different companies have to operate in the same industrial sites. The key aspects remain that is: sharing risk assessments that are up to date, identifying areas with potential hazards, anticipating what could happened and what to do, and making sure that the information is known and taken into consideration.

With a large number of industrial working places/situations for Solar, Wind or Hydro generation, with different hazards due to height, lifting, electricity, fire, pressure, … safety management is achieved by numerous dedicated works prevention plans that need to be setup after contracting the work. Before starting the works, a joint inspection must be organized that requires different data on the site and the work, the industrial team and the contractor's team. The efficiency of the plan that is produced depend on the experience on each side but also on the reliability with the exchanged data.

The difficulty to produce paper risk prevention plans for works in industrial environments, leads to the perception of bureaucracy instead of responsibility. New horizons open up by digitalizing the global process with a positive aim to improve the quality, to construct a stronger capacity of hazard identification and control.

Problem solved

Industrial works generate different situations with a high level of risk. In France, an executive Decree (N° 92-158) on specific health and security rules applying to the building, public works and water works sectors describes the required documents and steps that should be produced by the supplier. The key component is the risk prevention plan (RPP) which includes a mutual assessment of the risks.

Similar requirements exist among industries across EU, establishing, updating and reporting on works risk prevention requires a lot of coordination between the two parties and sometimes with the state. The information exchanged carries personal and commercial data.

Digitalizing the process in an extended Enterprise approach requires trustworthy data storage easily accessible to all kinds of companies -especially for different suppliers working on different industrial sites within the EU.

Different software packages are marketed, usually based on one industrial attempt to federate its suppliers. To go one step forward and gain time and efficiency and simplify the process, software solutions for works Risk prevention need a framework in order to develop new processes across the different stakeholders.

Solution

The Energy data space could accelerate the digitalization of the life cycle of risk prevention plans needed to fulfill EU/state requirements in terms of risk evaluation, risk reduction, works authorization.

The contractor and the industry would share data between them and sometimes with the State through digital canals accessible on site and from their respective offices, each party, having access to a specific part of the information.

The Data Space will guarantee that personal/commercial/sensitive data can be processed and shared through different means of communication. It will offer facilities of integration with industrial IT systems as well as easy user interface for small companies.

Concrete benefits

The main benefits are linked with the reuse of information describing work sites, risks, supplier's data saving time (finding easily existing information) and producing better quality data hence better risk assessment due to the increase of transparency obtained through the gain of control over data sharing.

To prove the value of a digitalizing the process, an experiment has been carried out on several HYDRO generation units using Software As a Service with storing data on a small cloud provider. The analysis shows that with 15 000 prevention plans per year on Hydro generation works, EDF has the forecast of a large saving per year (over 500k€) on Hydro Maintenance. The Data Space is a compulsory service for the success of such a project.

The benefits at a large scale would provide gain for suppliers as well as industrial actors. In result, less bureaucracy and more responsibility that will accompany a growing approach over risk management.

Questions/Answers identified at this stage:

- How can actual software/cloud providers involved in Risk management become a validated GAIA X provider? A proof of Value could be carried out at a small scale in order to illustrate how complicated it would be for a given solution to become compliant. An existing Cloud provider (already ISO 27001 and qualified for Health Data Storage) could join GAIA-X AISBL and an existing software provider would implement the needed federation services
- How can I impose the use of the Data Space Energy to my suppliers? Gradually suppliers will identify the benefits for themselves and will choose to comply. Before that stage it will be possible to take into account the added value, like respecting the semantic catalog, when contracting the works. Data Space Energy requirements would be added to the purchase process.
- How can I buy such a service – do I need to have many solutions in order to establish a competitive bidding? In order to setup a solution to carry out the Proof of Value, an innovation contract will be used through a consortium of industrials ready to make use of the solution on a number of works within a definite period. This will enable suppliers, large or small, to use the solution with no extra cost.

3.2.3 Renewables – Common taxonomy definition – IEC standards

Solution

The objective is to propose an approach and associated services that would allow to do a job or even to provide automatic alignment systems between different information models. For this purpose, we seek to align existing models across sectors and to find transversal vectors of common information model (e.g. CIM, ...) combined with the use of ontology building approaches. Considering the other GAIAX CUs and focusing on transposing these CUs for the renewable sector in a CTD (Common Taxonomy Definition) would allow to link and valorize the standards around the standard description of use cases, Role Model, Canonical Data Model(s) or even architectures for the energy value chain such as SGAM (Smart Grid Architecture Model).

Problem solved

In the energy value chain, which includes a multitude of actors and processes making it very complex, there are already reference and standardization frameworks that propose common representations to facilitate the understanding, exchange and operation of associated systems and subsystems. The matrix model associating the major energy verticals (Generation, Transmission, Distribution, DER, Customer) and sectors (Process, Field, Station, Operation, Enterprise, Market) has an IEC core model for the energy and electricity domain, which enables the management of associated information models. CIM Data Model, COSEM Data Model, IEC 61850 Data Model, CGMES, etc... but also models / "Standard "cross sector as SAREF, CIM+, NGIS-LD, FIWARE, ...

Nevertheless, although based on modeling standards such as UML, the semantic links between the different uses of these different standards, information models and ontologies are not a reality. This deeply limits a higher level of transverse interoperability.

In addition, the energy sector can be broken down into several sectors composed of several fluids and the actors and infrastructures that transport them. We are referring here to three main models: electricity, gas and heat (cf. IEC 63200).

We can then understand the extreme difficulty for systems and subsystems (increasingly digitalized) to navigate and mobilize these different representations and the complexity of aligning them.

Concrete benefits

Although the task seems extremely ambitious, namely to align proven standards (IEC) and Canonical Data Model (CIM...) with ontologies (SAREF, OneM2M, ...) or Linked data formats (NGIS-LD), the opportunity provided by GAIAX to align actors, CUs and data sets to define advanced interoperability models, opens up real prospects.

It seems imperative to consider the use of ontologies to achieve these cross-sector connections. The benefits are extremely numerous in the long run, because such approaches would allow to federate different knowledge spaces and representations in the energy domain without reinventing the wheel and consolidate the years of formalization.

3.3 Description Use Cases nuclear

General context

Essential, for the fight against global warming, the nuclear industry supplies energy in a sustainable and scalable manner:

1. A low carbon energy: France is today one of the countries emitting the least greenhouse gases and can rely on its electricity system to reduce CO2 emissions in other sectors (eg transport, industry, construction).
2. A competitive energy which benefits all economic agents: individuals, companies of all sizes...

The French nuclear industry, which controls the entire nuclear energy production chain, from uranium extraction to spent fuel reprocessing, is a benchmark worldwide thanks to its technologies, skills, and employee know-how. It represents more than 2,000 reactor-years of experience.

With its 220,000 employees and more than 3,000 companies, 85% of which are VSEs and SMEs, it also contributes, through its establishments throughout the European territory, to the development of local economies.

Gifen, a key player federating & transforming French nuclear industry

Due to the risks of industrial espionage and takeover bids, as well as the need to perpetuate European industrial factories, the future of the sector depends on its ability to ensure its industrial and technological sovereignty. It is critical for French and European energy sovereignty as well as for export capabilities of nuclear industry companies.

On the strength of these convictions, the companies in the French sector are united within GIFEN - by a common objective: to build together the French nuclear industry of today and tomorrow.

Gifen brings together nuclear facilities operators (EDF, ORANO, CEA, FRAMATOME, ANDRA), large companies in construction and engineering (ENGIE, VINCI, BOUYGUES), mid-size companies in construction and maintenance service, SMEs, VSEs, IS/IT providers, software vendors, electronic manufacturers, local and professional trade organizations, and associations ; covering all types of industrial activities (studies, manufacturing, construction, maintenance, etc.) as well as all areas of nuclear power generation (fuel cycle, research, power generation, equipment manufacturing, decommissioning, etc.). At the beginning of 2021, it represents more than 230 companies.

Thus, Gifen addresses all cross-functional stakes in the service of industrial excellence and offers services of common interest. In particular:

- Map the skills of the sector to anticipate future needs,
- Consolidate workload & purchasing forecast at short, mid, and long terms. according to 18 pre-identified business families,
- Analyze the supply chain workload capabilities in response to this forecast in terms of skills and industrial tools and implement actions to guarantee it.
- Put mid-sized companies / SMEs in touch with the major clients, who manage the major R&D programs in the sector,
- Develop collaborative platforms aimed at facilitating exchanges through the supply chain and increasing the studies and manufacturing quality.
- Support companies towards better safety culture and nuclear quality (e.g.: deployment of ISO 19443 norm),
- Structure French nuclear industry strategy for its international development regardless of the technology.

Gifen works in close collaboration with French & European public authorities.

Identified opportunities within GAIA-X

Regarding presented challenges concerning the nuclear sector, Gaia-X is the opportunity to define and implement technical, functional, organizational and governance solutions allowing the mastery of shared data as well as the necessary support to further deploy the digital transition of the nuclear industry.

The mapping of the sector capabilities using a data-centric approach and the usage of collaborative platforms around key extended enterprise stakes, illustrates the fundamental pillars of this transformation.

Considering this approach, five use cases are proposed:

1. Day-to-day collaboration capabilities within the Gifen
2. Nuclear industry observatory: capabilities Mapping & related data analytic services.

3. Usage extension of the ESPN1 Digital collaborative platform for the whole sector
4. Standardization & digitalization of Maintenance Work Packages2 (eWP / eDRT in French) through a collaborative platform, with opportunities to cover operations in non-nuclear assets.
5. Optimization of nuclear waste management

The use-cases put forward are not an exhaustive list of "nuclear use cases" within the framework of GaiaX. It is rather a selection of the more advanced and significant cases, calling on different bricks, to experiment and gain maturity:

- on the efficiency of the services being defined by IT providers,
- on the contribution of a common Data Space for Energy players.

Moreover, these use cases have the advantage of being under investigation from a business and IT perspective within Gifen working groups.

3.3.1 Nuclear – Day-to-day collaboration capabilities within Gifen

Solution

To contribute to the operating performance and development of the nuclear industry, it is essential to have collaboration services between actors under the Gifen governance. This means producing, storing, and exchanging information of various formats and criticalities in a secured manner by guaranteeing access control, traceability of exchanges as well as the correct application of the usage rules… It is a prerequisite for the Gifen, in order to succeed in the missions defined by the industrial companies of the sector.

For instance, exchange concerns industrial and technical project data, export market data, industrial feedback, studies, applied industrial and technical standards, etc.

Problem solved

Regarding the Gifen missions, the protection of data and their sharing is a critical issue. This protection covers:

- Know-how or patents (intellectual property)
- Financial interests
- Process continuity and integrity
- People and companies' ecosystem

In addition to these items, the main requirements are:

- Authorization and accreditation management,
- Access traceability
- Storage whatever the format of the information

[1] Equipment Sous Pression Nucléaire : Nuclear Pressure Equipment
[2] Dossier de Réalisation de Travaux électronique : electronic Work Package

- Functional modules dedicated to small entities (file sharing, chat, conference call, validation workflows, etc.)
- Interoperability between the information systems of main nuclear players and their partners.

Concrete benefits

A common language and associated collaboration solutions represent the basis for better collaboration, creating trust between stakeholders. That makes possible fostering innovation and the development of common projects. The benefits are difficult to quantify at this stage, in particular the indirect benefits linked to common projects that may be put in place. Most of operational benefits are around avoided costs: rationalization of collaborative spaces, consequences of a data leak and data inconsistencies.

3.3.2 Nuclear – industry observatory: capabilities mapping & related data analytic services

Solution

The observatory would include information from the various players of nuclear industry (operator, manufacturer, designer…) allowing consolidation of a detailed mapping aligned with Gifen missions. As instances, it would be valuable to gather in particular:

- Legal form of the actors,
- Workforce in terms of volume, skills, and distribution on the European territory,
- workload forecast at short, mid, and long terms based upon main industrial project assumptions,
- Breakdown over the 18 business families defined at Gifen,
- Information on international critical markets for the nuclear industry,
- Innovation programs data,

Mapping would be the basis of data analytics-like services enabling to understand, predict and make decisions on the industrial system in response to main nuclear industry stakes.

Notably, the adequacy analysis of the supply chain workload capabilities regarding the operators and main project forecast in terms of skills and industrial tools represents a top priority. It will significantly ease the identification of under pressure job and competencies and ease the definition of the related action plan.

It means implementing an interoperable system for collecting, analyzing, and sharing this information in a distributed or centralized and secured manner.

Problem solved

The set-up of a "nuclear industry" data space is a prerequisite for several fundamental missions of Gifen:

- Map the skills of the sector to anticipate future needs,
- Consolidate workload & purchasing forecast at short, mid, and long terms. according to 18 pre-identified business families,
- Analyze the supply chain workload capabilities in response to this forecast in terms of skills and industrial tools and implement actions to guarantee it.
- Structure French nuclear industry strategy for its international development, whatever the technology

Gifen has already initiated these actions with its own resources to demonstrate their value. A roadmap for industrialization is under definition. Without a trust & governed workplace nor rules for collaboration and sharing, it remains very difficult to implement this strategy.

In addition, interoperability with the upstream and downstream areas of the energy value chain, as well as related sectors, that are highly capital-intensive and require common skills such as infrastructure construction, is essential at mid-term. Indeed, transversal optimization is part of European Sovereignty, and thus, deserves to be tooled.

Concrete benefits

The benefits are difficult to quantify at this stage. They will be detailed for each added value services made possible by this observatory, notably orientations on the nuclear industrial system (manufacturing facilities, design center…) taken following the analysis of the adequacy of charges / resources in the short, medium, and long term.

This will allow to strengthen the industrial policy of the nuclear industry in the medium and long term, in particular by:

- a better identification of project risks,
- an eased consolidation of export opportunities.

3.3.3 Nuclear – ESPN Digital Platform for the nuclear sector

Solution

Background and ambition

The "ESPN Digital" project was launched as part of the EDF SWITCH program. It is the digital extension of the industrial control strategy of the Nuclear Pressurised Equipment3) regulation. The aim of these regulations is to guarantee a level of control of pressure equipment adapted to the nuclear safety issues at stake.

ESPN Digital is a digital platform built to facilitate the assessment of regulatory compliance of ESPNs. It complies with regulations while making exchanges more fluid between operators, manufacturers, certification agencies and the ASN4, enabling them to refocus on their core businesses, collaborate better and become more competitive.

The first version was developed and put into service on a limited number of projects. The ambition is toextend its usage to all the industry players, for the construction and operation of new ESPN equipment intended for nuclear facilities, but also for modifications or repairs of installed equipment.

Service description

The platform allows pooling and tracing all the information provided by stakeholders on ESPNs: history, provided justifications, data, workflow, etc.

Eventually, ESPN Digital will make available guidance to be followed, and enable everyone to draw up with confidence all the documentation required by the regulation and progressively automate its edition, thus facilitating the work of the ASN or the authorized agency (which will eventually lead to a reduction of the time required to obtain the ESPNs certificate of conformity).

[3] ESPN : Equipements Sous Pression Nucléaire (French)
[4] Agence de Sureté Nucléaire : the French Nuclear Regulator

Problem solved

The GIFEN wishes to respond to the needs and difficulties raised by the actors of the sector for the application of the regulation through this project. The main difficulties put forward are the following:

- Very long and unpredictable conformity assessment times
- Heterogeneous practices of manufacturers and organizations
- A limited number of actors mastering the ESPN process

Thus, the ESPN Digital platform extended to all the industry should help to meet these challenges by centralizing and making exchanges and collaboration more fluid between all conformity assessment stakeholders. The platform also has the virtue of harmonizing work methods and digitizing all processes to comply with regulations. Finally, the digital tool will offer a consolidated and 360° vision of ESPN Safety Cases and Certification processes to all stakeholders.

Concrete benefits

ESPN Digital stakeholders expect many gains through the implementation of this project:

- Direct benefits:
  - 20% of the cost of compliance certifications
  - Estimated savings of 15 M€/year in the current configuration of the EDF fleet + FA3
  - ~80 M€ for a new project (FA3 type) over 8 years
- Major indirect benefits:
  - Better control of project planning and potential impacts on the availability of nuclear facilities
  - Lowering entry barriers linked to ESPN regulations

3.3.4 Nuclear – eWork Platform

Solution

As part of the digitization of the sector, one of the goals of this intermediation platform is to standardize the Work Order (eWork) and its set of associated documents constituting the electronic Work Package . This use case will facilitate B2B exchanges between the various companies performing interventions on nuclear sites.

To facilitate the adoption of this digital Work Order (eWork) by all the companies, the platform must consider the following requirements:

- Guarantee a multitenancy architecture where access to documents and data of each member of the industry is secured.
- Allow access to eWork information through mechanisms adaptable to the digital maturity of each partners
- Implement mechanisms to verify the compliance of eWork with nuclear industry standards
- Provide configurable workflow functionalities,
- Offer visas / signature mechanisms for paper and digital documents such as digital procedures or QA documents.

The nuclear industry partners will have to define and agree on the standards for these digital data exchanges.

Problem solved

The digitalization of the electronic Work Package allows the numerous companies intervening on nuclear site, to have an interoperable and exchangeable format with the eWork. It can be exchanged and enriched by B2B exchanges between the players. These exchanges will be orchestrated to guarantee the best practices in the sector.

This digitalization should enable the sector to have at its disposal several software solutions compatible with the GIFEN recommendations.

For the many companies working on nuclear site, it will be possible to use, when appropriate, their own Work Force Management (WFM) tool well adapted to the company's process, by simply adapting their interfaces. These interfaces will be well defined thanks to this use case.

Concrete benefits

The digitalization of DRT allows the ecosystem to gain in efficiency by sharing the WO schedules and by digitizing all the data relative to this eWork.

This digitization will allow efficient B2B exchanges between several hundred companies that interact on field interventions in nuclear site.

Digital continuity will reduce the breaks in the chain between the client and the contractor:

- starting field activities quicker by transmitting information via telecommunication networks
- completing field interventions without returning to the office, facilitating the optimization of the planning of all interventions
- suppressing the costs of scanning and printing files; gains on this side contribute to a very short ROI.
- offering the possibility of optimizing maintenance operations by processing data analytics on a greater quantity of data captured.

3.4 Description Use Cases low-carbon hydrogen (H2)

3.4.1 H2 – Import/export international routes setting up

Solution

A dedicated low-carbon hydrogen import / export market will connect producers with end-users, similar to today's current gas market. There will be a need for local marketplaces, European marketplaces and international marketplace. These marketplaces will integrate various forms of hydrogen (gaseous, liquefied) and will need to feature the certification of low-carbon hydrogen (see specific use case).

To support the marketplace, a transparent data platform will be required to:

- Map hydrogen production based on location and relevant stakeholder
- Monitor supply and demand
- Monitor prices based on the different products (spot vs. long-term)
- Monitor management rules in case of unused capacity vs. congestion
- Enable market settlement after transactions

Problem solved

Low-carbon hydrogen production could take place next to consumption centers. However, in most cases hydrogen will be produced where it will be the most cost-effective – because renewable electricity is the cheaper, because gas infrastructure can be re-used. We are currently missing the global overview of hydrogen supply and matching demand

Concrete benefits

According to Fraunhofer ISE, a market for hydrogen import / export could be worth between 100 and 700 Billion € per year in Europe.

3.4.2 H2 – Station networks information sharing

Solution

The emergence of these H2 mobility technologies will be linked with the ability of the sector to develop a wide range of H2 stations allowing the user to move without constraints.

We are missing a global view of existing H2 stations, with their characteristics and the global matching H2 demand for mobility, to ensure a quick development of H2 mobility.

To support the development of H2 mobility, a transparent data platform will be required to:

- Map H2 stations based on location and characteristics
- Monitor H2 stations capacities and H2 demand

Problem solved

Mobility is today largely contributing to CO2 emissions in Europe, and solutions rely on the development of low carbon mobility such as EV and H2 mobility. EV is developing more and more while H2 mobility is still in the early phases. The development of H2 mobility is widely based on the capacity to propose a network of H2 stations that fits the needs of the consumer.

H2 mobility represents today a very small part of the mobility market, led by traditional carboned technologies, and emerging EV.

Concrete benefits

The benefit for such a sharing of information is difficult to assess but it will allow a fast development of H2 stations across Europe, optimized for the use of H2 mobility users.

3.4.3 H2 – Mobility asset monitoring

Solution

The focus of this use case is to build common knowledge representation, collect and share data on operations of Hydrogen refueling stations and hydrogen vehicle fleet. This could include data on main design characteristics, energy consumption of HRS and individual major component, energy efficiency of HRS and individual major components, hydrogen production rate, refueling time, vehicle efficiency, etc. A good basis of work is the listed data in "JIVE and MEHRLIN Performance Assessment" framework and this could be extended to higher collection frequency and a wider range of HRS and vehicle.

GAIA-X enables for this use case to provide a complete functional and technical framework which for this use case will provide the means to make available throughout the value chain and between multi-actors the data and representations shared to build portable and secure services that can address a federated monitoring by the actors concerned while respecting the rights and access to information. Moreover, the availability of these data and representations to allow the creation of new services by third parties who will commit to use these open and shared repositories.

Problem solved

The provision of data depends on the local data management, which is used by the operator on site, although there is no integrated common infrastructure.

It will allow to develop services around maintenance, individual component improvement and development, HRS architecture improvement.

Concrete benefits

This demonstrator focuses on the brought usability of vehicles and refueling infrastructure data. We see a huge retention to provide infrastructure data for further purposes due to the risk of being misused. By using GAIA-X and its components of identity & trust, sovereign data exchange and compliance third parties it will allow to develop services around maintenance, individual component improvement and development, HRS architecture improvement.

3.5 Description Use Cases energy efficiency

3.5.1 Energy efficiency – Energy renovation: map building potential for renovation

Solution

2021 marks a strong acceleration of the energy-efficient building renovation policy, with very ambitious targets in terms of the numbers of buildings renovated. Concrete financing mechanisms accross European member states have been put in place to subsidize residential and tertiary building renovations. The platform we would like to develop helps identifying and prioritizing the building renovation programs to be carried out; obtaining, in a context of multiple levers to master, the right financing; and manage and monitor the energy performance of renovated buildings over time.

Our platform offers automatic data collection and standardization flows from multiple databases, machine learning models and data sharing principles between public and private players in the energy renovation ecosystem, and therefore builds on a comprehensive and continuously updated database. This database would provide a set of detailed information on all the characteristics of the building and benchmarks for building energy consumption. It would make it possible to target the appropriate renovation work, illustrate the possible benefits and advise on the available fundings. This capacity was illustrated in the tRees project, developed by the namR startup, which allowed them to identify all the educational buildings in the Haut de France region in France (19,734 buildings), and to characterize them with more than 150 attributes.

Problem solved

Most players at national and local levels underline a lack of reliable data to define, finance, implement and manage their energy renovation policy and their assets strategy. The pain points identified include:

- A partial vision of their assets, difficult information to collect, limited internal human resources, costly and numerous external diagnostics and audits to implement to gather information
- Difficulty in identifying the renovation work that could be carried out and in estimating the associated financial and energy gains in order to be able to prioritize them
- Multiple funding levers to know and master, complex paperwork to undertake, including intricate analysis to be carried out
- Insufficient energy monitoring of buildings, while local authorities are to achieve ten-year energy reduction objectives and must manage new information on a regular basis
- Segmented industry with low interaction between stakeholders
- Archaic tools for planning, construction, and operation

Concrete benefits

Improve the energy efficiency and the energy bill of buildings, in line with the promise of a low carbon balance, to reduce the final energy consumption by at least 40% in 2030, 50% in 2040 and 60% in 2050. This will be enabled thanks to the ability to:

- Obtain / acquire quantitative and qualitative characteristics on buildings, local territory characteristics and the energy renovation sector and be able to compare them with other territories
- Target the buildings to be renovated, the types of renovation to be carried out and simulate the expected gains
- Determine the sources of funding available and simplify requests, in particular within the framework of the recovery plan
- Access a personalized tool library and a network of experts relevant to the renovations to be undertaken
- Estimate and monitor the financial and environmental impact of planned and completed renovations
- Cost-effectiveness ranking of various renovation technological packages

3.6 Description Use Cases Recharge of electric vehicles

3.6.1 Electric vehicle – Energy Roaming

Solution

A platform that allows customers to freely move and charge between their home charger and partnering public charging networks. Allowing a view of all of their EV 'fuel' in one place.

This platform will make use of online maps to help locate chargers, give an availability status, and also allow access to book a chargepoint, start, stop and pay for a charge.

It will provide reporting and data. This will require the access of data from various e-Mobility Service Providers, charge point operators and vehicle OEMs.

Problem solved

The problem to solve is that EV drivers can find charging their cars confusing and worrying. There are many data sources separately held that could unlock solution and value if they were aggregated and centralised for use and analysis.

- Multiple smartphone apps/ RFID cards are needed to access the different Public charging networks
- Varied pricing rates and structure on all networks – difficult to compare competitiveness (connection charge only, connection + unit rate, unit rate only, pay for a time period, etc.)
- Difficult to plan longer journeys across multiple networks you are a member of
- Difficult to know which networks are more reliable/trusted brands for quality & service
- Users frequently find charging points not working or already in use
- EV users must plan their journeys more akin to that of a commuter using public transport. It takes time, effort and can cause worry on the road
- Limited real interoperability of networks

The situation can be exacerbated if a driver does not have a home charger or lives in an apartment block with no EV charging facilities (which is likely at the early stage of EV market development).

Concrete benefits

GAIA X will enable the creation of a new service around the EV's owner experience. This shall occur by producing a set of standards aimed at facilitating the coherent centralisation of data owned by the relevant partners involved (CPOs and EVs).

3.6.2 Electric vehicle – New services

Solution

A platform/ecosystem where:

- An EV owner can reduce their total cost of ownership by making available the EV's storage capacity (battery) for a period of time under clear conditions (eg. minimum guaranteed level of charge of the vehicle and departure time with a sufficient level of charge),
- An operator can aggregate EV individual storage capacities in order to offer services based on a large storage capacity (Virtual Power Plant), with possibly specified grid connection points.
- An operator can actuate/manage the charge of EV currently connected to charging points in order to respond to TSO, DSO or Electricity supplier needs (peak shedding, ancillary services, voltage management at HV-MV power station perimeter or off-peak management etc.),
- An operator can act as an active agent of the electric market making arbitrage (buying electricity at a cheap or even negative price and selling it when price goes up) or at least optimizing the charging price (knowing the purchase contract of any individual customer and its needs).
- An operator or "smart charging services provider" can also help to optimize the sites' own consumption by helping it to avoid taking power from the grid when costs are higher and instead taking part of the load from the vehicle batteries (Vehicle-to-Building).

To do so, a huge amount of data needs to be shared among different stakeholders:

- Data of charging EVs: state of charge, time left until next use, minimum state of charge required by driver...
- Charging Point characteristics (location, power, V2G etc.) and status (car connected or not etc.)

- Data of network: voltage and load at HV-MV power stations level (real time and forecast), grid monitoring data, level of congestion of power stations
- Data of production: power produced (nuclear, hydro, coal, PV, solar...)
- EV owner electricity purchase characteristics,
- Market conditions and forecasts

And computing capacity must be available for real time calculations of the "smart charging algorithms".

Problem solved

This solution brings globally to the electric system the following services:

- Flexibility through load management, network equilibrium, peak shedding, and ancillary services
- Reduce total cost of ownership of EV by offering an EV owner the possibility to generate revenue from the electricity injected or off taken from the grid from the EV
- For electricity suppliers: real time management of their portfolio in order to balance consumption and sourcing of electricity. For example, if renewable energy production is high at a moment of the day when there is not enough demand, it is better to charge the EV than to sell electricity at negative prices

Concrete benefits

This use case brings the opportunity to share and to aggregate data from the different stakeholders of the EV value chain. These technical and personal data are the fuel of the services.

By offering this possibility, GAIA X will enable the creation of new services around smart charging, flexibility and V2G by offering a uniform, secure and real-time access to critical data points.

GAIA X would therefore play a significant role in the mainstream development of the EV ecosystem in Europe, while contributing towards the optimization of the whole electricity process from production to consumption.

3.6.3 Electric vehicle – CPO and DSO investment and planning

Solution

The solution has two parts:

- A technical part with the creation of a platform which can analyze and cross data
- A business part with the sale of studies, which use the data of the platform and personalize the result for the client

Problem solved

The main goal of this use case is to increase the efficiency of the deployment of charging stations in Europe, thanks to the data convergence between the different operators. Finding the best place for a charging station requires having the following cross vision:

- The city's electrical plan to find out if an area can easily accommodate a fast-charging station without doing a lot of long and expensive network work (from DSOs)
- The city development plan to know how the city will evolve (from local collectivities)

- The flow of vehicles in the city; data coming from local collectivities, parking operators and motorway companies. A special interest could be bring by data about where cars stop and where professional drivers are parking.

Vehicle flow could also be captured by passing through telephone operators, car manufacturers or pure players such as Waze.

Concrete benefits

A consolidated knowledge of the data of all the players would allow:

- CPOS to install the most profitable charging stations
- Local authorities to deploy charging stations where it is needed and at with an efficient price
- DSOs to plan in the medium and long term the evolution of their network

3.7 Description Use Cases local energy communities

3.7.1 Local communities – Local communities of energy setting up and decentralization

Solution

A local energy manager (LCE) coordinating the local energy efficiency by managing the renewable assets and energy infrastructures, by self-consuming and injecting the extra production to the distribution grids.

The business model will be consolidated by sharing economy principles. A variety of approaches to community ownership, including joint ventures, split ownership and shared revenue could be explored in the project. Enabling clean energy ownership through community enterprise meets the twin objective of decarbonizing with cheap onshore renewables and winning the support of the local community. Paring the constraints and opportunities of energy and real estate sectors, the UC plans to develop a new design/build/own and operate (DBOO) offer for new and renovation districts co-developed with the clients and by sharing investments and profits.

Problem solved

The LCE concept overcomes building energy seasonal peaks and provides interoperable business models and digital services based on trading of various energy carriers between the communities and the gross market and ancillary support to the distribution and transport networks. The essence of the business model is to have long time ambitions and to share a part of the gains with the end users that become prosumers

Concrete benefits

- Up to 20% self-sufficiency thanks to PV without storage
- More than 70% renewable rate thanks to renewable production, heat recovery, DHC, etc
- More than 30% seasonal peak covered by the geothermal or hydrogen storage

3.7.2 Local communities – Stadtwerke/local open data for business models

Solution

The focus of this use case is the interdisciplinary challenge of the grid connection process for both customers as well as prosumers, which requires a large amount of both data and information and sub-processes from individual grid operators (typically DSO) as well as a large amount of data from various sources, especially from public geographic information systems (municipal data for the grid connection point and other data from residential registration offices e.g.). While it is possible for a resident to initiate the grid connection process, it is yet not feasible to systematically incentivize e.g. residents that have a heightened potential for utilizing renewable energy technologies due to a favorable combination of their location, supply contract and other already installed technologies/appliances etc.

GAIA-X enables the central provision of needed data without media breaks and guarantees the quality assurance of the data provided. Thus, not only grid connection processes but also maintenance services as well as other integrated business cases relying on information about technology and usage pervasion can be accelerated.

Especially in the grid connection use case, data required in the grid connection process can be unified and standardized based on a common semantics and access platform with Gaia-X. In addition, the price of the required data for the customer /data receiver is set and there is a role-based access control for various kinds of service levels (e.g. DER contractors, utility, etc.).

GAIA-X offers the required common infrastructure and enables the transparent and traceable transmission of public data from public administration to the grid operators. GAIA-X promotes the digitalization of public administration processes and enables the improvement and added value of data-intensive processes as well as the development of future business models in the energy industry.

Problem solved

The provision of data depends on the local data management, which is used by the offices on site, although there is no integrated common infrastructure. There is currently a technical and organizational challenge to transfer public data in a way that they are digitized as a public administration process and are available to the grid operators even though there is a lack of uniform semantics and access platform.

Further challenges are the identification of the required data sources, the digitalization of analog data sets as well as the quality assurance and development of price models for additional services that can be offered. In addition, concepts for organizational governance and data ownership must be clarified and data maintenance must be guaranteed.

Concrete benefits

Open data has great economic potential: For Germany, the economic value of open data is estimated at around 12 billion euros annually. Positive effects of open data result from the use of data in the economy, its potential for innovation, increased transparency and its potential for cost savings. In addition, open data plays an important role for future business models, especially in data-intensive processes such as those found in the energy industry.

3.8 Description Use Cases energy networks

3.8.1 Networks – Long term scenarios

Solution

Creating long-term scenarios for the energy transition requires running mathematical optimization models which are to be fed by numerous data.

By creation of long-term scenarios, we understand optimum energy mixes (installed capacity and storages, expansion of networks) from now to 2050. There exist today many different initiatives and projects within the European modelling community, but it appears that models and input data are not fully open, suffer a lack of transparency, which makes the studies' results difficult to understand and analyse. Most of the needed data are often not available, non-consistent (coming from various sources) and not transparent.

The openENTRANCE project (started 2019, running until 2023) proposes a first step for more transparency and more data available. This project has the following main deliverables:

- A database offering access to modelling results and inputs
- A nomenclature of data (i.e., an accurate description of all different variables which are available on the database)
- A series of open models (made open during the project), connected to the platform (i.e., able to be fed with data based on a common data format)
- Long-term energy scenarios computed from open data, with an open-source model
- A series of case studies (inputs and results being available on the database) focused on some topics of interest.

The objective of the Gaia-X use-case would be to:

- Share and extend the data nomenclature
- Facilitate access to various sources of data (which would be made consistent with the nomenclature)
- Access to consistent data
- Run Advanced functions:
  - Selection/upload of consistent data
  - Various treatments of data
  - Allow users to run the open models. Those models require IT systems which are often not available for the teams willing to run the models. GaiaX could offer this facility (containerize models so that they can run on any IT system + rent High Performance computing resources)
  - Benchmark functions making it possible to re-run a specific study with the same model but different inputs /assumptions or the same inputs and a different model
  - Visualisation of inputs and outputs + statistical analysis
  - …

Problem solved

Decision makers, stakeholders and modelling teams, at European, national and local levels underline a lack of reliable, consistent, transparent data to build relevant long-term energy scenarios. Many studies are published by many different teams which the latter cannot easily interpret nor challenge, due to the lack of transparency both in input data, modelling assumptions and algorithms, and output data. Moreover, modelling team often cannot access to some of the data (including the fact that a high percentage of modelling resources is used to look for data or replace unavailable data) or only have access to low quality data in their studies, and it is very difficult to assess the impact of this lack of quality in data on the results.

The approach proposed by openENTRANCE includes most of the advanced functions but relies on a database which cannot be scaled up, as it was designed for small volumes of data. Moreover modelling teams do not have access to the adequate IT resources to be able to run big cases.

Concrete benefits

- Improve the European ability to build relevant and feasible long-term energy scenarios
- Enhance the reliability of scenarios
- Enable benchmarking of scenarios
- Increase actor's confidence in published scenarios
- Enable different kinds of actors to run their own energy system modelling studies:
  - Actors with access to data but not to state-of-the-art model
  - Actors with access and experience on models but lacking consistent and high-quality data
  - Actors without access to HPC resources….

3.8.2 Networks – OrtoPhotos

Solution

This use case aims to digitalize the mapping of existing networks to be more precise and have the possibility to create new services and serve new clients on this basis. It would be made possible by acquiring high precision aerial images (from 20 to 5 cm/pixel) and then recover, transform, store and disseminate the aerial images acquired.

This use case is part of the New Large Scale Mapping project from Enedis and is currently facing the following major issues:

- Human factor: Transfer between Regional direction and Supplier by physical exchange of hard drives;
- Integration & Injection into the IS: Data processing for customization;
- Storage: Large volume of data (75 TB);
- Service exposition: Consumption / data visualization / Ortho-photos via APIs.

Problem solved

Today, this network mapping is done manually and not precise enough.

Concrete benefits

- Improve the process to secure and track photo embedding
- Set up a scalable, reliable, robust and autonomous orthophoto service
- Ultimately allow new services to be opened and new users to be served

3.8.3 Networks – Real-time data for EaaS market design cross-border

Solution

The residential end-consumer wants to use its own produced energy in the way he wants. The national grids are slowly evolving to a more interconnected European grid enabling cross border flows. This would allow the end-consumer to charge his electric vehicle in another country when going on a vacation or business trip by using the excess of produced electricity, of course in consideration of congestion constraints.

Besides the necessary needed changes in market design and legislation. There is also a need for exchanging real-time data, first locally (between DSO, TSO and other market players) but alsocross border between different parties (DSO, suppliers, charging pole operators) so that excess electricity in real-time can be used for charging the electric vehicle by a EaaS (Energy-as-a-Service) provider. GAIA-X can provide the technology for the required platforms to enable these data exchange.

- Consumer data: Name, Address, EAN, Supplier, production
- Charging Pole Operator data: Name, Supplier, charging consumption, Location
- Electric vehicle data: Charging consumption, Location

If there is an excess in production of the consumer, this value will be substracted from the charged electricity leaving the consumer only to pay for the infrastructure of the charging pole operator.and the remaining charged electricity that is not covered by his own production. Off course, this means that the produced electricity is not remunerated by the consumer's supplier since it is already consumed and that the transferred energy is not charged by the CPO's supplier. The local DSO's will give a green light if this transaction not causes additional congestion problems while the TSO's monitor if sufficient cross border capacity is available for the transaction.

A centralised platform for these EaaS providers based on the GAIA-X technology can further facilitate the coordination between these EaaS providers when the same data is used by different EaaS providers. For example, you want to share your excess of electricity with your neighbour while at the same time charging your EV somewhere else. While at the same time, the output of certain services can be used as input for other services, for example, I want to know the average CO_2 emissions of the electricity consumed by my EV for a better insurance.

Problem solved

The traditional energy system stores a large number of data like consumption, supplier information, EAN about the consumer that is only shared between a limited number of parties within a country (DSO, TSO, suppliers). GAIA-X can provide a foundation to enable an easy access to this kind of data for new EaaS providers targeting an European client base.

Not only traditional energy players have a large number of data about the consumers also new big players like OEM (Tesla, Viessmann) will have data about the end-consumer. However these data is available with different players, in different formats but very useful for new EaaS providers. GAIA-X can provide guidelines that would foster standardisation and data interoperability.

And last but not least, GAIA-X can create a more consumer centric system. GAIA-X will not only enable the consumer to solve his pains in climate friendly way by use of EaaS (in this use case, charging his EV cross-border with his solar production). GAIA-X can provide the foundation of putting data sharing more in the hands of the consumer instead of the big companies.

Concrete benefits

- Increased consumer experience around the energy transition with monetary and non monetary value streams
- Lower entry barrier for new EaaS providers due to standardisation and easier access to data

3.8.4 Networks – Congestion management through TSO-DSO traffic light

Solution

The increase of decentralized renewables and the electrification (of the mobility, of the heating…) will increase the pressure on the distribution grid that has not necessary been initially built to withstand such energy flows and variation. At the same time the decrease of central power plant to balance the grid coupled to the uptake of renewables will require to leverage more and more the decentralized demand side asset for the grid services including balancing purposes activated by TSO. However the activation of such flexibility should take into account the local congestion impact and therefore be conditioned by an agreement from the local DS0.

For that reason DSO's should share "traffic light" to TSO in order to signal congestion risk in all step of congestion management: planning, forecasting of the need, market auction and finally real-time activation.

As presented in the *TSO-DSO report: an integrated approach to active system management with the focus on TSO-DSO coordination in congestion management and balancing*, the traffic light concept will be use to coordinate the flexibility activation.

- If the traffic light is green, the TSO can use the flexibility without restriction;
- If the traffic light is orange, the DSO will ask Flexibility Service Providers (FSP) to resolve a planned congestion which could limit flexibility activation
- If the congestion is not resolve in right before the activation

The DSO could also incentivize the participation to the market for resolution of congestion through the exposition of the orange traffic light state.

In order to get more accurate response of the flexibility portfolio at local level (e.g. heat pump, electric car…), the incentivization could be based on artificial model calculating best dynamic tariff price based on previous reaction. This could shorten the reaction and maximize value for the flexibility provider.

state is seen as out of the scope of this report.

Problem solved

The main challenge to deal with the congestion management will be related to the exchange of data in a standard and near real-time between TSO and DSO.

The use of standardized semantic should facilitate the translation of the traffic light between the DSO and the TSO and therefore enable near-real time activation of flexibility respecting the constraint of the congestion.

Concrete benefits

- The benefit of Gaia-X will be translated in the easiness to connect the different stakeholders Tso/DSO/OeM… This should then relates to low cost of implementation
- In parallel, European standard for TSO-DSO interface could offer to market players easy business model development at European scale (e.g. flexibility aggregation, optimization…)

3.8.5 Networks – Cross-TSO failure or labelled image database for predictive maintenance training

Solution

As the share of renewables is increasing in the energy mix, the volatility and uncertainty are making the management of the system more and more complex. Therefore, the high availability of the grid is more important than ever cause each failure could lead to more congestion risk and therefore more system operational risk and ultimately affect market conditions in case of high scale impact.

At the same time, the grid aging is increasing in Europe requiring more and more maintenance which will imply more risk of congestion in case of unplanned outage and increase of the maintenance cost. On the other side, maintaining an asset too early while it is still healthy is also leading to new cost that could be avoided. Therefore, it is very critical to get a deep understanding of the best moment for maintaining the critical asset to maximize the availability and minimize the overall maintenance cost.

For that reason, multiple players start to test and implement first condition based maintenance and then predictive maintenance.

The latter is based on artificial intelligence model that will be trained based on previous failures data. The data could be recorded occurrence of specific failures (as broken connector switch or explosion of transformer equipment) or some pictures taken generally by drones that are used to detect defect on pylons and lines (as rust for example).

However, as the grid is one of the most critical infrastructures, the maintenance is generally followed very closely and the number of unplanned failure is limited. For that reason, it is often difficult to get proper data to train predictive maintenance or image recognition algorithm.

In parallel, the value of the AI algorithm is sitting more in the data used to train and therefore by using multiple suppliers, companies are generally reinforcing indirectly the product of suppliers without benefiting from the potential commercial impact of it.

For that reason, it would be beneficial to put in common failures and/or pictures collected among the different system operators which could be used to train new algorithms. Later, the development of shared sovereign AI model for predictive maintenance could be envisaged.

However, to be efficient, such cross-company database would need to be coordinated among the different system operators and the data semantics / labels should be harmonized among the system operator to make sure the predictive maintenance solution can effectively be trained. That requires a strong alignment between the system operators and strict common rules for data exchange.

Problem solved

- *Unified data set*: The standardization of data semantics and exchange through Gaia-X rules could highly facilitate the integration of new data as training set for predictive maintenance will be easier.
- *Efficiency and portability*: On top, the use of efficient sovereign cloud infrastructure will facilitate the treatment of this cross-company data for the asset management analytics services.
- *Integration*: The use of unified API will also facilitate the integration
- *Sovereignty*: Finally the use of a co-built data set is ensuring a sovergnity of the data among the TSO (and potentially DSO) avoiding that analytics supplier keep the knowledge through training their model in blackbox and being the only one to benefit from the commercial added value of these dataset. The set-up of a unified cross-country data set could bring more power to negotiate with analytics supplier or even to develop own analytics services on top of the unified data-set

Concrete benefits

- Better trained predictive maintenance
- Sovereignty of data and potentially analytics model leading to more weight in the negotiation with service provider for predictive maintenance or even the development of sovereign analytics services.

3.8.6 Networks – Energy data-X

Solution

The energy data-X initiative applying for the BMWi Gaia-X Funding-competition is aiming to define the "Data Space Energy" for Germany. In Germany, as it is in Europe, the energy infrastructure belongs to the most critical infrastructure in our economy. This also applies to the data created and used in the energy domain, for example, the misuse of which could cause great social and economic damage. For this reason, the data obtained may only be used and processed in a way that is relevant to the matter in hand. Data exchange in the current market model is highly complex and decentralized with to meet the high data sovereignty and security requirements. This works in the classic energy market model where a few large producers guarantee the security of supply. In particular, the shift towards a decentralized and decarbonized energy market thereby requires major changes in order to meet the increased demands on data quality (e.g. highly granular or real-time smart meter data) and data transmission to ensure the security of supply. The currently used technologies as well as the given design of the market communication, where the (smart) meter values are transmitted every 15 minutes on the following day, will reach its limits in the near future. Furthermore, players such as e-mobility, prosumers or mass-market heat pumps are not yet integrated into the current system but will take on a core function in the energy market of the future.

Energy data-X uses the Gaia-X Data Space infrastructure to define and test a possible solution by creating an Energy Data Space where smart meter and sensor data is connected and made available for identified and authorized participants in the energy market. By "Sensor Data" we mean all data that is not collected via BSI-compliant measuring systems (e.g. in PV inverters, from uncalibrated meters of charging stations). The Energy Data Space then builds the basis of a digital energy economy that efficiently reduces the complexity of the future renewable energy system. This goal will be reached by simple and fast provision and post processing of required information through a common Energy Data Space. This enables a more efficient response to fluctuating feed-in, serves as a basis for new, cross-sector applications and enables the development and provision of Smart Services by and for the large number of players in the energy market. Enabling data-sovereign use of cross-company data for concrete analyses and decisions is the basis for the use of artificial intelligence. Energy data-X will define the integration of selected master data as well as sensor data via an Energy Data Space enabling an data efficiently, sovereignly and transparently use of exchanged data for system operation as well as value-added services ("Smart Services") and innovations. Furthermore certain process can be developed and provided centralized through the Energy Data space.

Problem solved

The current energy market model for data exchange is not able to meet the future requirements for data transmission, data quality and data security. The energy-data x initiative will define a solution for this problem by using the Gaia-X infrastructure. Thereby realizing economic potentials and synergies, enabling an increase in innovative capacity, clarification of the economic and technological benefits of GAIA-X for the German energy market and realization of competitive advantages with the GAIA-X data infrastructure.

Furthermore, energy data-X addresses the need in the market to include "sensor data" in certain processes. This sensor data could then be used by MPOs or grid operators for the purpose of substitute value formation. The Research focus lays on the following key elements:

1. **Applicability of Energy Data Space to crosslink smart meter and sensor data:** Enable interoperability and portability of data and data-driven applications within and across sectors. Data spaces aim to create an ecosystem (including companies, organizations and individuals) that generates new products, business models and services based on more and more accessible data.
2. **Advanced smart energy data services which base on the Energy Data Space** ("Innovative Smart Applications"): Include data-based business solutions that use, for example, AI, the Internet of Things (IoT) or Big Data. The GAIA-X ecosystem is intended to provide a marketplace for data monetization and incentivize trusted data sharing across different actors in the ecosystem.

The result will be a demonstrator of technical maturity level 4-6 that shows the suitability of the Data Space approach for a future data exchange model in the future German energy market model.

Concrete benefits

Establishing a large and comprehensive energy data space offering various data driven use cases for players in the energy market.

- Consumer: Simplified accessibility of data and service offerings, improved data security and data sovereignty.
- TSO: Improved system knowledge and system operations e.g. replacement value creation, forecast.
- DSO: automated settlement processes, process efficiency e.g. supplier switching.
- Service provider: Accessibility of data common data source for new and existing services
- OEM: additional data value streams

3.9 Description Use Cases Compliance and traceability:

3.9.1 Compliance and traceability – Green certifications

Solution

Within the GAIA-X Energy Space our solution is providing a certification service for green energy. The goal is to issue automated, timely and governmental approved sustainability certificates for Energy, cross-Sector and along the entire value chain. Covering certification of e.g. Electricity, Gas Hydrogen, Green-Fuels and other green goods

The initial solution scope could be as follows:

- Defining and implementing governance structure for partner ecosystem
- Define certificate standards for different energy sources
- Building decentral partner ecosystem and providing decentral digital identities for assets producing or consuming green energy (e.g. Wind turbine, PV-plant, Electrolyzer, Methanol-Synthesis-plant, Steel-plant)
- Connect decentral digital identities with asset sensors
- Implement proven standards into the certification management scheme
- Prove and confirm trustworthiness of implementation
- Issue certificates related to asset sensor data in asset specific wallets
- Transfer certificates between wallets (market participants) based on defined standards
- Devaluate Certificates based on timely (e.g. 15 minutes) asset sensor data
- Defining and implementing automated payment scheme for certificate management

Problem solved

Provide a working example. Prove that trustworthy and automated issuing and management of sustainability certificates works across multiple Energy sources and industrial Sectors as well as across EU countries. Demonstrate that decentral data ecosystems can connect different industries to prove the sustainability of produced goods in regards of energy

Concrete benefits

Get a demonstrator off the ground quickly. Solve all initial issues with applying GAIA-X concepts and architecture for a real-world sustainability certification application. Thereafter, use this demonstrator for training and onboarding of new stakeholders.

3.9.2 Compliance and traceability – Infrastructure data for new business models

Solution

Energy infrastructure belongs to the categories of most critical infrastructure in our economy. Critical infrastructures are those that ensure the supply of essential goods and services. They form the nerve cords of our modern society. Due to their importance for the interaction of all segments of society, these infrastructures require special protection. This also applies to data in the energy supply sector, for example, the misuse of which could cause great social and economic damage. For this reason, the data obtained may only be used and processed in a way that is relevant to the matter in hand.

At the same time, digitization has also arrived in the energy industry. It is driving forward the process of restructuring the energy system initiated with the energy turnaround in the form of more efficient processes and new business models. Several hundred energy start-ups are already supplying the energy turnaround in Germany with innovations such as virtual power plants, i.e. physical power plants that are interconnected via a platform. A 'dedicated turnstile' now provides them with even more support. Business models that drive the energy turnaround can and should also be implemented using infrastructure data on a simple and secure way.

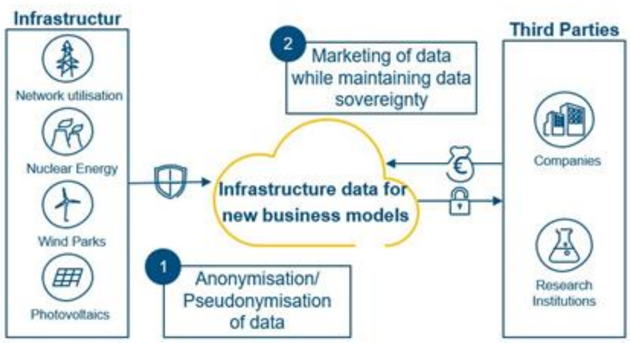
Problem solved

The challenge is to reconcile the objectives and principles of using data from critical infrastructures and the need to use data for new business models. To this end, regulatory issues should also be addressed: Is all data classified as critical or is there any differentiation? If so, may only a certain type of e.g. certified data centers be used for processing? Which market players would have access to the data they could use to transform value chains? How would data sovereignty finally be guaranteed?

In short, the provision and secure use of infrastructure data must be clearly regulated. One option could be to use only digital data twins, as proposed in the present Use Case. In this case, it would also be possible for energy suppliers or third parties to develop new business models based on this data. Some operators of critical information already provide such data twins which can be used by others for their own business models.

Concrete benefits

This demonstrator focuses on the brought usability of infrastructure data without endanger the critical infrastructure itself. We see a huge retention to provide infrastructure data for further purposes due to the risk of being misused. By using GAIA-X and its components of identity & trust, sovereign data exchange and compliance third parties will become providers of distinguishing data products and software appliances.



3.9.3 Compliance and traceability – Existing standards integration to GAIA-X

Solution

Gaia-X will be a non-domain specific platform and will be used in various contexts and use cases. However, those domains have a specific vocabulary as well as corresponding basic communication stacks and data models. The use cases already envision common semantics as data models for communication or automation and control of e.g. DER /DES but there is a strong need to foster the use of domain specific standards whenever possible and be open to incorporate and mediate to those legacy systems and technologies. From the UC point of view, one particular issue will be the convergence of both OT (operational technology) and IT (information technology) in the future Smart Grid. As data from IT and historical archives will be used for real-time optimization in OT (grid control contingency etc), there is the danger of format and semantics transformations which should be prevented. Given approaches like OPC which helps to use domain specific data models as address spaces, such an open approach shall be considered and documented for GAIA-X infrastructure services. Existing standards shall be screened for compatibility with the envisioned GAIA-X infrastructure and fallacies and gaps be documented.

IT/OT

Problem solved

NIST identified 75 existing standards and 15 high-priority gaps in support of smart grid interoperability, in addition to cyber-security issues, as a starting point for standards development and harmonization by standards setting and development organizations (SDOs like IEC and CEN/CENELEC). Sixteen Priority Action Programs (PAPs) have been initiated by NIST to address areas in which standards need revision or development to complete the standards framework according to their smart grid vision. n addition to the US perspective, the IEC Standardization Management Board (SMB) of Technical Committee (TC) 57 identified over 100 standards and standard parts in a strategic review of power system information exchange. Both of these studies concluded however, that only a small number of standards lie at the core of smart grid interoperability and they can be organized into a corresponding layered reference architecture described in IEC/TR 62357 – the so called SIA – Seamless Integration Architecture. The evolution of IEC/TR 62357 reflects the broadening scope of TC 57 in step with smart grid use cases from its original charter of ‘‘Power System Control and Associated Telecommunications” to ‘‘Power System Man-agement and Associated Information Exchange.’’ Generally this change reflects the shift in emphasis from lower level interconnection automation OT protocols to abstract information models in the higher levels of the architecture in IT as the number of business functions needing to interoperate with PSAs has increased with smart grid evolution. The TC57 architecture generally follows the form of the GWAC Stack layers 1-7, as it ascends from standards

concerned with communications relating to the connec-tivity of field devices through to information exchanges to support business pro-cesses and enterprise objectives. This reference SOA blueprint shows how these standards relate to each other, require harmonization and presents the gaps where further standards development work is required. In general all standards setting and development organizations advocate a collaborative approach to the development of open standards for the smart grid, with the reuse of existing standards as far as possible. Gaia-X will be a non-domain specific platform and will be used in various contexts and use cases. However, those domains have a specific vocabulary as well as corresponding basic communication stacks and data models.

Concrete benefits

The cost to fix a software defect varies according to how far along you are in the cycle, according to authors Pressman / Grady. One of the main costs drivers is the integration of components and system from various heterogeneous software or system vendors. Integrating based in standards lowers the amount of coordination and integration tests needed and fosters faster integration with less errors. As integration occurs in the later stages of a software project, costs of failed early interface semantics will cause a high maintenance and integration problem in the later stages.

3.9.4 Compliance and traceability – Trusted HUB

Solution

This use case focuses on the design and implementation of a managed service to address the demand of privacy-preserving machine learning and multi-party computation in the GAIA-X ecosystem. Aggregating, combining, and analyzing data — including data analysis, machine learning (ML), Artificial Intelligence (AI), and decision making — from different sources are becoming increasingly important almost in each and every domain from Energy 4.0 to Industry 4.0, Mobility, and financial sector. At the same time, this process is often complicated as relevant data is often privacy sensitive and created and owned by many different data owners that do not tend to share with others since when exchanging their data with third parties, they may not only reveal their business secrets but also lose control over their data and for what it is used. Many data owners are aware of the technical and economic potential that is realized by analyzing their data, in particular, in combination with data obtained from other data owners. The process of combining and collaboratively analyzing different data sources results in new insights, better AI/ML models, better decision-making as well as new/improved data-driven products and services. Considering this fact, this use case geared towards the integration of "Trusted Data Hub," a Hardware-Software privacy-preserving ML and multi-party computation solution, enabling several different parties to jointly analyze data, just as if they have a shared database without ever revealing those data. In other words, sensitive data sources held by multiple parties can be linked together in a secure manner, while parties gain no additional information about each other's sensitive data, except what can be learned from the output of data analysis.

Problem solved

AI/ML is widely used in many areas of the energy domain, from energy fraud detection to theft detection, anomaly detection of energy consumption, energy demand prediction, demand response management, renewable energy forecasting, planned/unplanned disruptions forecasting in the power grid, outage detection and prediction, predictive/preventive equipment maintenance, and energy trading, among others. Machine learning and big data solutions enable energy and utility companies to optimize their resources, improve energy flows, manage the grid, schedule energy, and prevent mistakes. Unfortunately, the utility of AI/ML solutions is currently hindered by limited data availability for algorithm training and validation due to the absence of standardized data sharing/exchange as well as the requirements and concerns to protect the privacy of data owners and parties participating in the energy ecosystem. Although International Data Space (IDS) and GAIA-X Data Space can partially address the first issue, the development of new solutions to concurrently address the demands for privacy and ML utilization is a necessity. Trusted Data Hub aims to bridge this gap by providing a secure, privacy-preserving, and multi-party platform preventing data owner's privacy compromise and protecting data leakage.

Concrete benefits

Privacy-Preserving and Multi-Party Computation play an important role in the data economy and the spark of innovative new business models. It bridges the gap between the utilization of AI/ML services and the privacy of data owners enabling transparent aggregation, trustworthy refining, and collaborative analysis of data sources to be provided as a new product/application on the energy markets.

3.10 Maturity indication of the data space and current health status

3.10.1 Addressing the demand side

The demand side is already well represented and the ambition is to expand further:

- There is a broad representation of Energy Companies from Germany, Belgium and France at the moment
- There are companies and use cases in all segments of the energy value chain: production (renewables, hydrogen and nuclear), networks (electricity, gas, heat, etc.), marketing, sales and compliance

This has to be completed by each Hub / country if necessary.

3.10.2 Representing the supply side

These energy companies are already able to develop smart services (AI, IOT, Machin Learning, Blockchain…) and to integrate suppliers to develop these services.

Technology companies able to work within GAIA-X to provide infrastructures and data protection services are also stakeholders of the data space.

3.10.3 Creating a sustainable business model in the data space

There is a very good equilibrium between demand and supply side in the data space Energy, ensuring the achievement of the roadmap with sustainable business models.

3.10.4 Ramping up the TRL – from prototype to operation

The business model of each us case is or will be described by each use case working group.

A pipeline of use cases will be organized with 4 different steps:

1. Use cases project mapping;
2. Use cases projects prioritization;
3. Use cases implementation - phase 1, for use cases already close to implementation;
4. Use cases Implementation - phase 2, for use cases needing R&D.

Several use cases are already detailed and a first prioritization has been done, identifying “quick wins” and “high value use cases”. New use cases will enter this pipeline in an iterative way, when data space’s stakeholders identify new subjects or are joined by new participants and experts.

The business value and the potential for adoption and further scaling are key criteria of prioritization.

Before implementation, each use case will be further deepened, especially on two aspects:

- Consortium building if needed, with relationships between all parties definition and necessary resources identification;
- Potential funding identification.

The use cases pipeline will be developed in the “roadmap of the use cases” of the data space energy, defining priorities and timing of implementation of use cases (see 4.1.)

3.10.5 Needed component certification from the GAIA-X federation services

All the main component of Gaia X will be certified:

- Identity & trust:
  - Federated identity management

- Trust management
- Federated access
- Federated catalogue:
  - Self-description
  - Service governance
  - Monitoring & metering
- Sovereign data exchange:
  - Policies & usage control
  - Usage control for data protection
  - Security concepts
- Compliance:
  - Relation between service providers and consumers
  - Rights and obligations of participants
  - Onboarding & certification

4 Evolution of the energy data space

4.1 Roadmap of the evolution

The roadmap of the data space energy will include 2 roadmaps, that will be built and actualized in consistency:

- The roadmap of the use cases (based on the pipeline of use cases described above) - that will need to be detailed in 2021
- The technical roadmap of GAIA-X infrastructures and services labeled by GAIA-X, ensuring use cases development; there will be a common technical layer of infrastructures and services ensuring secured data exchange and interoperability.

4.2 Quick-wins (for 2021)

- Define the data space governance (how to enter the core team and the data space? what rights and duties of the core team and attendants?)
- Build a community of cross-border European actors
- Define the data space roadmaps, as described above
- Qualify first use cases and build some demonstrators for implementation in 2022
- Lay the foundations around existing shared semantics

Use cases quick wins will be detailed in the soon-to-come roadmap.

4.3 Mid-term benefits (2022-2023) building on already-launched or soon-to-be-launched projects

Among the already or soon-to-be-launched projects, we identified:

- Renewable asset description model
- Renewable works – risk prevention
- Hydrogen station networks information sharing
- Nuclear equipment regulation
- Local communities of energy setting up and decentralization
- EV assets investments
- DSO network mapping
- Energy renovation
- “Green” certifications

List to be completed with the soon-to-come roadmap.

4.4 Long-term benefits requiring significant investments on the 2021-2025 period

- Contribute to the energy transition and carbon neutral economy, through new services and digitalization. Consistency between the Energy data space, the Green Deal data space or others (eg: mobility) will be ensured;
- Contribute to the development of European large cross-border infrastructures and data protection services;
- Develop large cross-border energy services and actors in Europe, able to be developed all around the world;
- Benefit to European citizens with better services, personal data protection, and job development in Europe.

References

(1) : C. Yang, V. Vyatkin, A. Mousavi and V. Dubinin, "On automatic generation of IEC61850/IEC61499 substation automation systems enabled by ontology," IECON 2014 - 40th Annual Conference of the IEEE Industrial Electronics Society, Dallas, TX, USA, 2014, pp. 3577-3583, doi: 10.1109/IECON.2014.7049030.