ITEA Smart energy customer workshop

Report

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1. Introduction

1.1. Organisation of the workshop and participants

From 3 June to 24 June, ITEA organised its seventh international customer workshop and this year it focused on Smart energy, a new challenge of ITEA 4. The workshop was co-organised with Atos, Enerim and Siemens Energy. Due to the COVID-19 pandemic it was the second ITEA customer workshop that was organised online.

The event gathered around twenty big players of the energy sector representing the energy value chain - energy providers, Transmission System Operators, Distribution System Operators and large energy users - and around twenty solutions providers - large companies and SMEs – of the energy sector. The following organisations took part:

Energy sector players / Customers	Industry	SMEs
Alpiq	Atos	Eneryield
Cellnex Telecom	CosmoTech	Green Power Labs
Deutstche Telekom T-Systems	CSEM	GreenWave Innovation
EDF	Dassault Système	Inavitas
EnBW	Enerim	let's dev
Engie	KoçSistem	Neroa
FFT	Schneider Electric	Opus One Solutions
Fingrid	Siemens Energy	Tangent Design Engineering
Kanca		Teknopar
KTH		TWT
Metsä Group		
Renault		
RTE		
Swedish wind energy association		
Swegon		
The European Technology and Innovation Platform for Photovoltaics		
Think Smartgrids		
Tofaş		
TotalEnergies		

The target of the workshop is to identify the actual customer needs, in order to create new ITEA projects based on clearly stated customer or end-user requirements. Therefore, we organised a mix of presentations and brainstorming activities:

- Kick-off session:
  presentation of the objectives of the workshop, its organisation and the IT tool supporting the workshop
- 4 Challenges sessions:
  customers presented their challenges and discussed the evolution of the energy sector
- 6 Brainstorming sessions:
  starting from an idea proposed by a participant, the participants brainstormed to identify potential research activities, skills and competences that can contribute to the idea
- Closing session:
  synthesis of the workshop (challenges and ideas created), presentation of the next steps, keynote speech on how to progress together and final words.

The sessions were recorded to allow a flexible participation of the attendees of the workshop and an easy access to the content.

The proposed ideas may be transformed in project proposals for ITEA Call 2021 that opens in September 2021 in conjunction with the online ITEA PO Days.

1.2. The importance of the customer workshop - ITEA's philosophy in a nutshell

ITEA is industry-driven, deals with the digital transition of all main industries and follows a unique bottom-up approach. In our hectic digital business domain, innovation is at the heart and coming from adventurous brains at a moment when others have not yet thought about it. The process is very different from the more strategically oriented innovations we observe, with the more top-down decision-making in the IC industry, with its necessary huge start-up investment. Both innovation processes, bottom-up and top-down, are necessary and target different results.

In ITEA, we cultivate the bottom-up approach. It is not an easy path because you already need to invest in projects when little consensus yet exists on the direction to follow. Thus, we developed a unique methodology to evaluate and coach these kind of projects, starting with going back to the user; what are the pain points you want to solve for which users and customers? Then we challenge the project with the State-of-the-Art (SotA); why can't we solve the pain points with the existing SotA? Then, if you want to push great ideas in our digital industry, you need access to the market, because the time-to-market windows are very short in our business domains. In ITEA we carefully check the market value chains of today and tomorrow, and how our consortia have access to them and how they can impact them. It is only when these pain points, targeted user and customer, and access to the value chains are clear, that we check the credibility of the proposed technologies to decide which project deserves the ITEA label. There is no success in ITEA without an impact on the market.
We created the international customer workshops to ensure that our R&D programme is close to the customers. Every year we choose an important thematic for ITEA, and this year the focus was on Smart energy.

2. Energy sector trends and potential role of software

The energy sector is currently undergoing important transformations.

- Due to the global warming problem, there is a strong move towards **carbon-free production of energy**. There is an urgent need to find alternatives to fossil energies (coal, oil, gas) which emit greenhouse gas and are responsible for the increase of the average global temperature. The development of renewable energy sources is a key trend that has a strong impact on the energy sector.
- Especially in Europe, there is a move towards a **more competitive market** with some new regulations to open the market to new players. Again, we see this trend exerting a powerful impact on the organisation of the energy sector that is transformed from a market dominated by national operators to a more competitive field.
- Third, both the need to move toward a greener economy and the will of organisations and citizens to use energy in an accountable way has created a trend towards **a better control of the energy usage**. The continuous introduction of a carbon cost in the economy governed by new regulations (e.g. carbon trading) is a strong incentive especially for large industrial sectors. In addition, we see the rise of the idea of sustainable development in society and economy. Consequently, everyone wants to be accountable for the energy he or she uses, and we see the emergence of the new notion of “value per energy unit” in our society.

Software is an important technology for all these transformations of the energy sector. Of course, it cannot be the solution to all challenges, but software is clearly an enabler that will help to tackle the problems in moving towards a greener and efficient energy sector. Software can especially:

- be a good mean to manage the complexity coming from the new energy sources or the emergence of more players by allowing the interactions of many players in more heterogeneous contexts.
- help to provide more automation to solve the complex challenge to balance the production and demand of energy.
- introduce new optimisation capability in most of the energy systems that will lead to greater efficiency.
- transform the new data sources that are collected into valuable information that will help the energy players.
- contribute to the standardisation of the exchanges between the players of the value chain through the development of API (Application Programming Interface) and domain specific ontologies.

All in all, software innovation is a key technology for the evolution of the energy sector.

3. Challenges presented during the workshop

During the workshop, the participants from the energy sector and the large energy users were invited to present the challenges that they face and the pain points that they would like to see solved. We organised four challenge sessions grouping the participants around a central topic that was shared by all the attendees of a session. The next sections are brief summaries of the exchanges that took place during the meetings.

3.1. Session New usages

The transformations of the energy sector create opportunities for new business and new usages. During this session, starting from the point of view of different industry sectors – automotive industry, paper industry, building sector - some of them have been discussed.

In the automotive sector the most notable move is the development of electrical vehicles and the need to find solutions to energise them. Currently, there is a big challenge to put in place **a reliable infrastructure that will support and allow a smooth transition**. If we are able to achieve this step, it will create important opportunities. One of them is that the vehicles could be considered as **moving energy storage** that can contribute to solve the flexibility issue that we face today in the electricity network. Another opportunity is that the evolution of the vehicle towards a software system can help to manage in a common way old and new generations of cars. The software that controls the vehicle and that serves as interface with the energy infrastructure can be the link between the customer and the automotive provider and allow the latter to develop new services for the former.

In the paper industry, the energy produced for the paper fabrication process can also be used to provide energy to the grid. However today the opportunity is not completely used due **to rigidities in the regulations and in the grid management**. The Central and Nordic European energy markets are making progress but not at the same pace on the heating and electrical networks. Some exchanges of best practices could be an opportunity to learn from each other and to progress quicker.

In the building sector, we see a challenge in designing buildings that do not have oversized capabilities. A more intensive use of simulation can help to avoid some **waste of resources and energy**. **The development of digital twins of the buildings** is an interesting opportunity to offer new services as energy saving and improved maintenance. This can help to plan for optimal heating and cooling of buildings taking into account external data sources as weather forecasts and energy production forecasts. The building by itself can be designed to provide flexibility in its energy demand/supply. However today, we lack a dialog with the energy grid providers to put in place new energy optimisation solutions. The regulations do not provide enough incentives and also the **lack of standards** is a roadblock to progress.

The participants to this session share the view that **new storage solutions are to be developed**. This can be the batteries of the electrical vehicles but also storages located in the factories and in the buildings. The availability of new storage options will provide more flexibility and a better balance between energy supply and energy demand. The current regulations are too rigid to incentivise this transition. Some other open questions to move in this direction are the **standardisation of the exchanges of information between supply and demand** of energy and the existence of a framework that enables transactions between the players with a very low overhead.

For the emergence of new business models, a smooth exchange of information is crucial. A way to progress could be to work on the standardisation of the exchanges of information and data that are needed to enable new transactions and so the emergence of new services and business models.

Simulation technologies have also an important role to play in the emergence of new usages. Simulation has to be used to analyse new business models (e.g. where to invest in charging stations). Most of the time not only physical systems but also economic systems have to be simulated and some progress would be welcome in this domain. There is also a challenge in the generation of the simulation models. Low-cost solutions to generate these models, especially for old infrastructures, would help a lot. For new systems, if the design process would allow the creation of the system and of its digital twin at the same time, it would be an important saving and a good progress. The data models coming from the machine learning field are also something that need to be developed for the energy sector.

Additional points of view mentioned during the session:

- Developing a new software over again for each new generation of products is not the right approach. We need to move to a continuous software-updated approach that leads to a unified management of the old and new generation products.
- Software becomes the core of most systems and creates new vulnerabilities. Most of the industry players are not specialists of these problems and may have difficulties to catch-up. New solutions for resilience systems are needed.
- New business models in energy are complex and therefore it is better to start with standardisation first. The new business will follow automatically.

3.2. Session Flexibility

One of the main challenges of the energy sector is to constantly keep the balance between the energy supply and the energy demand of the electricity grid. Developing flexibility in the management of the supply and demand sides would help a lot to tackle this challenge. Several stakeholders – energy providers, TSOs, DSOs and a Think Tank - have discussed during this session how to progress towards more flexibility.

There is a consensus that the complexity of the balance of the electricity grid has recently increased due to the introduction of new renewable energy sources; The congestion of the electricity grid is also a major problem of today. The **development of new storage capacities** (based on battery or hydrogen) connected to the grid would help a lot to provide the expected flexibility. Another trend is the development of services to industrial energy users who want to go to zero carbon emission and are open to new solutions from existing players or newcomers to help them manage their demand.

Another panellist mentioned the fact that currently the TSOs/DSOs have different ways to interface with the energy providers and therefore it is difficult to trade energy in Europe. The development of a **new platform that can integrate all the interfaces** and make the trading of energy transparent would be a real progress.

The development of electric vehicles also creates some opportunities to get more flexibility. First, the batteries of the cars can be used to better balance the supply and demand. Second, the cost of batteries will decrease due to a volume effect and make new storage solutions based on batteries profitable.

We can already observe some experiments or some concrete implementations of flexibility by some DSOs with grid offering adaptative connection, by some large industrial players with advanced demand control and by renewable energy providers who integrate several sources in a virtual plant that provides a stable supply. It is important that the **regulators in Europe develop a legal framework** that will foster these changes.

Another observation is that the flexibility is not an option but mandatory as the citizens in Europe do not support the development of new power lines or new power plants. The flexibility needs to involve the full value chain especially the customers that need to accept the new constraints that can result from the demand management. So, the **flexibility solutions have to focus on the value created for the end users** and not only on the value created for the energy suppliers and operators. New demand management solutions could be facilitated by the development of connected devices, but we need to have a **standardised way to control the assets**.

Regarding the control of the grid, the current architecture is most of the time too centralised. It would be good to develop a **more distributed control** that could be organised with three layers (one giving the global view of the grid; an intermediate level that will optimise 10-20 substations, and a local one allowing adaptation and protection of the assets). As the electricity grid is a common asset for all the stakeholders, it could be interesting to develop an **open source or open model of cooperation** to develop some piece of

the new control system of the grid in common. However, to move in this direction some progress would be needed in the standardisation of the data used to control the grid. Better solutions to exchange these data can also help to improve grid congestion management.

The panellists also see the explosion of data coming from the multiplication of energy systems and the development of additional sensors. These data are an opportunity to **apply new AI methods that can provide new ways to control complex systems** and so to offer greater flexibility. The integration of more precise forecasts can also give more accuracy in the prognosis of energy supply by renewable energy sources which takes more and more importance in the supply management. Again, AI methods are appealing to improve the quality of the forecast of renewable energy sources.

As already mentioned, regulations can play an important role to foster the flexibility. Currently the European regulations are too fragmented and there is an expectation from all the participants to see more alignment in Europe and new decisions to facilitate the development of flexibility.

The panellists see opportunities to develop new service-oriented business model as the energy users will need some help to adapt to a more complex energy supply system. Energy as a service can be developed by several players coming from different backgrounds. The scene is currently very open.

This session was very rich and other challenges were also mentioned:

- For greater flexibility, we need to develop AI methods based on real time measures that will provide more accurate forecasts
- The flexibility will also be developed with the help of the EV, and the smart charging market has to be integrated with solutions for distribution and transmission to improve the efficiency of the power grid.
- Data security in a multi-party system is a strong concern for the future electricity grid control
- The forecast of PV park is especially difficult and generates a new risk that need to be managed
- Scalability of large simulations (due to the quantity of data)
- We need to work on new incentives (variable prices) to influence the behaviour of customers and to have new service providers to help customers to better adapt their behaviour.

3.3. Session Optimisation of energy usage

On the demand side, more and more energy users want to optimise their consumption. This opens new challenges that have been discussed during this session that included large companies coming from the forging industry, the production plant provider sector, the automotive industry, the telecommunication sector and the cloud IT sector.

In the industry, solutions already exist to monitor and manage the production and SCADA (Supervisory Control And Data Acquisition) often gives information about energy consumption. However, most of the time, the optimisation of the production does not completely consider energy as a criterion. The analysis of the relationship between energy consumption and operations is too poor to allow a complete multi-criteria optimisation. **New solutions are needed to improve the energy efficiency** while keeping the production level. Another challenge is to better manage the transition phases and especially the switching on/off of complex systems. Some of these operations are quite costly in terms of energy and should be better controlled. The **development of energy storage solutions** inside the factory can also open the opportunity to generate energy if the inertia of some systems could be used.

Regarding data, even if the introduction of the ISO 50001 standard leads to the obligation of energy measurement, the **full use of these data is still to be put in place**. For example, it would be good to be

able to use energy consumption data to help in detecting failure in advance. There is also a demand to take into account external data (e.g. weather data) and to correlate them with energy consumption. With the pressure on green production, there is also the **need to be able to compute the carbon footprint** of the goods that are produced. This means that the energy providers and the whole supply chain have the ability to provide such information about the components involved in the transformation process.

Some panellists expect that new tools, especially digital twins of the factories, and new methods can help to solve some of this optimisation challenge. Again, getting digital twins of some old equipment may be a problem and data models to represent such old machines could be an appealing solution. There is also the need to introduce more real time features in the monitor and control system and this can lead to processing capability challenges. The importance of putting in place some methodology has been stressed to better manage the energy. It is key to correlate changes in the operations with energy saving and to prepare and follow an action plan for energy improvement.

In the ICT domain, we see the same challenge as in industry **to better schedule the operations to optimise the cost and the quantity of energy used**. The development of cheap storage solutions would be welcome to provide more flexibility for the operation of large data centres. In addition, for IT system there is a demand to develop **precise monitoring systems** that can assess the energy use by the software/application. Currently measurement can be made for each component, but the important information is what drives this consumption in the application/software. As the execution of applications is more and more complex (with some part in edge devices and some part in cloud data centre) it is difficult to get the complete picture and to control and optimise the energy used. There is also a **lack of development methods that could help to design energy efficient software**.

There is a consensus that the industry users would benefit from **a more comprehensive access to information related to energy**. More data need to be shared on the forecast of energy providers and especially on renewable energy productions together with meteorological data to better schedule their operations. If we want to move to a greener economy, it is key to **better track the energy that is coming from renewable energy sources** and to offer more options to the energy users. For the monitoring and control of the operations, one of the concerns is to **improve the reactiveness of the system and to increase the precision of the prediction**. In addition, with more complex multi-criteria optimisation, there might be a computing challenge to do all these acquisitions and processing in real-time.

3.4. Session Multi-energy

As already explained, some important trends are the development of new renewable energy sources and the interaction of different energy networks (electricity, gas, heat, hydrogen) leading to more complex multi-energy systems. This session gathered several panellists to discuss the challenges to progress towards these multi-energy systems.

The development of wind energy has progressed well, especially in the Nordic countries, where it represents 50% of the electricity market. To go further the big challenge is the grid capacity to balance resources which is crucial for wind energy. The economic dimension is more important than the technical one. The current regulation of the market Is not optimal and does not create the right incentive for more renewable energy. There is a challenge to be able to **simulate new market conditions** that would help to move forward.

For the photovoltaic (PV) energy the landscape is less advanced, but it will be a mandatory component to meet the European energy targets of 2050. Reaching these objectives means a massive electrification of the market (transport, heating, cooling…) and an increase in renewable power generation. For the good

development of PV energy, two main challenges are seen: **the development of an interconnected system at European level and the decentralisation of the control to optimise at local level**. The digital technologies have to support the **development of data platform that enable creation of new values**. It is also important to work on solutions for energy communities that need to organise the local trading or to aggregate different energy sources.

One of the panellists being from the High-Performance Computing (HPC) domain, it was mentioned that in this field several research paths were active to make HPC systems more energy efficient: new hardware developments is one, a better software control of the operation of HPC systems is a second and the third targets the development of leaner applications that can decrease energy to solution. For multi-energy systems, HPC can contribute on the topics of material research (e.g. new battery, new solar panels…), of large simulations to optimise complex infrastructures and of the combination of simulations approaches (digital twins) and data approaches (Machine Learning methods).

Amongst the stakeholders of multi-energy systems are territories. They must take important decisions as to invest or to authorise the developments of new energy infrastructures and they need to have decision support tools for that. The problem faced by territories is to reduce the greenhouse gas emission while keeping a competitive cost for energy to attract both citizens and industries. There is a **demand for new tools that will allow to consider the energy perspective in any decision** for either the renovation or the development of infrastructures. The tools have to take into account the economic dimension and to analyse the effect of direct measures or of incentives. In this period of transition of the energy sector, such tools would bring great value.

During the discussion on renewable energy production forecasting, it was mentioned that for solar energy, the weather forecast community was not ready to provide the radiant energy and so this forecast was challenging. Even if at global level, the errors can be compensated, at local level there are still errors, and the **presence of storage solutions is welcome to compensate the bad prognosis**. Another challenge is the development of **data models that could perhaps compete or even outperform physical simulations**.

The resilience of multi-energy systems is also a challenge. To design resilient infrastructures, simulation tools can again be used to model the interconnection of the systems and to find the options that will provide the most secure operation. As the systems will be heterogeneous and coupled, we **need new simulation tools that allow to represent systems that are quite diverse and the way they interact together**. The simulation tools need to handle the economic dimension of the operation of this complex system and to analyse different options. There is a challenge in generating the simulation models as there are quite specific for each configuration and quite costly to build. So, **finding an affordable solution to analyse the resiliency of multi-energy systems** is a problem. The modelling of urban systems also faces the challenge to correctly manage the privacy of some of the data that can be linked to personal behaviours and/or confidential business activities.

To progress towards more optimal energy systems, **data sharing** is an important challenge. To move in this direction several aspects need to be considered. First non-technical elements such as how to **build trust** or to propose **appealing models for data sharing** must be handled. Second, intermediate level elements such as how to connect the people, the security of the transactions, the organisation of marketplaces, the automation of the transaction must be considered. Last, some technical elements such as interfacing different data sources (format, quality) have to be managed. Today, the data are not standardised and for example DSOs use different data. Working on a **shared ontology of the energy data at the European level** can be very helpful to define standard data that could enable the data sharing.

The panellists also observe a lack of human resource to work on a better exploitation of the data. To overcome this difficulty, some open models of cooperation could be a good idea. It will also help to get more standard data representation and to handle the rapid evolution of the available data.

4. Ideas proposed during the workshop

During the workshop seven ideas have been generated by the participants and almost all were discussed during brainstorming sessions. They are presented below. The first three ideas target some components of the energy value chain. The four remaining ones are related to developing solutions that could impact the complete energy value chain.

4.1. Measurement & Verification tool for Emission Tracking within Buildings (F6 in ITEA Call 2021 Project idea tool)

Buildings is one of the major sectors for energy consumption and greenhouse gas (GHG) emission. New solutions could greatly help to reduce the GHG and to save energy. The proposed idea is to develop a software platform that quantifies the GHG emission reductions achieved within buildings based on measured and verified results of specific efficiency actions.

The platform would utilise data from permanently installed, open protocol energy sub-monitoring systems to establish equipment level consumption baselines. Specific efficiency actions would be entered via a User Interface such that machine learning software can continually track, measure and verify results to be used in carbon trading systems & ESG (Environmental, Social and Governance) reporting.

Such system will encourage ambitions and allow re-commissioning, behavioural and capital expenditure-based initiatives to be quantified as results. It will remove the utility bill level and theoretical modelling approaches that are error prone and manual. It will onboard all the building users to cooperate to the objective of GHG emission reduction.

4.2. Predictive Real Time Analyse Software (F3)

In industrial plants, there are opportunities to better monitor and manage the energy used for the operation of the factory. To go beyond the state of the art, the idea is to develop an AI based software that can manage, predict and analyse in real time the energy consumption of the equipment.

The platform will link data generated by the equipment and external data sources to increase the quality of the control. It will also be used to improve the prediction of the production and to do more global optimisation at the plant level.

The development of methods based on data and the real time features of the platform would be significant progress compared to current solutions.

4.3. New Adaptive Zonal Automats : Digitised new generation substation for integration of renewables and new uses (F2)

This idea aims to develop a new generation of substations with more digital capability. To allow a fast development of renewables, the “digitised new generation substations” of the transmission network represent an important potential for flexible and reactive integration, whether these renewables are

connected to the distribution or to the transmission grid. The digitised new generation substations will also enable other new uses and will benefit to services actually existing or that will be created.

It starts from the observation that the transmission grid substations concentrate flows of energy, flows of data, and host numerous applications that could be extended to functions and services addressing far beyond the classical supervision and monitoring. For example, zonal automatised functions could automatically monitor congestion management linked to renewable generation, and thus allowing the system upstream, and its operators, to deal with new functions.

The idea is then move from the actual technical state characterised by “components with embedded functions” to digitised substations made more flexible thanks in particular to “edge computing” and open-source development, that allow to globally pilot and modify in an agile way the algorithms that are used throughout all the substations (including in components/infrastructure).

This valorisation of the infrastructure (existing or new) in order to allow new uses is a virtuous circle that opens value creation.

The development of such capabilities needs to be accelerated to meet the Green Deal objectives, and other goals such as the EV integration. The set-up of demonstrators, the development of Proof Of Concepts or more would provide great leverage. These new substations (that could be named NAZA : New Adaptive Zonal Automats) will enable to switch from a centralised control to a decentralised control and to develop new services.

4.4. Resonance (F4)

The idea is to develop a framework to provide a solution to efficient manage cross-commodity energy systems.

In the current state of the art, there are several challenges:

- Current automation systems are not capable to address the complexity of sector-integrated and distributed energy systems
- Optimal control and decision making requires fined-grained access to data across different subsystems, which are not currently interoperable
- Optimal operation of distributed energy resources requires high-level of trust and transparency
- Consumers/prosumers are not interested nor capable of representing themselves in the daily operation of the energy markets

The project will aim to develop several aspects to provide solutions to these challenges:

- Scalable and adaptive resource management with AI (digital twins of buildings, power plants and energy networks)
- Interoperable and open interfaces to guarantee interoperability across existing silos
- Transparent value creation & audit trail of energy information exchange with blockchain technology
- Automated consumer/prosumer engagement with AI and blockchain

If successful, the project will deliver

- Cross-commodity benefits through shared aggregates
- Optimal control of buildings and other flexible assets
- Transparent value creation and audit trail of energy information exchange

In term of business impact, the expected outcomes are:

- Cost-effective integration of demand-side resources
- Scalable and accurate modelling of buildings and other flexible assets for cross-sector benefits

4.5. BENTRADE

The idea is to design a micro-grid with renewable energy sources and create a distributed ledger system that functions across grid-connected devices, with several financial alternatives for transactive energy, and a foundation that advances market design and technology in tandem.

These distributed ledgers will store, in a tamper proof manner, the energy presumption (production & consumption) data collected from IOT devices, while self-enforcing smart contracts programmatically define the expected energy flexibility at the level of each prosumer; therefore, outline the rules for balancing the energy demand with the energy production at grid level.

Developing these different innovations will deliver several advantages and especially you will:

- Decrease dependency on commodity electricity and disseminate use of Renewable Energy Sources (RES)
- Create distributed energy asset owners
- Balance demand and response at the grid level
- Reduce risks of failure and cyber-attacks by distributed model

The implementation of a project based on this idea could:

- Introduce DLT – Distributed Ledger Technology in electricity market
- Achieve better understanding of customers behaviour, interest and acceptance of active participation
- Give suggestions to the national governance method and regulations related to DLT
- Emergence of new ancillary markets and exploitation of excess of energy from distributed generation
- Decrease dependence on commodity electricity and disseminate use of renewable energy sources
- Reduce risks of failure and cyber-attacks by distributed model
- Help create disruptive business and revenue models
- Provide smart energy services to customer with trust

4.6. HEIDOS

The energy infrastructure planning process is a very complex task that involves several stakeholders and requires the consideration of several local and global factors and constraints. Furthermore, it requires to consider several phases of the infrastructure lifecycle at the same time: an aging asset which needs to be maintained and replaced, new infrastructure investment, but as well operations and balancing of multiple energy sources and networks.

The idea is to develop new tools that will optimise and simplify this process.

Amongst the technologies that could be used are:

- Digital Twin of the infrastructure and its management system with standard ontologies
- simulation of heterogeneous systems (System of Systems): physical and management systems
- testing any type of scenario (building new infrastructures, renovation of existing infrastructure, economic incentives…)

This idea could have several impacts especially:

- a successful transition to a carbon-neutral energy system
- predicting the impact of the decision on infrastructure for design, maintenance and operations
- measuring and optimise performance on all aspects: physical reliability finance, environmental
- auditable and transparent decisions

4.7. AMPLITUDE

The idea is to collaborate to set up a secure, cooperative infrastructure to unlock the full potential of data generated by distributed energy resources. In the energy sector, a lot of players generate data but most of the time, they are not the one that can create the greatest value from them. The idea is to have a framework for energy value chain players to share data and the value created with them.

Such an innovation enables:

- Data owners to control the level of access data users (e.g., analytics providers) have
- Setting up a collaboration between data owners and data users without requiring permanent data transfer
- Automated data flows and execution of algorithms, once agreed

This idea could have several impacts especially:

- Data science innovators gain access to large datasets for training purposes
- End users can benchmark data-driven solutions
- Data owners can generate additional income through the monetisation of their data towards multiple buyers

5. Conclusion

Once again, this international customer workshop reconciliated the customers concerns and the interest of technology providers (large industry as well as innovative SMEs). It occurred in a very open manner, thanks to all participants. It has been very fruitful with many challenges shared and 7 ideas of projects to build.

The participants and the whole ITEA Community are invited to use this valuable input to create or join a customer-oriented idea for a project proposal in ITEA Call 2021. Remember that the ITEA game is very open but based on added value of each partner, thus clarify in advance what you offer to the project and to the other partners to join a project.

In addition to the emergence of these solid ideas and of some collaborations, the workshop has helped to establish progress towards a shared vision of the research priorities to address the important transformation underway in the energy sector. The participants have developed new connections that will be important as no single player can tackle the current energy challenges alone. In conclusion, this workshop was very valuable in initiating ITEA's activity in this new Smart energy challenge.

Again, a big thanks to the organisation committee Atos, Enerim and Siemens Energy and to all the participants!

6. Annex: list of challenges

The four challenges sessions have generated a lot of potential challenges Not all of them have been mentioned in the session summaries. Here is a presentation of some of them as bullet points. The objective is to provide inputs to set-up collaborative research projects to address these challenges.

A first set of challenges is grouped according to hot topics of the energy sector: flexibility, electric vehicles and renewable energy. The second set of challenges has been clustered with a more IT point of view, listing challenged related to simulation, data and software architecture/methodology.

Flexibility

- How to exchange information on expected production/demand
- Opportunities for optimisation but lack of framework to find the best option between energy providers and energy users
- New integration platform to better interface different TSOs, DSOs
- New regulations that give incentive to develop flexibility
- Enabling transactions with low overhead to help developing micro-grids
- New services to manage end-user demands
- On boarding end users (creating incentives for them either financial or taking advantage of user willingness to develop green behaviours)

Electric vehicles

- Challenges
  - Development of a reliable infrastructure that can handle the development of the electric cars
  - Smart charging solutions need to be plug and play; the car owner wants a friendly and cost-effective solution
- Opportunities
  - Batteries in electric cars can be considered as mobile energy storage; new solutions need to leverage this opportunity
  - Development of low-cost batteries, lowering barriers for storage business models

Renewable energy

- Accurate forecasting production
- Management of uncertainty and development of a reward/penalty system
- Aggregation to several sources to provide a virtual power plant
- New services for local trading

Simulation-Prediction

- Currently to be on the safe side, several energy systems are still designed oversized; simulation could help be used to more optimal systems
- How to generate the digital twin during the system design phase
- Cheap solution to integrate old generation systems in digital models
- Standardisation to couple simulations and/or digital twins
- Complex market and/or system simulations (scalability, heterogeneity, economic dimension)

Data

- Use of existing data to extract models of old systems
- Development of new data models: energy forecast, energy demand prediction, maintenance

- Need to define an ontology of energy data which is shared by all players of the energy value chain (interoperability is still a challenge)
- Platform to enable data sharing and value creation by external players with rewards for the data owners
- Data quality, security and privacy issues
- Enabling carbon footprint calculation along the energy value chain

Software Architecture-Methodology

- Software as an opportunity to unify several generations of systems
- Real time data analytics for the choice of best energy options
- Distributed and layered architecture to control the electricity grid (cockpit, auto-pilot, local control)
- How to relate energy consumption with software
- How to develop application software that is energy efficient
- Open-source model to fit with the multi-actor structure of the energy sector
- Open model of cooperation for data