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Abstract:

This report is a consolidated report on the “soft” results of the FINESCE trials so far, i.e. results from user interactions with the trials, user feedback on the trials and learnings from the trials.

Keyword list:

Generic Enabler, FIWARE, Smart Energy, User Interaction, Energy Optimisation, Customer Engagement, Partner Interactions, Business-to-business Interactions

Executive Summary

This report presents the “soft” results of the FINESCE trials so far, i.e. results from user interactions with the trials, user feedback on the trials and learnings from the trials. It gives a concise overview of the “soft” results and learnings under a number of headings:
User Interaction
Energy Optimisation
Customer Engagement
Partner Interactions
Business-to-business Interactions
GE Usage

Additionally, results on the Smart Energy Platform are presented.

FINESCE’s WPs have each developed individual trial site infrastructures based on FIWARE Generic Enablers. Each WP is performing experimentation with their trial sites and preliminary results from user interactions with the trial sites are already being gathered. This report has presented a short, consolidated version of the results on what we have learned so far from the user interactions with the trial sites.

Our experiences and learnings in relation to FIWARE and GEs are also presented. While the overall experience has been positive, especially as regards the interactions with the GE developers, the FINESCE developers have been working with FIWARE as it has developed and matured over the past two years and so have gathered considerable experience of the problems that inevitably accompany such a developing technology: in this sense, positively critical comments are presented which reflect our experiences. FIWARE has many good ideas, but the overall maturity has not yet reached a level suitable for a critical infrastructure and stability issues and incidents where resources have been allocated to other purposes have had a negative impact.

During the past year the concept of Smart Energy Platform has been developed in the context of the FINESCE project work. This concept is being actively disseminated by FINESCE and has received much positive support in the last months.

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1. Introduction

The purpose of this report is to present the “soft” results of the FINESCE trials so far, i.e. results from user interactions with the trials, user feedback on the trials and learnings from the trials. The relation of these soft results to FIWARE and to the Smart Energy Platform is explained, where relevant.

This report consolidates the individual reports of WPs 1 to 5 on this subject, giving a concise overview of the “soft” results and learnings under a number of headings:
User Interaction
Energy Optimisation
Customer Engagement
Partner Interactions
Business-to-business Interactions
GE Usage

Additionally, results on the Smart Energy Platform are presented separately (these results are not consolidated from the underlying WPs’ deliverables).

Detailed technical results are not the focus of this deliverable. Such results will be presented in separate deliverables at the end of the FINESCE project.

2. Trial "Soft" Results and Learnings

2.1 User Feedback on Smart Energy Platform

The concept of an open-source Smart Energy Platform (SEP) based on FIWARE (see ANNEX 1 for details) has been developed during the past year as a result of the FINESCE project. Industry feedback on this concept and some details of ongoing activities are presented in this chapter.

The SEP Platform concept was presented in a keynote address at the E-World Energy and Water[1] trade fair in March 2015. There were over 70 visitors to the FINESCE booth who expressed interest in the Platform and all but two considered it a good initiative. A key aspect of SEP is that it is not a commercial platform which is being developed and marketed by individual companies but an open platform which avoids vendor lock-in: this is the aspect which differentiates it from commercial competition and makes it interesting to the industry.

As a follow-up to E-World, all these 70+ FINECE booth visitors will be invited to come to RWTH Aachen for the workshop for FEN Low Voltage in May 2015, where they will be invited to join the SEP co-operation community. More companies also have been approached in the meantime and will be invited to the workshop as well.

A webinar[2] on the SEP has recently been held under the IEEE Power and Energy Systems Society, spreading the news internationally to potential SEP co-operation community partners.

The SEP was a key topic in the E.ON ERC Annual Meeting at RWTH Aachen University on March 26th 2015 and was addressed by a number of speakers including Prof. Reneh Speh of Siemens. Particular focus was placed on the role of Smart Energy Systems within the larger context of Smart City.

A demonstration of the platform was also presented during the poster session at the E.ON ERC Annual Meeting with a live link to FI-LAB activating home-level energy management systems.

RWTH has had several meetings with E.ON top executives from Sweden and Germany in the last months to discuss the SEP. There is clear interest from E.ON to be engaged in the further development of SEP, as it is of great interest for them

Additionally, RWTH is preparing a number of EU project proposals about developing SEP.

Dr. Williams and Prof. Monti met Patrick von Howe from the European Commission: he is in charge of the most important projects in the area of EEGI (Electrical Energy Grid Initiative). The platform concept was presented and it was agreed that RWTH together with Ericsson will demonstrate how the Automation Architecture for Active Distribution Network (specifically the one proposed in the project IDE4L (http://ide4l.eu/) where RWTH/ACS is partner) can be mapped to the Smart Energy Platform System. The work will be performed in the next few months.

2.2 User Interaction

WP2 Horsens A User involvement programme was designed for all adults in the test houses.

Social Behaviour:

- Increased awareness on energy consumptions within the families

[1] http://www.e-world-essen.com/en/home/

[2] http://www.ieee-pes.org/webinar-cloud-transform-energy-biz-march-2015

- Participants are prone to engage in hands-on optimization of their new smart energy equipment to boost the potential rewards of the new systems
- Strong interest among the new owners in optimizing the performance of the individual units and/or the system as a whole

Energy Visualisation Service
Users are challenged by the large amount of information being presented.

Users as new Prosumers
- Users like being seasonally self-sufficient
- Consumption practices easily adjust to clearly rewarding behaviours
- Factors such as price regulations, utility licenses, and grid charges obscure the benefits of producing and using own energy.

External control
- Users' attitude towards having the home energy appliances externally controlled is connected to the sense of achieving something
- The users like external control enabling the same level of comfort as before, but now supplied by renewable energy.
- With regard to the EVs there is a slightly negative attitude towards the aspect of losing full freedom of spontaneous driving.

Recommendations for any end users engaging in a "green" transition, interested in converting their private energy resources into intelligent alternatives.

1. Well-designed support and instructions should accompany the delivery of intelligent, green technology both hardware and software, to encourage and empower end-users in the transition and to prevent old habits from counteracting the full potential of the investments.
2. Users ask for easy means to interact with external control services and system interfaces must invite the users to easy-accessible, shared control features with clear feedback on "who" has control, and for how long.
3. In the case of offering control as a service, the services must be open to accommodate clear local motivators. This means that intelligent control services must be flexible and adaptive in order to meet the present price and payment conditions, as in the case of profiting from free solar cell energy.

WP2 Madrid

A web-based GUI has been used to display consumption data to facility managers: their feedback will be used in further development to make the GUI generally usable in other buildings as well as to provide complementary mobile apps for making the information more accessible to public building end users. These are also provided with comfort information about the building through TV monitors, a concept which will be extended to give specific information about individual floors or areas where the displays are located, thus contributing to increase the awareness of the people using the building about energy consumption.

The web-based GUI has been tested by a small group of six building end users with ICT expertise but no specific expertise on energy efficiency. Additionally, the interface has been shown to and discussed with two energy efficiency experts working within the building and an additional energy expert external to the building, belonging to another business division of ACCIONA group, and feedback has been provided by them. The interface has been well received by the energy efficiency experts consulted, and they consider it proven adequate for providing information to facility managers and energy consultants. However, appropriate adaptations or complementary simplified interfaces (e.g. mobile apps) are needed in order to make it more accessible to tertiary building end users who do not have so much knowledge about energy efficiency. This is an area for further improvement which should be tackled in future work, and end users with neither specific ICT nor energy efficiency expertise shall be included in the tests.

WP3 The factory manager in such a system has a significant role, and hence a well-structured and useful user interaction with them is important in order to allow for a successful system.

The FINESCE Presentation Layer (FPL) has a scalable and flexible data visualisation approach, which can work in two different modes: the data analytics mode, where various displays of data help assess the Big Data transformations and data mining, and in day-to-day web application usage. For the latter, the users find the information that they access regularly as soon as they open the web application. For the trials, we focused on the aspect of an end-user application. This was perceived by the involved factory personnel as very helpful.

WP5 Feedback from users of the WP5 API showed that more precision was needed in the type of information and documentation shared with each individual contact, especially with the first explanation of the COS used in the email interactions. It was found that purely providing the API specification to users does not help with the overall understanding of the system and so the WP5 team has developed a user interaction process which better facilitates users. This has helped with the creation of more concise and precise documentation for potential new users.

2.3 Energy Optimisation

WP1 Malmö The infrastructure is capable of shifting load according to defined use cases. The potential for shifting loads without significant impact on the customer's comfort has been shown to be bigger than initially expected. All this is of course very positive as it indicates good opportunities for leveraging the loads' flexibility.

Therefore E.ON is now further exploring how the flexibility can be used to enable system optimization of district heating and district cooling grids. For example, provided that desired flexibility is available, that could enable avoidance of firing up peak production units which usually have higher operational costs and CO2 emissions. Thus, rolling out the infrastructure to the wider Malmö (here 5 buildings would not be enough, 50+ are required) could enable benefits to the whole City of Malmö.

In order to quantify the potential, different analyses and simulations have been activated (including activities beyond FINESCE) to identify a potential return of investment given the costs to set up a commercial operation of the infrastructure and rollout of required technology (compared to today's pilot operation with 5 buildings). Generally the potential seems promising for the district cooling grid in the Western harbour, Malmö. These promising aspects would not have been this far without E.ON's involvement in the FINESCE project.

WP2 Madrid The platform provides energy optimisation services for Energy Service Companies (ESCOs) for industrial and tertiary buildings in the areas of demand management, monitoring and auditing, and microgrid deployment and management. Energy experts consulted internally in the trial building and externally in other business divisions of partner ACCIONA are satisfied with the functionalities provided by the infrastructure tested in the trial, and consider it a useful tool for supporting energy efficiency consultancy projects for external customers.

2.4 Customer Engagement

WP1 Malmö The trial has experienced that all building owners are positive and engaged in the trial. They fully understand that this is a test-bed for future technology. Moreover, they are also investing own time and resources to support the trial.

Regular meetings have been held with the customers to update on status, which is appreciated by the customers. Trust has been earned and we have today access to test the use cases in all buildings and carry out desired analyses. We have also access to the user interface of most buildings' Building Management Systems (BMS). Additional building owners have also shown extended interest to be involved in the trial.

Further, several customers have also realized that a positive side-effect of the trial is that they get valuable feedback on how their Heating, Ventilation and Air Conditioning (HVAC)

installations are performing. Thanks to our tests, we have found different improvement opportunities in all buildings.

WP3

The trial showed that despite the controlled environment, the manufacturing plans often deviate from the original forecast. This could be confirmed by discussions with factory operators from different companies. A more detailed analysis showed that deviations from the plan were always underestimated beforehand as well as in hindsight by the factory operator of the Smart Factory of the trial.
The energy generation by distributed and renewable energy resource is dependent on the weather and characterised by volatile output levels. The trial showed that an efficient balancing between the energy generation of the VPP and the consumption of the smart factory has to be based on the forecast of both partners for the next day but has also to be controlled with an event-oriented architecture to identify deviations from the plans and enable fast responses from the partners.
The performed simulation based on a real-time digital simulator provides a safe framework to verify balancing of load and generation within the VPP in terms of technical feasibility. The scalability of the trial approach could be verified and different strategies were compared with respect to reducing the global balancing problem based on solving local balancing problems.
A key result from the trial in Cologne and Aachen is the finding that such a system can be executed efficiently without interference of the normal business operations of the involved partners. Hence, this means that

- a cross-border VPP can be set up and controlled using Future Internet-technologies and that
- a discrete production offers sufficient flexibility in their energy consumption to be a valuable partner for an energy optimization.

WP4

In order to evaluate the Demand Response approach, the users (private citizens or enterprises) have been involved in an assessment for a better comprehension of their aims and to evaluate their interest in the trial participation. All users have expressed interest to the trial, considering it important for the reduction of energy costs. Many of the users declared their difficulty to manage the consumption in compliance with the resolution plan, not having the possibility to defer in time some activities that require energy consumption.

ASM Terni as DSO is going to evaluate a potential market for a future development of new devices for the automatic management of loads. These automation devices could be controlled directly from the DSO or by the Aggregator on the basis of the information given in the resolution plan (Fully Automated Demand Response).

The trial indicated that the Demand Response for consumption could be applied with greater effectiveness by developing new devices for home automation directly managed by the DSO and by pushing the users to change the schedule of production cycles that require higher consumption of electrical energy to move them in periods in which there is a greater energy production from RES. For this ASM is evaluating the possibility to extend manual DR to fully automatic DR by continuous power factor regulation with the installation of a new switching device close to the customer's (device to be developed). In fact, if you take into consideration the power factor regulation, you can have more advantages in managing reactive power since it does not impact the user's habits.

WP5

The experience gained developing and integrating the Charging Optimisation System (COS) has shown that other Utility customer applications could be assisted by the COS. These include: electrical continuity enhancement, asset life prolongation, peak load management, distribution automation, as well as power quality monitoring and control.

The ability to control over a broad range of integration times means that from a customer perspective, a wide range of applications may be developed using this system. As a demonstration, one partner in the project has developed a renewable integration and inter-regional power flow optimisation system based on COS, with a medium level integration time of 15 minutes, sufficient for the application. The system operates via the API in exactly the same way as any customer would use the control system. The system has been working for several months.

A number of other applications have also been considered by external users. An external university (Trinity College Dublin, Ireland) has developed their own algorithms for management of renewable resources using electric vehicle charging. They have accessed the COS again via the API in order to plan testing using real vehicles.

Another external user (Social Charging) is developing an electrical vehicle route optimisation app for drivers, and has reviewed the availability of information from the COS, via the API, and is considering how real time data could be incorporated into their system.

Finally an international organisation (GreenWay) with control of a large number of public EV charging points was interested to review the COS to consider the scope for co-operation.

2.5 Partner Interactions

WP1 Malmö

Another very important part to have engagement from in the trial is the BMS integrators as those enable the link between the actual loads to optimize and the WP1 infrastructure. The BMS integrators which have been involved in the trial have also been very positive. This concerns the following integrators as of today (March 2015): Bastec, PowerIT Solutions, Automationsgruppen and Schneider Electric. Moreover, E.ON is currently discussing connection of additional buildings will all of these integrators. Those connections are likely to happen post FINESCE, implying that the trial infrastructure is very likely to continue to grow. Further, individual meetings are also planned with the integrators to understand how future connections could be even more efficient, i.e. what could E.ON do and consider to improve the process even further.

The positive feedback from the integrators includes but is not limited to the rather uncomplicated way to connect to the trial infrastructure thanks to a well-defined architecture. The integrators are also very positive for testing future solutions concerning energy management as it gives them a good insight towards future customer needs and how required technical solutions can be developed.

Integration to the BMS's has been made on different levels, which is proving that the trial infrastructure is very modular and open for integration on a deeper level. It has also been shown that the BMS integrators believe in the WP1 infrastructure, else they would not have agreed to be involved in the trial.

WP5

WP5 internal users of the WP5-internal COS API have reported as follows:
API responses are received in a timely manner (though the requirements have not been that challenging to achieve due to the implemented 15 min time slot duration) and it runs reliably over several months. The API was stable and responsive.

2.6 Business-to-business Interactions

WP3

Integration of factories is a crucial aspect of this set-up, as traditionally they do not actively engage with the energy grid. As discussion with factory operators showed, the complexity of such an integration should be hidden from the factory as much as possible. From the three possible communication strategies, we chose the least invasive one from the factory's perspective: The factory's production planning and control system (e.g. ERP or MES) creates three alternative production schedules of equal conformity with production goals. Those are being fed to the VPP, which then chooses the one with the highest overlap with their desired load profile.

To gather the necessary data for such an integration, energy monitoring infrastructure needs to be rolled out. Discussion with the industry show that such investments are only carried out if combined with an additional value proposition – e.g. predictive maintenance for the machines based on their energy consumption data.

Integrating such energy balancer in the VPP infrastructure allows to know about the energy consumption in advance and to be able to optimize energy generation accordingly. On the one hand this means to optimize the efficiency of the power plant and on the other side to distribute the energy locally and thus, to relieve the grids distributing energy.

To combine distributed energy sources to one VPP a monitoring infrastructure is needed to gather the necessary data. The monitoring and management of the VPP does not interfere with the normal operation of the energy sources. The ICT system to process the data and communicate with partners is separate from the energy sources.

WP5 At the grid level the COS has two main customers:

- firstly the Distribution System Operator, for the management of distribution assets to maximise their lifetime and for real time control of feeder voltages to ensure that regulatory obligations are met. For both applications interactions of the COS system with a prototype distribution management system, using the OpenADR 2.0b interface was developed in the trial.
- secondly, the Transmission System Operator can use the COS as a dispatchable resource, and can interface to the system using, in Ireland, the “electronic Dispatch instruction logger” (eDil) a web-based application, that allows the TSO to control the dispatch of a power station control, and could be used to control EV charging in much the same manner. The COS would interpret grid instructions to increase supply as commands to interrupt charging to a portion of the connected EVs, and similarly an instruction to decrease supply would increase the number of EVs charging. While an eDil interface was not developed in FINESCE, its structure is simple and could easily be added to the system.

The WP5 team is exploring ways to engage with potential DSO and TSO customers and to solicit their feedback on the possible usage of the COS.

The infrastructure prepared in Stream II is especially designed to foster the interaction between utilities and external stakeholders. It aims at offering a simplified but secure solution for data provision to external parties, a difficult issue for utility organisations. Although the trial has still not allowed additional parties to take part of it (except of ESB and FUNITEC), once it is completely deployed and the level of security provided is evaluated in depth, specific data from ESB will be offered through this infrastructure to be tested by other external stakeholders. In that sense, the trial may increase its scope to include a number of commercial electric vehicles, in which the data protection requirements for which are likely to be less stringent than for domestic uses.

2.7 GE Usage

FIWARE and GEs in General

WP1 The general experience of working with the GE’s has been very positive. The GE’s are rather stable and the documentation somewhat up to date, considering it is an ongoing project.

WP2 Horsens The global GE evaluation results have been positive, especially from the point of view of the adequacy of the GEs to the specific requirements of the trial, their capacity to handle the volumes of data generated within the building, and the versatility to connect to the different trial subsystems and manage subscriptions to them.

WP2 Madrid There are many good ideas, but the overall maturity has not reached a level suitable for a critical infrastructure. Especially, confidence in GEs as a whole is reduced when GEs that share a common interface cannot work together. The interaction with the FIWARE GEs development teams has most frequently been fluent and the support provided has been adequate. However, frequent problems have been spotted in the performance of FI-LAB where the Big Data – Cosmos GE instance is running. This does not seem to be an issue directly related the GEs themselves, but raises questions about the suitability of the hosting infrastructure for running commercial services based on the trial developments. One of the main issues encountered has been the deprecation of some GEs which were planned to be integrated or had already been integrated into the trial infrastructure. Although this had no impact on the working status of the trial, it is important that for the use of FIWARE in commercial deployments the planned evolution of the FIWARE Catalogue is communicated well in advance, in order to properly evaluate the impact that the different changes might have.

WP3 The use of GEs and FIWARE proved advantageous both when developing each specialised component and when integrating them in an overall offering. For developing and rolling out internal logic of the factories, FIWARE helps in applying a variety of best practices. While the use of GEs is transparent to the customers and end-users, for the designers and developers

they meant that the initial application prototypes were built in weeks rather than in months. By decoupling the analysis and visualisation from the data gathering on the shopfloor, we also decreased visible complexity to the factory manager. The analysis models and procedures can then be transferred between companies much more easily, increasing the return on investment for factories, because solutions developed in one factory may be easily applied in other similar factories.
Using the FIWARE platform for deploying the solution ensures portability between customers. Wherever using public instances of FIWARE is not acceptable due to enterprise policies, the availability of the tools for setting up private instances of the FIWARE platform warrant fast deployment. The availability of the crucial GEs also means that the developers may focus on solving customer's direct problem such as gaining optimal energy consumption from renewable energy sources rather than spend time and effort with technology itself. The customers perceive this as faster time from concept to production-level solutions.

WP4 For a developer:

- the key factor of choosing a GE would definitely be the availability of a contact person (the "GE owner"), as well as IT players committed to exploit the FIWARE ecosystem , who help him/her in sorting out issues during both set-up and operation;
- most of the GEs are natively integrated each with the other thus representing a Future Internet "ecosystem" through which data can be acquired, stored, processed/analysed and, finally, exposed;

For an IT company or an IT department of a DSO,

- setting up an entire experimental infrastructure would not imply costs of hardware, hosting and licensing in the context of the FI-PPP programme and beyond;
- GEs are based on "open standards" and so can easily "work" in conjunction with other products both open source and COTS.

WP5 Difficulties appeared with not advertised changes in FIWARE Lab. Although they were resolved, this was considered as a risk, so those changes could decrease the high availability of the whole system

Data/Context Management

WP1 The integration of Orion Context Broker into the WP1 architecture has probably been the easiest and most uncomplicated. The implementation and usage of this GE is well documented and was easily fitted into our requirements and expectations.

The purpose behind integrating Orion Context Broker and Cosmos BigData Analysis to the WP1 trial was to carry out complex analyses and process large amount of customer consumption data. The analyses work are ongoing and it is proven that the infrastructure can handle data sources for approximately 20 000 buildings+. Going further, WP1 has requested support for R in Cosmos which is a widely used framework for analyses. R also integrates well with Hadoop and Hive, whereby adding support for it in Cosmos would soon increase the value and strength of the GE far beyond the invested time for each single GE user to add it.

WP2 Horsens The most positive experience with using GEs has been with the Publish/Subscribe Context Broker and Backend Configuration Management. We have experienced good support from the developers, frequent updates with advance notice and it is available as Open Source on github. The documentation has been good for our usage as well as performance. It has a FI-LAB image, which makes the installation process very easy.

However, the images have not been entirely stable. In our view this stems from issues related to FI-LAB rather than the GEs but we do not have the insight to analyze this fully. The idea behind FI-LAB is very good, it is easy to deploy and setup new instances. FI-LAB has the possibility to become a very powerful tool, but stability issues and incidents where resources have been allocated to other purposes have a very negative impact. Based on experiences during the trial, we would not recommend using it for critical components yet.

WP3 The GE Publish/ Subscribe Context Broker greatly supported to connect separate components into a greater whole, showing again the advantage of open interfaces such as the NGSI and the easily deployable services such as Orion.

WP5 The CEP GE is suitable for integration directly into a distributed system for responding to complex events such as the COS in WP5 Stream I. It is quite usable. From a developer perspective the install process for the Complex Event Processing GE was a simple matter of copying the application WAR files into the Apache Tomcat webapp folder and then following the configuration settings on the wiki.

Security

WP1 The Security chapter of the GE catalogue supplied WP1 with GE Identity Management KeyRock, GE Authorization PDP AuthZForce and the GE PEP Proxy Wilma. Their integration resulted in the graphical user interface that the users can log into using the same credential mechanism as for any other FIWARE applications. This helps the customers to always use the mechanism they are used to. Also, it lowers the complexity of the needed administration, because the users can all be managed in one place for multiple applications. By following the recommended patterns, the deployed application offers a high level of security in terms of unauthorized access prevention and data privacy.

WP2 Horsens The Identity Management (GCP) provides good functionality, many features and good support and documentation from the developer. The fact that it is a software as a service, and therefore very closed, is our primary issue.

WP3 Dealing with data in the IoT, it is critical to make sure that the data is only accessed by authorized entities. For this purpose the trial demonstration uses GEs, which implement state of the art authentication mechanism.

WP5 The integration of IdM Keyrock GE was complex because it was planned to use the GE for the authentication of the storage system at local and FIWARE Lab level using the same instance experience. However, and although the available documentation could be improved, the deployment of a new instance was fast and its usage was easy. The lack of information only led to some mistakes in the process of deployment, and consequently unexpected responses of some of the API calls. However, the bugs were corrected (thanks to the help of the IdM Keyrock GE contact person availability in some cases).

The IdM GCP GE was very easy to use due to the nature of the system being an online service which provides a REST API. The documentation was very comprehensive and every call to the application was stepped through and provided expected parameters and showed every eventuality which made the system easy to test and debug. All the parameters were well specified and accurately described in the documentation, and all mimetypes were respected.

The Content-based Security GE was used to encrypt a message originating from a DSO/TSO, and initiated a simulated grid emergency which shutdown all EVSE devices connected to the charge optimisation system. A minimal set of the CBS GE's functionality was used in the WP5 COS and it was necessary to interact directly with the developer in order to gain access to the source code of the GE to ensure it worked in our use case. The documentation for this GE was reasonable, there was enough information on the wiki in order to get a good idea how to get the system installed, and up and running for testing.

IoT Service Enablement

WP2 Horsens Our experience with the GEs from the IoT Service Enablement has been mixed and at times frustrating. Individually the GEs worked satisfactorily, but integration between the GEs resulted in many issues. For instance, the intention was to integrate an IoT setup entirely based on GEs, but because of incompatibility, we ended up creating links that could translate the NGSI messages between the different GEs. We have the impression that the IoT section have been subject to a lot of changes like replacement of the Gateway Device Management (OpenMTC) and the Backend Things Management being spilt up into separate GEs.

WP5	Developers' and users' experiences using the Object Storage GE were positive. The documentation was comprehensive and every call to the Openstack Swift was stepped through and provided expected results, and showed every eventuality which made the system easy to test and debug.

3. Conclusion

FINESCE's WPs have each developed individual trial site infrastructures based on FIWARE Generic Enablers. Each WP is performing experimentation with their trial sites and preliminary results from user interactions with the trial sites are already being gathered. This report has presented a short, consolidated version of the results on what we have learned so far from the user interactions with the trial sites.

Our experiences and learnings in relation to FIWARE and GEs are also presented. While the overall experience has been positive, especially as regards the interactions with the GE developers, the FINESCE developers have been working with FIWARE as it has developed and matured over the past two years and so have gathered considerable experience of the problems that inevitably accompany such a developing technology: in this sense, positively critical comments are presented which reflect our experiences. FIWARE has many good ideas, but the overall maturity has not yet reached a level suitable for a critical infrastructure and stability issues and incidents where resources have been allocated to other purposes have had a negative impact.

During the past year the concept of Smart Energy Platform has been developed in the context of the FINESCE project work. This concept is being actively disseminated by FINESCE and has received much positive support in the last months.

ANNEX 1 Smart Energy Platform

The Smart Energy Platform is conceived as a business-class platform based on an open-source approach using FIWARE technology. It is a cloud-based, service-oriented, open-source middleware platform that is capable of supporting the business models of the different Smart Energy actors. The term “Smart Energy” means making electricity grids, buildings and cities “smart” through the introduction of ICT and automated control, i.e. it covers Smart Grids, Smart Cities and Smart Buildings.

Actors can carry out their business by means of offering services through the SEP and using the services offered by other actors include, for example, Utilities, TSOs, DSOs, equipment providers, electricity retailers, electricity aggregators, energy service providers, electricity market regulators, electricity prosumers, electricity end-customers, building management firms and ICT companies. Hence, the SEP is envisaged as a hub for Smart Energy business, and must be built to be powerful, robust and secure enough to support real business use cases.

There are several technical pillars upon which SEP is based:

- use of open source software, to create a dynamic development community;
- development as a cloud-based platform, to achieve scalability (in terms of geography and size) at reasonable cost;
- use of a service-oriented architecture, allows simple, extensible APIs between the various actors, which hide underlying complexity;
- use of a 3-layer platform model (integration of various data sources, middleware and API layer) to allow SEP’s services to address multiple miscellaneous data sources.

In order to support the open source approach, FIWARE open source Generic Enablers will be used as building blocks for the SEP, and it will be hosted in the FIWARE cloud. hence, the components inside the 3 layers shown in Figure 1 will comprise GEs and DSEs.

Components developed within the Smart Energy Platform will be made available under open source licensing agreements as DSEs, thus contributing to the FIWARE offering to developers.

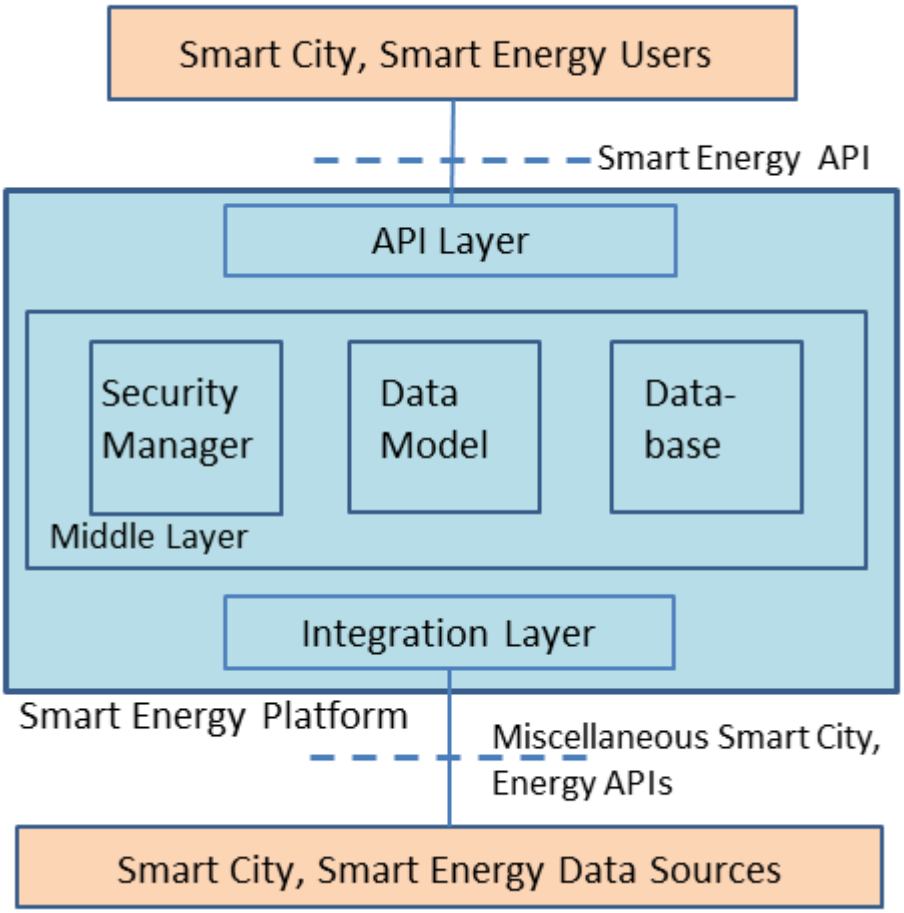

Figure 1: Smart Energy Platform Concept

The attraction of the SEP for utilities is that it will allow them to develop business applications based on the Platform infrastructure by adding their own specific service logic, by means of which they can create added-value and develop services which can be made commercially available through the API Layer. It is envisaged that the development of SEP will be driven by developing support for the business use cases required by users such as utilities: such development will mean developing functionality for basic Platform functions (which will be made available as GEs or DSEs to other Platform users as part of the open source approach) and also application-specific functionality, which would remain the property of the company developing it.

The vision is to develop a sort of Linux of Energy Services. The commonality of interfaces is a winning point for everybody. It is clear though that whenever somebody wants to offer a commercial solution will branch out and offer a supported version: hence, SEP offers a winning combination of shared open source functionality and commercial proprietary functionality.

The open source functionality, comprising FIWARE GEs and SEP's DSEs, will form the basis of individual instances of the SEP, which will be developed and operated by SEP community members to implement their own use cases.

1.1 Organisational Aspects of SEP

RWTH has been selected by the German government to drive the Industry/University relations for the next 15 years in the field of electrical networks (Forschungscampus Flexible Electrical

Networks). In this context, RWTH created an external company FEN GmbH that is based on Industry participation. Within FEN, we develop joined research activities driven by Industry. It is not then the typical research scenario: it is more oriented towards direct exploitation and innovation.

The long-term intention is to run SEP using a foundation model. However, in order to get the initial projects organised it is intended to start running it using the Flexible Electrical Networks (FEN) GmbH to organise the work.

The intention is to set up a co-operation community based on the consortium of utilities, service providers and ICT companies formed for FINESCE and also the companies already involved in the Flexible Electrical Networks consortium.

Industry will pay a fee to join the SEP community and in return can:
- define the program of the Community
- have free access to any result of the Community
- have special access to the RWTH infrastructure
- have discounted access to Industry oriented training programs
- when desired, rent space in Aachen at special price.

In our view this is a very good model to support and develop an open source version Smart Energy Platform in a way that allows sharing of the costs. It has a clear funding schema and it is self supporting.

FEN GmbH will also operate to attract more research funds to develop further collaboration among its partners. We will have special focus on EU funds. With this second instrument, partners will be able to put together large consortia to support joint research and development.

The role of FINESCE partners is, therefore, to be founder members of the SEP community. By so doing, FINESCE partners have the opportunity to implement their use cases in an open business platform and benefit from the use cases implemented by other SEP community partners.

FEN GmbH will also operate to attract more research funding to develop further collaboration among its partners. We will have special focus on EU funding. With this second instrument, partners will be able to put together large consortia to support joint research that could, for example, support the transition from the Open Source implementation to a supported implementation in different companies.

1.2 First Steps Towards SEP

The FINESCE Data Repository is a first step towards the SEP, in that it incorporates Integration Layer functionality towards FIWARE Lab Data, some Middleware functionality and API Layer functionality (offering the FINESCE API).

In addition to its business application, SEP is also meant as a test environment for new standards, interfaces and devices in the energy industry. Development in this direction is already ongoing at RWTH but not as part of FINESCE: work is ongoing to connect laboratory equipment to a FIWARE cloud platform to make a cloud-based Smart Energy testbed. This will provide the opportunity to test new services and components at different levels, ranging from pure software testing to hardware and Power-Hardware-in the-Loop testing. The pure software testing is suitable for testing cloud-based algorithms, services and the interfaces between them. Involving real Smart Home Gateways and Control Units in the tests, known as Hardware-in-the-Loop, enables the user to analyse the integration and interaction of real hardware with the cloud. A further step, the incorporation of the Smart Home test bed, developed at the E.ON Energy Research Center, allows for testing entire Smart Home systems.