Terni Trial Site: Future Internet building the Energy Marketplace

PREMISE

Energy scenario is characterised by a growing density of Distributed Energy Resources (**DER**), mostly based on renewable energy sources. This is helping to reduce greenhouse gas emissions and thus to contribute to the European Union target of 20% reduction in these emissions for 2020. However, DER also become more and more a challenge for grids: injected electricity from DER depends from the variable weather conditions. So DER energy has a **high deviation** over time and this creates **imbalances**, **power losses** and **instability** in the grid: those **critical conditions** stress electrical components, that may reduce their operational lifecycle.

Many solutions from the state of the art, mostly based on controlling power generation, are characterised by **high cost. FINSENY** project [1] analysed a new promising approach as a combination of **Demand Side Management** and **new Market mechanisms** [2][3][4].

FINESCE[4] **WP4** aims to instantiate a **marketplace for Energy**, enabled by **Future Internet technologies** (FI-WARE Generic Enablers)[6], for demonstrating advantages of this approach.

CONTEXT & PROBLEM

FINESCE WP4 is setting up a trial site in Terni, a small city in Umbria region (Italy). The trial is conducted in a small portion of the power grid managed by ASM in Terni, characterised by photovoltaic (**PV**) plants and a hydroelectric power station. Nowadays, the **22%** of the overall demand energy is covered by DER generation.

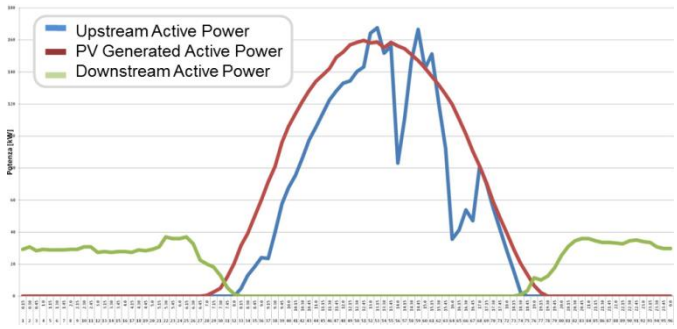

Figure 1: 24 hours Load Profile

This **high density** of **DER** is highlighting more and more grid issues, as introduced in the premise (i.e. instability, reverse power flows and power losses) mainly due to energy consumption not aligned with respect to production from PV plants, as shown in Figure 1.

In this perspective, problem has to be addressed as follows

> Energy Consumption needs to be shifted in order to **maximise** usage from local PV plants and **minimise** power flows and losses

PROPOSED SOLUTION

The proposed solution is based on mixing **Demand Side Management**, that aims to control energy consumption from the consumer side, with **new market-mechanisms** for better engaging consumer, as well as any other existing and new actor, in the energy marketplace.

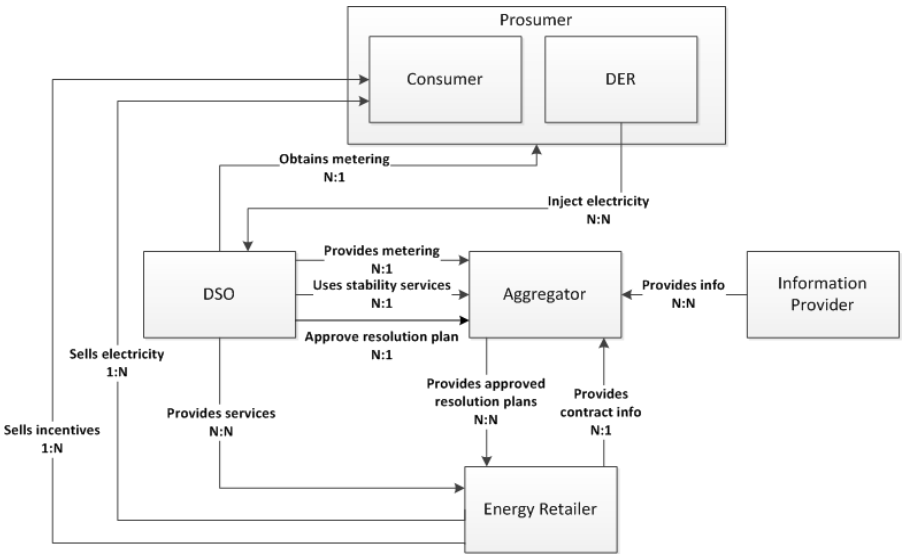

Figure 2: Actors involved in the proposed solution

As shown in Figure 2, solution involves five main actors[7]: DSO, Aggregator, Energy Retailer, Prosumer and Information Provider.

Aggregator identifies **imbalances** in power demand and supply and proposes a **resolution plan** to address them.

DSO has the overall control of **distribution grid** and **approves** resolution plans.

Energy Retailer transforms the resolution plans to specific **incentives** tailored to the **Consumer**, that consequently shifts its consumption in order to derive more benefits. But also Energy Retailer derives benefits by suggesting usage of energy when price is lower and this maximises its incomes.

In practice, the proposed solution solves an optimisation problem for satisfying minimisation of grid instability (requirement of the DSO) and maximisation of incomes/benefits (requirement of the Energy Retailer and Prosumer).

The system requires a large amount of data, from the Automatic Meter Reading (**AMR**), that has to be processed in near-real-time with contextual information related to causes impacting energy consumption/production (e.g. weather conditions, social events, contract, regulations, energy dynamics).

The system is conceived to use a set of **FI-WARE Generic Enablers** and to provide its features through **API** (as shown in Figure 3), in order to: i) guarantee re-use of solution; and ii) be later integrated and extended in other trials.

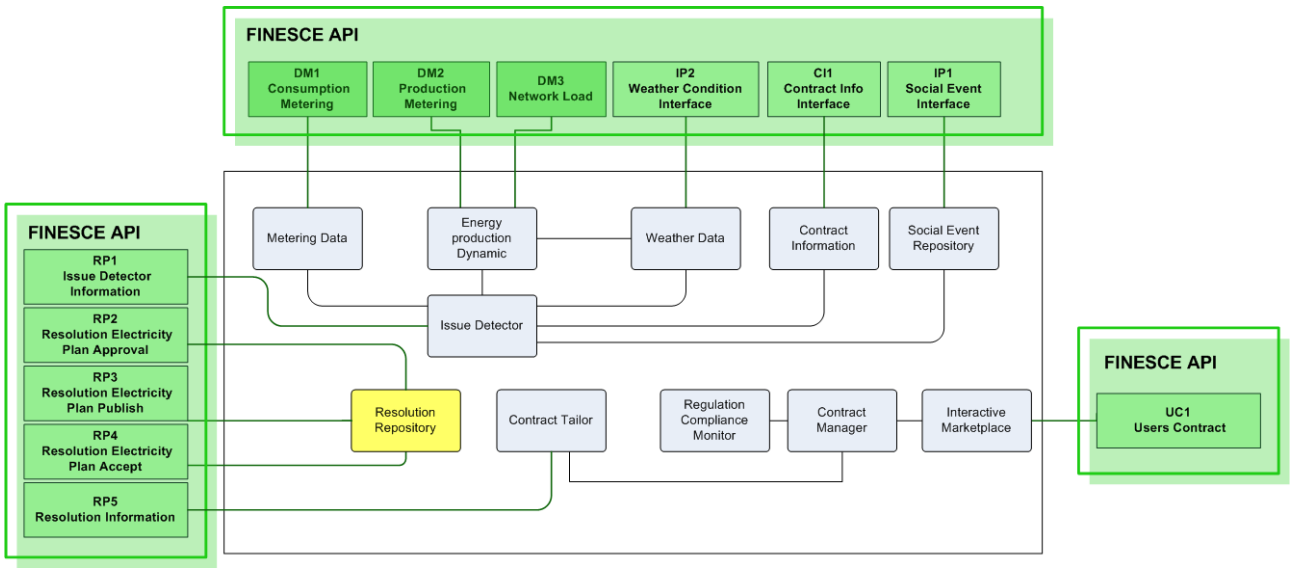

Figure 3: System and API

REFERENCES

[1] FINSENY – Future INternet for Smart ENergY - http://www.fi-ppp-finseny.eu/

[2] L. Briguglio, M. Nigrelli, F. Eichinger, J. Lucio Ruiz-Andino, V. Bella: "A Marketplace-Based Approach to Demand-Side Management in the Smart Grid". ERCIM News 92 (2013) 32-33. http://ercim-news.ercim.eu/images/stories/EN92/EN92-web.pdf

[3] L. Briguglio, F.Eichinger, M. Nigrelli, J. Lucio Ruiz-Andino: Marketplaces for Energy Demand-Side Management based on Future Internet Technology. Computing Research Repository (CORR) (2013) http://arxiv.org/abs/1304.5346

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[7] CEN-CENELEC-ETSI Smart Grid Coordination Group - Smart Grid Reference Architecture - http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group1_reference_architecture.pdf