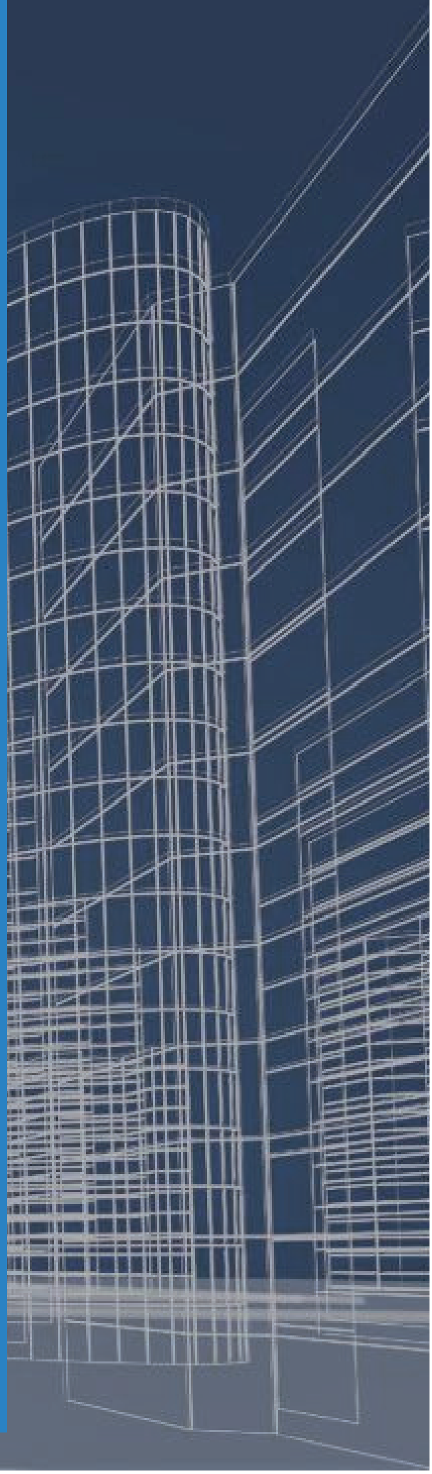
TABEDE

Towards buildings ready for Demand Response



Newsletter N1

March 2020

www.tabede.eu

This newsletter series briefly describes a few aspects of the TABEDE (H2020) project.
For the enclosed maiden voyage, you'll find an introduction to the project, as well as highlights on one of the project's key technologies (BMS-E) and one of its three pilots (Bergamo, Italy).

- Key facts about TABEDE
- Interview with the coordinator
- Technology spotlight (BMS-E)
- Pilot highlight (Bergamo)
- Publications and upcoming events

AT A GLANCE:
“Key facts about the TABEDE project”

01

Why do we need TABEDE?

To fully realize the European Demand Response (DR) potential, buildings must enter DR schemes and expose all available energy flexibility, including HVAC and thermal inertia, to the local aggregator. However, several limitations still need to be overcome (e.g. interoperability, cost, and functionality). Also, current Building Management Systems (BMS) do not support DR applications out of the box. Therefore, buildings need a 'BMS add-on', a bridge to the smart grid—independent from the building's BMS brand.

What is TABEDE exactly?

TABEDE is a 3-year H2020 project that's developing a DR-enabling technology that allows all buildings to integrate energy grid DR schemes through a low-cost extender for Building Management Systems (BMS) or as a standalone system, which is independent of communication standards and integrates innovative flexibility algorithms using a Multi-Agent Systems (MAS) framework. The TABEDE solution can make all building types DR ready without needing high investment cost. It will allow building managers to lower energy cost without affecting occupant comfort and energy providers to take advantage of the building's flexibility, maximize the usage of renewables, and ensure power quality.

TABEDE will also allow the integration and the control of new elements to the BMS and ensure the communication with the grid. It will provide an advanced control system, which will establish the best DR strategy to operate the connected electrical loads based on the profile received from the grid and the prediction of the renewables production (if needed and available) while respecting the occupant's comfort and the appliances' use constraints.

Where are TABEDE pilots?

The feasibility of the TABEDE solution is being validated though the technology deployment on three test sites (France, UK, and Italy) that are representative of EU conditions in terms of climate, building occupancy and energy infrastructure. TABEDE's impacts on the electric grid will also be modelled through a district-level simulation environment.

When will TABEDE be market-ready?

The TABEDE project will close in October 2020 at which point the integrated solution will reach an estimated TRL-7, and the technology will be commercially available pending further testing and development.

Who is developing TABEDE?

TABEDE has 7 partners, namely: ENGIE Impact[1] (Belgium) is the coordinator of the project and in charge of the electricity grid simulation; R2M Solution srl. (Italy) leads the dissemination, exploitation, and economic assessment activities; CEA the French Atomic and Alternative Energy Commission does the energy system & flexibility modelling, advance control and testing; Cardiff University (UK) establishes the simulation environment, forecasting algorithms and validation while leading one of the three pilots; CSEM, Centre Suisse d'Electronique et Microtechnique leads the development of the TABEDE Hardware and Software; and Schneider Electric Industries SAS (France) and Schneider Electric SPA (Italy) are the other two pilot site leaders leading tasks related to the integrated TABEDE solution.

1. ENGIE Impact is the new name for Tractebel's Advisory and Advanced Analytics Team.

EDITORIAL:

"Interview with ENGIE Impact, the TABEDE coordinator"

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ENGIE Impact

ENGIE Impact is a leading consultancy group in energy systems operation and analysis. Its worldwide multidisciplinary team provides public authorities, industrial firms and other clients with the regulatory, financial, economic, technical, and engineering expertise needed to complete major energy transition and sustainability projects.
ENGIE Impact's competencies extend across diverse fields such as policy and regulatory analysis, macroeconomics and market design, energy system consulting (power, gas, district heating/cooling, CO2, energy access), smart decentralised solutions, smart cities (telecom, mobility and energy interactions), renewable energy sources, energy efficiency (data centres, industrial, commercial and residential buildings) and energy storage systems (hydrogen, thermal, battery, etc).
ENGIE Impact has partnered with leading universities, utilities, research centers, industrial companies, and cities and territories in cutting edge collaborative R&D projects. Topics covered through these projects include: multi-fluid energy districts that exploit synergies between power, gas and heat; electricity market modeling with a focus on transmission and the distribution network; optimal integration of electric vehicles in distribution grids; and new planning and operational tools for distribution grids in the presence of high penetration of distributed energy resources.

Role of ENGIE Impact in the project

ENGIE Impact serves several important roles in TABEDE. First and foremost, it is the project leader, with responsibility for project management, all project-related reporting, the governance structure, and communication flows. Additionally, ENGIE Impact is the leader of Work Package 2, which establishes the detailed requirements and specifications of the TABEDE system. It is also contributing its expertise in grid modeling and simulation to a number of other tasks related to the project.

Expectations from TABEDE

If successful, TABEDE will unlock demand response potential across the European Union and beyond, while enabling energy efficiency improvement and renewable energy integration. Specifically, ENGIE Impact foresees the following key impacts resulting from the project:

- Enable the achievement of at least 30% energy savings in buildings
- Increase by 25% the penetration of renewable energy sources in the generation of electricity.
- Reduce/defer DSOs required investments in grid reinforcements and grid balancing by improving assets and network utilization.
- Open the energy markets to new participants

All these impacts are consistent with ENGIE Impact's business interests and aligned with societal goals to accelerate the clean energy transition.

TECHNOLOGY spotlight:

“BMS-E, the key to building-level flexibility”

03

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Building Management Systems (BMS) monitor and control the mechanical and electrical equipment found within a building. However, typically a BMS can't communicate with smart grid protocols to accommodate demand response-enabled energy flexibility.

The TABEDE (H2020) project has created an innovative product called the "BMS-E (BMS – Extender)" capable of unlocking building-level flexibility by accommodating most communication protocols available on the market, so it can be "plug and play" and quickly communicate with different devices/appliances, regardless of the manufacturer.

Figure 1 shows the "BMS-Extender" product created in the TABEDE project

The BMS-E enables buildings equipped with energy management systems (EMS) to integrate DR schemes through optimization and control of building-level consumption patterns based on grid signals. The BMS-E begins by collecting building-level appliance and equipment energy consumption data; user preferences entered by the building owner and/or occupant through the End-User Interface; and grid signals simulated by the DR Automated Server (DRAS). The Real-time Energy and Environmental Forecasting and Simulation (REEFS) system receives the energy consumption data from the BMS-E and uses it to produce 24-hour, day-ahead forecasts. The Agent Based Optimizer (ABO) receives the forecasts from REEFS and combines it with the DR signals and user preferences it receives from the BMS-E to create optimized load profiles. These are then sent back to the BMS-E. The BMS-E sends control signals to the appliances and equipment to match the optimization specified by ABO.

Deployment of the BMS-E is being validated on the three test sites (France, Italy and UK), namely: two residences (Bergamo, IT and Cardiff, UK) and one commercial/industrial 'smart and energy-efficient' building (Schneider's Grenoble, FR site), and as well at district scale through simulations.

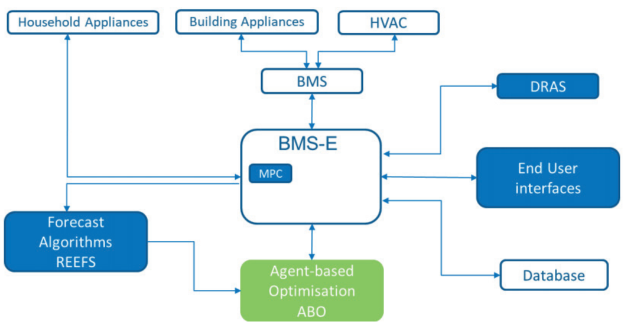

Figure 2 illustrates the process steps and roles of the various systems being tested in TABEDE

TEST SITE
Focus story:
“Schneider Electric demonstration in Bergamo”

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Schneider Electric SPA will test the TABEDE solution in a pilot case located in the province of Bergamo, northern Italy. The chosen demonstration site is a residential building, recently refurbished and with a very basic BMS system installed. The typology of this building, with no or limited technological solutions for monitoring installed, is one of the most common for the Italian and European residential market, therefore it is important to properly study it in the TABEDE project to ensure the largest replicability of the outcomes.

Through pilot testing, the project team will evaluate TABEDE's effectiveness in managing electricity consumption in the home in accordance with grid constraints, reduce energy bills, and increase renewable energy consumption. An important feature of this test site is the presence of an electric heat pump and water tank that together can act as a renewable energy storage device. When on-site solar PV production exceeds the home's needs, TABEDE will enable the excess energy to be used to heat and store the water for later use. In this way, the project team believes that TABEDE will allow the home to consume 100% of the solar energy it produces.

The technical room of the building is composed, at the beginning of the project, of a condensing boiler for hot water, a chiller for air conditioning and 4 pumps for each zone; additionally, 6.4 kWp PV plant is installed on the roof. As said, the building is equipped with a basic standalone controlling unit for the management of the boiler, the chiller and pumps for the water distribution. A standalone energy meter is installed as well.

The system already installed, together with the new equipment installed during TABEDE project, will be used to establish a base for the TABEDE extender to act as a user-friendly HMI for monitoring and control and a set of indoor and outdoor sensors. The addition of the TABEDE extender, will also allow to investigate users' behaviours and integrate strategies of DR.

ANNOUNCEMENTS:

"Publications & upcoming events"

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Please look out for the following scientific papers about TABEDE results:

- 2018, Going Beyond the Mean: Distributional Degree-day Base Temperatures for Building Energy Analytics Using Change Point Quantile Regression; Q Meng; M Mourshed; S Wei; IEEE Access
- 2019, A Multi-Agent Approach to Energy Optimisation for Demand-Response Ready Buildings; O Kem, F Ksontini (Book chapter to be published)
- 2020, Change-point multivariable quantile regression to explore effect of weather variables on building energy consumption and estimate base temperature range; Q Meng, C Xiong, M Mourshed, M Wu, X Ren, W Wang, Y Li, H Song; Sustainable Cities and Society, Elsevier Ltd
- 2020, Unlocking demand response at the building level: a distributed energy optimisation approach; Special issue of Applied Energy
- 2020, Handling demand-response requests at the building level: Modelling demand-response incentives and user discomfort; 12th International Conference on Applied Energy (ICAE 2020), Elsevier
- 2020, Energy distributed optimisation in dynamic environments: A multi-agent perspective; e-Energy 2020, ACM
- 2020, Weather data for building energy applications; Building and Environment, Elsevier
- 2020, Forecast and real-time weather dataset for energy simulation; Energy and Building, Elsevier
- 2020, Energy Metering and Environmental Monitoring in Buildings and Smart Grid; Energy and Building, Elsevier
- 2020, MPC and real-time management for HVAC energy systems; Energy and Building, Elsevier

To meet with TABEDE partners, please find us at the following upcoming events:

- 23-24 April 2020, ICAE 2020: 12th International Conference on Applied Energy (Tokyo, Japan)
- 1 – 10 May 2020, Architecture festival Turin (Torino, Italy)
- 24-29 May 2020, ENERGY 2020: 10th International Conf. on Smart Grids, Green Communications & IT Energy-aware Tech. (Venice, Italy)
- 3 – 5 June 2020, SP2020: Sustainable Places 2020 (Aix-Les-Bains, France)
- 16-18 June 2020, Industrial Efficiency 2020 – Decarbonise industry! (Gothenburg, Sweden)
- 22-26 June 2020, e-Energy 2020 (Melbourne, Australia)
- 23-25 June 2020, EUSEW Networking Village (Brussels, Belgium)
- 23-24 June 2020, ICCGE 2020: International Conf. on Clean and Green Energy (London, UK)
- 27-29 October 2020, European Utility Week (Milan, Italy)


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