



Towards buildings ready
for Demand Response

Newsletter Ed. n°4
April 2021

www.tabede.eu

Enclosed in the TABEDE Newsletter Edition N°4 is:

- Editorial by Andre De Fontaine, Engie Impact, TABEDE Project Coordinator
- Test Site: Industrial building in Grenoble, FR
- Test site: Smart Home in Bergamo, IT
- Methodology for validation and analysis of results
- Policy and standardization landscape
- Webinar recording: The TABEDE Solution for Demand Response: final results and lessons learned

EDITORIAL:

*By Andre de Fontaine,
ENGIE Impact,
TABEDE Project Coordinator*

01



Dear readers,

Welcome to the fourth and final edition of the TABEDE project newsletter. After 42 months of intense research, development, and deployment, the project team is pleased to share that it met its primary objectives of developing an interoperable demand response solution for all building types and validating the system at three test buildings and a simulated district.

Research results were summarized in the webinar "The TABEDE Solution for Demand Response: final results and lessons learned", held on 23 April 2021. For those of you that were unable to join, we invite you to view a recording, [available here](#). To summarize, TABEDE was demonstrated through on-site deployment and off-line simulations to reduce energy costs by 3 to 11% at the three test sites, with savings varying based on the specific configuration of flexible devices within the building and the availability of solar PV. Generally, savings were achieved through a mix of strategies, including shifting loads from times of high electricity prices to low, concentrating energy consumption during periods of peak PV availability, and optimizing heating management to reduce energy needs while maintaining occupancy comfort. Moreover, at a district level, we showed how TABEDE increases on-site solar PV utilization, thereby reducing energy costs for end users, cutting GHG emissions, and reducing the risk of PV curtailment. Additional details regarding TABEDE results and the methodology used to quantify energy cost savings are summarized further in this newsletter, along with a more thorough overview of the Bergamo, IT, and Grenoble, FR, test sites.

As we look ahead to the exploitation of our research results, we know that policy, regulatory and standardization measures will be critical to the growth of TABEDE and related Demand Response (DR) solutions. That is why we have engaged with policy and standardization bodies throughout the project period. In this newsletter, we present a few recommendations for how policymakers and standardization bodies can improve the overall regulatory landscape in order to speed the adoption of DR and building-level flexibility technologies and solutions.

While the TABEDE project will soon end, we know much work remains to further advance and deploy DR solutions to more rapidly usher in the clean energy future we aspire towards. To that end, we will maintain our on-line community through LinkedIn past the project end date, and invite you all to join the group "[Flexibility, from demand response in buildings to renewable energy communities](#)" so that we can continue to share news and updates on the critical topic of DR and building flexibility.

Sincerely,

Andre de Fontaine, ENGIE Impact
Project Coordinator

TEST SITE:

TABEDE SOLUTION FOR
ENERGY EFFICIENCY IN AN
INDUSTRIAL BUILDING IN
GRENOBLE, FR

02





How do you reduce the costs of energy use, without impacting comfort or convenience? In other words, how do you save money while maintaining your desired level of indoor temperature, lighting and appliance use?

The technology developed within the TABEDE project is strongly innovative in terms of energy optimization and flexibility for residential, commercial and industrial buildings. Schneider Electric Industries SAS, partner of the project, performed tasks related to the integration of TABEDE solution, ensuring that the data necessary to control and optimise the energy consumption could be acquired and provided to the TABEDE system; Schneider also assisted the solution providers during the off-line and on-line (see the explanation of the impact assessment methodology below) testing, contributing also to the analysis of the results.

Grenoble test site: Industrial Campus in Grenoble, FR

As a commercial/industrial building, the Grenoble site differs in important ways from the two residential test sites. Such differences provided a diversification of the validation activities and offered the opportunity to demonstrate how the TABEDE technology can serve also larger buildings, with different systems and devices and different energy consumption patterns.

The selected building is the T11, which is part of the Green Ovalley project for the optimisation of the number of buildings of the Schneider Electric Industry/Energy Business Research and Development offices in the Grenoble area, at the 38TEC site.

The T11 is a 11000 m² office building, distributed on 3 floors, with 600 occupants and it includes a restaurant, a cafeteria, several meeting rooms. Building T11 has been planned to be a high-efficiency building, producing renewable energy from solar panels and seeking to provide a high level of comfort for the operators who work in it. [Read more about it here.](#)

Grenoble building is therefore bigger than Cardiff and Bergamo, with multiple zones, and a wider and more complex range of energyconsuming devices.

For the TABEDE deployment, we focused on heating and someplugloads (laptop PCs) as the sources of controllable, flexible loads.

The expected benefits of TABEDE for commercial buildings

For the TABEDE deployment, we focused on heating and some plug loads (laptop PCs) as the sources of controllable, flexible loads. Three use cases, of incremental complexity, have been identified to test the functioning of the system and the impacts that TABEDE system can provide on this type of building:

- **Use Case 1:** Connecting TABEDE with the Grenoble BMS

Use Case 1 is aimed at validating TABEDE's applicability to a large commercial/industrial building. The goal is to test the full TABEDE communication loop at the test site, with control signals sent from the BMS-E to the Grenoble BMS, through Schneider's open, cybersecure database. This use case resembles Use Case 1 from the Cardiff site, but applied to a large commercial/industrial building.

The Key Performance Indicators for this use case are more qualitative in nature: (1) successful data flows, demonstrated by each TABEDE component receiving and relaying appropriate information to enable full system performance; and (2) equipment controllability, demonstrated by the ability of the Grenoble BMS to receive, understand, and then deploy the TABEDE control signals to the site's energy-using equipment.

- **Use Case 2:** Building Energy Optimization with Differentiated Tariffs

In Use Case 2, the goal is to test TABEDE's ability to optimise energy consumption and generate cost savings from differentiated electricity tariffs. Specifically, Schneider's expectation was to validate TABEDE's ability to shift flexible loads to lower-price periods while respecting user preferences and business priorities.

The Key Performance Indicator for Use Case 2 is 5-10% energy cost savings achieved while respecting business-driven user preferences.

- **Use Case 3:** Load Shifting from Explicit Demand Response Requests

Use Case 3 is similar to Use Case 2, but instead of time of use pricing, an explicit demand response request has been introduced. This case seeks to validate the TABEDE system's ability to shift loads in response to a specific request from the electric grid and to quantify the resulting cost savings.

The Key Performance Indicators for Use Case 3 are: (1) total flexibility provided by the building to the grid, measured in kwh shifted; and (2) the associated revenue generated by the building from responding to the DR request.

More on SCHNEIDER ELECTRIC - FRANCE

Schneider Electric is a global specialist in energy management and integrated solutions across multiple market segments, including leadership positions in energy and infrastructure, industrial processes, building automation and data centers/networks, as well as a broad presence in residential applications. Schneider Electric will perform tasks related to the integration of TABEDE solution and act as demo site manager in France.

TEST SITE:
*TABEDE SOLUTION
FOR ENERGY EFFICIENCY
IN A RESIDENTIAL BUILDING
IN BERGAMO, ITALY*

03





How do you reduce the costs of energy use, without impacting comfort or convenience? In other words, how do you save money while maintaining your desired level of indoor temperature, lighting and appliance use?

The building automation system developed in Italian test site enhances the smartness of the house. Lights, heating and cooling and energy management are improved, and everything is under control through an application and ad-hoc graphical pages. The installation of an electric heat pump allows to optimize the use of the energy produced by renewable sources such as PV, therefore decreasing cost for heating and cooling. Smart Appliances can be activated when more energy is available on-site.

TABEDE gives more access to demand-response programs for residential customers

TABEDE prepared the Italian test site to be ready for demand response schemes. House owners can set their preferences and TABEDE automatically optimized the usage of energy loads taking in consideration production from renewable sources, cost of energy and other constraints, such as the maximum peak load that is largely used in countries like Italy.

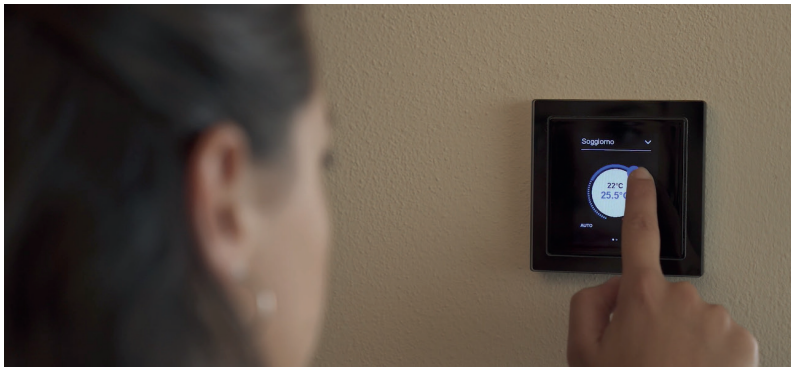
Bergamo test site: a Villa with 2 apartments and 1 office.

The Italian test site is located in Grumello del Monte, close to Bergamo, in the North of Italy. The city has a humid subtropical climate, with cold winters and hot summers. The apartments of the villa are occupied by 2 families of 4 people each and in the office are working approximately 5 people.



The expected benefits of TABEDE for residential buildings

TABEDE ensures that energy is used at its best. More self-consumption of solar energy translates to decreased costs in the electricity bill and decrease of general CO2 emissions. In addition the "smartification" of the building translated in better user experience for occupants: lights can be controlled with voice while set points of heating and cooling can be set with intuitive and nice touch screens. Occupants have the possibility to monitor consumption of the building and production of photovoltaic through a tablet or a PC.



More on SCHNEIDER ELECTRIC - ITALY

Schneider Electric is a global specialist in energy management with operations in more than 100 countries, and integrated solutions across multiple market segments, including leadership positions in energy and infrastructure, industrial processes, building automation and data centres/networks, as well as a broad presence in residential applications. Schneider worldwide leading position is to make energy: safe, with power and control; reliable, with critical power and cooling; efficient, with energy efficiency; productive, with industrial, building and home automation; green, with renewable energy solutions. The subsidiary in Italy offers products, equipment and services for ICT solutions for infrastructures, building & residential markets, and Industry.

METHODOLOGY FOR VALIDATION AND ANALYSIS OF RESULTS

04



The TABEDE solution has been tested and evaluated in two different ways:

1. By deploying it in the three real-world test site locations—two residential buildings (Cardiff, presented in Newsletter n3 and Bergamo, presented in this Newsletter) and one tertiary building (Grenoble test site, presented in this Newsletter). Each Test site identified a series of use cases, aimed at validating the correct functioning of the TABEDE system and its impact in terms of energy cost savings, increased flexibility, and increased renewable energy consumption.

2. Through a Simulation Environment, simulating TABEDE's behaviour and impacts when scaled to a district level. In this case, the district is composed of 66 houses and impacts have been assessed in terms of both aggregate savings across the homes as well as grid-level impacts such as loss prevention and congestion management.

Here, we will provide a short description of the methodology applied to make the assessment of TABEDE system's impact in the test sites (case 1 above) and presentation of the main results.

In the real test sites, the goal of the assessment was to evaluate TABEDE system's impact in terms of improved flexibility, reduced energy costs, and increased utilisation of renewable electricity onsite. Additionally, a qualitative assessment was performed to understand user satisfaction and involvement with the TABEDE solution.

A similar technoeconomic assessment was performed in the context of the simulation environment, but here, additional grid-level key performance indicators were also calculated, such as TABEDE's impacts on minimising RES curtailment, cutting CO2 emissions, limiting energy losses, and reducing peak demand.

Assessment methodology

The applied methodology consisted in a series of "off-site" and "on-site" testing activities.

The "off-site testing" consisted in creating simulations without the execution of the commands at building level: These simulations allowed to test the interaction between the TABEDE modules in a way that does not impact occupant comfort or convenience and to observe how TABEDE's optimisation results vary in response to different energy tariffs, varying levels of RES production, and the presence of different flexible devices and energy storage

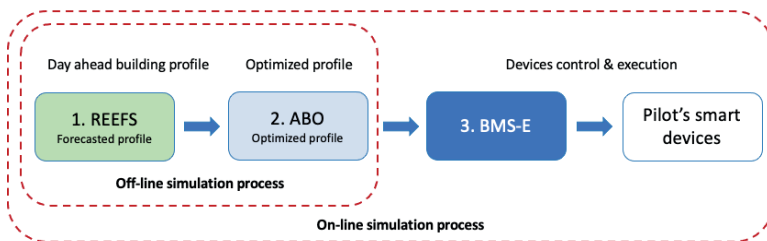
mechanisms. They allow also to calculate Key Performance Indicators, such as energy cost savings and increased PV onsite utilisation, under different circumstances.

To be clear, these processes include all aspects of the TABEDE loop, as illustrated in the figure below, only without the final connection the BMS-E with the building BMS and the onsite devices control.

Concretely, the way we calculate energy impacts in the off-line simulations is by comparing the first iteration of the building's forecasted energy consumption (provided by REEFS) with the first iteration of the optimised energy consumption (provided by ABO), with the forecast serving as the baseline, representing the expected energy consumption in the building in the absence of TABEDE. The ABO profile then shows the change in energy consumption after it has been optimised by TABEDE.

In the "on-line" testing, the TABEDE system was deployed onsite for at least one day at each of the three test site locations. In this testing, the calculation of key performance indicators follow a different approach based to the real data measured during a day of TABEDE execution and compared with a baseline represented by a common day without TABEDE interactions

The scope was to validate the "off-line simulations" and demonstrate that TABEDE is able to effectively work in a real environment, connecting the building BMSs and working in synergy with them. It means that during the tests, the signals elaborated by TABEDE have been sent to the local BMS and executed in the flexible devices.



TABEDE simulation methodology

Results of Impact assessment in the Test Sites

The assessment (off-line and on-line) conducted in Cardiff considered, in addition to the fixed load (uncontrolled devices), the usage of: Washing Machine, Air purifier and Robotic Vacuum Cleaner

The Results of the off-line simulations are:

- Export energy reduced by 100%
- Self-consumption optimized 13%
- Cost saving: 6% of the daily cost

During the online testing, the technoeconomic assessment provided these results:

- TABEDE increase PV penetration by around 40%.
- The export is increased by 32.4% (higher PV production in the test day).
- Energy generated on site and used by flexible loads increase from 0.2% to 20%
- The TABEDE system demonstrated high stability, working with no interruption or fault, for the whole (24 hours) test duration

The assessment of the off-line and on-line testing conducted in Bergamo considered, in addition to the fixed load (uncontrolled devices), the usage of: Washing Machine, Dish washer and Robotic Vacuum Cleaner

The Results of the off-line simulations are:

- Cost saving: 3% of the daily cost

During the online testing, the technoeconomic assessment provided these results:

- TABEDE increases the flexibility in the use of energy from PV until the 50.8%.
- The export is reduced by 13% (energy stored in the thermal puffer)
- The optimization generates 10% of increase in the self-consumption

The Grenoble test site, as mentioned above, differs from the other two ones as for the typology of building and therefore also in the devices that can be controlled. In that test site, the flexibility is provided by the plug loads and the heating system. TABEDE simulated the control of DR signals sending limits of import from the grid at building level and in consequence limiting the flexible loads (plug loads)

The off-line simulation produced also in this test site encouraging results:

- All energy produce by PV is consumed onsite
- Heating energy is reduced by 37%
- Cost saving: 11% of the daily cost reduction by ToU exploitation

The results from the DR simulation are positive and TABEDE demonstrated to be able to manage signal from aggregators or DSO. The limits of import has been respected for the 94% of the simulation period apart from short intervals where the fixed loads, not controlled by TABEDE, exceeded the imposed limits.

*POLICY AND
STANDARDIZATION
LANDSCAPE*

05



As part of the TABEDE project, test sites were deployed to understand the level of success that TABEDE can achieve as well as the limitations surrounding the project. In that context, existing policies, regulations and standards that would impact eventual market adoption of TABEDE and Demand Response from buildings throughout Europe were explored to better understand the extent of the limitations from a market readiness perspective.

Through systematic research and engagement with key stakeholders, coupled with our practical experience, we formed the basis of the regulatory and standardization recommendations. Those recommendations were both informed by and shared with a set of key stakeholders that we consulted with over the course of the project, such as The European Commission's Directorate General for Energy and The World Green Building Council.

Policy drivers are quite essential in facilitating the adoption of demand response and enabling market solutions, such as the TABEDE BMS-Extender. Currently, several existing directives and regulations at the EU-level set a nurturing environment for the market propagation of smart buildings and their participation in DR. To take DR to the next level, however, member states should continue to transpose these directives into local regulations

To support market adoption of solutions like TABEDE, we recommend that regulators and policy makers 1) ensure adequate remuneration for end users to participate in DR schemes; 2) maintain and increase policy support for distributed energy resources and energy efficiency technologies that drive building level flexibility; and 3) facilitate business model innovation that allows distribution system operators to access the benefits of building-level flexibility.

Building rating systems, labels and certifications could also be useful mechanisms to make DR more tangible for a broader audience of non-energy experts and, in turn, lead to a wider adoption of flexibility strategies. They establish clear benchmarks that building owners, architects, and engineers can aim for and they allow for differentiation, especially in the commercial building market, as companies compete to demonstrate their sustainability credentials. One new rating system, the European Commission's Smart Readiness Indicator for buildings, directly speaks to a building's ability to adjust energy consumption in accordance with electricity price signals. We recommend stronger incentives to ensure wide market adoption of the SRI. At the same time, we propose that other green building rating systems emphasize DR and building-level flexibility to a greater extent within their frameworks.

When it comes to communication standards, they have special significance as they address the needs for interconnection and interoperability which are particularly important for open networks. Having uniform and open standards would allow mobile users to add a diverse set of equipment and services within the building management system. It would also highly reduce technical complexities associated with the integration of new equipment to existing systems. This would in turn reduce costs and encourage upgrades and additions to existing systems and enable new features and services such as Demand Response.

Additional work on communication standards and protocols is needed to help advance the market for DR-enabled building management systems. Our recommendations concern harmonizing the implementation of standards and protocols, creating interoperability testing networks to allow developers and product manufacturers to more easily design their solutions around prevailing standards, and establishing within Europe a common standard to govern the communication of demand response signals from the grid to the building.

WEBINAR:
*THE TABEDE SOLUTION
FOR DEMAND RESPONSE:
FINAL RESULTS AND
LESSONS LEARNED*

06



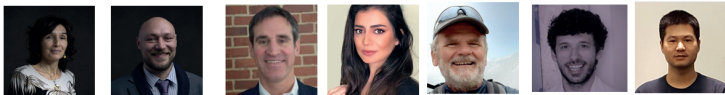
In the first two TABEDE webinars, consortium partners introduced the concept of demand response and how it can be implemented, using the TABEDE BMS-Extender solution both in buildings equipped with Building Management System (BMS), as well where no BMS is installed. In the last webinar, attendees have been presented the 3 TABEDE Test sites: a smart house (in Cardiff, UK), a residential building (in Bergamo – Italy) and an industrial office building (in Grenoble – France) to see how the BMS-Extender has been deployed and the impacts of TABEDE have been assessed. Additionally, the consortium provided some recommendations to standardization and regulatory bodies that could empower the widespread adoption of demand response tools.



TABEDE Webinar:

“The TABEDE Solution for Demand Response: results and lessons learnt at the end of the project”

23rd April 2021



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AGENDA:

11h00: "Intro" (Eva Coscia, R2M Solution)

11h05: "TABEDE: goals and solutions" (Andre de Fontaine, Engie Impact)

11h20: "The Cardiff smart home test site" (Kui Weng, Cardiff Univ.)

11h35: "The Grenoble industrial building" (Henri Obara, Schneider France)

11h50: "The Bergamo residential building test site" (Francesco Martinelli, Schneider Italy)

12h05: "Policy & standardisation landscape" (Taline Dekermenjian, Engie Impact)

12h20: "Questions and answers" (monitored by Zia Lennard, R2M Solution)

12h30: "Thanks and closure" (Eva Coscia, R2M Solution)

The final TABEDE webinar recording and presented slides are now available on the media page of the [project website](#) and below:

[Webinar recording](#)

[View the presented slides](#)



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