

A KNOWLEDGE AND COMMUNICATION PLATFORM INTEGRATING A BUILT ENVIRONMENT TOOL TO FOSTER COMMUNITY DIALOGUE ON THE TRANSITION TO A LOW CARBON ENERGY SYSTEM

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ABSTRACT

This paper presents the implementation of the ENTRUST Knowledge and Communication Platform, a set of prototype tools aimed at disseminating and sharing of knowledge within communities, and promoting dialogue on energy efficiency and the transition to a low carbon energy system.

The core of this set of tools is the user platform, through which users can access knowledge that has been collected and generated within the ENTRUST project, and share it for discussion within their community. The user platform, which was developed both as a smartphone app and a website, includes gamification features to foster engagement and productive conversations among users.

A companion prototype simulation tool, the Built Environment Tool (BET), was developed to investigate the impact of potential energy interventions in communities, with a particular focus on electricity demand, supply, storage and distribution. The BET has been trialled by application to the University College Cork community, to evaluate the impact of interventions such as improved building efficiency and the inclusion of renewable DER on CO₂ emissions and operating costs.

INTRODUCTION

Europe is on the verge of an energy transition to a low carbon system, which poses complex challenges at the intersection of social and technological transformations. Within this context, the Horizon2020 project Energy System Transition Through Stakeholder Activation, Education and Skills Development (ENTRUST) project carried out a broad multidisciplinary research based on the concept of energy citizenship, with the aim to ascertain energy-related practices and attitudes in European communities. The final aim was to develop transition pathways, and methods and tools to stimulate engagement to foster the adoption of new technologies at community level.

This paper presents a trial implementation of one of these solutions, the Knowledge and Communication Platform (KCP). The KCP is a set of prototype tools that include a user platform developed as a smartphone app and a dynamic website and a Built Environment Tool desktop application (BET) that can be used to simulate scenarios at community level and post results to the user platform. The KCP allows users to create an online account via the smartphone app or the dynamic website, through which they can interact within their community and across other communities in the platform. User capabilities offered in the platform are presented in the following sections of the paper, focussing first on the core concept, then providing an overview of the knowledgebase and community sections of the platform. The underlying methodology of the platform was presented in a previous paper by the authors [Oates et al, 2017].

Through the same account, users can log in to the platform from the BET, explore energy scenarios in their community, and post community scenario results to their community. A pilot application of the BET to one of the ENTRUST communities was carried out under the project, and is presented in the last section of this paper to discuss the integration of energy scenarios within the social networking framework of the KCP.

USER PLATFORM CONCEPT AND IMPLEMENTATION

The main aim of the ENTRUST Knowledge and Communication Platform is to provide a place for meaningful interaction within communities of practice in the energy transition. Research carried out within the ENTRUST project showed that citizens seek trustworthy knowledge that is relevant to their community [Dunphy et al, 2017]; and that while people are willing to transition to a sustainable energy system, there is a widespread feeling that the general population will have little control on how this transition will be enacted [Dunphy, Revez, Gaffney and Lennon, 2017].

As such, the user platform was designed to collect curated resources developed by the ENTRUST partners on topics that were highlighted as relevant during consultation with the communities; and furthermore, to allow citizens within the communities to discuss these resources with other members of their community within the social area of the platform. In parallel, the Built Environment Tool supports the development of community-specific insights, as it allows users to investigate the impact of energy interventions in their community (including the installation of renewables) without requiring

actual data from the local built environment. As such, the BET was designed to be accessible for users who do not have domain-specific knowledge. The connection of the BET to the online user platform intends to bring back insights gained by the exploration of the local built environment to the online social area, closing the information loop and allowing people to explore energy transition scenarios within their community.

Furthermore, the entire platform was developed as a multi-language solution to ensure broad applicability within the communities of the ENTRUST project and beyond. The languages offered are English, Italian, Catalan, French and Spanish. The multi-language features in the online community section can translate from multiple languages in the user's language of choice. This multi-translate option allows users to browse discussions in other communities and engage across communities without language hurdles, fostering exchange of experiences.

ONLINE PLATFORM CAPABILITIES AND FUTURE STEPS

As mentioned in the previous section, the online platform includes content developed by the ENTRUST partners, made available to user through categories and tags that allow filtering by content (Figure 1, left). The aim of the knowledge base section is to make a curated selection of resources available to community users across languages for discussion and engagement within their community or to external social networks. Shared knowledgebase resources appear in the user's community feed (Figure 1, centre). Within the community feed, users can interact with other members of their community or comment on posts made in other communities.

Beyond the usual reply, edit and delete capabilities, the discussion features of the online platform also allow to up/down vote others' posts and to report them for immediate removal and review by platform managers. In keeping with a gamification framework [Kim, 2015], a point and badge system was devised to reward users for positive interaction and increase engagement (Figure 1, right).

In particular, the system awards points to users for sharing contents, commenting, and posting in the community; furthermore, upvotes from other users award points, while downvotes reduce a user's score. As users receive points, they gain levels, which are shown in their profile in the user interface; the total points are also used to create a platform leaderboard, which shows the users with the most points gained. The influence of other users' up and down votes on scores was envisaged as a way to allow community self-moderation and recognise organically the community champions. Additionally, as users reach certain point thresholds they acquire levels and the related badges. Badges are also awarded after a specific number of events of a certain type occur (e.g. new posts created). These badges allow to identify users that are community leaders on specific aspects, and are shown in a dedicated collection area in the user profile.

Figure 1 Knowledgebase (left); filtered community feed (centre); gamification badges (right)

The online user platform described above was developed according to the outputs of the ENTRUST research, which did not include testing activities in its scope; after the project end, the platform is now available for pilot implementation within communities, to evaluate its functionalities in real case studies. While these activities have not yet started, testing priorities have already been identified: in particular, the gamification and community self-moderation tools are of highest interest for further large scale testing, in order to optimise their functioning to maximise user engagement and minimise the need for a structured moderation role, empowering the community to self-regulate according to its specificities.

To carry out these tests, both metrics and confidential user feedback would be used to identify the features that need adjustments. For example, should metrics indicate that a user receiving a high number of upvotes is not in a high position of the leaderboard, and a sizable distribution of user feedback within the community indicate the user as a community champion, the point system could be adjusted to reflect better the outcomes of the polling from the community. Conversely, complex situations could appear, such as users who receive a significant number of downvotes and have several reported posts, while still being prominent in the leaderboard. In this case, user feedback would be needed to enrich the understanding of the dynamics at play: users could be occasionally prompted to provide information on the interaction action they just took (up/down vote, report) to supply an explanatory narrative which would in turn inform the mechanics adjustments.

The efficacy of these adjustments would be measured by tracking the variations in common analytics metrics such as time on site and repeat visits, plus specific metrics such as the average number of comments, replies, and votes provided by each user, as a direct measure of the increased or reduced engagement on the platform; direct feedback from pop-up surveys to the users would also be required to estimate whether the adjustments put in place met the user expectations and to gather unstructured suggestions.

BUILT ENVIRONMENT TOOL PRINCIPLES AND TESTING

The BET is a desktop software prototype that allows to define via a streamlined workflow the current status of the urban area, and to explore a series of potential interventions to evaluate their impact on the local electricity network. The BET was developed as a high-level design tool, allowing simple modelling of district electricity distribution, relying on benchmark data, in order to carry out quick quantitative estimations for energy scenarios in a community.

The development of benchmarks was fundamental to allow the use of the BET by users without domain-specific knowledge, as it removes the need to be aware of energy performance values and input their values within the community model. Instead, the benchmarks allow the user to simply assign a building type to each building item within the community model, allowing to choose across a broad range of typologies including apartments, offices, schools, universities, single family homes, hospitals and others. The underlying dataset was collated from several resources including over 250,000 buildings in the UK [GOV.UK 2018].

While benchmarks provide maximum user ease of use, by their nature they do not portray exactly the specific performances of the actual buildings. However, the results are considered to be valuable to users in that they show a potential for interventions at community level that can be explored in later stages through a detailed technical design.

Parallel to the assignment of benchmarks, users can apply interventions to the community model. These range from building level design options to local or centralised Distributed Energy Resources (DER). In particular, the building level options allow the user to assign a qualitative evaluation to the overall performance of the building, and to assign simple design interventions such as increasing the equipment efficiency or enacting demand-shift strategies. In keeping with the benchmarking approach outlined above, both building options and DER are modelled within the BET and do not require the user to input specific performance values.

The underlying simulation engine combines the energy loads, generation, consumption and storage both at building and DER level, and presents detailed and aggregated results on energy, CO₂ emissions and costs [Bennett et al, 2018]. The results obtained can then be shared back to the user platform to foster a conversation about potential technologies and strategies with a positive impact on the community.

To assess the functionalities of the BET and its underlying approach, a test case was carried out on the University College Cork (UCC) campus, involving 37 buildings with mixed uses (residential and university buildings). The appropriate benchmarks were assigned accordingly to model the as-is performance of the campus, obtaining energy demand profiles for each building and for the campus for one year (2017). In the test case, five scenarios were developed, to estimate the current

performance of the area and evaluate the performance improvement after a mix of interventions, such as building equipment optimisation, deep renovation, and the extensive addition of PV panels to the roofs of each building. The development of the baseline model and scenarios, including results, took just a few hours of work, providing a first confirmation of the ease of use principle that underscored the software design.

Through the test analysis, it was possible to estimate that PV panels installed on each building could supply around 4% of the total energy demand over the year when paired with energy efficiency improvements (an intervention with low cost and low impact on the users), with a reduction of indirect CO₂ emissions for electricity of approximately 25%. On the other hand, the overall energy supply contribution provided by the PV panels would rise above 24% in the event of deep renovation, with a total yearly export of over 800 kWh of electricity to the grid and a significant reduction of indirect CO₂ emissions for electricity, nearing 90%. These results appear intuitively aligned with the specific use of the buildings, as universities have hours of operation that are well matched with the peaks of solar energy production.

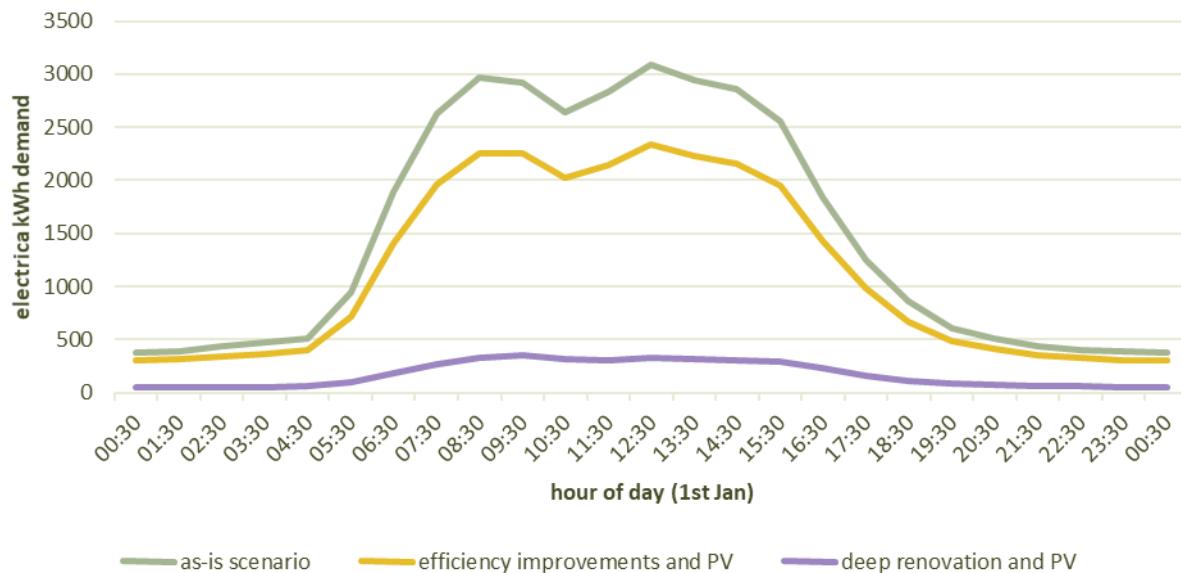


Figure 2 Comparison of energy interventions in the test case (sample daily energy demand)

A complementary financial analysis based on parametric costs showed that while the intervention costs would at minimum double in the deep renovation, its payback time would be just over 3 years, while the intermediate scenario with efficiency improvements and PV panels would pay back within 5 years [Bennett et al, 2018].

CONCLUSION

The present paper discussed the prototype implementation of a Knowledge and Communication Platform, composed by an online area for knowledge sharing and interaction, connected to a Built Environment Tool, in an aim to expand engagement opportunities with the energy system across communities of practice and demonstrate potential structures for meaningful engagement beyond the top-down/bottom-up paradigm divide.

The presented approach shows promise, however it requires further experimentation and refinement to validate underlying assumptions that define the user interaction patterns throughout the KCP. With this in mind, the platform was designed with a scalable infrastructure and interaction features which can be adjusted over the course of future testing activities.

In particular, given the overall aim of the KCP to support users to gain meaningful understanding of the energy transition in their community, the authors consider of particular interest further testing of the BET as a tool for rapid exploration of energy scenarios within communities. Future steps in this direction include additional testing in further contexts and validation against actual energy patterns in communities that have adopted large scale DER interventions, to refine the profiles that underscore the modelling approach.

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