Amsterdam University
of Applied Sciences

me²

INTEGRATED SMART CITY MOBILITY AND ENERGY PLATFORM

COLOPHON

Publication
Amsterdam University of Applied Sciences
Faculty of Technology
Urban Technology
www.hva.nl/urbantechnology

Contributors
Claudia Antunes
René Bohnsack
Luis Caridade
Vera Gregorio
Jeroen Groot
Robert van den Hoed
Sana Khan
Luisa Matos
Rui Mendes
André Oliveira
Natalie Prüggler
Wolfgang Prüggler
Milan Tamis
José Teixeira
Halldora Thorsdottir

Editing
Metamorfose

Images
AUAS
MediaPrimer
MME
VPS

URBAN EUROPE

This project was supported by the ERA-NET Cofund Smart Cities and Communities (ENSCC) call of JPI Urban Europe and funded by the national funding agencies NWO (the Netherlands), FCT (Portugal) and FFG (Austria).

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BRINGING TOGETHER ENERGY USERS IN AN ONLINE, URBAN COMMUNITY

Creating awareness of energy consumption patterns is the first step in improving those patterns. Using smart grid technology, awareness of household and electric vehicle consumption can be put in context with solar panel generation. Combined with social incentives and gamification in an online platform, consumers are motivated to collectively reduce peak-hour consumption.

With growing consensus on the need to reduce carbon emissions, energy efficiency and electricity play a key role in the way forward. Electric vehicles are beneficial for air quality in cities, but at the same time add to the energy consumption of households during peak hours of the already strained electrical grid. Individual households have the potential to be very flexible when it comes to the amount and timing of their electricity usage. The best and most effective example of flexibility is the smart charging of an electric vehicle: the car stands connected in front of your house the whole night, could it be enough to charge it in the morning just before you need it again instead of at six o'clock in the evening?

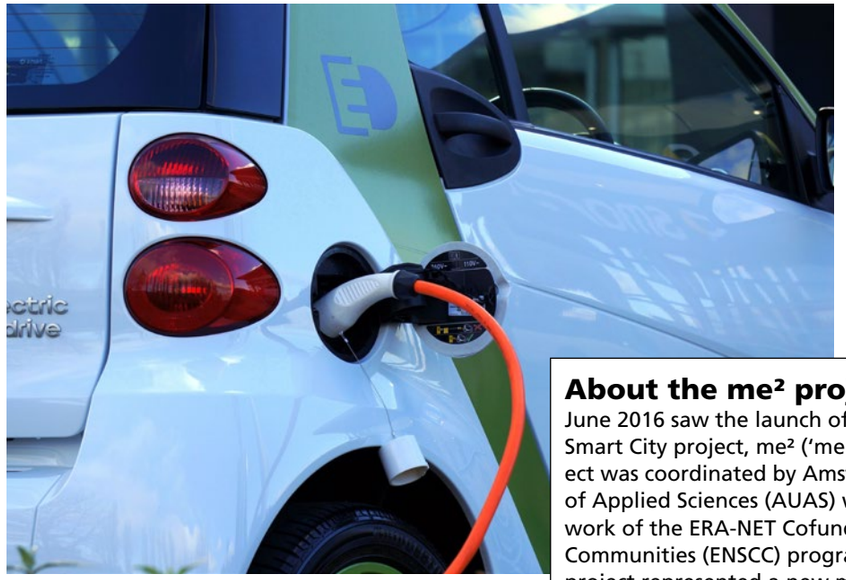
In order to change their behaviour, consumers need to be made aware of the potential flexibility. Collectively, a group of consumers, individual households, electric vehicle drivers and even small businesses can achieve a more significant change. Bringing them together in an online, urban community will allow them to gain awareness, inspiration and advice as a collective on how to improve their energy behaviour.

The Smart City Aggregator me² is designed to motivate the community to reduce and shift their electricity consumption through gamified incentives at the front end, the Community Layer of the me² platform. Community members can seek added efficiency through personal recommendations for technological innovation in the Market². Behind the scenes, a community manager or energy providers can propose specific changes in consumption patterns (e.g. allowing delayed EV charging), thus employing demand-side management, and reward the consumer's demand response by making use of dynamic market prices. In addition to yielding lower costs, the collective savings in energy can reduce the need for investment in the grid infrastructure and energy production.

Results

The me² project's researchers investigated which incentives are effective in activating demand response and maintaining user engagement, both through literature research and through testing those incentives in two cultural contexts involving very different communities. The main results of the project are as follows:

- A tested and operational Smart City Aggregator platform, comprised of a pilot validated B2C Community Layer – a gamified and informative web platform and app, a Market² connecting the communities with energy-related products and services and a B2B interface for a prospective community manager or energy providers.
- Two pilots in different settings. The first one, in Lisbon, collected the experiences of a community of mainly municipality employees and focused on household energy awareness and reduction. In the second pilot, residents of the greater Amsterdam area brought together their household, EV and solar energy on the me² community platform. The energy needs of the two communities were very different from each other, as was the degree of experience with energy-efficient practices. Both groups provided feedback, which was fed into the design and implementation process.
- Increased understanding and integration of e-mobility and electricity behaviour. Mechanisms that were developed include direct feedback messages in a culturally appropriate theme, gamification using energy data, smart algorithms and environmental awareness as well as community-building to facilitate social comparison and information exchange.
- More than half of the Lisbon pilot participants achieved a more than 10% smoothened load curve through increased awareness and direct, gamified peak-shaving incentives. Dutch participants reduced their EV charging during peak hours by more than 30% in a community challenge. The potential for lowered energy costs for consumers was calculated using electricity market prices. A third of the Portuguese users could save more than 10% on household energy costs by following the energy reduction measures they carried out in the pilot, assuming dynamic prices. Dutch households' consumption did not decrease and thus neither did their costs.
- A policy report was written to reflect on European legislation and its outlook for aggregators like me². Strategies such as dynamic pricing for smart charging are not yet a regulatory option. By cooperating with incumbent DSOs, e.g. in the form of a licensable platform, Smart City Aggregators could add value to data and hardware facilities.
- A realistic business plan analysis was conducted to calculate the potential amount of target users and estimate the percentage of the market that could be covered. Several risk factors, such as long-term user engagement, were identified in a case study.



About the me² project

June 2016 saw the launch of the European Smart City project, me² ('me square'). The project was coordinated by Amsterdam University of Applied Sciences (AUAS) within the framework of the ERA-NET Cofund Smart Cities and Communities (ENSCC) programme. The me² project represented a new marketplace for urban players, in which a community of electric vehicle (EV) users and smart meter (SM) owners were brought together by means of a local urban online community. The combination of these technologies in a community allows the integration of mobility with electricity, the balancing of the grid, the reduction of electricity costs, and the encouragement of a feeling of local belonging. Me² enables urban demand-side management in that it aims to modify consumer demand for energy, for example in the use of less energy during peak hours in an urban community.

Relevant partners: AUAS and Católica

INCENTIVES BASED ON CULTURAL NORMS AND PERSONAL ENERGY DATA

At the beginning of the project, Universidade Católica Portuguesa (Católica) and AUAS assessed the requirements, barriers to and potential of the me² system. This research laid the foundations for the platform design, algorithm and incentives deployed in the field pilots as well as the business plan.

What motivates people to change their energy consumption? Which societal factors contribute to new energy practices? To prepare the ground for answering these questions, a consumer analysis was carried out before the actual testing of the me² platform in the two project pilots. This combination of literature study and surveys, design requirements and user-targeted algorithms was an essential part of the pre-implementation work. A white book report summarising the main findings of this work was made available on the project website. Recommendations for the different phases of user interaction were given, along with an evaluation of the effects of various types of incentives in the cross-cultural context of the two project testing grounds, Portugal and the Netherlands. Finally, a user scenario for the me² platform was described.

Cultural norms and willingness to change

Surveys were conducted in the larger Portuguese EV community as well as within both pilot communities. The pre-pilot survey showed that many participants involved thought it easy to adopt energy-efficient behaviour, even though they usually did not exhibit it, as evident from questions about their daily habits. Respondents were asked if they were willing to change their energy consumption to e.g. benefit the stability of the energy grid or if they could earn energy points. Notably, many of the Dutch pilot participants responded that they had already taken all possible measures to save energy (see section 'Field pilots').

Literature research indicated that different types of intervention should be used as end users move from the initial 'activation' phase to the later 'continuation' phase in changing energy behaviour – for example, starting with financial incentives and then introducing social comparison mechanisms. When determining suitable types of incentives, a six-dimensional model was used to describe the cultural differences between the two pilot countries, Portugal and the Netherlands. This was translated into an estimate of which incentives would be most effective in either country. Most prominently, an incentive based on social comparison was expected to be quite effective in the Netherlands, whereas Portuguese me² users were expected to be more averse to this concept and to preferably emphasise the importance of positive energy behaviour in itself, rather than its competitive aspects. This was later confirmed in interviews with the pilot participants and influenced the types of incentive messages sent for each pilot.

Policy report

Católica conducted an extended study of the current status and anticipated future developments regarding the European electricity market and demand response legislation and documented the outcomes in the me² policy report. The benefit of aggregated smart homes within the me² community, particularly with me²'s aspired addition of smart EV charging, offers high flexibility, which can be used by DSOs for peak-shaving and valley-filling operations in the local grid load profile. Demand response is encouraged in the European Commission's Energy Efficiency Directive, and European network codes like demand connection, electricity balancing, and load frequency reserve codes will help implement me². Currently, there are limitations in place on the electricity market regarding minimum bid value and capacity guarantees. However, a debate is underway in Europe to facilitate the participation of platforms like me² in these markets, and thus also their implementation. Said implementation is also hindered by the lack of stable regulatory frameworks and varied interpretations of EU directives. Reforms would be required in individual member states, for example regarding the regulation of retail prices. Strategies like time-of-use or dynamic pricing for smart charging and even discharging of EVs are not a regulatory option, although the technical feasibility is getting closer in

Green Points

Algorithms were designed to predict the electricity demand curve of a given user on a given day, to determine improved timing of electricity usage, and to motivate behavioural changes in terms of electricity consumption. The last element was implemented through a credit system called Green Points. Users received points on a weekly basis if they had reduced their electricity consumption. During the Dutch pilot, this was extended to awarding additional Green Points for consumption reduction during peak hours. A user ranking based on each user's Green Points was presented in the me² dashboard during the pilots. These features, as well as advice on the clustering of users, are detailed in the white book.

‘Social comparison and gamification seems to be more effective in the Netherlands than in Portugal. Portugal is expected to react more effectively to financial incentives and the Netherlands to environmental and gamification incentives.’

– White book, p.18 –

terms of algorithms and hardware. Since these strategies rely heavily on the data, facilities and cooperation of local DSOs and TSOs, me² could establish itself as a licensable Smart City Aggregator platform, enabling incumbent parties and their customers to harvest the flexibility of a smart home community with electric vehicles and photovoltaics.

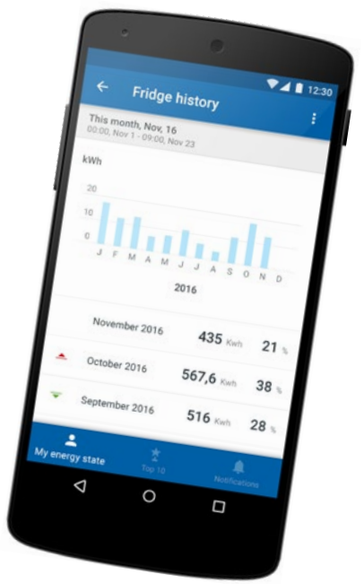
Energy grid analysis

The examination of peak hours as exhibited by electricity market prices provided parameters for incentive algorithms, implemented in the me² community platform. Furthermore, data from the public electric vehicle charging infrastructure in Amsterdam were used to calculate the potential savings that an aggregator could make by applying smart charging strategies and using dynamic market prices. This showed that a 30% reduction in costs is achievable. The savings could be even higher among certain groups of EV drivers. The potential effects of household peak shaving were then simulated on the basis of the Portuguese pilot data. Different levels of peak shaving were examined, by e.g. ‘asking’ the simulation agents whether they would agree to reduce their morning electricity usage by 10% or by shifting the load of an electric vehicle to the night hours. The results were summarised in a report combining pilot data and the energy grid analysis.

Publications:

M. Tamis, R. van den Hoed and H. Thorsdottir. *Smart charging in the Netherlands.* Proc. of EEVC. (2017).

K. van Montfort, H. Thorsdottir and R. Bohnsack. *Benefits of smart charging for EV drivers and aggregators: an empirical study.* Under review. (2017).



COMMUNITIES AND BUSINESSES CONNECT WITH AN ONLINE MARKET SQUARE

The developed me² system consists of three layers. MediaPrimer developed a Community Layer for the front-end users, households and EV drivers. The B2B market place, developed by VPS, includes an interface for energy providers on the back end, as well as the Market² (‘market square’), which connects the community with energy-related products and services.

The developed me² system consists of three layers. MediaPrimer developed the platform to support the Smart City Aggregator System and the Community Layer for the front-end users, households and EV drivers. The B2B market place, developed by VPS, includes an interface for energy providers on the back end, as well as the Market² (‘market square’) connecting the community of front-end users with energy-related products and services.

The development of the me² system demanded a set of multiple skills. Several scientific and technical challenges needed to be overcome, ranging from data collection from homes, devices and EVs, to data management and to information availability to the Community to create Smart Urban Communities. In those challenges, new opportunities for operations improvements and field data validation were identified that will allow new product advancements.

Thorough discussions within and amongst the partner companies led to the bringing together of different components of the Smart City Aggregator by defining relevant features, enabling data management and data exchange among the components, and identifying the main services to be provided by each of them. These steps were instrumental in achieving the project goals and identifying the platform possibilities and limitations for future development.

B2C – Community Layer

The me² Community Layer is one of the most exciting and visible results of the me² project. Community Layer helps to create smart urban communities that incentivise behaviour changes, focusing on saving electricity costs at home and for electric vehicles.

Based on a new conceptual design approach that uses Gamification, Community and socialisation Influence principles, Community Layer offers an innovative set of features that easily engage users and make an interesting user experience.

On this platform, they include a Project Home Page, a User Management Dashboard and a mobile app (iOS and Android). Users can assess their electricity consumption by appliance, define personal goals, compare their performance against other participants and receive notifications of their performance (less consumption yields more Green Points).

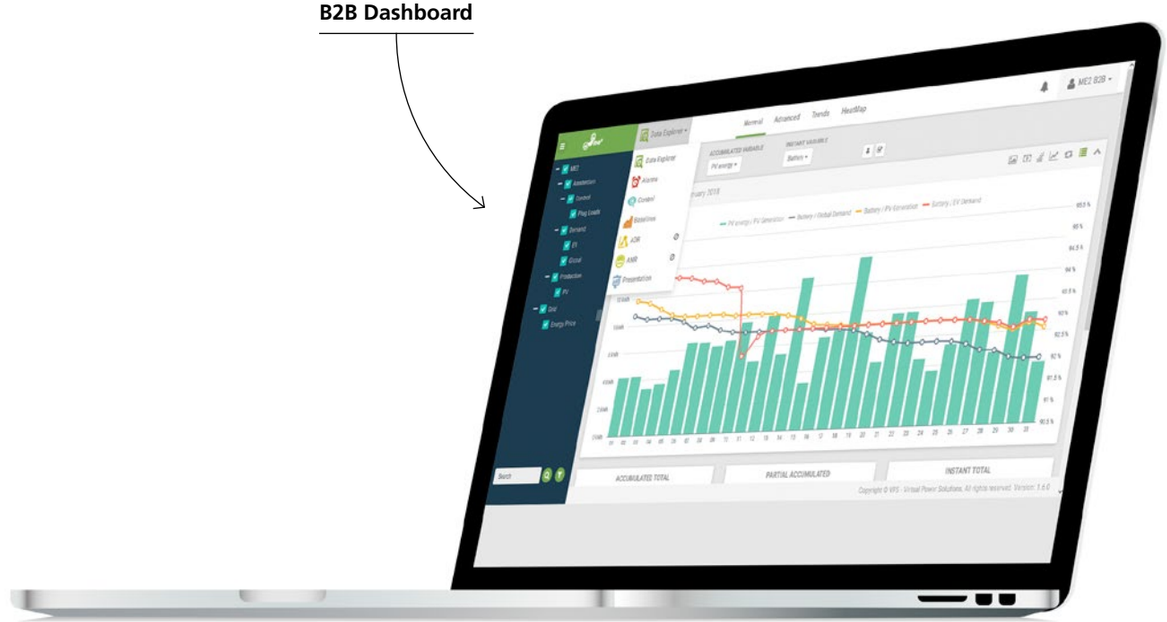
To support smart meter data integration, data from public charging sessions, data analysis and smart algorithms that provide consumption and cost forecasts as well as incentives based on a peak-shaving strategy, Community Layer was based on primerCORE (© MediaPrimer®), using fast-paced, agile and cross-platform technologies to make the process of publishing to different environments (multichannel) feasible.

User experience and communication was also

SYSTEM DEVELOPMENT

B2C Dashboard

B2B Dashboard



a big concern in this development, particularly when choosing to always use direct, meaningful and natural language instead of a technical or statistical impersonal approach. Me² B2C supports language definition and is currently available in Portuguese, English and Dutch.

Market²

The Market² is the urban, online marketplace of the me² project that supports communities to enhance their sustainability and energy savings. It enables access to products and services that can help communities reach their sustainability goals and/or to create and promote new offers to community members. Through the Market², community members can receive tailored suggestions for new energy-efficient services and appliances, based on which data they choose to provide. The idea behind the Market² was developed during the me² project.

B2B provider interface

The B2B provider interface is the interface for the community manager and energy providers. It enables them to access all community data (aggregated consumption, aggregated generation, EV charging information), set up demand response programmes and optimise energy management in communities, allowing them to take full advantage of the flexibility of the me² energy communities. The me² B2B can accommodate multiple users and user communities and enable predictions of energy consumption and production. Therefore, it allows the introduction of innovative services to me² stakeholders and can give them a better understanding of the potential value creation.

Utilities, EV fleet operators and municipalities are among the various actors that could use the B2B interface. By aggregating all community data, the B2B provides insight with which energy consumer behaviour can be nudged in a collective or personalized way.

The B2C Community Layer and the B2B market place can jointly help to translate energy efficiency into financial gains for households. In addition, information about the environmental benefits can be made available to platform users.

The three layers of me² are connected at a website developed by both partners, available at http://me2.energy.

Relevant partners: AUAS and Lisboa E-Nova

DUTCH AND PORTUGUESE PILOT COMMUNITIES YIELD DIFFERENT RESULTS

Two field pilots were conducted to integrate the end users' perspectives and the smart grid into the me² system, the first in Lisbon, the second in the greater Amsterdam area. Up to 50 users participated in each pilot.

A combination of questionnaires, interviews and surveys were used to gather consumer feedback to optimise me²'s system specifications. The energy consumption of the households of all community members was monitored using smart meters (VPS's Cloogy) and Green Points were awarded for improved energy consumption.

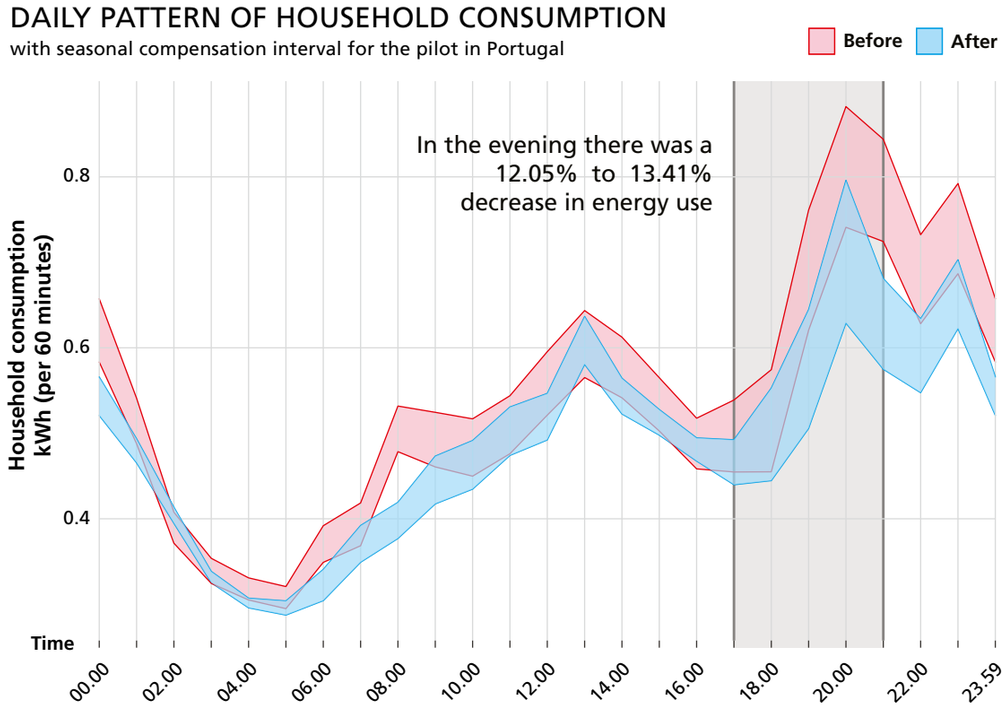
Pilot timeline and setup phase

The Lisbon me² pilot started in December 2016 and ended in July 2017. It involved a community of around 50 members, including several EV users and mostly municipality employees. The Lisbon community received three smart plugs to monitor specific electric appliances. Lisboa E-Nova, the pilot organiser, recruited the pilot community primarily through municipality channels with the goal of having a closed community. E-Nova also facilitated the installation of the smart meters and platform registration with support from partners VPS and MP. The set-up phase saw numerous emails and phone calls to ensure the monitoring of the voluntary participants. A workshop with focus group discussion was held in April 2017 and a final workshop, including external speakers and attendants, concluded the pilot in July. During the pilot, the participants received incentive messages targeted at increased awareness (financial, educational or environmental) and improved energy consumption practices.

The Dutch me² pilot community was comprised of 50 households, all with electric vehicles. 75% of those had a private EV charging point and 50% had solar panels. Due to the diversity of the electricity facilities of the households, they received different, tailored smart meter kits (Cloogy) in order to measure household and EV consumption, as well as PV production. EV charging data from the public infrastructure were also made available. Recruitment was primarily through channels related to electric vehicles. Participants were welcomed at a kick-off workshop in June 2017, where the 20 present also received their smart meter kits. Open monitoring, with full access to the me² platform and app, started in September 2017 and ended in February 2018. AUAS facilitated technical support for smart meter installation and contacted users that were slow to start the monitoring.

Community challenges

In addition to incentive messages, three community challenges were implemented where users could exchange part of their Green Points for a donation to a good cause (11 participants) or receive additional Green Points for either overall reduced electricity consumption (3 participants) or delayed EV charging (13 participants). During the last challenge, a 32% drop was measured at the EV charging points of the participants. A focus



Savings and smoother load curve

An analysis of electricity data from the participating households showed that the average peak hour consumption of the Portuguese pilot community was reduced by 13.41% between the start and the end of the pilot (see figure). This resulted in a smoother load curve, with 17 out of 30 analysed having more than 10% less variance. Importantly, this period coincided with going from winter to summer, i.e. from a period of high to low overall consumption. The potential seasonal effect was estimated with Portuguese energy usage data. In the figure, the upper range of the green curve shows the measured data at the end of the pilot, whereas the lower range shows seasonally compensated data. With seasonal compensation, peak hour reduction was 12.05%. Costs of electricity consumption were calculated using Portuguese market prices, showing that 16 out of 30 households could reduce their electricity costs by more than 10% (given dynamic market prices) if they kept following the consumption pattern during the pilot.

The Dutch data, on the other hand, showed that consumption remained similar or even increased between the start (September '17) and the end (February '18) of the pilot. Notably, the seasonal effect was the opposite of that in Portugal, combining cold weather and reduced photovoltaic production. Seasonal compensation using Dutch external energy usage data brought the overall peak hour increase down from 10% to 4.5%. 15 out of 27 users analysed achieved a 10% smoother load curve, with seasonally compensated data. Since the energy usage, especially during peak hours, was not reduced by much, neither were the costs. On the contrary, they remained stable apart from a slight increase towards the end of the period, coinciding with cold winter weather in the Netherlands.

group was hosted during a final workshop in March 2018.

The differences between the two communities became clear early on. Most of the Portuguese participants reported increased awareness of their electricity usage through the monitoring provided by me², since they had not had access to such equipment before and not been aware of the energy consumption of their home appliances. The Dutch community, on the other hand, consisted solely of EV drivers, most of whom were highly aware, technologically savvy users who had already adopted many energy-efficient habits. By consequence, opportunities to change their energy behaviour were fewer among the Dutch participants.

When interviewed, the pilot participants confirmed the sentiments predicted in the cross-cultural analysis carried out before the pilot. Portuguese participants described their aversion to social comparison through the statements 'I am willing to change my energy consumption if it helps me to perform better than the others', average agreement 3.9/7, in comparison to several other statements such as 'I am willing to change my energy consumption if it benefits the environment', average agreement 6.5/7. On the other hand, many in the Dutch community missed more diverse opportunities to collect Green Points. This reflects their interest in the competition, but also highlights a sentiment reflected in a pilot community survey by the statement 'I have already taken all possible measures to save energy', with which the majority agreed (average 4.6/7).

Lessons learned

Most users were highly interested in the disaggregation of the household's electricity consumption for individual appliances and enjoyed the diverse graphical presentations of the data available on the platform. Several suggestions about visualisation and other design features were collected from the interviews. In general, users preferred the app over the website platform. A recurring theme in both pilot groups was that accuracy and reliability of the smart meter data were essential for continued engagement. This was also crucial in order to enable tailored and personalised feedback, e.g. a weekly overview of consumption with advice for improvement, as was suggested by several participants.

About half of the Portuguese users would be willing to pay for the smart meter and 60% expected around 15 euros' worth of monthly savings through the me² system, or that the system would pay for itself in 6-12 months. Only four out of the 23 Dutch users interviewed said they would be willing to pay for comparing their own usage to that of others, whereas more than half were interested in receiving a reward (e.g. financial) in exchange for Green Points. Also, several users expressed an interest in the community aspect of the me² platform and direct communication with each other about local collaboration or technical issues. For an online community, physical location is no barrier to mutual information exchange and discussion.

In terms of organising a pilot that requires a technical installation, much preparation and effort is required for customer support, an important consideration for valorisation. The specific target groups for me², namely municipality employees (Portugal) and EV drivers (both), were largely determined by the prominence of EVs in the respective countries. This was an underlying factor in the energy awareness in the communities prior to the project and could be a consideration when selecting such a participant group.

The setup and research methodology of both pilots, as well as the interview results, are described in more detail in the system validation deliverable, available in spring 2018.

Cloogy smart plugs were used during the pilots

Relevant partners: AUAS, Católica and MME

BUSINESS PLAN TO ASSESS MARKET POTENTIAL AND RISK FACTORS

Valorisation and dissemination activities were carried out throughout the project and overseen by MME, with contributions from AUAS and Católica. A business model was developed and a feasibility study was carried out to evaluate possible revenues and costs and how to allocate them to potential stakeholders. The resulting business plan can be used by different actors in urban areas.

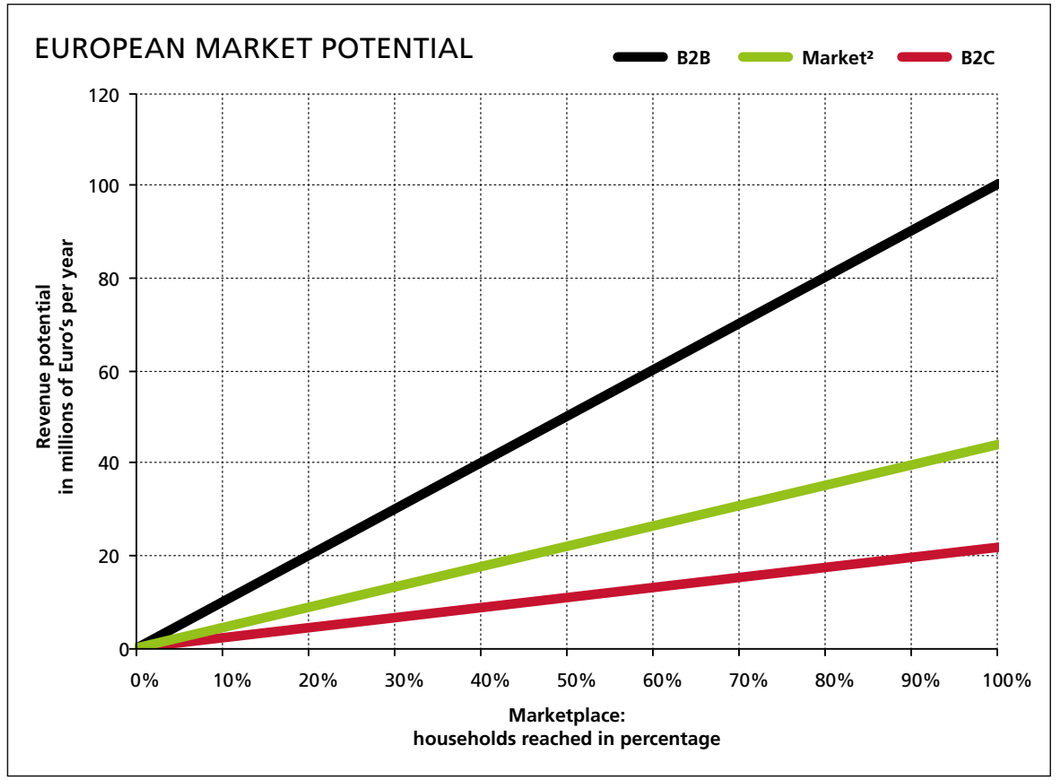
From the very early stages of the project, the consortium (especially commercial partners) worked on obtaining information about the current market situation, analysing the existing solutions and future ways and chances for exploitation and actual commercialisation of knowledge and products similar to me². This market analysis involved a study of both the country-specific national and European markets, resulting in high theoretical potentials (revenues of up to 100 million euros per year on a European level) for B2C, B2B and Market² activities.

A realistic business plan analysis was conducted to estimate the potential amount of target users, the percentage of the market that could be covered in the short and medium term, and a list of potential target countries for its implementation. A business plan case study showed that a viable business plan could be realised only under ideal conditions, as there are many risk factors – especially related to long-term customer interest (also observed during the field trials). It is therefore recommended to improve the developed solutions further by implementing additional functionalities.

Market analysis and business model

The market analysis that was conducted yielded insights into future ways and chances for exploitation of the B2C, B2B and Market² segments. Revenues in the B2C segment are generated by fees for the optimisation of electricity consumption costs at the household level. In the B2B segment, revenues are created by licencing the platform to other utilities (e.g. electricity, heat or gas utilities, EV aggregators). Moreover, the developed Market² offers the opportunity to realise further revenues by gathering fees from vendors who sell products on the Market².

Based on the field test findings, combined B2C, B2B and Market² potentials were calculated as shown in the figure. Accordingly, it was assumed that existing smart meters can easily be equipped with meter-data interfaces in the future.



Business plan case study

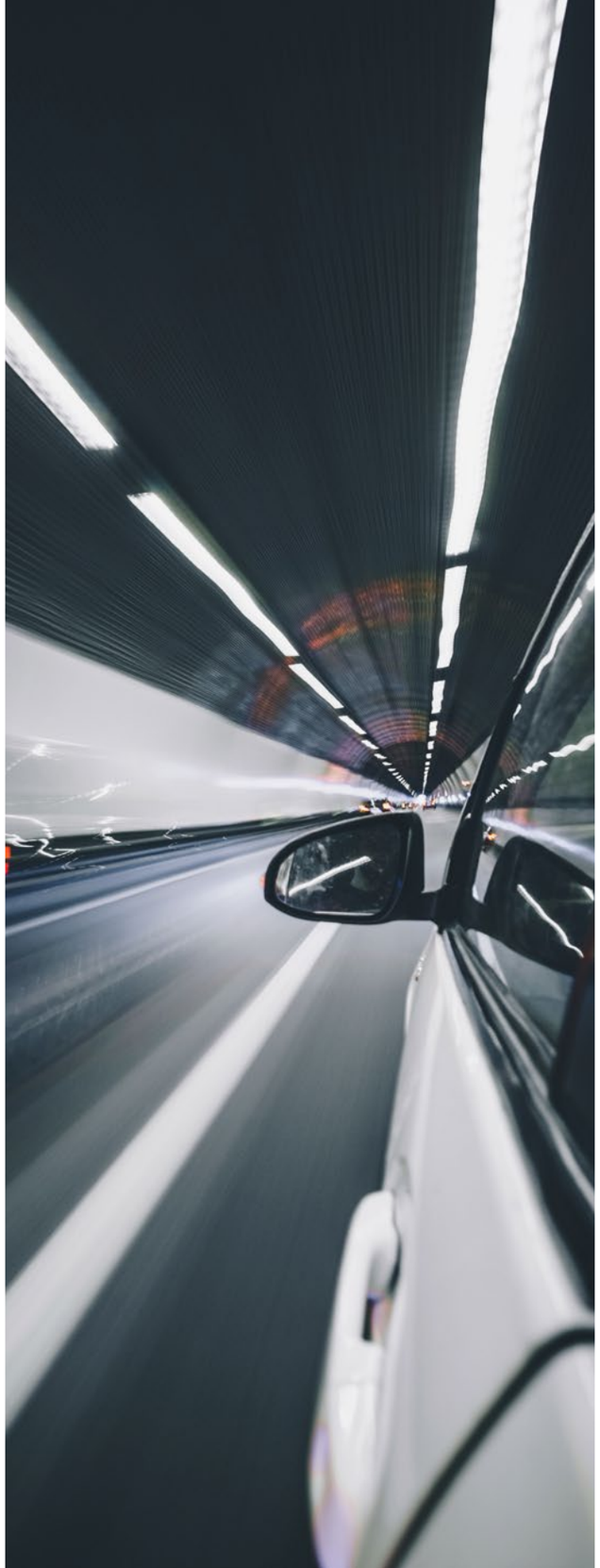
Based on the me² market analysis data, a business plan case study (for a company selling the developed me² products) was carried out. Accordingly, staff and equipment costs in Portugal (company headquarters in Lisbon) as well as sales offices in the Netherlands and Germany were considered. However, detailed business plan calculation results and corresponding parameter variations revealed the following risk factors with a high economic impact:

- The estimated number of employees required for customer acquisition and care might be too low.
- The estimated customer acquisition rate might be too high.
- Customer interest may be low (as seen in the field tests).
- B2B and Market² revenues might be lower than expected.

Suggested additional functionalities to address the risk factors in the current developed solution include selling and buying electricity or grid capacities (for fast EV charging) directly through the platform and its members or trading Green Points for platform offerings or Market² products.

The deliverable containing the me² market analysis that was conducted will be publicly available by the end of May 2018.
www.me2-project.eu

FUTURE PROSPECTS



After carefully designing, building and testing the me² Smart City Aggregator, the project consortium is in ongoing discussions about the next steps for development and the opportunities for commercialisation. The partners see various possible directions in which they could head in order to bring the developed system to market, ranging from supplying small DSOs with a smart home energy platform to enabling EV charging demand response programmes with energy retailers. Feedback from the field pilots, from both novice as well as experienced users of smart home equipment, has provided valuable input for improvement. Both this input and the market analysis have been internalised in the business model to indicate which markets could be feasible. It is clear that different European countries, such as Austria, the Netherlands and Portugal, are at different stages when it comes to the availability of and thus the existing competition between smart home energy management systems. Combined with the regulatory framework, this makes the readiness of the product even more dependent on the context. As the me² project comes to an end after having successfully achieved its objectives, the next steps will be to clarify the mutual goals of the partners and fine-tune the system mechanisms to make it attractive to both front end users and prospective community managers and energy providers.

Amsterdam University of Applied Sciences

The Urban Technology Research programme of Amsterdam University of Applied Sciences (AUAS) carries out applied research in the field of sustainable energy, smart mobility, urban design and circular design. Electric mobility and smart grids are among the research priorities of the programme, with a focus on monitoring, modelling and simulation of charge behaviour of electric vehicle users. AUAS was the project coordinator of me².

MEDIAPRIMER
design · digital media · software

With expertise in software and data management, graphic design and digital media, MediaPrimer develops platforms that integrate different smart meters, data loggers, SCADAs or IoT monitoring equipment for sectors such as energy, water and environment. Recently the Portuguese Electric Distribution Company (EDP) has adopted MediaPrimer's technology to manage the national public street illumination, confirming MediaPrimer's market position as a developer of integrated management platforms.

CATÓLICA LISBON BUSINESS & ECONOMICS // SCIL
smartcityinnovationlab

The interdisciplinary research team of the Smart City Innovation Lab at Catolica Lisbon unites the fields of business model innovation, digital transformation and smart city technologies. SCIL has the vision to make urban areas smart and sustainable for citizens and businesses. SCIL produces scholarly knowledge on the highest level, engages international research projects, and informs practice via consulting, workshops and the online business model platform smartbusinessmodeler.com.

MOOSMOAR ENERGIES OG

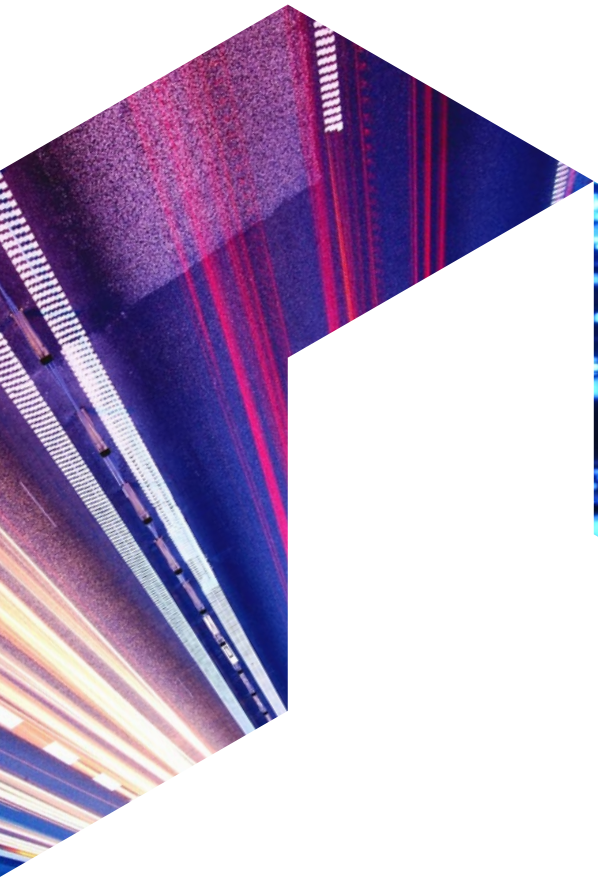
MME's employees have profound experience in project development, handling, elaboration and dissemination. Topics regarding the economics of energy system design, energy markets, the integration of Renewables, Grid Regulation, Smart Grid and Smart City solutions as well as business modelling have been fully covered in past and current research projects.

LISBOA e·nova
AGÊNCIA DE ENERGIA E AMBIENTE DE LISBOA

Lisboa E-NOVA is a non-profit association operating under private law that seeks to contribute to the sustainable development of the city of Lisbon through mainstreaming good practices in urban planning, construction, urban management and mobility, involving all of the city's key stakeholders, including political decision-makers, all major urban stakeholders and the citizens of Lisbon. Lisboa E-NOVA is responsible for the development and monitoring of Lisbon's Energy-Environment Strategy, signed by the Municipality of Lisbon in 2008.

VPS Virtual Power Solutions

Virtual Power Solutions (VPS) provides Energy Savings as a Service (ESaaS) to all sectors, industrial and commercial, SME and domestic, enabling the creation of Energy Communities with VPP technology to deliver new added value connecting distributed energy resources. VPS has strong knowledge and experience with the Internet of Things (IoT), developing hardware and software solutions, cloud-based M2M communication platforms and mobile applications for Smart Homes, Smart Cities and Smart Grids.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646453.