AmsTErdam BiLbao cItizen drivEn smaRt cities

Deliverable: 3.2 Highlights and results Track 1:

Integrated Energy Systems and Electro-mobility

WP3, Task 3.2

Date of document

25/11/2024

Deliverable Version:	D3.2, V.1.0
Dissemination Level:	PU[1]
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[1] PU = Public

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.864374

List of beneficiaries

No	Name	Short name	Country
1	GEMEENTE AMSTERDAM	AMST	Netherlands
2	AYUNTAMIENTO DE BILBAO	City of Bilbao	Spain
3	FUNDACION TECNALIA RESEARCH & INNOVATION	Tecnalia	Spain
4	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO	TNO	Netherlands
5	FUNDACION CARTIF	CARTIF	Spain
6	STICHTING WAAG SOCIETY	Waag Society	Netherlands
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28	ZABALA INNOVATION CONSULTING. S.A.	ZABALA	Spain
29	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	Fraunhofer	Germany

Document History

Project Acronym	ATELIER		
Project Title	AmsTErdam and BiLbao cItizen drivEn smaRt cities		
Project Coordinator	Frans Verspeek f.verspeek@amsterdam.nl City of Amsterdam		
Project Duration	01/11/2019 – 30/04/2026 (78 Months)		
Deliverable No.	D3.2 Highlights and results Track 1: Integrated Energy Systems and Electro-mobility		
Diss. Level	Public (PU)		
Deliverable Lead	TEC		
Status		Working	
		Verified by other WPs	
	X	Final version	
Due date	31/10/2024		
Submission date	29/11/2024		
Work Package	WP3 - PED Innovation Atelier		
Work Package Lead	TNO		
Contributing beneficiary(ies)	AMST, City of Bilbao, Tecnalia, CARTIF, Waag Society, AUAS, PSI, SEZ, UDEUSTO, CEPV , IBE, TELUR, EVE, Spectral, Republica, EdwinOostmeijer, AMS Institute, WATNL		
DoA	**Subtask 3.2.1** Activities in this track support the tailoring and implementation of smart urban solutions related to energy (systems) and electro-mobility for PEDs in the city.		

Date	Version	Author	Comment
06/11/2024	0.1	Eduardo Miera/Omar Shafquat	First draft of deliverable
20/11/2024	0.2	Carla Rodríguez (CAR) / Eva Winters & Jeroen Brouwer (TNO)	Review
25/11/2024	1.0	Eduardo Miera (TEC)	Final version
02/12/2024		Coordinator	Final review, submission

Disclaimer

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Abbreviations and Acronyms

Acronym	Description
PED	Positive Energy District
RES	Renewable Energy Resources
ICT	Information Communication and Technology
WP	Work Package
EU	European Union
LH	Lighthouse
SCC	Smart Cities & Communities
BaU	Business as Usual
SECAP	Sustainable Energy and Climate Action Plan
EV	Electric Vehicle
NECP	National Energy and Climate Plan
GIS	Georreference Information System
DSO	Distribution System Operator
EMS	Energy Management System
ESCO	Energy Service Company
aFCR	Automatic Frecuency Containment Reserve
LEM	Local Energy Market
OMIE	Operador Mercado Ibérico de Energía (Spanish Energy Market Operator)

0. Executive Summary

One of the main challenges for implementing Positive Energy Districts (PEDs) is the involvement of stakeholders and citizens in the process. This is a complex system with different property owners, tenants and users as well as different energy service providers (involved in generation, energy efficiency and management) and private companies with different interests. Also, it should not be forgotten the role of public administration and research organizations providing innovative solutions. In sum up, a very complex eco-system converging in the pursue of an optimization of the availability of resources in the local context.

ATELIER project placed an innovative solution for the management of this complexity. Thinking not only in solving problems related to the implementation of the project but also considering benefits that PEDs can provide to any city's energy transition. The development of the Innovation Atelier concept has pursued the co-creation of new solutions building up the capacity to learn and innovate across the city and with other cities.

Although with a common purpose the specific structure and activities developed have been adapted to the specific goals in each city. This report shows how the understanding of a common track structure has been interpreted in different ways in the two demonstrators (Amsterdam and Bilbao) and the results have also been tailored to the different needs. For the case of Amsterdam to deep dive in the PED development and find other potential technology solutions to complement the demonstrator and a potential scalability, and in the case of Bilbao to study and analyse technology solutions for the development of other PEDs and for developing the city's energy transition vision and strategy.

Please note that probably previous structures and relationships among partners in the project also had an impact on the typology of results and on setting the goals. In the case of Bilbao most of partners were used to collaborate and were part of the energy cluster who has been the nexus for the Innovation Atelier implementation. This structure is previous to the ATELIER project and will also last beyond the project providing continuation to activities carried out in the project. In the case of Amsterdam, however, without previous structures, there was a discussion on the services provided and their value beyond the lifetime of ATELIER. A specific business model has been developed to give continuity to activities.

In both cases the potential of Innovation Ateliers for engaging stakeholders from the complex local eco-system and making them collaborate to gain knowledge, share experiences and co-create solutions has been demonstrated. Differences in the implementation are good examples for its scalability potential as it has been shown with the fellow cities. The report presents the different developments, results achieved and, what may be more interesting for other cities, learnings to share. Out of the reflection process in the two demonstrators the main solutions for the development of PEDs are presented considering barriers and how to overcome them when possible.

1. Introduction

ATELIER focuses on developing and implementing Positive Energy Districts (PEDs) as a contribution to achieve a carbon neutral transition in European cities. Conceptually, PEDs correspond to an urban area or group of connected buildings designed to produce more energy than it consumes on an annual basis. This energy surplus is mostly generated by combining a maximization of energy efficiency, local generation from renewable energy sources (RES) and use of energy flexibility to match supply and demand adequately. Therefore, one of the crucial elements is the integration of systems including energy, mobility and Information and Communication Technology (ICT) to ensure efficient energy management and supply.

In the case of ATELIER project there are two demonstrators (Amsterdam and Bilbao) where PEDs have been designed, implemented and tested, and six fellow cities (Bratislava, Budapest, Copenhagen, Cracow, Matosinhos and Riga) where replication potential has been studied. Threaten by Covid pandemic, Ukrainian war and rise of energy prices, its implementation has been a challenge at all different levels and beyond usual problems encountered in this type of projects. But, at the same time, a process full of learnings specially at collaboration and management level.

Successful implementation requires coordination among multiple stakeholders, including local governments, private companies and residents. However, no doubt that ensuring effective collaboration and management is difficult considering different interests, resistance to change or lack of awareness.

ATELIER develops the Innovation Atelier concept with the aim to support the deployment of PEDs by enabling an innovative collaboration process with the local innovation ecosystem to foster co-creation of new solutions and building up the capacity to learn and innovate across the city and with other cities. This is a collaboration framework embracing not only project partners but also other stakeholders, public administration and any other entity potentially interested in bringing ideas, knowledge and willingness to support the energy transformation process in the city. The main purposes are to:

- Foster an integrated approach for tailoring, implementing, assessing and reviewing smart urban solutions in the cities which is supported by state-of-the-art knowledge from both academia and practice.
- Accelerate market uptake and foster the cooperation in the innovation ecosystem by creating joint capacities to tailor and implement PEDs.
- Develop learning capacity and capture lessons learnt that support the upscaling of PEDs locally and replication to other EU cities.
- Sustain implementation of PEDs beyond the lifetime of the project within the city

However, self-sustained structures beyond the lifetime of the project require dedicated resources and funding that will only be possible if provided services are perceived with an added value for users. This is an issue addressed at implementation stage together with roles, tasks, conflict resolutions, etc. Certainly, one that will look for continuity in order to fulfil goals related to market uptake, replication and other that are difficult to reach in the short lifetime of an European project.

As part of the potential added value services several working lines have been defined for all Innovation Ateliers. Topics that in the context of PEDs are generally interesting to be analysed:

range from technology solutions to legal frameworks, use of data and financing schemes. These have been grouped into four innovation tracks:

- Innovation Track 1: Integrated Smart Energy Systems and Electro-mobility
- Innovation Track 2: Governance, Integrated Planning and Law
- Innovation Track 3: New financing instruments
- Innovation Track 4: Data, privacy and data platforms

Nevertheless, there are also subjects that can be analysed from the perspective of more than one Innovation Track and whenever possible a holistic approach has been applied to cover all different scopes in the meetings. Also looking at the exchange of information on each Track among the different Innovation Ateliers (mainly Amsterdam and Bilbao during project implementation). All with the aim to maximize learning experience to reach goals set for scaling up PED solutions and increase learning capacity across cities.

This deliverable focus on the work delivered in Track 1 in Amsterdam and Bilbao as well as the activities carried out together.

1.1. Purpose and Target Group

The purpose of the deliverable is to present the work develop within Track 1 as explained in the introduction. This work started with the establishment of the Innovation Ateliers and the design and planning of activities within each of the innovationTrack. It continued with the implementation of the activities first by each Innovation Atelier and finally by joint activities. Therefore, an evolution can also be observed in the typology of actions and target groups.

Local events asked for taking advantage of potential engagement and involvement while national or international events pursued a more information exchange scope. Sharing of technology solutions has been of interest for both public administration and private sector but also to other stakeholders depending on the specific purpose of the activity. At some point the entire local innovation ecosystem has participated.

1.2. Contributions of Partners

The following Table 1 depicts the main contributions from project partners in the development of this deliverable.

Partner short name	Contributions
TEC	Overall content to all sections
AUAS	Content to section 3.3 and 3.4, plus feedback on section 4
TNO	Document structure and review
CAR	Review of the document

Table 1. Contributions of Partners

2. Overall Approach

Development of Positive Energy Districts (PEDs) require an open innovation model for their planning, deployment and replication, and a cooperation within the city with different types of stakeholders, from industry, service providers and investors, to citizens (ref SET Plan[2]. There are barriers to overcome and solutions that fit best for each urban context but on top of that there are dos and don'ts that can improve the uptake of PEDs in the city.

The Innovation Atelier concept is a strategic approach to driving innovation. At city level this means counting on a diverse spectrum of entities who are part of the innovation ecosystem (quadruple helix): private companies, academia, research centers, and public administration and citizens among main stakeholders. They all play an important role in tailoring measures to the local situation and providing experimentation and creativity for the deployment of PEDs. Therefore, their participation in the Innovation Atelier is highly recommended.

Figure 1: Representation of a Quadruple Helix model

ATELIER project provides an adequate framework to establish a formal structure for Innovation Atelier in Amsterdam and Bilbao and explores services that can be delivered. The main value is the opportunity to share, exchange and be part of the process. However, it also consumes resources and, hence, the provided added value through services should be perceived clearly by participants. Otherwise, sustainability of this structure will not last beyond ATELIER project. Involvement of participants in the design of services has turned out a key question so that common demands could be discussed and answered through collaborative work. In that sense, Innovation Atelier has made use of the innovation ecosystem for strengthening capacities in potential deployment of PEDs through a collaborative approach. But without forgetting that sustainability will only come if participants perceive sufficient added value for their involvement.

Various methods and instruments have been developed and demonstrated to identify and discuss specific smart (energy) solutions, by developing and reviewing new institutional arrangements, new forms of cooperation and governance, new business models, new financing schemes and funding opportunities that support the technical solutions. Work that has implemented different type of events, actions and activities with the purpose of exploring solutions, enablers, barriers and understanding co-benefits.

[2] https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan_en

Further information on the setup (including stakeholder involvement), vision and mission of Innovation Ateliers can be found in "D3.1 The PED Innovation Atelier Organization Document"[3].

2.1 The Innovation Atelier methodology

From the point of view of methodology, the knowledge creation has been organized in four "innovation tracks", each of those delivering specific domain expertise and know-how to the innovation ecosystem gathered in the PED Innovation Ateliers. These were pre-determined in the preparation of the project proposal based on the critical added value for PED ambitions in cities. The co-creation of innovations extends, thus, beyond the technical domain and is integrated with innovations for institutions, financial instruments, data and policy.

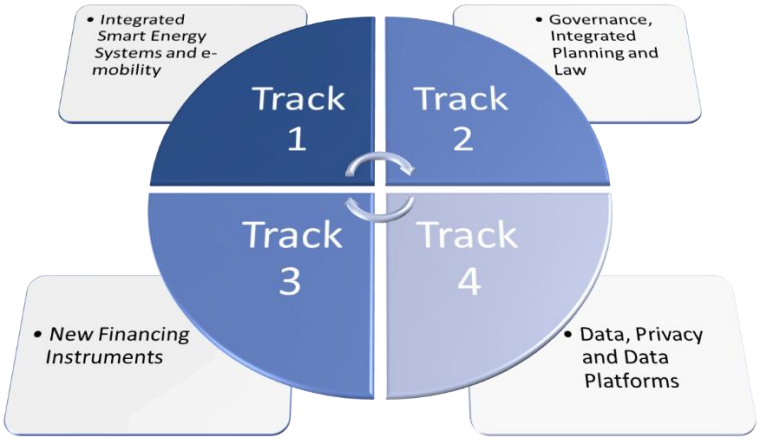

Figure 2: Innovation Tracks in ATELIER project

For each of the Innovation tracks, a local track coordinator has been appointed within the Cities' Innovation Ateliers, as first point contact and to support identification of specific knowledge needs, questions, opportunities or threats within each domain. Playing a leading role for knowledge sessions, workshops and deep dives to answer the specific needs or questions. Among other tasks the work has included posing subjects, leading and dynamizing discussions, drafting programmes for knowledge sessions, defining target audience, finding and inviting external practitioners that could contribute, etc.

All sessions have been documented for recording the lessons learned in order to share them with other cities as well. First within ATELIER project with partner Fellow cities (Bratislava, Budapest, Copenhagen, Krakow, Matosinhos and Riga) through WP3 and WP6 activities and second within the wider realm of other European cities through activities developed in WP8 and WP10.

[3] https://smartcity-atelier.eu/outcomes/deliverables/d3-1/

2.2 Purpose of Track 1

Innovation track 1 has been focused on *Integrated Smart Energy Systems and Electro-mobility Activities*. This track includes the design and optimization of dedicated smart urban solutions for reaching energy efficiency goals that are 'beyond existing codes' for buildings, implementation of positive energy systems, deployment of E-mobility solutions and integrated operations and management. Furthermore, models are used to assess under which conditions smart urban solutions can have the biggest impact for PEDs. This track has also assisted in collaboratively designing pathways/ scenarios for upscaling the smart urban solutions to the city level and even beyond.

Integrated smart energy systems are essential for the development of PEDs. On the one hand due to their energy sources integration capability (solar, geothermal, etc.) plus maxiimizing efficiency. Advanced energy management systems and smart grids ensure that energy is generated, stored and distributed optimally. On the other hand they provide real time data and analytics on energy usage, generation and storage. This enables PEDs to make data-driven decisions, optimize energy efficiency and identify areas for improvement. A third interesting aspect to consider would be enhancement of grid resiliency. Although in this case some controversy could be reported due to grid congestion issues for instance. Nevertheless enabling PEDs to operate in isolation during outages or grid failures may help improve resiliency of PED area.

This analysis also includes understanding technology solutions and potential integration in the PED where tailorization is a must. For instance, for both demonstrators solutions showed a different grade of adequacy. In the case of Bilbao heat has been one of the main issues and therefore, from the Innovation Atelier, the focus has been related to diving on the analysis of possibilities of decarbonisation of the current and future heat networks.

In the case of emobility, it be must said that it was chosen as a main driver due to its profound impact on the grid, driving the adoption of renewable energy, improving grid resiliency, and promoting energy security. But also causing the increase of peak demands or strains on existing infrastructure. By integrating electric vehicles, smart charging infrastructure, and V2G technology, PEDs can create a more efficient, sustainable and regenerative energy system. But they can also suffer its deployment.

Having these topics as premises Innovation Ateliers in Amsterdam and Bilbao prepared and delivered the outcoumes that are further explained in section 3 of this report.

2.3 Expected Impact

As explained Innovation Ateliers have provided support in the feasibility of new solutions and have helped in the development of the city's vision towards 2050 and the development of energy transition action plans for 2030. From this approach the expected impacts can be summarized in the following points:

- **Sustainability:** Provision of not only short-term interventions and solutions but also long term strategy and how PED can collaborate in setting the correct pathways.
- **Feasibility of solutions:** Understanding the benefits and problems of each solution and their business model.
- **Innovation and technology readiness:** Analysing solutions at different technology level including the ones that are not in the market yet.

- **Stakeholder engagement:** Having the participation of all stakeholders (public and private) for the provision of solutions and their compromise in the implementation phase.

2.4 Relation with other work packages

The work developed with Innovation Ateliers has complemented the work developed in other spheres of the ATELIER project. And, in particular, the work developed in Track 1 related to smart energy management solutions and e-mobility have been crucial in many activities.

There is a direct relation to the work developed in the two demonstrators (WP4 for Amsterdam and WP5 for Bilbao) for establishment of PEDs. In both cities, implementation has gone through countless vicissitudes due to unexpected situations such as the war in Ukraine. In that context, Innovation Ateliers have been of help in providing resiliency and solutions to critical situations. They were of help to solve barriers in many cases. For instance, the demonstrator of Bilbao changed implementation regarding buildings, renewable energy generation and electromobility. The city council, together with project partners, redesign the actions and the Innovation Atelier provided support in the feasibility of the new solutions.

Another field with a direct involvement of Innovation Ateliers is the development of the city's vision towards 2050 and the development of energy transition action plans for 2030 (actions within WP2). Innovation Ateliers have provided the framework for organizing a participatory process with the involvement of city's municipal departments and external stakeholders. Having a steady working group with the involvement of regional government, city council, research organizations and private companies has been important to grease the whole machinery.

Beyond the implementation, AELIER also analyzed the scalability of PED to other sites in the cities (WP6). In this area Innovation Ateliers have also been of help to understand the potential of smart urban solutions, their feasibility and adequacy to other urban environments.

And last but not least, in relation with fellow cities that have implemented their own Innovation Ateliers and got feedback from the learnings in Amsterdam and Bilbao related to Track 1. It has been a proof of knowledge transfer across cities based on articulation of local ecosystems and their requirements.

3 The Innovation Ateliers

In this chapter the results of the Innovation Ateliers are described centered in the work developed in Bilbao and Amsterdam. As introduction to each lab, a brief description of their general framework is provided and their main outcomes follows up. Finally, there is a specific point related to joint activities that shows collaboration among both pilots.

3.1 Framework in Bilbao

Existing networking structures in Bilbao allowed a fast implementation and deployment of the innovation Atelier. The Energy Cluster, partner in the project, accommodates not only private companies but also public administration, universities, research & development entities, etc. They play a key role in the innovation ecosystem providing services very much aligned with Innovation Atelier purpose. And being most of partners in ATELIER, members of the Cluster, this resulted in having a lead partner and a formal structure that will continue beyond the lifespan of the project.

It is also important to notice the involvement of regional level government in addition to the city council. From the administration point of view, this level of multi-governance makes easier to take advantage of policies and resources.

The Innovation Atelier also provided tools and follow up activities to ATELIER project:

- Every month pilot meetings with partners have been carried out. The goal was to review the work develop in the project, coordinate actions and connect with ongoing activities out of the scope of ATELIER. This has been very useful in terms of deciding what to deliver in the Innovation Atelier and how to engage or involve other stakeholders. Meetings were also useful as co-design exercises for many activities.
- The Innovation Atelier in Bilbao also provided a shared repository in Teams where not only documents but also all activities could be reported. The tool allowed an easier exchange and arranged all information.

3.2 Outcome of the Innovation Ateliers in Bilbao

As explained, in the case of Bilbao, the Innovation Atelier met every month during the lifetime of the project with the aim to follow up the activities. This accounts to over 40 meetings facilitating the smooth development of planned actions, redesigning new implementations and coordinating efforts from all partners (project meetings, monitoring issues, administrative requirements, etc. All these meetings resulted in establishing a professional and a personal relationship among partners, strengthening their collaboration.

The Innovation Atelier also played a crucial role in the development of all ATELIER activities: WP2 for setting Energy Vision 2050 and the 2030 Energy Action Plan, WP6 activities related to scaling up the PED concept to other sites in the city, WP7 for citizen engagement, WP8 for connection with other European projects and WP9 for the monitoring.

Follows up activities delivered outside of these meetings which were considered to be complementary and interesting for the development of PEDs in Bilbao. It is included a table (Table 2) with a summary information of events to ease its relationship with Track 1 objectives. Longer description of each activity is also provided later.

Activity	Track 1 goal	When
Technology solutions from neighbor LH cities in SCC projects	Set up of working group with other SCC projects. Within a radius of 150 Km from ATELIER there are 4 more projects (3 LH and 1 FW cities).	19/06/2020
SWOT Diagnosis for Bilbao's Energy Transition	Co-creation of diagnosis with local stakeholders for the Energy Vision in Bilbao.	15/04/2021
Bilbao's Energy Vision and scenarios	Co-design of Energy Vision and Master Scenario for Bilbao	26/10/2021
Electrification of heat demand in PEDs	Analysis of technology solutions related to electrification of heat demand. Comparable to solutions applied in ATELIER demonstrator.	15/12/2021
Bilbao's Energy Action Plan 2030	Co-design of Energy Action Plan 2030 that will complement the preparation of Bilbao's SECAP	29/112022
Opportunities for energy communities in the framework of the energy transition in Bilbao	Exchange of experiences in the implementation of energy communities and understanding how they may help in the energy transition of Bilbao	17/05/2023
Energy planning for the decarbonization of heating and cooling supply in cities	Informative session on solutions applied by different cities in the decarbonization of their heating and cooling supply.	24/10/2023

Table 2. List of activities in Bilbao

Technology Solutions from Neighbour LH cities in SCC projects

When & How:

Delivered on June 19, 2020 this was the first workshop under pandemic restrictions and hence it was online.

Subject & Purpose:

The goal of the workshop was to share and exchange lessons learnt, best practices and experiences from other SmartCities & Communities (SCC) projects in H2020 calls. The three main lines of debate focused on the governance model and tools, best technical solutions and citizen communication and participation mechanisms put in place. Therefore, it can be considered that this workshop belongs, in fact, transversally to different innovation tracks, including Track 1.

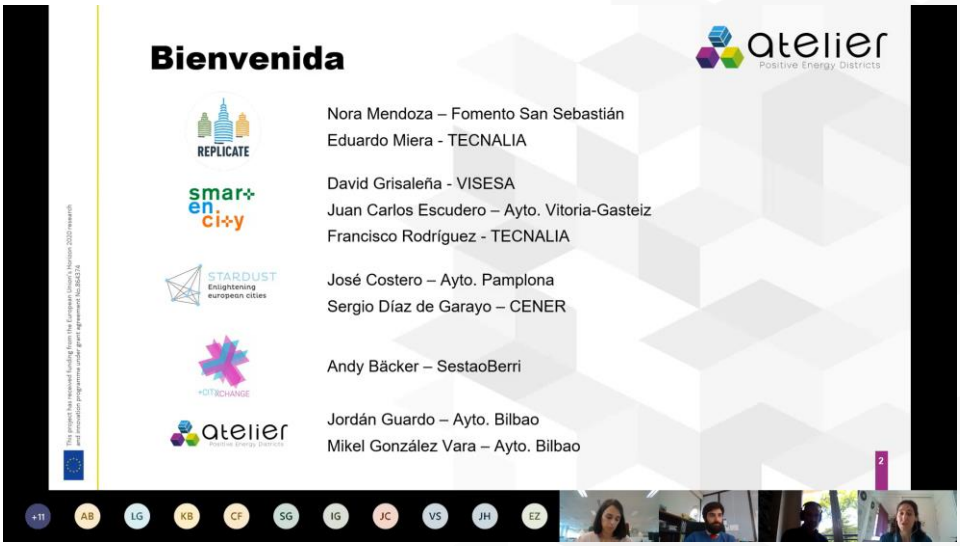

Figure 3: Projects that participated in the online workshop

Main participants:

The workshop, led by the Basque Energy Cluster, featured a distinguished panel of representatives from the following projects: REPLICATE (Fomento de San Sebastián, Tecnalia), SMARTENCITY (Vitoria-Gasteiz City Council, VISESA, Tecnalia), STARDUST (Pamplona City Council, CENER), +CITYXCHANGE (SestaoBerri) and ATELIER (Bilbao City Council). All five projects within 100 km radio and with many common partners which makes easier the exchange and replication of solutions.

Results & lessons learnt:

The workshop was very rich in particular cases. Different experiences manage in the best possible way but to wrap up most remarkable points follows up a list:

- Planning is necessary in advance. Specially, if citizen engagement and participation is required. Economic and social issues are many times more important than the technology solution. In some projects, door-to door campaigns have been implemented but regretfully only when the project already started which slowed down the execution process.
- From the point of view of technology solutions all projects tackled energy efficiency (building retrofitting, electrification of heating, etc.), local renewable energy generation (PVs, geothermal energy, etc.) and adopted mobility measures including deployment of EVs (and corresponding charging infrastructure), electrification of public transportation, fleets, last-mile deliveries, etc. Also, the use of ICT to improve energy management, monitoring, etc.
- Yet one barrier is the legal framework for energy generation and use of energy flexibility.
- Coordination of different municipal departments is difficult. A steady transversal team may help to coordinate activities with departments. All should be part of the challenge. The concept of Innovation Ateliers and Smart City Planning Groups are something that may help in this coordination process.

One of the results of the meeting was the proposal to establish a working group with these cities (Donostia-San Sebastian, Vitoria-Gasteiz, Pamplona and Sestao) as there were many topics of common interest. A follow up meeting was proposed in the context of +CITYxCHANGE consortium meeting on October 2020.

SWOT Diagnosis for Bilbao's energy transition

When & How:

Delivered on April 15, 2021 through a co-creation workshop for the development of the SWOT diagnosis in Bilbao's energy transition process. It was delivered face to face and online for a total of 6 parallel workshops and plenary sessions.

Subject & Purpose:

The main purpose was to launch Bilbao's 2050 City Vision. An open participatory process to define the transition strategy for the future of the city. Main goals were:

- Activate the participation of local agents who should be involved in the energy transition development. Explain them the process and methodology and get their involvement.

- Organize them by groups of expertise so that their contribution could be not only in the diagnosis but also in the co-design of the vision, plan and in its ulterior implementation.
- Get a sectorial diagnosis shared with local agents in SWOT format.

The session was linked to actions from WP2 for the definition of the city's 2050 Vision.

Main participants:

The workshop was led by Tecnalia at the Bilbao's City Council premises with a broad participation of departments and external agents. A total of 48 attendees participated (some face to face and others online). As a starting point, several presentations were delivered by high level representatives of the city and the Basque Government, as well as from General Director of Tecnalia explaining the opportunity of using technology and innovation as an engine of change in the energy transition. The event continued with other sessions to explain the main goals of ATELIER project, the Innovation ATELIER concept and its structured and expected interactions.

Prior to the event, an integrated review of plans and programs affecting Bilbao were analysed in order to integrate them in the City Vision 2050. This led to internal contrast with different municipal departments and the development of the first SWOT version (SWOT V.0).

Due to COVID-19 restrictions some participants were online and, hence, discussion took place around a digital board in which SWOT V.0 results for each thematic table were dumped. A total of 6 parallel working groups were considered: Governance and Society, Energy, Mobility, Adaptation to Climate Change, Built Environment and Digitalization.

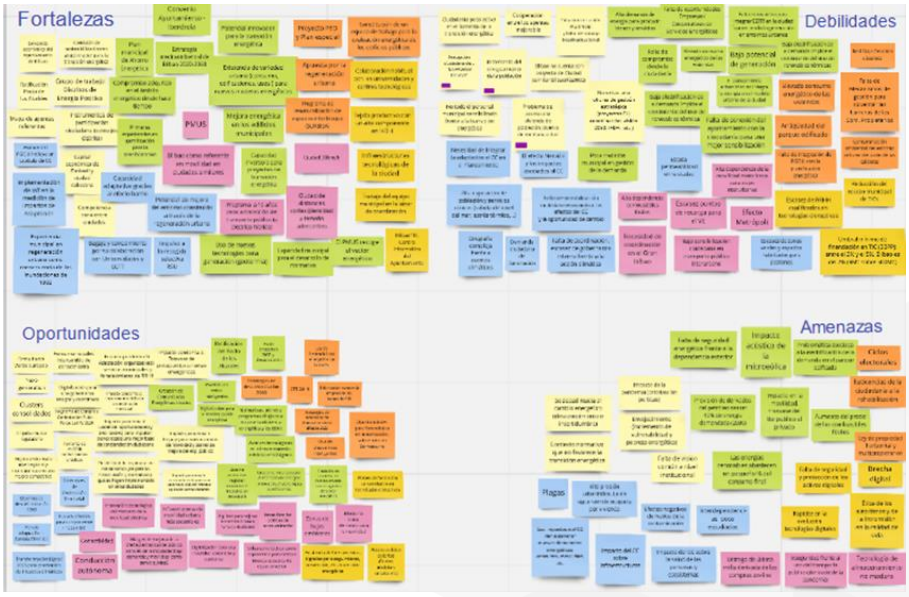

Figure 4: SWOT analysis

Results & lessons learnt:

The session was successful in providing feedback to the initial SWOT analysis produced with City Council's departments. Some new relevant aspects were added to the first version and some other were corrected. The heterogenous composition of the groups derived in consideration of different points of view that fed a fruitful discussion. As a result, the first analysis was enriched with broader interests.

All groups met a minimum criterion of composition with representatives from quadruple-helix. This means a minimum of 5 to 6 people in each group. However, in most of cases some stakeholders were missed. Specially the absence of social perspective and socio-economic reality of the city as citizens were not fully represented in the worktables.

More dedicated time for discussion was also suggested. Not only for worktables, where depending on the number of participants time was short, but also for integrating the results from all tables and find connections. In many cases there were common topics and concerns and probably longer time for discussion would have resulted in a better co-creation process. Nevertheless, longer time may also result in having less participation as professionals do value their working time. Finding balance is essential for good results. In the case of this ATELIER workshop, it can be concluded that result was satisfactory for participants.

Bilbao's 2050 Energy vision and scenarios

When & How:

Delivered on October 26, 2021 this workshop was held face to face in Azkuna Zentroa Alhóndiga Bilbao. It was divided in plenary sessions and worktables so that participants were informed of the progress of the project and could exchange knowledge and provide feedback to the development of Bilbao's 2050 Energy Vision. All the event was delivered with the help of facilitators from Tecnalia.

Subject & Purpose:

Main purpose was to involve local stakeholders in a co-design process of an Action Plan for the Energy Transition in Bilbao. Counting with the Master Scenario generated in previous phases the preliminary work implied a review of the scenarios and goals and validation, as a general framework, to develop the actions. Three potential alternative energy scenarios to the Business as Usual (BaU) were proposed in order to achieve the 2030 goals as an intermediate milestone. After the analysis one was voted as most desirable for the city of Bilbao.

Once the working scenarios were chosen, participants, divided in groups, worked in setting action plans for the preparation of a Sustainable Energy and Climate Action Plan (SECAP) 2030 for Bilbao.

Obviously, the involvement of local stakeholders provided answers to the need of making this process more participatory and, hence, more open to new inquisitiveness and proposals. But it also produced a natural embracement by all participants and guaranteed further involvement.

Main participants:

The workshop was led by Tecnalia, with over 30 participants from different organizations: local government, energy agency, energy cluster, private companies, universities, etc. Considering not only ATELIER partners but also other entities as long as they could be meaningful for the action plan.

For over four hours attendees worked in three tables: i) rehabilitation and edification, ii) mobility and public space and iii) energy generation. In all tables a facilitator guided the discussion to ensure a better understanding of the purpose and avoid too long exchanges in less important topics. Gathered information would later be processed to be integrated in the action plan.

Results & lessons learnt:

Up to thirteen contributions were collected in the first part of the event. Among others we can point out topics related to metropolitan governance and the need for a more holistic vision involving all stakeholders. Specially getting engagement of citizens and property managers as key agents for the renovation of the residential housing stock. Nevertheless, the complexity of delivering impactful incentives and policies in this sector was understood to be beyond generating mere involvement. Management capacity at local administration, resistance to change and lack of solutions with sound business models were mentioned as key barriers in this sector. Not only the residential part but also tertiary buildings and public building stock was analysed.

In the case of the mobility sector the big discussion was over the deployment of Electric Vehicles (EVs). But also other potential alternatives such as biofuels or hydrogen. In any case limitation to combustion vehicles was understood as a key enabler for achieving faster deployment. Regarding public transportation it was considered unattainable to achieve a 100% electric bus fleet by 2030. And the discussion went more around providing alternatives such as active micro-mobility, implementation of superblocks, improve dissuasive parking lots and shared mobility.

Finally, in the energy generation field, there was a dichotomy between optimism and realism. In one hand because energy efficiency to reduce consumption was considered as a fundamental pillar. However, this relies very much in engagement of private sector and, although awareness is increasing, results show a slower pace in impact than desirable. There are also some barriers linked to the lack of dynamism of the legal framework. New models and concepts related to flexibility are appearing (development of local energy markets, energy communities, etc.) and legal framework reacts slowly to new requirements.

Results of contributions to alternative scenarios are shown below:

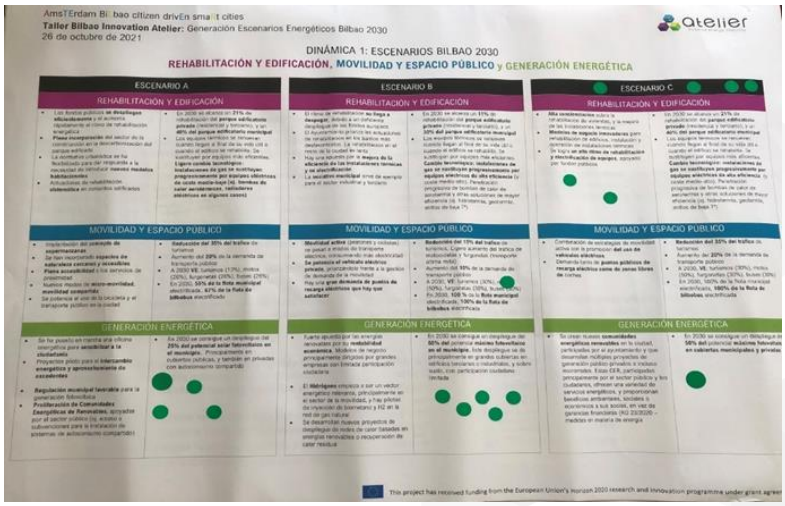

Figure 5: Results of contributions to alternative scenarios

In each worktable over 20-25 actions were proposed. All inputs were further analysed and considered for the definition of the SECAP 2030 that as Covenant signatory shows an official commitment. The workshop achieved expected goals and allowed interactions among participants in other subjects.

Electrification of heat demand in PEDs

When & How:

Delivered on December 15, 2021 it was organized by the Energy Agency (EVE) to showcase a number of technical solutions for the electrification of heat demand in urban positive energy districts. The format was an online webinar open to the participation of any interested local administration, private company or other organizations.

Subject & Purpose:

Given the need for decarbonisation of heat in the building stock in Bilbao the purpose was to present the current situation and demonstrative cases for the electrification of heat demand. Mainly these cases were based on heat pumps due to the link with local renewable energy generation (photovoltaics and geothermal) and the one coming from the grid. According the National Energy and Climate Plans (NECPs) 74% of final electricity consumption will be supplied by renewable energy in Spain by 2030[4].

Presenting different approaches and solutions to a common problem was part of the Energy Agency strategy to foster the deployment of electrification in heating. In addition to establishing a number of incentives, events and webinars for communicating and disseminating results among professionals, workshops are also interesting for awareness purpose and show practical implementations to general public.

Main participants:

Over 40 people attended the webinar. Three introductory presentations were delivered with one keynote speech from ATECYR (Spanish Klima and Cooling Technical Association). Over 100 companies belong to this association and overall there are more than 1.500 members. Their participation also guaranteed further dissemination.

Regarding the projects five different solutions implemented by 5 different organizations were presented. This provided a good overview on different solutions:

- Rehabilitation of the Arkaute agri-food campus through geo-exchange (TELUR)
- Individual air-water heat pump in an existing home (IBERDROLA)
- Hybridization of geothermal and aerothermal energy in a fire station (GEINOR)
- Combined ventilation, air conditioning and District Heating and Water production system. (ORKLI)
- The air-water heat pump as main heating and DHW production system in the residential sector. (TECNALIA)

Results & lessons learnt:

Presented detailed heating demand maps using GIS tools showed potential for the deployment of heat/cold electrification in Bilbao. For this case, first step could be a hybrid solution with low temperature district heating network as in ATELIER. Scalability potential within the island of Zorrozaurre and in nearby neighbours was one of the presented results. This could be one key action to decarbonize the building stock of the city.

[4] Last modification to the NECP in Spain suggests a goal of more than 80% (September 2024). But not yet approved at the time of writing this deliverable.

From the varied case studies, a common lesson learnt was to start from lowering thermal demand as much as possible through refurbishments. First energy efficiency.

Need for low temperature could easily be satisfied by heat pumps. In the case of high temperatures hybrid solutions were presented including a combination of natural gas and air-water heat pump.

From the economic point of view, it is important to notice that most of cases are related to tertiary buildings. Some public. This is meaningful because beside economic return there are other benefits considered making the solution of interest. Another aspect is whether this is linked to a new building or an old one. The latest probably would need extra adaptation work which is perceived sometimes as a difficult barrier to overcome.

Bilbao's Energy Action Plan 2030: From master scenario to the action

When & How:

Delivered on November 29, 2022 it was organized by Tecnalia at the City Council of Bilbao's premises. It was a face to face meeting for a working session of 3 hours to define the city's Action Plan 2030. The design of the session followed a methodology developed by Tecnalia to light up an awareness process in participants prior to the meeting with interactive questionnaires and a dynamization process during the event. This resulted in having participants very much aware of the purpose, actions to be evaluated, and their role.

Subject & Purpose:

The goal of the workshop was the co-creation and validation of main activities to be included in the Energy Action Plan 2030 for Bilbao. Having the master scenario and previous work developed in ATELEIR project (Vision 2050, setting decarbonisation goals for 2030, etc.) the session focused in working over the strategic lines of the Plan and evaluating potential actions and their impact. The evaluation was conceived not only from a qualitative point of view but also considering measurable impacts.

It must be pointed out that the session allowed to integrate a systemic approach combining expertise and administrative burdens to decide on most effective actions. For example, analysing the viability of the solutions from the financial point of view, alignment with city's financial plans, affection to the urbanism, need of inter-departmental collaboration, etc. Bringing each case to reality and understanding their key enablers and barriers as well as potential benefits at city level.

Main participants:

Only City Council's departments participated in the session with 15 people representing most important fields (mobility, buildings & infrastructures, tax, development agency, lighting, energy, urbanism and ICT departments). The session facilitated the exchange among departments that were not use to collaborate too often.

Results & lessons learnt:

Main conclusions from the session can be summarized as:

- Over 90% of the emissions belong to private users. The role of the city to decarbonize it must be well understood as there are clear barriers to intervene in some areas.
- Although the City Council can adopt own normative framework this can become a barrier for some developments. An example was explained in relation to building

rehabilitation: This was the case in one city where they established higher requirements than in rest of the region for refurbishments. It meant that envelop renovation required more insulation to be more energy effective. But this also meant higher costs and as result the year renovation rate slowed down to a half in the next years.

- The case of mobility is hard to evaluate. In one hand because the emissions inventory of transportation lacks data. Many times, this is linked to the number and typology of vehicles registered in the city, without considering real consumption. On the other hand, data related to incoming and outgoing vehicles is not sufficient. All this makes difficult to understand where the city really stands.
- One of the main problems is related to a massive deployment of EVs. Although it was already expected for recent years the process is much slower than initially forecasted. Private users are very reluctant to change (higher prices, shorter autonomy, charging difficulties, etc.). The city council is planning a public charging infrastructure and to provide financial incentives for the purchase of EVs. They are also working in establishing emission free areas in the city with high restriction to combustion vehicles. However, they are very well aware that the planned change is out of their hands and probably will take effect in a slower pace.
- In the case of Bilbao decarbonisation of thermal consumption in residential level is a difficult task due to lack of sound substitutive solutions. Generally speaking, demand is low, because of mild temperatures over the year, and most used system is individual gas boilers for both heating and hot water. Individual solutions would be related to heat pumps, but they would need changes beyond only the boiler (inner heating circuit would also need changes) causing higher costs the adaptation.
- Transversal work among departments and governments is needed. There are many interdependencies that are not considered properly. Governance is a key issue not only interdepartmental but also with other government levels (regional, national and European). The constitution of the SmartCityGroup in ATELIER as seed for development of the City Vision 2050 and the Action Plan 2030 has proven to be a good tool to address some of these linkages.

Opportunities for energy communities in the framework of the energy transition in Bilbao

When & How:

Delivered on May 17, 2023 it was organized by the Energy Cluster as an open live event in Bilbao. The workshop presented a number of cases and a roundtable to allow discussion and answer the questions from the audience.

Subject & Purpose:

The main purpose of the workshop was to share experiences and good practices in the deployment of energy communities by public administrations. This topic was addressed in the first session of the day. During the second session technological developments that could facilitate the implementation, operation and management of energy communities were presented and discussed.

Main participants:

Over 40 people attend the workshop. After an introduction of the progress of ATELIER project and the actions at Zorrotzaurre island by the Bilbao City Council, the Basque Energy Agency (EVE) presented Ekiola initiative, aimed to promote the creation of cooperatives energy

communities. The Araba Provincial Council also presented their recent experience in commissioning Ekiola cooperatives in their territory. This first session concluded with the presentation from i+DE (DSO belonging to Iberdrola Group) to describe the capacity of the distribution grid in the Basque Country and the challenges to accommodate the new self-consumption facilities planned in the short/medium term. This led to an interesting discussion on the existing regulatory framework and alternative configurations of energy communities.

Estimados/as,

El proyecto H2020 **ATELIER** (https://smartcity-atelier.eu/), que el Ayuntamiento de Bilbao co-lidera junto con la ciudad de Ámsterdam, tiene entre sus objetivos el desarrollo y validación de diversas tecnologías y modelos de gestión que favorecerán la transición energética de Bilbao.

En este marco, el Cluster de Energía dinamiza – en colaboración con los socios involucrados en el demostrador de Bilbao - el ***Bilbao Innovation Atelier***, un foro de encuentro para facilitar la participación y el contraste con otros grupos de interés a través de talleres (*workshops*), con objeto de difundir los avances del proyecto, involucrar a agentes relevantes en la adaptación de dichas innovaciones al contexto de la ciudad de Bilbao y aportar conocimiento y buenas prácticas para escalar los resultados a otros distritos y a otras ciudades.

A fin de compartir experiencias y buenas prácticas en el despliegue de Comunidades energéticas impulsadas por las Administraciones Públicas y en el desarrollo de tecnologías que favorezcan su implantación, operación y gestión, os invitamos a participar en el taller sobre **Oportunidades para Comunidades Energéticas en el marco de la transición energética de Bilbao** - promovido por el Cluster de Energía en colaboración con el Ente Vasco de la Energía (EVE) y el Ayuntamiento de Bilbao, y que tendrá lugar el **miércoles 17 de mayo a las 9:00h**. en el Palacio Euskalduna **de Bilbao, sala 3B**, con la siguiente agenda:

9:00h. Bienvenida y contexto del taller (*Cluster de Energía*)
9:10h. Proyecto ATELIER y su impacto en la transición energética de Bilbao (*Ayuntamiento de Bilbao*)
9:30h. Comunidades energéticas ciudadanas: Iniciativa Ekiola (*Ente Vasco de la Energía, EVE*)
Experiencia de la Diputación Foral de Álava (*Diputación Foral de Álava*)
10:00h. Café-networking
10:30h. Panel: proyectos e iniciativas de I+D en colaboración en el ámbito de las Comunidades Energéticas (*Modera: Cluster de Energía*)
- ENEBRAIN (*Energy Brain*): Solución de gestión de la energía para Comunidades y prosumidores comerciales e industriales (*Edinor*)
- ELKARTEN (*Elkarte Energetikoa*): Desarrollo de tecnologías para la optimización de la gestión de la energía en comunidades energéticas (*Giroa Veolia*)
- CEUIS 2.0: Metodología para la implementación y digitalización de Comunidades Energéticas urbano-industriales (*R2M Solution*)
- Comentarios y aportaciones por parte de los asistentes

12:00h. Cierre del taller

En caso de interés en asistir, os rogamos que os registréis en este enlace.

Gracias de antemano por vuestra participación.

https://smartcity-atelier.eu/ @AtelierH2020 AtelierH2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.864374

Figure 6: Invitation with agenda of Energy Communities event

The second session focused on the development of technologies that could facilitate the implementation, operation and management of energy communities. A panel of companies presented different projects and solutions (residential and industrial) and ended with a round table discussing about lessons learned, challenges and recommendations for the deployment of energy communities.

Results & lessons learnt:

Main conclusions would be:

- A proactive role of municipalities as a key agent for fostering deployment. Not only by providing municipal rooftops and/or land plots but mainly engaging citizens in the process. City councils are perceived as a trustful agent and they can play an essential role in communication and dissemination
- Current regulation is highly protective in terms of access and connection rights and this contributes to delays in the processing times.
- Based on the experience of several participants, citizens prefer to be assessed by promoter on the typology of legal entity that needs to be created as energy community (private company, cooperative, association, etc.).
- Many times, management of energy communities requires expertise from external assessment. This gets more difficult if members do not share same retailer. Consensus may help in getting better services.
- Current services offered by traditional energy retailers result to be insufficient and this leads to creation of new retailers.
- It may be advisable that once the energy community is constituted, promoters continue to be linked somehow to support in the management of trading, maintenance, insurances, etc. In many cases these are provided as a service by promoter company.
- From technology perspective, main challenge is the provision of aggregated services considering all the system components (storage, renewable energy generation, EV charging infrastructure, etc.) and ensuring proper energy system balance.

Energy planning for the decarbonization of heating and cooling supply in cities

When & How:

Delivered on October 24, 2023 together with DecarbCityPipes Project (https://cordis.europa.eu/project/id/893509) it was organized by Tecnalia and the Energy Agency of the Basque Country (EVE) in a webinar format (https://www.youtube.com/watch?v=IEYOLaBbIbA).

Subject & Purpose:

The purpose was to delve into the planning of the heating and cooling supply in cities and the examination of solutions for the phase out of fossil fuels in this sector. According to the new Energy Efficiency Directive 2023/1791/EU all cities above 45.000 inhabitants must develop decarbonisation plans for their heating and cooling systems. Therefore, in a short time many cities will need to find solutions that ATELIER and DecarbCityPipes among other projects can inspire.

The aim of the workshop was to exchange and share experiences from different cities in Europe as well as providing general framework on the situation of the district heating and cooling networks in Spain.

Main participants:

The webinar was attended by over 100 people from public administration and heating and cooling sector (energy companies, ESCOs, developers, etc.). Being a webinar later it has been also viewed by over 250 people more.

Three main ideas were presented:

- An example of a methodology and tool to address the energy planning in cities, as well as an example of its application in Bilbao
- General context of the deployment of district heating and cooling networks in Spain
- Practical examples of solutions to decarbonise these networks and business models applied in each case.

Up to 8 speakers participated with presentations of no more than 10-15 minutes each. The webinar also allowed a Q&A time to enhance exchange.

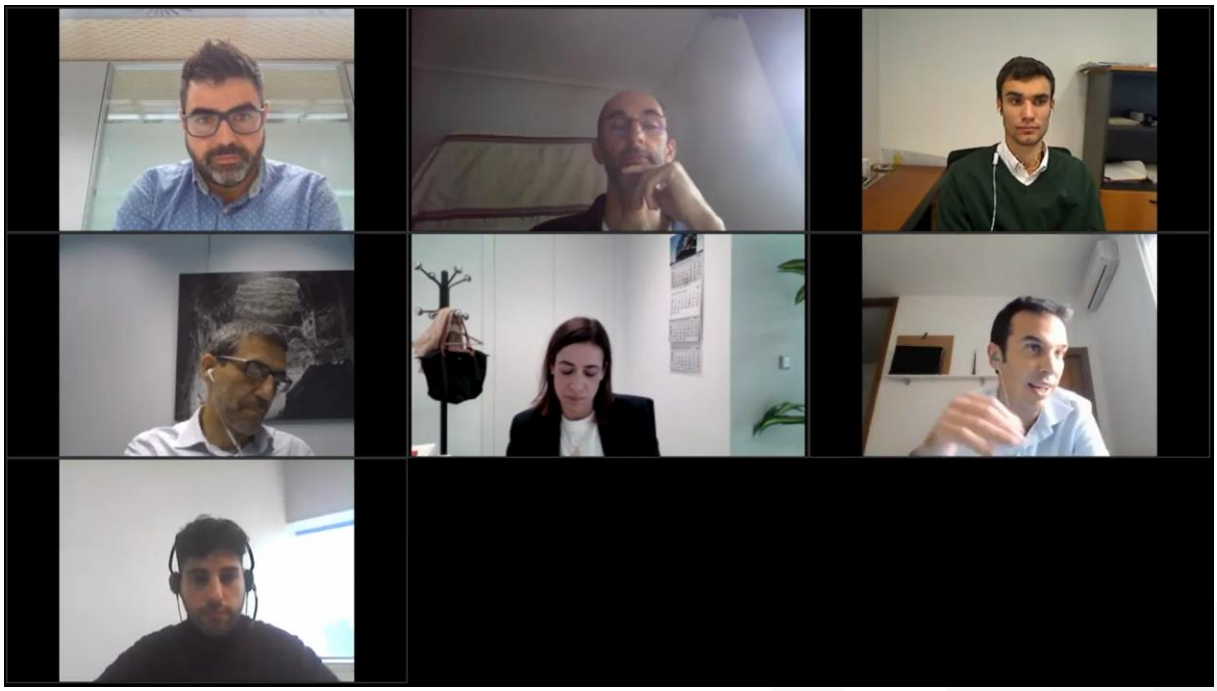

Figure 7: Decarbonization of heating and cooling supply: Speakers in the Q&A session

Results & lessons learnt:

Heating and cooling at urban level represents one of the main consumption sector for residential and tertiary buildings. But solutions are far from being easy specially in old buildings. The webinar provided some interesting results & lessons learnt:

- Requirements get to cities but many times do not have knowledge and resources to implement what is needed. Common tools and resources should be provided.
- In the case of Spain almost all cities have a good natural gas network. Mostly with individual boilers. The use of district heating and cooling networks is low in many geographical areas. Low heat demand in South, East and North of Spain. Only central area has continental climate. Therefore, in most of cases networks need public support to be funded.

- In last years the number of networks has grown and there are more companies interested in promoting their implementation. Sometimes connected to downstream business as in the case of biomass or biofuels.
- New Energy Efficiency Directive comes to speed up the transition process. However, cities are not ready yet.
- Technology wise most solutions are related to third generation heating networks with biomass as a main fuel.

3.3 Framework in Amsterdam

Context, planning, participants

Amsterdam presented a contrasting case compared to the innovation eco-system in Bilbao. While, in Bilbao the Energy Cluster was a pre-existing organization with project partners pre-engaged, in Amsterdam such a platform was missing with all partners participating. Additionally, during the early stages the COVID pandemic also posed some additional challenges. Nevertheless, Amsterdam Innovation Atelier was kicked off on 7th of December 2020 with an event with various stakeholders held at Schoonschip. Since then, a rich eco-system encompassing the municipality, knowledge partners, business community and citizens, in line with the overall quadruple helix approach adopted in the Innovation Ateliers.

Innovation Atelier in Amsterdam comprises of a core group where ongoing challenges related to the project implementation are regularly discussed. The core group, comprising of Amsterdam local project partners, plans the activities and sets the agenda for the Innovations Ateliers. The core group also regularly engages with the wider Amsterdam innovation eco-system, e.g. Amsterdam Smart City (now Amsterdam InChange), Energilab zuidoost as well as wider local and regional initiatives and dedicated competence has been brought in on a topical basis for the various deep dives. The activity of Innovation Ateliers is also integrated with the monthly meetings of the demo site meetings where both emerging topics but also the results from Innovation Ateliers are presented thus offering a strong integration with the project.

3.4 Outcome of the Innovation Ateliers in Amsterdam

Innovation Ateliers in Amsterdam had a strong focus on addressing core challenges that arose during the planning and implementation of various solutions in the Buiksloterham PED. In total six deep dive workshops were held in addition to the joint activities mentioned in section 3.5. Several of these were cross cutting across the four innovation tracks especially with Innovation Track 2: Governance, Integrated planning and Law. For the Innovation Ateliers conducted in relation to Track 1 a summary is presented in the table below.

Activity	Track 1 goal	When
Additional RES production I	Deep dive in possibilities for additional PV in Republica	10/09/2020
Additional RES production II	Second session on additional PV in Republica	24/09/2020
Congestion in the PED area	Evaluation of potential solutions to mitigate impact of grid congestion problems on the project.	16/11/2022

Table 3. List of activities in Amsterdam

While the three additional Innovation Ateliers, one conducted in 2021 on energy communities and two conducted in 2024 related to Energy Sharing and Group Contracts have an impact on

Track 1, due to a much stronger focus on governance, regulation and legislation rather than the technical aspects they are covered within Track 2 activities. In addition, several activities with Amsterdam Smart City (now Amsterdam InChange) have been conducted which are summarized at the end.

Additional RES production

When & How:

The first Innovation Atelier was conducted in two parts on September 09, 2020 and September 24, 2020. The goal was to investigate the possibilities for additional PV resources in REPUBLICA. The first meeting was organized as an online working session with breakout sessions in three areas i.e. spatial planning, legal and technical. Experts and stakeholders were divided into these topics based on their background and interest. The second follow up session, focused on PED definition and demarcation, as well as scenario development and assessment for the addition RES resources.

Subject & Purpose:

ATELIER has a high ambition of achieving a positive energy district in the Buiksloterham area with REPUBLICA, a multi-use development, as a core part of the PED. However, reaching this goal requires additional RES resources than the ones planned within the development. Therefore, the Innovation Atelier explored various possibilities for integrating additional RES in the site. Due to the multi-dimensional nature of the problem, a three-pronged approach was taken covering special planning, legal and technical aspects. In the follow-up session, the insights from the first session were used to discuss PED definition and boundary, and develop scenarios for integrating additional RES. Finally, the scenarios were evaluated in terms of their feasibility.

Main participants:

The first session was attended by 21 experts and stakeholders while the second session had 28 participants. The participants comprised of representatives of:

- Knowledge institutes
- Municipality
- DSO
- Property developer
- Energy community at Schoonschip
- Eystem integrator and solution providers

Results & lessons learnt:

During the first session various solutions for additional RES were discussed. Based on the urban development plans for the area, possibilities where addition space can be utilized were looked at. Façade integrated PV and on-site wind energy were ruled out as infeasible due to low yields and space limitations respectively. Possibilities for utilizing rooftop space at an adjacent parking garage as well as wind energy from outside the geographical PED area were explored. This resulted in the need to assess whether these options would still comply with the PED definition. On the legal aspects the need to avoid social costs (e.g. grid congestion and balancing issues) was discussed. The legal and regulatory compliance for potential solutions were laid out and the financial trade-offs for the solutions were also considered. Finally, the technical aspects related to the potential solutions were discussed. Possibilities of connection

additional resources “before or after the meter” were elaborated and integration with the proposed Local Energy Market (LEM) was considered. The experts also encouraged further examination of energy efficiency on site which can result in a lower need for additional RES. As a follow up of this first Innovation Atelier, two task groups were setup to elaborate on the definition of PED and provide scenarios for additional solar and wind integration.

The follow-up session started with a discussion of PED definition. The definition provided in the original call text for the project (LC-SC3-SCC-1-2018-2019-2020) was used as the basis for this. It was established that the definition doesn’t place a large emphasis on the geographical boundaries of the PED and provides possibilities to integrate addition resources from outside the physical boundary of the area. The stakeholders preferred the solution to be as close to the PED area as possible. Following this, two main and two sub scenarios were discussed:

1a. *PV connected to the Republica microgrid with energy cooperative as owner:* This scenario looked at utilizing spaces in the immediate vicinity of Republica for an additional PV plant. This scenario had the advantage of the installation falling within the regulatory sandbox exemption, this giving the energy cooperative much more flexibility in terms of tariff design as well as access to the SDE+ and the SCE subsidy schemes. The main disadvantage discussed was that the energy cooperative will be responsible for the cable management and costs and additional investment in the PV plant.

1b. *PV connected to the Republica microgrid with 3rd party ownership*: This scenario looked a 3rd party owned PV plant connected to the microgrid of the project. In this case the cable installation might still be a part of the sandbox exemption offering flexibility of tariff design. It will also lower the investment exposure of the energy cooperative. A power purchase agreement (PPA) can be used to purchase electricity from the 3rd party. This also lowers the impact on the potential grid congestion. However, the energy community will still be responsible for the cable management and associated costs.

2a. *PV connected to the public grid of the DSO with energy cooperative as owner*: In this scenario the PV plant is owned by the energy cooperative but is connected to the project through the public grid. This gives energy cooperative control over the installation and removes the costs and responsibility of the grid connection. However, an intermediary (energy supplier/balance responsible party BRP) will be needed. Main disadvantage with this would be the dependency on the DSO in terms of connection and grid costs.

2b. *PV connected via the public grid and owned by 3rd party*: This scenario carries the least responsibility for the energy community as well as least upfront investments. However, the energy community will have the least control over both the grid connection and fees as well as the energy costs. A long-term power purchase agreement (PPA) will be needed.

Following a detailed elaboration on the scenarios the stakeholders presented their preference for the scenarios described above.

				Likert scale				
Discussion matrix PED definition				++	+	o	-	--
				very good/high preference	good	moderate	unfavorable/low priority	not good at all
Different border options versus preference/requirements of different stakeholders								
		On buildings plot	Postcode roos	Local energy according to EPG	Medium Voltage station service	Local energy trading area	None of the previous	Comments
Mun Amsterdam		++	++	+	+	o	--	As local as possible
EU		++	++	++	+	o	--	Little geographical requirements
Alliander		+	o	o	o	o	o	Alliander prefers a societal beneficial solution
Developer Republica								Affordable

Figure 8: Preference of additional RES scenarios for Republica

Congestion in the PED area

When & How:

The Innovation Atelier on grid congestion took place on November 16, 2022. Grid congestion and its impact on the project goals became a core issue during the implementation of the project. This Innovation Atelier was organized to address the challenges that emerged due to the congestion in the PED area and to evaluate potential solutions to mitigate the effects on the project. The workshop was organized by TNO and comprised of topical presentations from the Republica developer, building simulation results from TNO, results of congestion analysis from SPECTRAL (ESCO) and a group discussion.

Subject & Purpose:

Republica initially applied for a grid connection of 2MW transport capacity however, during the processing period of the application the area was designated as a grid congested area on the demand side with the DSO unable to provide this capacity. Instead, a non-firm transport capacity agreement was offered, with only one fourth of the demanded capacity during 08.00-21.00 during the winter months (November to March) and 75% of the requested capacity available during the rest of the time period. This presented a key challenge for the project and an Innovation Atelier was organized to provide and update on the status of grid congestion and potential solutions to the issue. The session aimed to address two main questions:

1. Will Republica (both household and utility buildings) be able to function under these transport capacity limitations?
2. Are there alternatives for the contract offered by the DSO available?

While the second question is central to Innovation Track 2, this deliverable presents some outcomes related to the first question.

Main participants:

The workshop was attended by 12 participants. The attendees were carefully selected with expertise most relevant to the topic and represented.

- Knowledge institutes
- Grid operator (DSO)

- Municipality
- System integrator (ESCO)
- Project developer

Results & lessons learnt:

In order to address the question of Republica being able to function under capacity constraints, TNO developed a digital twin of the site. This provides and assessment of flexibility available in the demo site. Due to large number of flexible assets i.e. a hybrid heat pump and district heating systems coupled with a hot water buffer; a 1 MW battery and EV chargers there is significant flexibility potential that can be utilized. The analysis revealed that the Republica can stay within the limits imposed by reduced transport capacity.

The analysis also revealed that during a few hours EV charging might need to be limited in order to stay within the stipulated limits. Additionally, utilizing the battery towards congestion management can help mitigate risks. While this allows the project to proceed, the impact of congestion on business model of assets such as the battery were significant. The original aim for the battery was to operate on imbalance and ancillary markets (FCR), with the congestion issue, the battery could not be fully utilized for this.

The remainder of the Innovation Atelier covered the advantages and disadvantages of various congestion contracts e.g. Capacity limiting contract (CBC).

Events organized with Amsterdam Smart City

Amsterdam Smart City[5] (currently Amsterdam InChange) is an open innovation platform that brings together innovation professionals from governments, companies, knowledge institutions and civil society organisations to shape the city and region of the future. With several ATELIER Amsterdam partners present there, it offered a unique opportunity for us to engage the wider Amsterdam innovation eco-system and stakeholders on topics of interest. This synergy is being further explored to ensure long term sustainability of Innovation Ateliers post project.

Some sessions of relevance to Innovation Track 1 organized with Amsterdam Smart City are:

- An interactive work session on Smart Cities Dilemmas – Role of Energy Citizens. (January 7, 2021): This session looked at various approaches to Energy Citizenship, such as peer-to-peer platforms, behaviour, justice, cooperation & conflict, skills and technical aspects
- Work session on local smart energy systems and P2P trading governed by citizen's energy communities, moving from research and innovation projects to replication and upscaling (May 16, 2023)
- Work session on Local Energy systems, scale up, scale up, scale up (June 6, 2023). This session explored the challenges of scaling up local energy systems and exploring what obstacles and barriers are there that are in the way of scaling up these initiatives

[5] https://amsterdamsmartcity.com

Figure 9: Session on Local Energy Systems

- A deep dive session (August 30, 2023) and a work session (October 10, 2023) on Local energy systems challenge: How to organize collaboration and knowledge sharing for the creation of local energy systems? A framework was devised for this workshop which is presented below. The framework takes a systems perspective on Local energy systems across four-dimension, policy, energy markets, energy system and end-users.

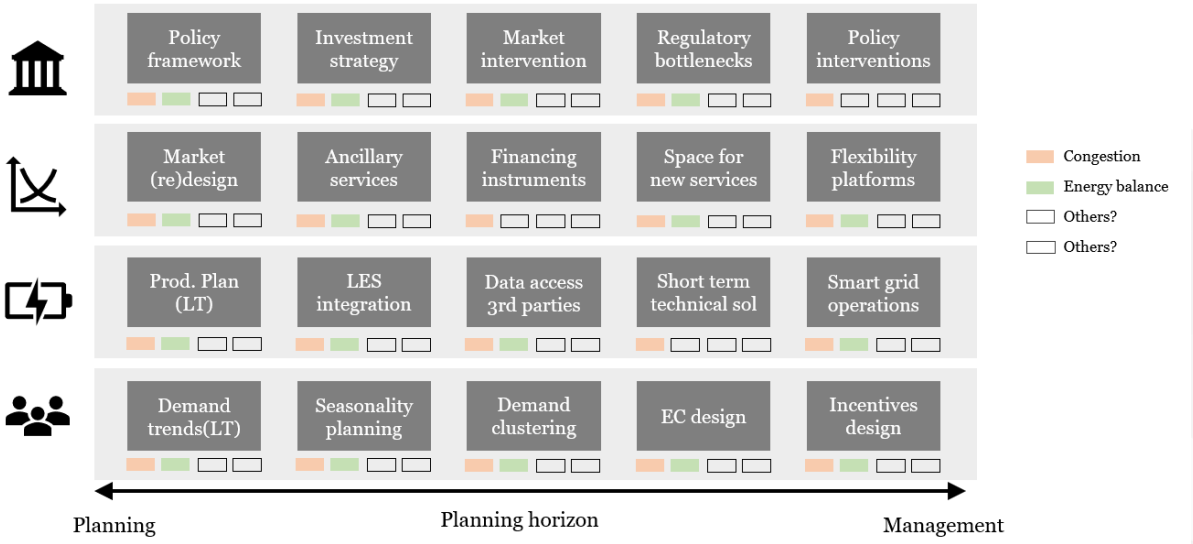

Figure 10: Local energy systems across four dimensions

3.5 Outcome on Joint events

Some events were organized as joint events between Amsterdam and Bilbao in the framework of Innovation Ateliers activities. These were delivered aiming to exchange knowledge and find learnings under different formats including two site visits and an open webinar.

Activity	Track 1 goal	When
Smart grids management	Workshop among ATELIER partners to exchange knowledge on smart grids. Technical visit included to Iberdrola's smart-grid lab. Face to face meeting in Bilbao.	29/03/2023
Energy Management Systems & Local Energy Markets	Workshop with ATELIER plus CityXChange to discuss on Energy Management Systems and deployment of Local Energy Markets. Face to face meeting in Amsterdam.	13/03/2024
e-mobility and its role in the Transition	Open webinar to present impact and solutions to grid congestion problems due to e-mobility.	17/10/2024

Table 4. List of joint-activities

Description is as follows:

Smart grids management

When & How:

Delivered on March 29, 2023 it was part of the technical site visit to Bilbao. During the two days visit, a specific session about smart grids management was delivered at the innovation hub at Iberdrola's premises. It was a face-to-face meeting with only the participation of ATELIER partners to foster discussion and share experiences.

Subject & Purpose:

The purpose was to exchange over grid management including day to day problems related to congestion, e-mobility, etc. Both Spain and Netherlands have made significant progress in smart grid innovation, driven by the need to integrate renewable energy sources, improve energy efficiency and reduce greenhouse gas emissions. However, the approach is different and the session allowed to highlight strengths, challenges and opportunities without trying to compare them.

Main participants:

The meeting was attended by over 20 people involved, both in Amsterdam and Bilbao's PED pilots including public administration.

Presentations went over the following ideas or subjects:

- Smart grids and capacity management in Netherlands delivered by Spectral
- Smart charging modelling presented by DNV
- Iberdrola presented the smart grid and mobility hub
- Developments on energy management systems by Tecnalia.

About 20-30 minutes per presentation plus Q&A session was organized.

Figure 11: Participants in the workshop at Iberdrola's innovation hub

Results & lessons learnt:

There are distinct approaches to achieving a sustainable and modern energy system. While Spain and Netherlands share similar goals and challenges, their unique strengths, weaknesses, and policy frameworks have shaped their smart grid development paths.

Spain's more centralized approach has enabled the development of a robust grid management system, capable of integrating high levels of renewable energy. For instance, smart meter deployment reached over 90% of households. However, this may limit the potential for decentralized energy solutions and peer-to-peer energy trading. In contrast the Netherlands' decentralized approach has fostered a more dynamic smart grid with strong emphasis on blockchain-based energy trading and creation of innovative platforms for peer-to-peer energy trading. But his poses challenges in terms of grid management and coordination, particularly as the share of renewable energy sources continues to grow.

Some challenges are shared, including the need to address cybersecurity threats, develop clear regulatory frameworks, and raise public awareness and engagement. In the future further innovations can be expected such as advanced weather forecasting, predictive maintenance and artificial intelligence. These technologies will enable grid operators to optimize energy distribution, reduce energy losses, and improve the overall efficiency of the grid. Additionally, the increasing adoption of electric vehicles and decentralized energy sources will require development of new business models and revenues streams, such as grid services and energy storage.

Energy Management Systems & Local Energy Markets

When & How:

Delivered on March 13, 2024 was held in a face to face meeting at the offices of AMS Institute in Amsterdam. Delivered as part of the technical site visit to Amsterdam by the partners of Bilbao's pilot.

Subject & Purpose:

The purpose of the workshop was to have an in-depth discussion on the architecture of the Local Energy Market of both Amsterdam and Bilbao pilot sites considering the energy management options and implications for Republica, and buildings in Bilbao.

In addition to this, a broader scope was considered related to the situation of Local Energy Markets in Netherlands and Spain.

This was completed with a discussion among the partners between Amsterdam and Bilbao demonstrators about the commonalities, differences, learning and recommendations.

Main participants:

The workshop was attended by over 20 people from partners in ATELIER project. There were a set of presentations accompanied by questions and discussions from the participants for a total duration of 2 hours. Follows up a brief introduction to each presentation:

- Inspiring session from CityxChange: CityxChange is an European project dealing with the PED concept. The project develops a local flexibility market as well as an energy sharing mechanism between prosumers belonging to energy communities. The presentation included a demonstration of the developed tools in the project.
- EMS in Bilbao (Tecnalia): The EMS developed in the framework of the ATELIER project for the pilot in Bilbao is based on the concept of energy communities. The developed EMS includes a two-layer architecture, the prosumer layer is in charge of the optimization of the energy assets of each prosumer while the community coordinator layer is in charge of calculating the energy prices of the community. The overall approach follows a collaborative mechanism with the goal of maximizing the whole community self-consumption as well as minimizing its energy costs.
- Local Energy Markets in Spain (Iberdrola): The presentation describes the regulatory aspects related to local energy markets in Spain including the most recent activities of OMIE as the Spanish market operator. The presentation also includes the experience of Iberdrola in several research projects related to flexibility management and local energy markets (CoordiNet, BeFlex, etc.).
- EMS in Amsterdam (Spectral): The EMS in Amsterdam is based on the provision of ancillary services to the grid operator. These services include frequency regulation services such as aFCR where the main energy asset is a battery system able to provide 1 MW of power regulation (upwards and downwards regulation).
- Local Energy Markets (LEM) in Netherlands (Spectral): This presentation is about the local energy markets in the Netherlands. Currently the approach to LEM is based on a group connection contract with the DSO. Within this approach, several end users can share a single connection contract that limits the overall power export/import of the group.

Results & lessons learnt:

The main findings of the workshop were the following:

- The EMS of the pilots in Bilbao and Amsterdam are complementary in the sense that they are addressing different aspects of interest. On one hand, the EMS in Amsterdam is addressing the provision of ancillary services to grid operators (congestion management and balancing). On the other hand, the EMS in Bilbao is related to the

concept of energy sharing within energy communities in order to maximize self-consumption and minimize energy costs.

- Although the EMS of both pilots have a different goal, it is interesting to see that the functionality of the EMS in Amsterdam would be useful also for Bilbao and the other way around, the concept of the energy community developed in Bilbao would be of interest also for Amsterdam.
- The grid connection issues that are currently facing in Amsterdam did not yet appear in Bilbao, but the local energy market concept explained by Spectral is an interesting approach for solving these issues in a longer term in Bilbao (if these raised). Basically, there is a share on the connection capacity between different/ building prosumers who have, all together, the commitment of not exceeding the demanded power respect to a certain value, so they share dynamically the total capacity to be below contracted values.
- The EMS in Amsterdam and Bilbao will reach different development levels. The EMS in Amsterdam is already in operation operated by the electricity supplier GreenChoice. In the case of the EMS in Bilbao, this will be more a proof of concept to be validated in a mixed real and simulated environment.
- It seems that the situation of the electricity grids in the Netherlands is more stressed than the ones in Spain. Currently there are many networks in the Netherlands with congestion problems. In any case, it is expected that in Spain congestion problems will also arise in a near future due to the electrification of new sectors such as space heating and electro mobility.
- In Spain, the electricity market operator (OMIE) is clearly involved in the definition of new Local Flexibility Markets (project IREMEL). It is expected that in the near future new business models and market opportunities for flexibility will be created as long as these new concepts are regulated and put into practice.

e-mobility and its role in the transition

When & How:

Delivered on October 17, 2024 with a webinar format, delivered in English, and open to the participation of anybody interested in the topic. The event was widely disseminated through partners, project's communication channels and through the task group of Communication and Dissemination from Scalable Cities. The webinar format allows also recording and later view. The recording is on the project's Youtube channel:

https://www.youtube.com/watch?v=fef1zpmoWYY

Subject & Purpose:

The purpose of the webinar is to cause discussion on e-mobility and its role in the transition towards energy neutral cities. Specially from the point of view of its integration in local energy system and the challenges that appear on reliance, security and planning of the energy infrastructure. The webinar presented three speakers with complementary speeches focused on:

- An introduction to the integration of EVs in the electricity system
- A georeferenced methodology to measure impact of electrification in urban grids
- And finding out which are the smart charging strategies

The three presentations analysed the impact of mobility electrification at grid management, at urban level planning and in terms of smart charging strategies to avoid grid congestion and be more efficient.

Figure 12: Flyer announcing the webinar

Main participants:

Over 40 people registered for the webinar and over 30 people kept connected during the whole event. Most of participants were from outside of the consortium which is a good sign of the dissemination efforts and awaken interest.

Results & lessons learnt:

Shared results and conclusions can be summarized as:

- Out of the study developed by DNV can be concluded that 9 EVs per charger used as norm at many EU countries is not sufficient. The analysis with a co-simulation-based environment to assess the impact of EVs in modern residential neighbourhood and the EV behaviour model based on empirical data complement this result.
- On the analysis of the full electrification of mobility at urban level (case study of Bilbao) is shown that in the short term (2030) the change is manageable for the grid infrastructure. However, in the long term (2050) there may result in an overload of the grid, with consumption exceeding 300% of capacity.
- Essential elements to consider are heat pumps due to high efficiency levels and incentives for charging vehicles during off-peak hours. Self-managed batteries are a new challenge for the grid as loading and discharging may take place simultaneously.
- Smart charging is a term that encompasses many different types of optimisation strategies. And their implementation may have very different outcomes.
- There is a need to adapt regulatory and incentive schemes for flexibility systems. Policy makers and grid operators have to balance these interests. Although there are big differences in optimisation goal between public (grid congestion/stability) and private (price) a balance is needed.
- User awareness is very important and communication strategies play a fundamental role in behavioural change.

4. Lessons learned

In the following section a summary of learnings gathered in deploying the activities of Track 1 in the Innovation Ateliers of Amsterdam and Bilbao is provided. It has been a journey of several years delivering different activities and events which have left interesting results to foster not only the implementation of PEDs but also the formulation of energy and climate strategies. And above all, the establishment of a model based on the local ecosystems to collaborate in the design and implementation of actions and strategies.

The section is divided in two parts: The first one for presenting main conclusions over the results out of the different activities delivered related to Track 1 “integrated smart energy systems and e-mobility”. This is based on a list of solutions explored during the activities either because they are directly linked with demo sites in the project or because they have been analysed for the scalability of PEDs and aligned with the energy and climate strategy planning at city level. The selection of these solutions comes out of the analysis delivered within the innovation ecosystems and is presented with the aim of emphasising which are the most interesting ones for the development of PEDs.

On the other hand, a second subsection with general recommendations is presented. The purpose is to provide tips on how to use and work with an Innovation Atelier. Although focused on Track 1, it is possible that some recommendations can also be interpreted as common to any other Track. However, the ones considered have been highlighted considering the specific work developed in relation with technology solutions.

Both conclusions and general recommendations subsections form the wider lessons learned chapter.

4.1 Conclusions

Integrated smart energy systems and e-mobility are the backbone of PEDs, playing a crucial role in their development and success. By integrating renewable energy sources, optimizing energy management, and promoting energy efficiency, these solutions enable PEDs to produce more energy than they consume. This not only reduces greenhouse gas emissions and mitigates climate change but also creates sustainable, resilient, and economically viable neighborhoods.

For this subsection follows up an analysis of solutions related to integrated smart energy systems and e-mobility that have been explored in the context of their implementation in PEDs. Main barriers and challenges are also presented for a better understanding of difficulties in their deployment. These come from lessons learned in the implementation phase of demonstrators and from exchange sessions in the Innovation Atelier with different stakeholders.

For the purpose of this chapter, the different solutions have been grouped as follows:

- Solutions that improve energy efficiency
- Solutions that increase renewable energy penetration
- Solutions for energy storage
- Solutions that optimize energy management
- E-mobility

The aim is to reflect for each group the main solutions that can foster the PED development. But it must be said that this analysis does not intend to be exhaustive. Only points out the solutions discussed within the context of ATELIER hoping that other cities may find of interest provided arguments to open their own reflection process.

Solutions that Improve energy efficiency:

Reduction of energy consumption is the first principle so highly efficient buildings with low consumption are very much the first step towards generating a positive annual energy balance. Good insulation, building orientation, materials, …, there are several variables to be aware of. In terms of technology solutions more efficient systems are also possible: appliances with high energy performance, changing heating systems to more efficient ones (changing gas boilers for heat pumps for example), etc. All these can contribute to reduce the overall energy consumption.

However, implementation is not straight forward as some obstacles may also appear.

- ***Cost-effectiveness***: As in any solution, improvement of energy efficiency must be analysed considering its cost-effectiveness. It is demonstrated that business models around passive solutions are not always attractive for final users. Specially for retrofitting actions. This is also true in the case of changing some systems. Energy savings may not be sufficient to justify certain changes.
- ***Adaptability of proposed solutions:*** Sometimes changing an existing system requires to also change all its distribution. Difficulties over a pure change may become hurdles difficult to overcome. A typical example would be changing the gas boiler for a heat pump when you would also need to consider an underfloor heating system. Requirement of refurbishment works on top of changing the equipment may represent a hard obstacle. There is room for improvement and innovation on solutions that are more easily adaptable to current systems.
- ***Resistance to change:*** There is also a social aspect to all this. People prefer avoiding changes and this tendency is more evident with elder people. This becomes a barrier when trying to refurbish buildings or implementing new energy systems.

Generally speaking, it is easier to work with new buildings or new urban development areas than with already existing built districts or areas. Many of the latest solutions can more easily be implemented if there is no need to replace an existing performance.

Solutions that Increase renewable energy penetration:

No doubt that PEDs contribute to the deployment of renewable energy solutions. For electricity generation solar power is the most commonly used solution. The exploitation of other technologies such as wind power or hydrogen for PEDs are not so frequent. In the first case due to restrictions related to urban built environments and in the second case due to high cost of current solutions (for instance hydrogen fuel cells for building stocks).

For thermal energy generation there are more options although some may be debatable. Heat pumps, for instance, are a mature technology that is much more energy efficient than boilers. They allow greater use of renewable energy sources, ambient energy, and waste heat. Barriers come from architectural restrictions in its installation and cost compared to gas boilers.

Biomass is another energy source that may produce renewable thermal energy. It has been analysed as complement to the low temperature solution for peak demands. From the economic point of view this is probably the most interesting solution. There are, however, lots of criticisms to its use due to particle's emissions in the process and the need of transportation of the raw material. For instance, in Spain RD 376/2022 frames the need of considering only local raw material (from within 500 km) and emissions savings are between 87 and 93% in this case. Very high but not completely renewable. Regarding the emissions of particles from biomass and health problems due to its use please see Sisgaard et al[6].

Another very important source of thermal energy is recovery of waste heat energy. And solutions based on waste heat recovery can complement other renewable systems. The main problem related to these sources is the guarantee of availability. In the case of Bilbao the sewage system has been analysed to study a potential heat recovery for its used in a low temperature district heating. Analysis show a high potential although a deeper study must be carried out.

It needs to be said that renewable energy generation must be local so there is a strong geographical component attached to the PED location. Morphology of land and the built environment in the district become a barrier for deployment of these solutions.

Solutions for energy storage:

For electricity, batteries are the main storage solution for discontinuously generated renewable energy such as solar or wind power. Batteries can also play a role in peak shavings or load shifting reducing strain on the grid. Technologically speaking ion-lithium batteries are the most usual ones although sodium based batteries are also gaining market share. However, most of solutions are expensive yet. In the case of Bilbao considering not only the CAPEX but also the OPEX the return of investment (ROI) is many times not affordable. In none of the buildings the investment was interesting. Probably also due to relatively low excess solar generation. Another issue is the connection with the grid and its use as a flexible energy source. Services derived from using batteries are not widely extended in the market.

In the case of thermal energy storage different options may apply: use of ice, water (in tanks or aquifers), ground or even phase change material systems (to absorb or release heat). This can be considered for single solutions and/or district level solutions (district heating or cooling systems for instance). Thermal energy storage systems combined with district systems may allow to satisfy not only thermal energy needs but also to export it outside of PEDs. These systems play a crucial role in generating on-site renewable energy and making possible to transfer the surplus out of the boundaries. They can offer not only the generation but also the distribution of cold and heat. Furthermore, low temperature systems (known as 5th generation systems) may integrate waste energy while offering both cold and heat. In the demonstrator of Bilbao a geothermal ring has been deployed to take advantage of thermal storage system (underground water) and other renewable energies (solar thermal energy for instance) and possibly waste heat recovery in the future (sewage system).

[6] "Health impact of anthropogenic biomass burning in the developed world" European Respiratory Society position paper, Sigsgaard et al., Septiembre 2015

Solutions that optimize the energy management:

Optimization in energy management can be tackled from different angles. In ATELIER two main sides have been analyzed: Tools and management processes. Regarding tools monitoring and energy management systems have been implemented in the demonstrators to evaluate performance and control energy supply and demand allowing optimized management and reduced energy waste. It should be noted that optimization may pursue different goals such as, among others, lowest energy consumption or most economic system for users. These different approaches have been analyzed and their energy management systems, at least conceptually, developed. However, there is a limitation regarding the implementation of new energy services related to local energy markets. Participation of new players in the market is not yet completely regulated as some participation barriers remain established. Business model in the grid does not allow a widespread free participation of private consumers and companies, and regulation for local energy markets is still a pending task for many administrations.

E-mobility:

Electric mobility is obviously at the forefront of transportation transformation. Apart from reducing greenhouse gas emissions, there are many other benefits such as improvement of air quality, reductions of noise pollution, lower operating costs, higher energy efficiency or reduction of infrastructure costs. However massive deployment remains as a challenge. There are also many barriers obstructing the change, among others to name a few, a weak charging infrastructure, range anxiety due to battery's autonomy or high upfront costs. In regard to PEDs EVs can play a very interesting role as element for the energy management. Their energy storage capacity together with smart charging systems could help maximizing energy generation and use. However, in both demonstrators the deployment of charging infrastructure has been limited and, hence, results and impact for the PEDs have been less significant. For better impacts higher number of vehicles and charging infrastructure must be considered. Perhaps involving public or private fleets.

The impact of e-mobility on the grid needs also to be considered. At urban level grid congestion issues may appear if the number of EVs grows massively. Management of charging systems is another key question on the table as high number of vehicles may charge simultaneously. This is also connected with the potential role of EVs for storage that would only work if energy is recovered when needed. Otherwise, the assumed role of flexibility balance in the grid will not work.

4.2 Recommendations for operation

As recommendations on the operation and functioning of Innovation Ateliers regarding Track 1 and the analysis of energy management systems and e-mobility follows up a description of lessons learned grouped by impact criteria:

- **Sustainability:** PEDs should be integrated as part of the city's long term energy vision and strategy. They play a role as enabler for developing maximum exploitation of local resources and services. Furthermore, by creating energy positive districts, cities can reduce energy costs for residents and businesses, making them more competitive and

attractive. Sustainability should not only be understood from the point of view of reduction of greenhouse gas emissions but also considering that PEDs provide showcasing of innovative technologies and fostering community engagement while achieving competitive sustainable energy. In short, PEDs support city's resiliency and competitive development. Applying this system-thinking approach in the design and implementation of PEDs, resistance to the concept may be more easily overcome.

- **Feasibility of solutions:** Obviously the understanding and analysis of solutions is one of the main tasks for Innovation Atelier. Taking advantage of the participation of different stakeholders, the approach should be holistic as far as possible. This means that beyond technical and economic sides other impacts and co-benefits should also be considered where possible and applicable.

  The PED concept requires to reach a surplus of energy locally. And this goal is achieved by a combination of solutions: energy efficiency measures, generation of renewable energy locally and optimization of the energy management (including potential storage and use of demand flexibility). Therefore, proposed solutions should be evaluated as part of the integrated response and by their complementarity. For instance in the case of Bilbao a low temperature district heating was selected as solution providing not only heat but also cold. Perhaps the cooling demand in the PED area was not significant however its potential exportation to other urban areas or group of buildings made a good case for its business model.

  Another fact is that regulatory framework may hinder some implementations. Different normative levels should be considered and solutions must face them. It is important to adapt solutions to each case specific context and avoid, when possible due to their impact, lengthy approval processes. For instance, in the implementation of the ATELIER project important events (Pandemic and War in Ukraine) occurred during the approval of building permits for new buildings. One of the consequences was a rise in raw material prices that made unfeasible some implementations.

- **Innovation:** Innovation opens the door to adaptation of existing solutions and processes as well as to completely new systems that are more efficient, affordable and appealing to consumers. But this is also true from the point of view of creating new business models, services and experiences that can redefine the way people interact with energy. Therefore, this is not only about new technology solutions but also about being able to understand different ways of participation and perception of added value. By leveraging innovation, cities can create more sustainable, resilient and livable communities to meet the needs of both current and future generations. On top of that, integrating innovation in the process can help to foster entrepreneurship and creativity, driving the development of new products and services.

  New solutions have been developed and tested in both demonstrators. Even when these solutions could not be properly deployed. This has been the case of local energy markets that due to current regulatory framework some solutions have not been fully implemented. However, energy management systems have been developed and tested with capabilities to connect and interact in a potential local energy market.

- **Stakeholder engagement:** This is probably the main asset built up in the Innovation Atelier. A steady group of stakeholders engaged in the co-design process of solutions and planning for PEDs. A minimum quadruple helix model of collaboration and interaction should be considered:
    - **Government:** Representing policy, regulation and funding
    - **Private companies:** Representing business, entrepreneurship and commercialization
    - **Academia:** Representing research, education and knowledge creation
    - **Civil society:** Representing non-governmental organization, community groups and social enterprises.

  By working together, they have been able to leverage each other's strengths, resources and expertise to create new opportunities, address complex challenges and foster the implementation of PEDs. Perhaps in both demonstrators the involvement of civil society has not been as fruitful as desired. Nevertheless in both cases building's private owners and tenants have been engaged.

In order to conclude with these lessons learned section, it is noteworthy to point out that beyond common issues a tailoring effort must be considered for each context. There are many variables and actors, and their combination results in a high number of scenarios with different solutions, partners, etc. This should also be seen as an opportunity to explore possibilities where co-creation processes can be very rich in the design and analysis phases.

It should not be forgotten the role of city council departments. Their involvement is essential to connect all and deliver the best possible answer to short and long term strategies in the city. Lack of participation from municipal departments weakens the impact of the PED.