DECARB CITY PIPES 2050

Report on exchange activities and lessons learned from transition experiments

Deliverable 5.2

AUTHORS
Prepared by:
Jon Gonzalez, Bilbao
Patxi Hernandez, Tecnalia
Reviewed by:
Nora Fernandez, Tecnalia
Viktoria Forstinger, UIV

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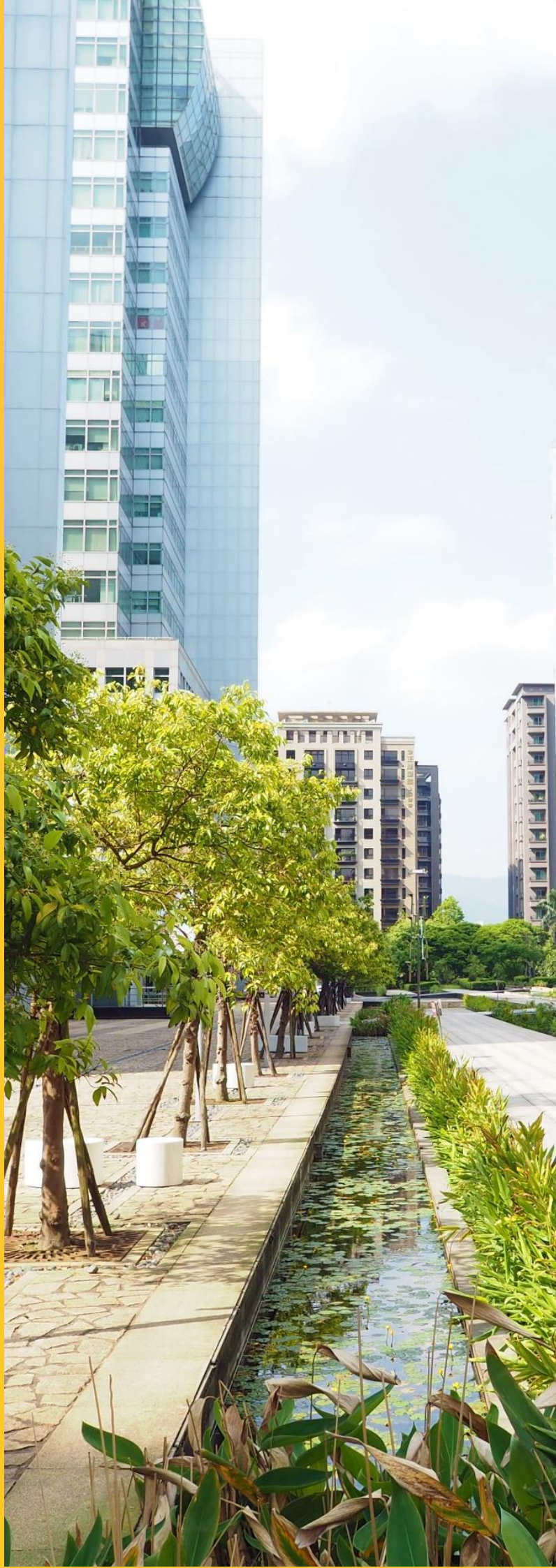

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Executive Summary

Report on exchange activities and lessons learned from transition experiments

The learning exchange activities of the Decarb City Pipes 2050 project focused on deepening knowledge and building capacity on various regulatory, technical, organizational, social and economic opportunities for cities on their path to fossil fuel phase-out.

The objective of this task was to stimulate crucial exchanges between partner cities and support their testing by scientific partners, and subsequently consolidate key findings and documentation for replication.

The learning exchange focused on the visits to the different cities and the understanding of their projects on the use of alternative solutions for heating and cooling buildings and the energy transition in general.

This report describes the different study tours that took place in the different cities and the lessons learned, mainly related to the experiments conducted as part of the project. For more information on the transition experiments, see report *D5.1 Summary of Transition Experiments.*

Introduction

Context and Overall Objectives of the Project

Responsible for roughly half of the EU's final energy consumption, transitioning heating and cooling to energy efficient, renewable solutions will be critical to bring EU countries in line with their pledged climate and energy targets. Given the long-life cycles of the grid infrastructures involved, there is an urgency to start the planning of this transition today. But how? What first? Which systems? How to govern this process? Increasing complexity of the energy system together with technological uncertainties require a high level of knowledge and skills to act wisely. Cities are not yet fully equipped for this. They lack capacity and skills as well as legal empowerment to act.

Decarb City Pipes 2050 showcases how local authorities can build capacity to succeed in this challenge. Seven cities - Bilbao, Bratislava, Dublin, Munich, Rotterdam, Vienna and Winterthur - teamed up to work out actionable roadmaps to decarbonize heating and cooling for buildings in 2050, thereby taking up the challenge of phasing out natural gas in heating. They explored pathways suitable for their local challenges and built up skills in the use of data, planning tools and instruments, techno-economic as well as process and transition management knowhow. In a participatory process with stakeholders, they developed transition roadmaps, building up trust and commitment for its implementation along the way. In deep peer-to-peer exchanges, cities and utilities shared knowledge to benefit from other perspectives, stages of advancement and planning traditions.

Objective and Purpose of this Deliverable

This report deals with the information about the exchange activities on transition experiments carried out in the framework of the project. The exchange activities are mainly focused on the different site visits that have taken place in the different cities. The places visited are in some cases related to the transition experiments carried out by the partner cities (see report D5.1 Summary of transition experiments).

The goal was to increase the knowledge of the participating cities about novel solutions and to build capacity regarding the different opportunities on the path to energy transition.

The following chapters report on the site visits and lessons learned in each city. At the time of writing, future study visits (e.g. Dublin) have not yet been completed.

Summary on Exchange Activities

Initial Workshop on Transition Experiments

The initial session on Transition Experiments was part of the agenda of the online project meeting organised in October 2021. It was set up as a collaborative activity between WP4 (Transition Roadmaps) and WP5 (Experimenting with solutions) with the aim of learning from area-based initiatives/pilots and potentially transferring that knowledge into the development of the city-wide heating transition.

The participating seven cities were paired in break-out groups and divided – according to the content of their experimentation areas – into four main topics (large-scale building refurbishment, area-based/zoning, institutional resource capacity and business case, and legal framework and socio-economic issue).

Despite this structure, discussions remained rather broad and thus covered a wide range of elements. The aim of the exercise was for the cities to refine their proposed experiments, make them more robust and develop a broader strategic and long-term approach. In the process, the exercise also aimed to identify commonalities and differences between the cities (socio-political context, energy vision and policy, governance...) and to explore the extent to which stimulating exchanges can be organized to address local and general obstacles.

For each of the four break-out groups, the work process was structured along three separate sections linked to the execution steps of the pilots:

Making the urban H/C experiment: Cities reflected on the identification of challenges that could arise during the urban experiment implementation.

- Analysing and describing gaps in terms of knowledge and procedure and how can they be overcome or ameliorated.
- Identifying potential outcomes from the experiment as a result of its operation either in the process or at the end.
- Identifying next steps and needs for implementing the experiment.
- Possible strategies to build coalitions between different parties involved.

Maintaining the urban H/C experiment: Cities reflected on the relevance of the experiment in the context of their urban transition strategies.

- Institutional/economic/regulatory resistances that can affect the experiment.
- Needs for a productive coalition between actors.
- Connection of the experiment with urban agendas and the institutional support.
- Ensure that experiment leads to a broader strategic urban change.

Living the urban H/C experiment: Cities reflected on potential learnings.

- Verify, monitor and capture learning from the experiment and the purpose of that evaluation.
- Narratives, policies and procedures that can help.
- Role of politics when considering the potential of the experiment to reconfigure existing urban HC system.

The following paragraphs briefly summarize discussions in the four break-out groups:

Large-scale building refurbishment: Vienna and Bratislava

The City of Vienna is working on neighbourhood-based solutions for decarbonizing the building stock as part of a large-scale urban project (WieNeu+). A significant knowledge gap that currently needs to be filled is the matching of supply-side mechanisms of different heat sources (low and high temperatures) to the local-specific heat demand. Essential to this is the determination of the best heat supply solutions to meet demand in the course of a spatial analysis. In some cases, it is also based on the combination of different heat sources or supply.

Vienna has developed an urban energy atlas to map the spatial availability of heating sources. Also, further digital applications have been developed for house owners to access information on heating sources. However, data on the state of renovation of building blocks is yet often lacking (if not done with a subsidy) and there is a lack of procedures and standards to assess what is needed for which blocks and how to align different sources in tailored demand structures.

The heat transition is currently largely hindered by the high upfront investment costs for end users to install a new heating system. Subsidies are thus important to push for exchanges. More importantly, however, adequate regulation is necessary to give house owners legal clarity on what heating system they need to install in case the current one needs to be replaced or is being built anew. Also challenging is the fact, that, even though the legal owner of the building is responsible for the changes in the heat systems, tenants need to agree on the replacement of a boiler, since most apartments in Vienna are heated with individual gas boilers inside the flats.

A decarbonization process must consequently bring all the relevant stakeholders on board. In the case of Vienna, the utility (electricity, district heating and gas) has already announced its intention to switch to district heating as far as possible and to decarbonize the existing district heating network. Green gas is to be used in Vienna in the area of heat supply only to balance the network and to cover peak loads in the network. The utility as well as the DSO are also part of the local municipal working group. Both are aware of the public cost of the infrastructure and possible lock-in effects of the technology. Pilot projects are seen as a turning point to raise awareness of the need for an appropriate regulatory framework and proper policies that establish general procedures for the entire city.

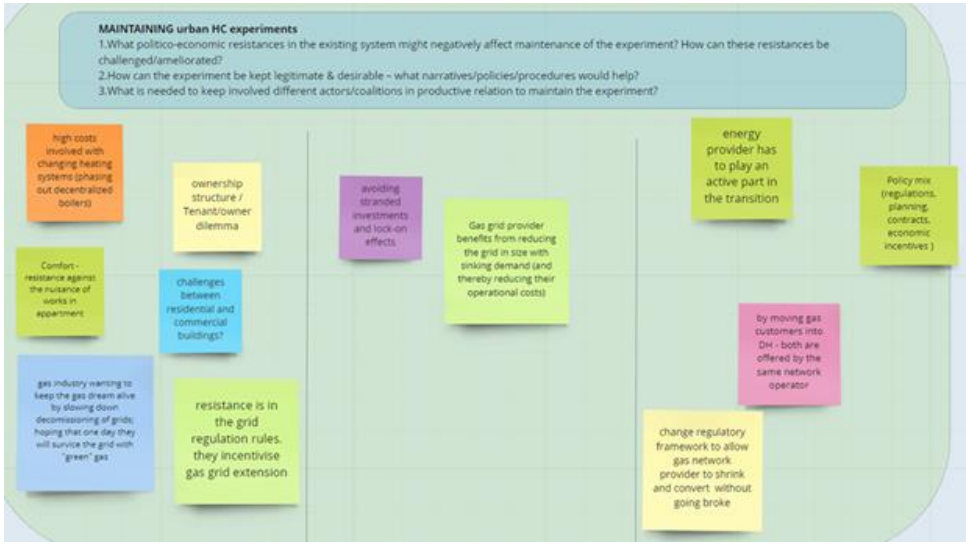

FIGURE 1: MIRO BOARD OF THE SESSION

Area-based/zoning approach towards decarbonising heating and cooling: Rotterdam and Dublin

Rotterdam and Dublin are both pursuing a similar trial project based on a district approach with the aim of decarbonizing certain parts of the city. In Rotterdam, some district-wise systems for heating water are already in operation, but in some cases still using fossil fuels. Dublin, however, is taking a completely new approach to this for the city. Dublin is very much supported by the authorities in the implementation of decarbonization zones, as they will serve as a test area.

The common goal is to create a standard roadmap with a multifunctional methodology. Both cities have already done extensive work on mapping spatial, infrastructural, and techno-economic aspects, but are still uncertain whether they will have a legal basis for enforcing mandatory connection in these zones. Since theory is always much easier than applying it to a real case in a neighbourhood, both cities agree that the process must be won through practical experience.

A strategy to involve citizens is of paramount importance. Substitution of natural gas is not an easy task, as even currently there are still favourable economic conditions or it is simply more convenient to obtain it. Therefore, communication with citizens is highlighted as a key issue. In order to gain the trust of citizens, it is important to show the advantages and potentials of switching from natural gas to a renewable system, to involve stakeholders, but also to make prices transparent and accurate comparisons.

Institutional resource capacity/business case: Munich and Bilbao

Bilbao´s experiment focussed on a feasibility analysis of the replacement of oil boilers by renewable energy systems, such as heat pumps. Munich instead focused on allocating sufficient resources and staff for the large-scale neighbourhoods retrofitting plan in the city. In this sense, both cities were committed to create more institutional capacity and try to set a standardised business case for their experiments. The City of Bilbao appreciated the example of Munich for the implementation of district offices and managers, responsible of the refurbishment plan of each district. That could be potentially replicated in Bilbao, e.g. in

context of a business case development on oil boiler substitution. The experiments aim to demonstrate a successful scaling up. However, that needs of course corresponding funding.

Bilbao further highlighted the political and economic difficulty to foster the heating transition and the engagement of citizens. When solutions (heat pumps for instance) are not economically feasible, tailored business models through subsidies or other potential systems need to be found. In the case of heat pumps, the option to provide cooling is a competitive advantage to other products. However, it is for the time being not so demanded yet in residentials. Munich spoke of the promise of the neighbourhood-based experiment, provided that neighbourhood concepts are holistic and include multiple narratives that are tailored to the individual district.

Both partner cities agreed that experiments are vital steps to build important strategic bridges to a new future. They further underlined the vital role of an adequate and supportive political framework to prompt this change and of course the money to deliver.

Legal framework and socio-economic aspects: Winterthur and Vienna

The proposed experiment by Winterthur draws its basis from the new Canton energy law. The Canton of Zurich has authority to promote this law which enacts an obligation for house owners to substitute their of oil/gas heating systems with renewable systems. The gas network, which is publicly owned, is no longer extended. In recent years, according to official statistics, there have already been more approval procedures for the installation of renewable heating solutions than for systems based on fossil fuels. Consequently, the change is already underway. The law will now accelerate it further. However, citizen engagement is still a hurdle, especially since installation costs for non-renewable systems are still cheaper in comparison. However, considering the total cost (energy and maintenance), renewable heating systems are more cost-effective. Thus, there needs to be good and detailed communication and education about this. This requires a good communication and support plan, which should especially consider low-income families.

The goal of this experiment is not to implement the provisions arising from the law in the real world. In the next few years, the city must accelerate the expansion of district heating to meet all of its renewable heat needs. This requires a lot of resources, high upfront costs, and a high level of public acceptance. It becomes even more complicated with the elderly who may need active care. In short, passing and implementing this bill is a real challenge, but is of unmistakable value in achieving the net-zero urban goal.

Lessons learned

This Transition Experiments kick-off meeting was a first point of contact to foster interaction between the partner cities and to push for a better understanding of the development of the experiment and its integration into each city's heat transition roadmap. A key finding was that the cities share similar challenges and barriers, and their approaches to solving them can be mutually beneficial.

As a result, several study visits were arranged to learn about the pilot projects of the "experiments" in detail. These visits are described below as further activities of an intensive exchange of experiences.

Study Visit in Rotterdam: Gas-free-neighbourhood Heindeijk

A first-ever study visit in the context of Decarb City Pipes 2050 in Rotterdam in April 2022 (after having been postponed time and again due to Covid-related travel restrictions) included a site visit to the Heindijk neighbourhood, which is one of the several zones related to the city´s district-oriented approach. Several colleagues from CODEMA, the City of Dublin, the City of Bilbao, City of Bratislava, Energy Cities and UIV as well as from the City of Rotterdam took part in this study visit.

This low-carbon area-based approach aims to not only foster and accelerate the phase-out of natural gas in specific districts, but also to set a standardised and scalable business case, which can then be replicated across the city.

In each of the city´s gas-free-neighbourhood districts, and specifically in Heindijk, Rotterdam´s so-called WHAT-map has been used for providing insights into the alternatives to natural gas with the lowest social costs for existing buildings. As such, this district-oriented approach offers the opportunity to minimize inconveniences for house owners and reduce costs, while at the same time improve the living environment of residents. Rotterdam thus aims to link several opportunities of the heat transition.

There is a clear commitment that Heindijk becomes free of fossil fuels in 2027. The area comprises 638 houses and 7 utilities.

Which steps have been followed for the process?

At first, a technical evaluation of the current heating systems, demands, and possibilities of energy sources was undertaken. Four main alternatives to natural gas were envisioned (district heating and insulation, all-electric and insulation, district heating for apartments. and all-electric for single houses, and low-temperature district heating).

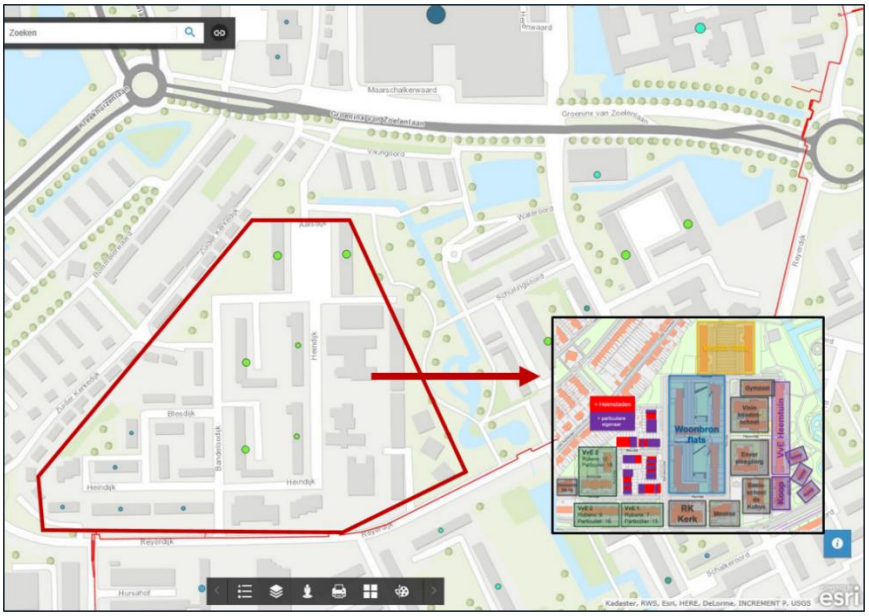

FIGURE 2: HEINDIJK NEIGHBOURHOOD

Subsequently, a financial study of the total costs for all solutions was conducted. The basic idea was to make the transition affordable for every resident and leave no one behind. A low threshold and a relief approach are important so that residents experience little additional stress and regulatory pressure. Total costs for all stakeholders include both infrastructure and building-related measures (connection costs). The results show that district heating is the most viable solution. A business case that takes all stakeholders into account is about to be submitted after the investment decision has been refined with the heat supplier.

Social marketing techniques (surveys, meetings, etc.) were essential in discussions with residents to obtain direct feedback on their expectations. The evaluation of the approach focused on the Heindijk district shows, among other things, that the communication strategy based on timely information, tailored solutions and positive personal interaction was a clear strength.

FIGURE 3: STUDY VISIT AT HEINDEIJK IN APRIL 2022

The projects lead to a neighbourhood contract, which is concluded with the most important actors in the neighbourhood, e.g. the social housing association, private owners, private tenants and actors with high heat demand. There is not yet a mandatory legal requirement forcing connection to district heating, and each resident makes their own decision. Nevertheless, the results were impressive: 73% of homeowners agreed to be connected to the heating network, as did one private tenant, one social housing company and some utilities.

Lessons learned

The participants of the Study Visit in Rotterdam had the opportunity to get a first-hand understanding of the district-based approach project during the visit to the Heindijk district. In the course of the longer walk through the neighbourhood, it was also possible to hold occasional conversations with residents, and even to visit a residential building recently

connected to the district heating network, some of whose residents have already switched from a gas stove to an electric stove in the spirit of a holistic gas phase-out.

A key finding noted was the importance of conducting a comprehensive financial analysis of social costs for all solutions considered before making a decision. It is also important for the development process to engage all stakeholders (including heat suppliers) in the solution.

Finally, the benefits of social marketing techniques are highlighted. In most cases, residents are more interested in issues related to their neighbourhood than in decarbonizing their energy supply. However, these social dynamics within a neighbourhood can also be actively used to help residents understand the benefits of connecting to district heating.

Site Visit in Vienna: Replacing individual gas boilers through a centralized heat supply system

The Site Visit at Miesbachgasse 10 (in Vienna´s 2nd district) took place on 11th May 2022 in the context of Decarb City Pipes 2050´s 4th project meeting.

The social housing company SOZIALBAU AG, one of the largest in Austria, tested in its residential building located at Miesbachgasse 10 in Vienna its concept of a "community boiler" (= “Gemeinschaftstherme”): the centralization of the heat supply through the construction of community heaters.

FIGURE 4: VISIT OF MIESBACHGASSE IN VIENNA

After reaching an agreement with the tenants, the apartments are connected to a community boiler located on the roof. The pipes are laid through the chimneys, and with minimum intrusion to the apartment, the individual apartments are then connected to the centralized distribution network. The initial heat source for this centralized supply in this case was an aerothermal heat pump. Once more apartments are connected, additional heat pumps might be added.

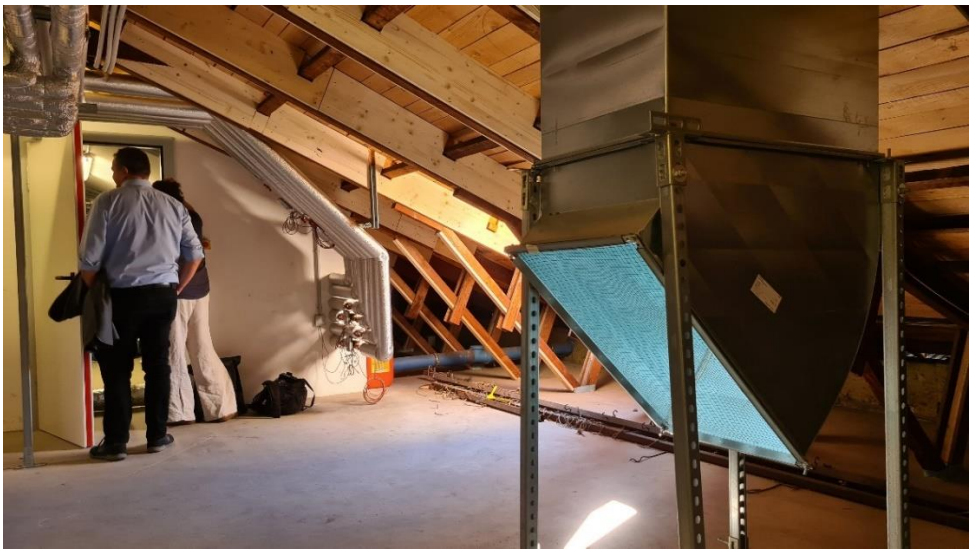

FIGURE 5: OUTSIDE AIR SUPPLY FOR THE HEAT PUMP IN THE ATTIC

FIGURE 6 . PICTURE OF CENTRALIZED HEAT DISTRIBUTION SYSTEM.

As it can be observed in Figure 6, the centralized heat distribution has already been connected to some users and is ready to be connected to the remaining apartments when an agreement with the tenants is reached.

This solution has allowed individual gas boilers to be removed in those apartments which are connected to the central system. An electric boiler was installed in each apartment for water heating supply.

This system has since then already been implemented in several other houses of Sozialbau AG. In case no adequate chimney system is in place the pipes connecting the central system to the flats are situated at the outer façade of the building (e.g. at the one´s located at the inner courtyard).

Lessons Learned

During the site visit the interesting approach towards engaging tenants to move towards this centralized solution was discussed. The social housing company has made a strong effort to communicate, for example, by creating a funny video in form of a movie trailer to convey in a simple yet clear manner the low effort involved in changing the heating system[1]: In a first step, the centralized system is installed by the social housing company´s own building service firm in the attic of the apartment buildings. Once an agreement is made with a tenant, the connection to the centralized system is very quick and with minimum disruption.

There were shared concerns from project partners about the costs of such a process, including of marketing and communication, individual negotiations and agreements, financing the centralised installation before the tenants connect, and the final connection and management of the centralised system etc. While this was possible in this case with a large social housing organization, it might not be possible if this type of intermediary is not available (e.g., private buildings or small public housing organizations).

Project partners also suggested a technical improvement to the current solution by also connecting hot water loads to the centralized heat system.

Site Visit in Winterthur: 2000W Quartier “Lokstadt”

The site visit in Winterthur was held in the context of the 5th project meeting on 8th November 2022. An initial presentation with the description of the Lokstadt project was provided in the meeting venue followed by a tour to the site.

FIGURE 7: VISITING "LOKSTADT" IN WINTERTHUR

[1] Sozialbau AG. Großprojekt Gemeinschaftstherme: https://www.sozialbau.at/gemeinschaftstherme/

The Lokstadt project is located on a part of the old site of the diesel engine maker Sulzer and the Swiss Locomotives & Machines factory (SLM). This industrial site was founded in 1834 and operated until 1989. Once closed, Sulzer tried to find a way to bring back life in the area. After two failed attempts, the first successful housing project was awarded in 1999 and saw the “Kranbahn” housing project coming to life in 2004. This marked the start of a new use of the area, with the construction of a building for the city government and the refurbishment of the former test facility for gas turbines into a school for health sciences.

In 2010, Sulzer Real Estate was bought by the company Implenia, which launched a new architectural competition to continue reviving what was to become the Lokstadt site. After a popular vote in 2015 to approve the public neighbourhood development plan, the first batch of constructions was realised between 2017-2020. The overall Lokstadt project is expected to be finalised by 2026.

The neighbourhood keeps the spirit of the former industrial area while making it fit for present-day uses, through diversifying the use of spaces. Of the available 131,000m² above ground floor area, 21,000m² are reserved for outdoor space. The rest is occupied by residents and professionals. In total, 31 shops, SMEs, and restaurants are located in the site, to make sure that there are activities going on and exchange is incentivised. In terms of housing, 750 apartments for more than 1,500 people are being built, and 30% of the residential surface is reserved for residential housing. In addition, a 100m tower, the Rocket, is under construction, to host 206 flats and 138 hotel rooms. This will be the tallest hybrid construction of the neighbourhood, mixing wood and concrete, with substantially lower emissions during the construction phase and afterwards.

FIGURE 8: SITE VISIT IN WINTERTHUR

From the beginning, the aim of the Lokstadt site was to be energy-efficient. The construction materials and the life of the building afterwards have been carefully studied to emit as little emissions as possible. The heating system is supplied by the local district heating (fuelled through waste incineration). The Krokodil building, one of the spaces reserved for social housing, has 42% of its power consumption covered by PV. The building of 41,000m², composed of 248 flats, has a bearing structure in wood from the 1st floor on, which allowed

to save 1,100 tons of greenhouse gas emissions during the construction time. All these efforts have allowed the Lokstadt site to be certified as a 2000-Watts area.

The 2000 Watts certificate

One of the modern aspects of the Lokstadt site is that it is 2000-Watts certified. There are two aspects to the certificate:

1. The quantitative proof: Greenhouse gas emissions of the sites, non-renewable primary energy used, and total primary energy used have to be monitored and remain below a certain level.
2. The qualitative evaluation: several aspects must be implemented to ensure a good quality of life on site. This includes a management system, good communication with residents, use and diversity of the site, supply and disposal, building, and mobility aspects.

The certification is only valid for two years, which forces labelled sites to always strive for keeping standards and improving, and working for the next certification

Lessons Learned

While the greenhouse gas emissions from construction and renovation can be more easily anticipated and regulated, it is more complicated when it comes to people's behaviours. That is why newcomers will receive a guide in a welcome pack, to ensure the most possible energy-efficient behaviours. Managers of the project have also developed an app, which could propose monthly challenges to residents to cut down their carbon footprint. When it comes to mobility, many squares are thought for pedestrians, and there will be a limitation of the number of cars in the area. The maximum is set at 200 car drivers per hours during rush hour.

All these characteristics allowed the Lokstadt site to be certified as a 2000-Watts area. The project thus poses as a great example of how a historic neighbourhood in a city can be modernised and brought back to life.

Study Visit in Munich: Geothermal power plant

The 1 ½ day study visit in Munich took place directly after the fifth Decarb City Pipes 2050 project meeting in Winterthur on 10-11th November 2022. Project partners from Vienna, Munich and Winterthur joined in, as did further colleagues from Vienna and its sister city Innsbruck (energy utility, DSO, office of the city councillor for climate and the office of the councillor for finance). Munich, Winterthur, Vienna and its sister city Innsbruck used this meeting also to exchange on current activities, framework conditions, targets and measures to achieve those. Among others, Munich also presented its neighbourhood approach, which was also taken into account in the context of its "experiment". In the afternoon, the group joined in on a visit of the geothermal energy plant already in place.

FIGURE 9: PRESENTATIONS AND DISCUSSIONS DURING THE STUDY VISIT IN MUNICH

Munich focuses on intensive neighbourhood development and energy consulting on site. The topics of this neighbourhood approach, however, go beyond heating, cooling and electricity and also include aspects of climate-neutral mobility, economy, climate adaptation, lifestyles and circular economy. The current approach of the city administration towards a new quartier is threefold and proceeds as follows:

- Creation of an integrated neighbourhood-specific concept,
- outreach consulting for single and two-family house areas,
- implementation of individual neighborhood-related measures, e.g. Sommerstraße, Repair Café, Zero Waste Store, etc.

The "outreach energy consulting within the neighbourhood" then is as follows:

- Analysis of the respective on-site conditions.
- Discussions with initiatives, citizens, etc. to clarify needs and ideas.
- Letter with an offer of energy consulting to the homeowners by the city leadership.
- 3-4 weeks before the start of the consulting initiative, various accompanying measures are taken, e.g. activation of a digital participation platform, special sections of the websites, on-site consulting support points are set up.
- If necessary, a kick-off event is held in the neighbourhood to initiate contact with energy consultants.
- "On-site consulting" or implementation of outreach consulting by certified energy consultants.

In the field of energy, in the medium term (= within 5 years), in addition to outreach energy advice in single-family and terraced house areas, solar exchange, energy refurbishment by owners, connection to district heating or, if necessary, the realization of a local heating network will be pushed in particular. The focus of the neighbourhood work is on networking and concentrating activities in a small, limited area. Attempts are also being made to bundle refurbishment activities in order to make the best efficient use of, for example, plumbers, fitters and other workmen, who are currently limited in capacity anyway.

In the afternoon of day one of the study visit in Munich, the group joined in on a visit of a geothermal power plant (HKW Süd).

FIGURE 10: VISIT OF A GEOTHERMAL POWER PLANT IN MUNICH

FIGURE 11: INSIDE A GEOTHERMAL POWER PLANT IN MUNICH

Geothermal energy is a central element in Munich´s Transformation plan for its existing and expanding district heating network. Within the framework of its heating strategy, SWM however also promotes, depending on the heat demand density, in addition to the expansion of district heating, a neighbourhood supply or an individual object supply. Great potentials are also seen for district cooling supply.

Munich is also already actively working to incorporate energy, mobility and climate aspects into urban planning in a standardized manner, and has developed a so-called “Climate Roadmap” (“Klimafahrplan”) for this purpose that is to be applied to all future development plan procedures. A city council resolution has stipulated that energy, mobility and climate resilience concepts are to be implemented on a mandatory basis. All development plans must include provisions on climate protection and adaptation, unless there are legal, technical or usage-related reasons for not doing so. In addition, all development plans shall include provisions on photovoltaic systems.

In its "Climate Roadmap", the city put forward a simple procedural principle that helps to strengthen climate protection and climate change adaptation concerns in a standardized spatial planning procedure by taking them into account in planning at an early stage and on an ongoing basis (i.e. not just by dealing with them selectively at the beginning and end of a procedure). This intends to ensure transparency and a reliable procedure for all parties involved. Focus is on integrated and interdisciplinary planning and joint development of the best solution. The inclusion in the procedure also provides the opportunity for standardization of individual building blocks.

Lessons Learned

Neither Vienna nor Munich - unlike Winterthur - can currently build on a particularly favourable legal framework that gives house owners legal clarity on what heating source they are allowed to use in the future. Winterthur's already taken "tough" stance on decommissioning its current gas network therefore met with great interest.

Munich considers geothermal energy as a central source for decarbonising its district heating system. However, further locations for geothermal energy plans will require adequate spatial resources, which need to be well considered in the context of the city´s spatial planning at an early stage. Installing and maintaining a geothermal power plants comes with certain of challenges and risks. Cost-intensive test drilling, for example, may not yield the hoped-for result even with horizontal drilling.

Collaboration I with Atelier

ATELIER is a Horizon 2020 EU-funded project, in which the city of Bilbao is one of the "Lighthouse" cities. In the context of this project, Bilbao has developed a city vision, and demonstrated the application of a Positive Energy District. As part of a series of "Innovation Atelier Workshops", which were organized by project´s team, on the topic of "Electrification of Heat in Positive Energy Districts", Decarb City Pipes 2050 was invited to present its experiences on working towards transition roadmaps to decarbonise the building sector in European cities.

This 2-hours workshop was held on 15th of December of 2021, with the following agenda:

- Introduction: Iñaki Bóveda, Head of Renewable Energy and Resource Utilization Department. Basque Energy Agency.
- DECARBCITYPIPES: Decarbonization strategies for the building stock in Bilbao. Patxi Hernández, Senior Researcher in Energy Planning. TECNALIA.
- Possible solutions for electrifying building demand to achieve the 2050 objective: Net Emissions. Ricardo García, Vice President of the Technical Committee. ATECYR.
- **Practical Cases**
  - Rehabilitation of the climatization system of the Agroalimentary Campus of Arkaute through Geothermal Exchange. Ane Sáinz-Trápaga, Head of Geothermal Studies and Projects. TELUR.
  - Individual air-to-water heat pump in an existing residence. Alberto Sota, Head of Residential Smart Climate. IBERDROLA.
  - Hybridization of Geothermal and Air Source Heat Pumps. Zalla Fire Station. Iñigo Ruiz Ayesta, Manager. GEINOR.
  - Combined ventilation, air conditioning, and domestic hot water production system for efficient housing. Rafael Bravo, R&D Manager. ORKLI, S. COOP.
  - Air-to-water heat pump as the main heating and domestic hot water production system in the Residential sector (HAPPENING project). Iñigo Urra, Senior Researcher in Energy Efficiency. TECNALIA.

Presentations at the workshop can be found at: https://eve.eus/Jornadas-y-Noticias/Jornadas-de-formacion/Jornadas/Jornada-ATELIER-Distritos-urbanos-de-energia-posi?lang=es-es

Collaboration II with Atelier

A second workshop was held in the context of the ATELIER “Innovation Atelier”, which focused on regulatory aspects of local energy transition. Two cities from the Decarb City Pipes 2050 project (Winterthur and Vienna) were invited to present at this workshop, which was held on 18th November 2022 with the following agenda:

- City of Winterthur - Regional Energy Law – compulsory renewable connection/gas disconnection for new buildings. Heinz Wiher, Energy and Technology Officer
- City of Vienna Energy Zoning – a way to mandate renewable energy in certain areas. Peter Lichtenwöhrer, Energy Planning Officer,
- City of Donostia/San Sebastián - Municipal tools against climate change- Energy efficiency ordinance of Donostia/San Sebastián. Asier Manuel Bengoa, Energy Efficiency Officer

FIGURE 12. COLLABORATION WORKSHOP ATELIER

Conclusions

Main Take-aways and Lessons learned

All of the activities described above, which were fostered under Work Package 5 of this project (Transition Experiments), served the purpose of stimulating relevant exchanges between the partner cities, supporting their experiments through inputs from scientific partners, and consolidating the key findings and documentation of the experiments for replication.

The first meeting, dedicated to collaborative learning and knowledge sharing on the Transition Experiments, was held online due to Covid constraints. Unfortunately, COVID constraints prevented a face-to-face project meeting from being organized. However, this showed that online meetings can also be fruitful. This was a collaborative activity between WP4 and WP5 with the goal of learning from experiments or pilot projects and using them to define a broader strategic and long-term approach. Despite the diversity of experiments, most cities agreed on the relevance of a number of topics to support the heat transition:

- Thorough spatial mapping of the city with accurate heating data is essential for heat planning.
- Long-term goals as well as a coherent roadmap are elementary.
- More municipal resources are needed.
- All relevant stakeholders in the process, especially heat suppliers, should be involved early in the process.
- Tailored financing models are needed, developed in accordance with the situation of the end customers.
- Citizen engagement is also a crucial aspect.
- Of absolute necessity is a suitable legal framework that regulates an orderly and rapid phase-out of fossil fuels in heat supply.

After Covid travel restrictions ended in 2022, site visits could be conducted for the first time. Subsequently, site and study visits were organized separately or in the context of project meetings. These site visits were a perfect way to foster interaction between cities and learning from experiments.

In the case of Rotterdam, the visit was dedicated to the Heindijk neighbourhood, where the city is testing its neighbourhood-based concept of a gas-free neighbourhood. The use of the WHAT mapping tool, which provides insight into the alternatives to natural gas with the lowest social cost for existing buildings, was a key finding for city partners. In many homes in Heindijk, using or converting to hot water heating was the most viable solution. Another lesson learned was that business cases should at best be made in exchange with local stakeholders. Social marketing techniques (surveys, meetings, etc.) are also essential to get direct feedback on residents' expectations.

In the course of a site visit in Vienna, a residential building from the 1960s was visited, in which the centralization of the heat supply was carried out by building a so-called "community heating system". The approach to communication and tenant involvement in the conversion to this centralized heat supply solution was very interesting. The social housing association made a great effort to communicate, for example by creating a video to easily convey the effort involved in the conversion of the heating system. However, it can be assumed that this type of solution, unless there is a large housing association behind it, is not so "easy" to implement.

In Winterthur, a holistically redeveloped industrial area formerly used for diesel engines and locomotives was visited. This is a successful example of revitalizing an industrial wasteland and converting it into a residential area by diversifying the use of space. At the same time, the goal of the project was to make the area as resource-efficient and energy-efficient as possible. The building materials, the heating systems connected to the local district heating (waste incineration) and the installation of PV panels lead to rewarding results in reducing CO_2 emissions.

During the study visit to Munich, presentations included Munich's approach to an integrated neighbourhood concept. In the course of this, a holistic neighbourhood redevelopment is undertaken on the part of the city, taking into account energy and sustainability aspects, but also other aspects such as mobility, economy, climate adaptation, lifestyles and circular economy. This method of neighbourhood orientation is truly inspiring. The goal is to network and concentrate activities in a small and limited area. Discussions with citizens about initiatives are also planned to clarify needs and ideas, and if necessary a kick-off event with energy consultants.

Apart from these exchanges and site visits, cooperation with other projects could also make a valuable contribution. Two cooperation workshops with the EU project ATELIER provided the Decarb City Pipes 2050 project with the opportunity to bring the work done to a wider audience and to sensitize local partners in Bilbao to the necessary heating conversion.

DECARB CITY PIPES 2050

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