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Climate Positive Circular Communities – Lessons learnt from 6 demonstration sites around Europe

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Abstract. Within the framework of the EU Horizon 2020 project 'ARV', 6 demonstration sites with Climate Positive Circular Communities (CPCC) have been designed and implemented in 6 different cities in Europe, representing different climate and contexts. The demonstration projects encompass the development of a plus energy school and cultural area in a former industrial site in Oslo, Norway, energy upgrades of multi-family blocks with district heating in Sønderborg, Denmark, industrialized renovation of social housing in Utrecht, the Netherlands and in Trento, Italy, the transformation of an health care centre into a living lab for CPCC in Karvina, Czechia, and urban transformation of a city district in Palma de Mallorca, Spain. The paper describes some key lessons learned from the planning, design, construction, and operation phases of the demonstration projects, and highlight the related innovations that have been developed to make these projects viable.

1. Introduction

The research described in this paper is based on some of results from the EU Green Deal project 'ARV' (https://greendeal-arv.eu/) which aims to demonstrate and validate attractive, resilient, and affordable solutions for Climate Positive Circular Communities (CPCCs). It includes 6 demonstration sites that encompass urban regeneration projects in 6 locations around Europe. The demo projects have been carefully selected to represent the different European climates and contexts, and due to their high ambitions in environmental, social, and economic sustainability.

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The Renovation of social housing and public buildings are specifically focused. Together, the ARV partners will demonstrate more than 50 innovations in more than 150,000 m^2 of buildings.

A CPCC is an urban area which aims to achieve net zero greenhouse gas emissions, enables energy flexibility, and promotes a circular economy and social sustainability. The concept focuses strongly on the interaction and integration between new and regenerated buildings, users, and energy systems, facilitated by ICT to provide attractive, resilient, and affordable solutions for citizens. A comprehensive assessment framework [1] has been developed to provide a coherent guideline for the design and evaluation of CPCCs, featuring 36 Key Performance Indicators (KPIs) organized into 6 main categories: Energy, Environment, Social, Circularity, Architecture, and Economics.

The aim and scope of the paper is to provide examples of lessons learnt from the wide range of solutions that were applied in the planning, design, construction of CPCCs around Europe, to address the multitude of criteria (KPIs) that should be met to realize sustainable CPCCs.

2. Planning and design of the CPCCs

This chapter describes a selection of approaches applied in the planning and design processes in the demonstration sites. The strategies are selected to demonstrate the wide range of approaches that is needed to meet the extensive list of KPIs that has been defined in the ARV assessment framework [1].

2.1 Nature-based design in Palma de Mallorca, Spain

One of the actions employed in the demo site in Palma de Mallorca is the design and construction of a new positive energy social housing in a building with 35 apartments. The organisation of the space, the structure, and the material choices makes up a building with a very low energy need, low greenhouse gas (GHG) emissions, high quality living conditions, and with high architectural value.

All the apartments have natural cross-ventilation, which together with the captivating use of the double thermal intermediate spaces, are acting as greenhouses. Solar control and thermal inertia allow for very low energy demand while maintaining a high level of comfort and avoiding the installation of active cooling and heating systems. The combined annual demand for heating and cooling was reduced by 82% (6.2 kWh/m^2) compared to an average demand for new residential buildings (34.7 kWh/m^2) [2]. Revision and increment of the size of PV systems in the building makes it possible to reach an annual net zero non-renewable primary energy balance.

In addition, there was a strong focus on using as many local materials and components as possible. Approximately 42% of the mass of building originates from the island. The local sandstone, called 'Marés', is a reliable material that withstands the passage of time without changing its characteristics. The prototype used in the project was a 10 cm thick stone wall as a structural element, instead of 20 cm which is the common thickness. This was possible thanks to the geometry of the building, which is very repetitive, has small spans and is structurally connected in both directions.

Another local material is 'Posidonia', a seaweed which was used to insulate the roof (20 cm thickness compressed to achieve 150 kg/m^2 density). In the Balearic Islands, dead Posidonia leaves are one of the most common types of residues. Although Posidonia is a protected plant and its use must be authorised by the Ministry of Environment, the abundance of dry Posidonia in the Balearic Islands allows for its use as thermal insulation in construction. Moreover, it does not require artificial treatment, as sea salt acts as a preservative and biocide.

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A detailed GHG emission analysis of the building was performed by the LCA methodology [3], and showed that most of the CO_2 emissions (47%) are produced during the extraction, transport, and manufacturing of the materials (A1-A3 stages), accounting for 427 $kgCO_{2e}/m^2$ [2]. Compared to a reference value of 750 $kgCO_{2e}/m^2$, the project achieved a 43% reduction.

2.2 Parametric design of BIPV in Oslo, Norway

One of the actions implemented in the demo site in Oslo is the design and construction of a positive energy school building at Voldsløkka. To reach a plus-energy goal, the building should generate at least 2 kWh/m^2 per year of electricity more than its total yearly primary energy use, thus providing a total energy generation of 224 000 kWh/year [4].

The final building design encompassed 1 853 m^2 of photovoltaic panels with a total installed capacity of 337 kWp consisting of building-attached photovoltaic (BAPV) and building-integrated photovoltaic (BIPV) panels on the East, West, and South façades, and on the roof. The building's North-South orientation was not optimal for PV production. In addition, the regulatory provision requested the school façade not to resemble that of an office building, meaning that solutions that entail large and monotonous surfaces with PV panels, were not accepted. The challenge faced by the design team was therefore to overcome the combined limitations given by the suboptimal building orientation, the need for a non-homogeneous façade appearance, and the highly ambitious energy goal for the building.

The team decided to use a combination of green-coloured and black PV modules, with a black-to-green module ratio of 1:4 and 1:2.5 on the west facade and south facade, respectively. The PV panels are hung on aluminium profiles on which a secondary profile system is attached with a 20-degree angle. The angle of rotation of the profile system and the PV panels was decided by using a parametric design tool by Format Engineers Ltd (*https://formatengineers.com/research* /k2engineering.html). The design team tested several orientations to find the one that would provide the required 224 000 kWh/year of electricity generation and at the same time give an aesthetically pleasing appearance. The parametric design tool allowed for a quick overview of the number of installable PV panels by considering the geometrical constraint of the facades. According to interviews done with the local architects, a task that would have required months to be completed manually, was successfully done in a much shorter time.

2.3 A social renovation approach in Utrecht, the Netherlands

One of the actions applied in the demo site in Utrecht is a novel social renovation process in the neighbourhood Overvecht. In this deprived neighbourhood, not only the homes are improved, but simultaneously the tenants are actively offered help before, during, and after renovation. The renovation offers an opportunity to reach out to the tenants. In this holistic approach, the housing corporation collaborated with the municipality and the social workers that were active in the neighbourhood, organised as a living lab to bring the different stakeholders together. These partners simultaneously implemented interventions to improve the tenants' conditions, such as work, mental support, healthcare, housing, social contacts, and finances.

Evaluation of the approach shows that 76% of the supported tenants would not have found help without the intervention [5,6]. Research into the effects as well as the methodology to measure the effects show that on the long term, the approach has a positive effect on the health of the tenants [5,6]. On the short term, social interventions and support reduce renovation stress. Also, the approach helps establish more trust in institutions and government in the neighbourhood.

Based on the positive results, Utrecht municipality has investigated a city-wide application of the approach. However, this is challenging due to lack of experience in social renovation with the other housing corporations, and lack of capacity with the social partners to do both their regular work and this additional intervention.

2.4 A Living Lab for a Positive Energy District in Karviná, Czechia

The Karviná Living Lab has the aim of stemming the outflow of young people and fostering the development of the Positive Energy District (PED). An existing health care centre has been renovated and turned into a Living Lab for the district where 9 municipality buildings located within a radius of 500 metres are earmarked for the first phase of PED development. This is significant for the construction and energy and industry in the region that has historically been built on coal mining.

The Living Lab is coordinated by the local municipality and adopts a participatory approach centred on education and engagement of young citizens, particularly pupils aged 14 to 19 [7]. The core objective is to spark interest in the topics of energy transition and sustainability and to foster a deeper connection between the youth and their region, with the broader ambition of motivating them to stay or return and contribute to local development. A key feature of this approach is the educational platform established within the Living Lab, which delivers interactive, sustainability-focused seminars in secondary schools, centred on urban projects in the region and potential future job opportunities. These sessions combine lectures with hands-on assignments such as planning photovoltaic installations, planning changes in urban public space, designing upcycling projects, and designing the use of closed coal mines, followed by peer feedback. Beyond the youth target group, the Karviná Living Lab also reached out to institutional stakeholders such as schools, hospitals, and municipal utilities through semi-structured interviews. These engagements aimed to gather diverse perspectives on sustainability and identify potential roles for these institutions in future city projects.

In addition to these activities, online surveys were conducted to gather feedback from tenants, visitors, and construction workers at the city's health centre, which serves as the Living Lab's demonstration site. This input informed the user-centred monitoring strategy.

2.5 Designing for cost-optimality in Sønderborg, Denmark

In Sønderborg, new design criteria for a combination of building integrated solar PV panels and batteries have been developed for multi-apartment buildings [8]. The cost-optimal combination of solar PV and batteries was found to be 8 m^2 solar panels per apartment combined with 1-2 kWh battery per apartment. With this combination 40-50% of the electricity consumption can be covered by solar electricity. With the batteries, the building can use 70% of the produced solar electricity, and only 30% are exported to the grid. Without batteries, only 40% of the produced solar electricity can be used in the building, and 60% has to be sent to the grid. Also, with batteries it is economic feasible to install a solar PV area that is 75% bigger than a solar PV area without batteries connected.

Another cost-optimal design that has been developed in the Sønderborg demo project includes a concept to reduce the district heating return temperature from substation systems in multi-flat buildings. Reducing the district heating return temperatures from buildings allows the main district heating network to operate with a lower temperature level, which again allows the district heating company to utilize energy sources at a lower temperature level, enhancing the utilisation of energy produced by heat-pumps, excess heat from factories, cooling applications, data centres, etc. In Denmark, building users are economically rewarded if they can reduce the return temperature from their buildings back to the district heating network.

The new 'aftercooling concept' applied in Sønderborg is based on cascading the service of domestic hot water circulation and space heating. The main idea of the aftercooling concept is to utilize the relatively high district heating return temperature from the domestic hot water circulation via the space heating circuit. This application requires an additional heat exchanger and a set of control components. Calculations show that the return temperature reduction potential is around 3-6°C.

2.6 The development of a catalogue in Trento, Italy

At present, a comprehensive range of construction solutions is available in the market to address various design objectives. However, one of the main challenges in designing or retrofitting buildings aiming at sustainable solutions is the absence of a systematic approach that integrates multiple factors and addresses various challenges simultaneously. In Trento, a new catalogue of building and architectural solutions has been created to address this issue. It considers integrated circular and sustainable solutions for buildings with a positive and low carbon footprint, aiming to support all stakeholders (from designers to users) and encourage public administrations and decision-makers to choose sustainable solutions for new and refurbished buildings. Both physical and digital solutions have been considered and categorised as follows: urban green and blue infrastructures, energy systems, shading devices, building technologies, and digital solutions. Each category is further divided in sub-categories, according to the type of solution considered. Each category answers to a specific climate-related challenge: energy sustainability, temperature regulation, sustainable water management, health and wellbeing, and synergies among them are highlighted as well [9].

For each solution, the catalogue provides a brief description, details of the challenges it addresses, its objectives, its performance guarantees and its benefits, even if these are not strictly related to the challenges. Each solution is associated with one or more case studies that are considered best practices. One of the catalogue's main innovative features is the inclusion of information sheets on products, building systems and technologies, primarily from local manufacturers, which can contribute to the implementation of the proposed solutions. The solutions are presented in general terms, and real market products, particularly at a local or regional level, are listed. Depending on the intended use of the building and local environmental conditions, the pros and cons of each solution in relation to environmental challenges are defined, along with specific objectives and related performance criteria. The catalogue is intended to guide designers and public administration technicians towards local, circular and efficient (re)design and planning processes.

3. Construction of the CPCCs

In this chapter, a selection of key considerations in the construction processes in two of the ARV demonstration sites are described.

3.1 Plug-and-play elements for industrial renovation in Utrecht, the Netherlands

The social housing corporations in Utrecht are tasked with renovating their 1960s and 1970s high-rise flats to achieve Zero or Positive Energy Building (PEB) standards where possible, in line with the ambition for a carbon-neutral built environment by 2050. These buildings, constructed

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using industrialized methods, reflect the construction typologies of that era. As a result, they share many similarities in terms of construction methods, dimensions, and spatial configurations.

The company Inside Out Technologies in the ARV consortium has developed a new renovation system, together with Utrecht University of Applied Sciences, that leverages these similarities. The system consists of six resizable and standardised portfolio products named after the NATO alphabet [10]: The Alpha Solar Module is a specialised structure designed to be placed on the roof of a building. It allows more solar panels to be placed on the roof. The Bravo solar module is constructed from steel and features fully prefabricated solar panel frames. The Charlie facade installation module includes a radiator, a decentralised ventilation system, and a solar panel, and can be easily installed in one day. The Delta facade module is an innovative solution combining facade and installation technology. It enables a house to be fitted with a new facade that can insulate, heat, ventilate, and generate energy, all in just one day. In addition, the Echo Balcony Module is a unique modular solution designed to maximise the use of solar energy in high-rise buildings. It allows for the retrofitting of the balcony and provides an opportunity to generate power from the balcony railing through integrated solar panels. Finally, the Foxtrot Data module is the central processing unit of the energy system. It serves as the brain of the system and ensures the smooth integration of all the components. Together, this system has the potential to reduce costs and installation times, thus allowing for rapid neighbourhood renovation and reducing nuisances for the occupants during construction.

3.2 Prefabricated wooden elements for renovation in Trento, Italy

One of the actions applied in the demo site in Trento is the renovation of a medium-rise residential building located in the Povo District. A hybrid renovation approach was applied, as the renovation involved both the use of a traditional ETICS system, and a timber-based prefab kit called 'Renew Wall' (https://www.renew-wall.com/). The renovation process marked the first large-scale installation of Renew Wall - produced by the local manufacturer Fanti Legnami – after a previous R&I project took place in the Province of Trento (Italy), where the technology was developed and tested as a mock-up.

The Renew Wall installation in Povo confirmed most of the advantages usually associated with off-site construction and retrofitting: Accurate design and manufacturing, ease of installation, reduced renovation time, and limited inconvenience of works on building occupants, without compromising architectural and aesthetic quality.

Furthermore, the coexistence of ETICS and prefabricated components in the Trento demo case allows to assess the performance of the different technologies involved: Dedicated sensors have been installed to monitor the thermal performance of both the retrofit systems. Internal comfort and well-being are subject to investigation by means of temperature and relative humidity sensors positioned in 4 apartments.

End-users' perspectives have been addressed through a noise and dust perception campaign targeting the installation of the 'Renew Wall' kit vs. ETICS. First evidence showed a significant dust reduction perceived, while an increase in noise was detected, though limited in time. A Post Occupancy Evaluation is currently planned and will allow to collect additional relevant data on the comfort of end-users after more than one year since the renovation occurred.

Besides technical and comfort aspects, the Trento demo case raised further analysis and considerations around the cost optimization of the prefab kit vs. business-as-usual solutions, the scalability potential of deep retrofit through industrialization, and the opportunity given by large-scale retrofitting processes to renovate multiple building blocks at the same time.

4. Operation and use of the CPCCs

In this chapter a selection of lessons learned from the operation and use of buildings in the demonstration sites is described.

4.1 Lessons learned from optimizing the energy performance in housing, Sønderborg
The combined solar PV-battery systems in Sønderborg (ref. section 2.5) have been in operation now for more than a year. The systems are functioning well, and in 2023, the solar PV-battery systems covered 36% of the total electricity costs for the 432 apartments in the 19 housing blocks.

During the period, a new app called EnyDay has been introduced to the tenants. In this app the tenants can follow the actual hourly production of solar electricity and the actual electricity consumption in the apartment. Based on this information, the tenants can plan the optimal time for using washing machines, dishwashers, etc.

Also, another app called EMMA has been implemented in the solar-battery systems. This app can operate the batteries in an optimal way using the actual electricity prices. Often there are so much solar and wind energy available during the day, that the electricity price in the grid gets very low. In these periods the battery app can store cheap grid electricity instead of storing solar electricity.

During the work on reducing the return temperatures from the radiator systems in the apartments (ref. section 2.5), it was realized that the heating consumption and the tenant operation of the radiator thermostats varied very much from apartment to apartment. Therefore, information activities were initiated for the tenants on how to operate the radiators in an optimal way. It is optimal to have all radiator valves slightly open in all rooms instead of having some radiator valves closed and others more open. If all radiators are slightly open, the return temperature is reduced.

4.3 Lessons learned from the implementation of a CPCC Living Lab in Karviná, Czechia
A central element of the Karviná LL engagement strategy was the educational platform aimed at pupils aged 14–19 (ref section 2.4). Workshops which focused on themes such as sustainability, circular economy, and energy-efficient building design, proved to be highly effective. Pupils engaged enthusiastically with creative group assignments, and the involvement of subject matter experts, as well as the use of interactive formats like peer assessment, enriched the learning experience. However, the organizers found that overly technical tasks reduced motivation and were less accessible to the students. As a result, a key lesson learned was the importance of simplifying the content and incorporating more creative, hands-on elements. Clear structure and expectations, combined with the freedom for students to express their ideas, significantly increased their willingness to participate. Furthermore, logistical challenges such as scheduling the sessions around school calendars, highlighted the need for early and flexible coordination with educational institutions. The format of the workshops was adjusted to a single, intensive all-day seminar to reduce time demands and increase efficiency. This new format also allowed time for excursions and outdoor activities, enhancing the overall learning experience.

In addition to youth engagement, the Karviná Living Lab initiated a series of interviews with twelve key local institutional stakeholders, ranging from energy centres and schools to hospitals and public service providers. These semi-structured conversations explored the institutions' approaches to sustainability, their current challenges, and their interest in future collaboration. The process was met with strong support and revealed that stakeholders were indeed interested in contributing to energy-related projects, but only under clear and well-defined conditions. Projects must have specific, realistic goals, demonstrate cost-effectiveness, and offer a long-term vision. The economic dimension was especially emphasized, as most institutions are willing to adopt sustainable solutions only when these are financially justifiable.

Public engagement was another important pillar. The city organised and joined a series of events such as Earth Day celebrations and participation in the URBIS Smart City Fair, targeting the general public and aiming to raise awareness about sustainability and local energy initiatives. These events effectively attracted both children and adults through formats of creative workshops, scientific demonstrations, and accessible informational stands. A significant takeaway from these efforts was the importance of combining education with entertainment to attract and maintain public interest. However, the events also revealed the presence of vocal groups in the Czech Republic who are strongly opposed to the Green Deal and related sustainability topics. Their confrontational attitudes posed challenges during public engagements, highlighting the need for thoughtful communication strategies to address scepticism, defuse tensions, and ensure a constructive atmosphere.

5. Business models as enablers for CPCCs

This chapter describes key lessons learned from designing and applying climate positive business models to support the uptake and wide scale roll out of project innovations, therefore improving the bankability of CPCCs.

Within the ARV project, seven business model blueprints have been co-designed, tailored to various real-estate ownership structures, including social housing, rental, privately owned, and public buildings. These models include energy service companies, PV forecasting solutions, one-stop-shop solutions, district heating product solutions, and publicly funded energy communities.

Economic analyses reveal that while some models offer attractive profits or investment returns, many rely heavily on public funding or subsidies, posing risks due to fluctuating political priorities and limited public investment available. To enhance the business case, it is crucial to quantify and communicate the broader societal benefits, such as reduced healthcare costs and carbon savings. Additionally, embedding business expertise within technical teams and collaborating with entities, such as business accelerators, that can bridge gaps in market development and stakeholder engagement is important and should be prioritised more highly in project design and development phases.

Barriers to wide market adoption include human factors such as low engagement, lack of knowledge, and limited trust in technical solutions, compounded by data privacy concerns. Complex governance procedures and slow decision-making processes within housing associations or communities - often key customer groups for CPCC innovations - also hinder progress. Additionally, the complexities around measuring and quantifying the multiple benefits from CPCC innovations remains a challenge, therefore limiting their uptake and growth. Conflicts of interest between established market players and emerging solutions and actors can impede innovation, and region-specific solutions, while beneficial locally, may be difficult to replicate elsewhere.

Mitigation strategies include targeted communication campaigns and demand creation through customer engagement and showcasing successful examples, as well as highlighting fiscal incentives. Dedicated personnel or services, such as one-stop-shops, can further facilitate these processes.

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6. Discussion and conclusions

The ARV demo projects indicate that it is possible to achieve climate positive circular communities that meet a wide range of sustainability indicators. However, it requires increased effort to integrate of technical systems, while balancing the trade-offs between various considerations, such as costs, social issues, and architectural quality. To handle this balance, some key methods, tools, and approaches have proved valuable in the demo projects: 1) The use of digital tools for mapping, design, performance prediction, manufacturing, user engagement, and operation, 2) taking advantage of local resources and techniques for building design, 3) industrialization and prefabrication, and 4) the use of a Living Lab approach for community engagement, communication, and education. To improve profitability and enable a wide scale-up, a wide range of new business models needs to be designed and implemented, involving key actors within the construction and energy industries, along with financing bodies.

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References

[1] Salom et al (2022). Framework and Tools for Effective Implementation and Assessment of CPCCs, https://greendeal-arv.eu/library/d2-1-assessment-framework-for-cpcc-2/.

[2] Design guidelines for refurbishment and new buildings in the Positive Circular Community in Palma, Report from the ARV project, https://greendeal-arv.eu/library/d4-3-design-guidelines-for-refurbishment-and-new-buildings-in-the-positive-circular-community-in-palma-draft/.

[3] CEN (2019). EN 15804:2012+A2:2019 – Sustainability of Construction Works – Environmental Product Declarations – Core Rules for the Product Category of Construction Products, Brussels.

[4] Lolli et al (2023). Design Guidelines for a Climate Positive Circular Community in Oslo. Report from the ARV project, https://greendeal-arv.eu/library/d4-1-design-guidelines-for-a-climate-positive-circular-community-in-oslo-draft/.

[5] Koops-Van Hoffen et al (2023. Understanding the mechanisms linking holistic housing renovations to health and well-being of adults in disadvantaged neighbourhoods: A realist review, *Health & Place, Volume 80*, https://doi.org/10.1016/j.healthplace.2023.102995.

[6] Koops-Van Hoffen et al (2025). Applying a systems perspective to understand the health effects of holistic housing renovation in a deprived neighbourhood in the Netherlands: Development of a causal loop diagram, *Cities, Volume 158*, https://doi.org/10.1016/j.cities.2024.105635.

[7] Staňková et al (2023). CPCC Living Lab Reports. https://greendeal-arv.eu/library/d3-3-cpcc-living-labs-report-m24-draft-pending-european-commission-approval/.

[8] Esbensen et al (2024). Guidelines for Integrated Design and Implementation of Renewable Energy Systems and Energy Storage Systems for Buildings and Neighbourhood Energy needs in Sønderborg. Report from the ARV project, https://greendeal-arv.eu/library/d6-2-guidelines-for-integrated-design-and-implementation-of-renewable-energy-systems-and-energy-storage-systems-for-buildings-and-neighborhood-energy-needs-in-sonderborg-draft-pending-approval/.

[9] Albatici et al (2023). Design Guidelines of Climate Positive Circular Communities in Trento, Italy. Report from the ARV project, https://greendeal-arv.eu/library/d4-5-design-guidelines-of-climate-positive-circular-community-in-trento-draft-pending-approval-from-the-european-commission/

[10] Meijer et al (2024). Pre-manufacturing workflow. A report from the ARV project: https://greendeal-arv.eu/library/d5-1-pre-manufacturing-workflow-draft-pending-approval-from-the-european-commission/