HORIZON 2020
The EU Framework Programme for Research and Innovation

Demonstration and Evaluation Final Report

Deliverable D5.3

DATE
31 March 2023

ISSUE
1.0

GRANT AGREEMENT
no 870337

DISSEMINATION LEVEL
PU

PROJECT WEB-SITE
http://cure-copernicus.eu/

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1 CURE DEMONSTRATION WORKSHOPS - OVERVIEW AND METHODOLOGY

The Copernicus for Urban Resilience in Europe (CURE) 2nd Demonstration Workshops (2nd Demos) were held on Friday 14th and Monday 17th October 2022 in Brussels, focusing on participants from different target groups. These workshops were a follow up to the 1st CURE Demonstration Workshop, which was held online in October 2021. These October 2022 workshops (2nd Demos) aimed to address a main research question: 'What is the added value of the CURE cross-cutting applications for urban planning?' More broadly, the objectives of both workshops were:

- To demonstrate the technical operational feasibility of the CURE cross-cutting thematic apps via the CURE portal;
- To demonstrate how the CURE apps have been used by the CURE project "front-runner" cities and are applicable to cities more widely;
- To evaluate how the CURE cross-cutting applications can be operationalized for urban planning.

In pursuit of these objectives the workshops provided detailed information about the CURE project and the CURE cross-cutting applications, and engaged in dialogue with focus groups of participants. These dialogues provided input to an assessment of the potential impact of the CURE applications as well as an identification of their added value for urban planning in enhancing the resilience of cities.

1.1 Pre-Workshop Process and Methodology

In accordance with University of the West of England, Bristol (UWE) ethical requirements, an ethics application was submitted to the Faculty of Environment and Technology Ethics Committee in September 2022, requesting full ethical approval to run the workshop in October 2022.

Participants to both workshops were identified via a collaborative process between CURE partners UWE and FORTH, resulting in a total of 57 in person and online participants for both workshop events. Participants for the Friday workshop were primarily city level stakeholders involved with the CURE project including both "front runner" and "follower cities", plus members of the CURE consortium, and CURE Advisory Board. The Monday workshop targeted participants at the European level including the European Commission, Copernicus Entrusted Entities, Climate KIC, Covenant of Majors, URBACT, and ESPON.

Pre-workshop information was sent to all invitees in September 2022 including an overview of the workshop and draft agenda, together with registration link to a Participant Information Sheet which explained attendees' involvement in the workshop and use of personal data (see

Annex 1 - Participant Information Sheet). Participants were encouraged to attend the workshop in person, to facilitate discussions, although a streaming link to attend online was also provided.

1.2 During the Workshops

Both Friday and Monday workshops were hosted at the Council of European Municipalities and Regions (CEMR) offices, Square de Meeûs, Brussels. The Friday workshop consisted of a full day session from 10:00 to 16:00 CEST and managed in 3 parts, parts 1 and 2 in the morning and part 3 in the afternoon (see Annex 2 - Workshop Agendas).

Friday Workshop Part 1: set the context for the workshop comprising welcomes and introductions, plus a CURE project overview from the project team, followed by presentations from the European Commission and CEMR.

Friday Workshop Part 2: entitled 'CURE in Action' included presentations to demonstrate the CURE applications and the CURE portal together with their capabilities, structured around 3 urban planning requirements of Climate Change Mitigation (Heat and CO2 applications), Climate Change Adaptation (Nature-Based Solutions and Flood/Subsidence applications) and Healthy Cities (Health, Thermal Comfort and Air Quality applications). Finally in the morning session 3 case study presentations were provided illustrated by the CURE project case study cities Berlin, San Sebastian, and Copenhagen.

Friday Workshop Part 3: The workshop afternoon session was organised as a Dialogue Café (see Annex 3 - Dialogue Café Methodology), with the aim to address questions of the added value of the CURE applications in city planning. The Dialogue Café included both in-person and online attendees and was structured to address the following questions:

- Which specific challenges are or could be addressed by CURE apps in your city?
- Which additional CURE capabilities or products would be high priority for your city?

In addition the following 3 questions were used to promote engagement on these issues:

- Which city policies/strategies are best supported by CURE apps?
- What additional CURE apps can best enhance the resilience of your city?
- What is most needed to improve your city's resilience planning?

Participants used post-it notes to capture their thoughts whilst those online contributed via online white board and the chat function. All discussions were recorded for analysis via audio recording and note-taking.

The Monday workshop was held as a morning meeting only from 10:00 to 13:00 CEST with format and presentations identical to the Friday workshop as detailed above.

For both Friday and Monday workshops, the inclusion of the online participants was actively managed by the researchers throughout, so all participants contributions were considered equally. Furthermore, both workshops were managed as a single plenary meeting, without break out group discussion to promote common understanding in respect of all presentations, discussions, information and questions arising.

1.3 Following the Workshops

Following the workshops, audio recordings and workshop notes were transcribed and transcripts sent to the relevant participants for accuracy checking. The transcripts were then anonymised so individual opinions could not be attributed to specific stakeholders, and analysed according to the various themes of urban planning resilience. Finally, the workshop presentations were made available to the workshop participants' and to specific invitees according to their requests.

2 CURE DEMONSTRATION WORKSHOPS - MORNING PRESENTATIONS

2.1 Workshop Part 1 Presentations: Context

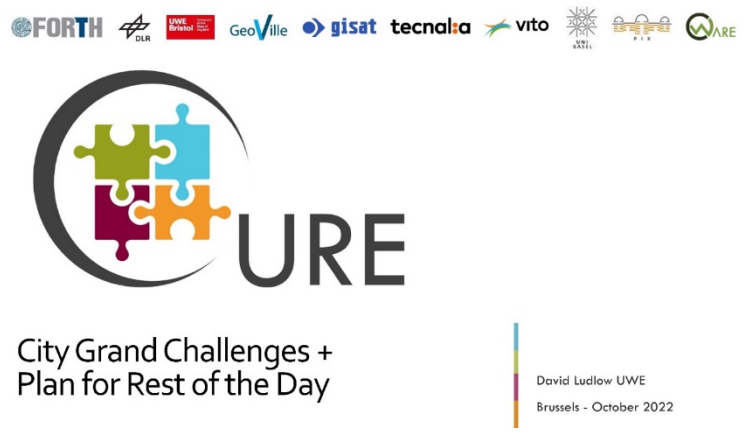
2.1.1 CURE Project Overview

Nektarios Chrysoulakis (FORTH) outlined the importance of CURE, the concept of the project, CURE case study cities, CURE applications, CURE portal and the expected outcomes. The presentaion also demonstrates how the CURE project links with the Horizon Europe Missions and the short-term and long-term visions for CURE beyond the current project.

Please follow this link to the presentation: 01_CURE Overview.pdf

2.1.2 City Grand Challenges and Plan for the Workshop

David Ludlow (UWE) outlined 3 integrating policy areas of Climate Change Mitigation, Climate Change Adaptation and Healthy Cities as policy frameworks for development of the CURE apps in supporting decision making to deliver city planning strategies.



Please follow this link to the presentation: 02_Plan for the Workshop.pdf

2.2 Workshop Part 2 Presentations: CURE in Action

CURE in Action was presented by CURE partners Tomas Soukup (GISAT) and Zina Mitraka (FORTH). Tomas and Zina demonstrated the CURE portal and the capabilities of the CURE applications, followed by 3 CURE city case study presentations:

- Berlin - Jörn Welsch (Berlin) and Mattia Marconcini (DLR)
- San Sebastian - Alessandra Gandini (Tecnalia) and Efren Feliu (Tecnalia)
- Copenhagen - Rasmus Reeh (Solutions Lab) and Birgitte Holt Andersen (CWare)

These presentaions provided details of how climate change is impacting each of the cities, the various programmes and strategies adopted by each city to address these impacts, and the functionality of CURE apps in that city planning context.

2.2.1 CURE Portal and Applications

Please follow this link to the presentation: 03_CURE applications.pdf

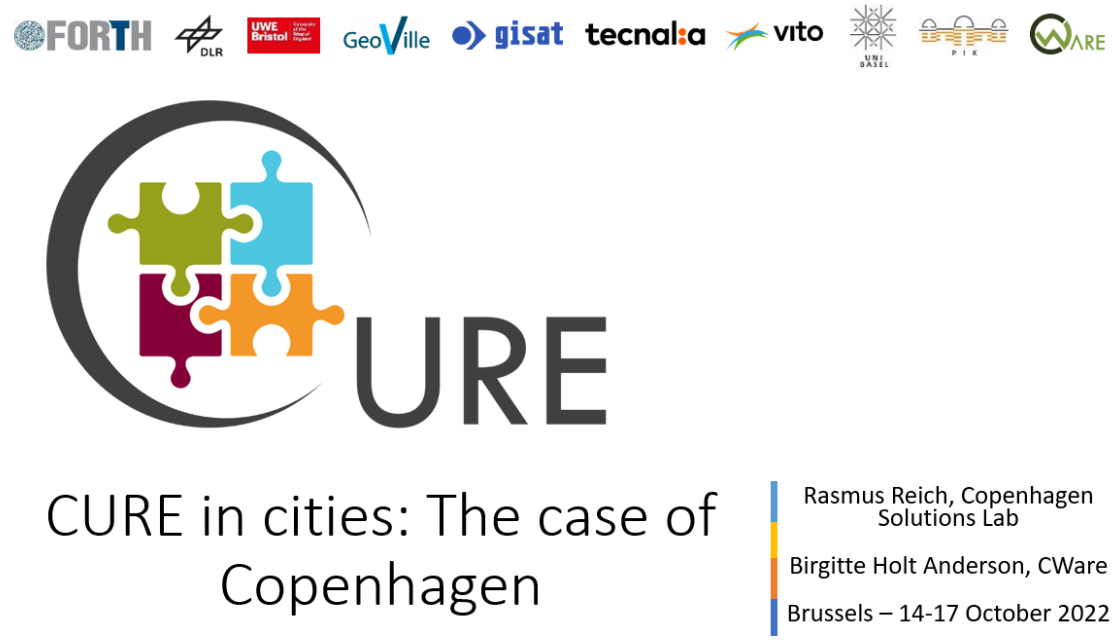
Berlin Case Study

Please follow this link to the presentation: 04_Berlin case.pdf

San Sebastian Case Study

Please follow this link to the presentation: 05_San Sebastian case.pdf

Copenhagen Case Study



Please follow this link to the presentation: 06_Copenhagen case.pdf

3 CURE DEMONSTRATION WORKSHOPS – CITY LEVEL DIALOGUE CAFÉ

The afternoon session of the Friday workshop engaging with the "cities communities", was promoted as a Dialogue Café, fostering engagement with city representatives regarding the specific urban challenges addressed by CURE apps, and the priorities for the further development of CURE app functionalities. Two groups of questions were addressed during this dialogue session, the first concerning the urban challenge related policies or strategies supported from the CURE system and its apps, and their added value and effectiveness. The second concerning additional capabilities, products or applications that are needed by cities and urban planners particularly in relation to the grand challenges of climate change mitigation, climate change adaptation and healthy cities.

Central to these considerations in the application of enhanced intelligence supporting decision-making process, include the means to factor this new intelligence into the decision making process most effectively, and indeed how to use CURE apps to drive the development of new decision making methodologies and tools. Discussion in the Dialogue Café exchange regarding these issues was captured by transcript presented as follows.

3.1 CURE Portal - Diverse User Requirements

The need to address the multiple dimensions of the user requirements for new intelligence tools and methodologies also points to the added value of the CURE portal, as now it's possible to showcase the range of CURE apps and their functionalities online, offering greatly enhanced accessibility to the added value assessment of the CURE apps. This added value assessment emphasises the CURE products as pieces of the jigsaw of information and intelligence required by cities and these pieces can have different values for different cities. This is because some cities may already have their own capacities, so they view the added value of CURE in their specific context. Time series is a very good example because typically local data might be limited in respect of historical time series data, deficiencies that CURE can overcome.

3.2 CURE Added Value – Observation Frequency

Urban planning key requirements include transport related greenhouse gas emissions and the way we live in cities today. This is a transformational dynamic as a post-covid "new normal" city is emerging with new relations of transport and living. These are the drivers of change across Europe and where planners are working to develop visions for post-covid "new-normal" living and working, developing liveable neighbourhoods, and 15-minute city solutions. It is here that the urgent need for new decision making intelligence, tools and methodologies that can be supported by CURE, is most evident.

In this respect CURE facilitates the increasingly important need for frequent observations to capture the rapidly evolving socio-economic dynamic of the city today. This can be applied in relation to monitoring, specifically finding "hotspots" or trends in city dynamics, but also for

calibrating models with inputs from CURE greatly enhancing model accuracy. Temporal series modelling, for example, can be supported by CURE apps to overcome knowledge gaps at the municipal level, and so reinforce the technical capabilities of the city planners.

Berlin as an example, has much data but a major added value of CURE relates to the infrequent updating of Berlin data for the time series. As an example, the strategic Berlin noise map data dates from 2017, and the next data update does not take place until 2024. Between these dates there is no overview of the development of the data, and this is an important part of the added value of CURE in respect of more rapid update of timeseries data.

3.3 CURE Added Value – Thematic Integration

A second point, concerns the ways that CURE services can support cities at an operational level. Because whilst the CURE portal is a good demonstration, for operational work cities need to fully integrate the CURE data into their workflows. This also has a technical side, where CURE dockerizing aims to support end users external to the project in interactions with the services. But the second level of this integration concerns thematic integration, what to integrate and how. And this is much more complicated and needs considerable discussion from both sides to understand the local situation on one side, and the strength of the data, and what is most appropriate in any given situation. And this is definitely one of the development pathways for the CURE apps.

A prime test for discussions concerning thematic integration of CURE apps is the post-covid "new-normal" world of city living and the development pathways that it identifies for CURE. The "new-normal" relationships of work and home bringing working and home together in the neighbourhood, as identified in the concept of the 15-minute city, and provides major opportunity to support climate change mitigation leveraging the options to substitute active travel by walking and cycling for car-based transport in many parts of the city. This is the job for urban planners to push the transformation and to encourage change. But whilst there are political commitments to CO2 emissions reductions, specified in terms of tons of CO2, and urban planners are aiming to reach these targets, there is no reliable and convenient means to quantify these emissions reductions at the local level according to alternative development options. However, if it's possible to specify how a city neighbourhood contributes to these targets, and by what means, then there is the basis for a coherent narrative, argument and strategy for behaviour change.

So the necessary direction of travel is well known, and visions defining the requirements for the net-zero neighbourhood, as identified for example with the 15-minute city, are being developed. But currently the intelligence and tools necessary to quantify the impact of more local living and working in our city neighbourhoods are not available. Calculation of these impacts allows planners to make good judgments and to give politicians the means of making clear and powerful arguments for transformation that generate the political will necessary for

change. At the same time it's equally important to consider the campaigning side and the importance of raising awareness. CURE apps are visually powerful and can be most effectively applied in supporting effective campaign communications to raise awareness and promote behaviour change.

Heraklion, for example, has been collecting data and intelligence for many years, and the city's Smart City platform is a portal that makes this data available, even if so far, this data has not been fully used. One of the strategic planning directions for Heraklion is focused around promoting resilience policy, so CURE data can offer added value to the wealth of data that Heraklion has already collected, not only for the planning authorities but also for the public. FORTH is collecting remote sensing data in Heraklion including meteorological variables, and CO2 emission data and so on, and this is already made available through the Smart City platform. But given the great wealth of data that is available through CURE, it is necessary to discuss how this data can be used most effectively to support planning decision-making process. Data collection is all well and good and as mentioned Heraklion has a lot of data. But what is missing is the real analysis of this data to derive intelligence and support conclusions in the decision-making process.

3.3.1 Climate Change Mitigation – Heat Related Apps

One point of departure for this analysis of the added value of data to support planning decision making is in relation to CURE heat related apps for urban resilience. In the process of discussing with urban planners and those that need to put this data into action, it turns out that it's not so straightforward to specify the usefulness of the data. So, the surface temperature is the kinetic temperature of the surface, the surface of the street, the walls, the roofs, not the temperature of the air. The temperature of the surface can be used for assessing the surface urban heat island effect, an assessment that is delivered by the CURE surface urban heat island service. This should not be confused with the canopy urban heat island, which is mostly referring to the air temperature difference between the city and its outskirts. The CURE surface temperature product can assess the temperature differences between sealed and paved surfaces as within the city, and other kinds of surfaces, vegetated mainly, or non-sealed surfaces outside the city. This service also facilitates understanding, for example, of the effect of applications of cool materials, that can be directly assessed by observing differences in surface temperatures.

While the surface temperature service is satellite-based and its products help towards quantifying and monitoring the changes of temperature over the city surfaces, there is always the need to go more deeply. One methodology for assessing the heat load, involves the assessment of air temperature, which cannot be purely satellite-based, but needs ancillary sources and/or combined with other sorts of information, to produce indicators, as with the thermal comfort app, that connects temperature to the feeling that individuals sense in any given part of the city.

Besides these issues, what's also really important for urban planning is the surface balance energy, involving two other CURE apps concerning heat storage and heat emissions. These are important apps to assess the energy load of the city, given that energy is coming to the city mainly from the sun and also anthropogenic sources, the latter for example when air conditioning chills the room inside, but delivers heat outside. So, energy is changing, and heat emissions, for example, is an indicator for the heat exchange between the surface and the atmosphere. Therefore, in deploying CURE products, it is possible to identify which areas perform this energy transformation, faster or slower, and where interventions are required.

Similarly for heat storage, which is the rate at which the city stores or releases energy, and it is the main driver of the heat island effect. Particularly buildings, but all the urban surfaces store energy, and store it with different rates, and release energy with different rates. So, that means that if the temporal evolution throughout the day is known, and also via CURE throughout the year, together with the spatial distribution of heat storage, how fast urban surfaces (i.e. buildings, streets) store and emit energy, then it is clear where intervention is required in order to save energy or to mitigate the effects of heat.

Berlin, for example, in decision-making on the future transformation of Tempelhof former Airport and the potential importance of this area for climate mitigation. For this it was recognised that satellite-derived surface temperatures over night of the Templehof grassland could give a true understanding of the temperature impact of the locality. This understanding prompted response from the political Senator that the airfield grassland is “the fridge of Berlin, and we have to save it from rebuilding as a stadium”. So, in this way the transition of the former airport to public park was influenced using this kind of satellite-derived intelligence to support decisions about the future of the former airport.

3.3.2 Climate Change Adaptation – Floods, Subsidence and NBS apps

Discussion also centred on the issue of climate adaptation and the CURE flood and subsistence apps critical to the assessment of climate change adaptation challenges, and in particular the means by which municipalities use these apps and combine their data for urban planning decision making. It was recognised from the beginning of CURE development that these flood and subsistence apps in many cases support each other. Copenhagen is an excellent example, given the potential problems from rising water and the critical need to understand the nature of the challenge in relation to both existing structures and proposed new construction, to support any necessary countermeasures, as part of a broader preventative strategy.

In this respect, CURE flood and subsistence apps provide quite unique data in an effective way, when applied in the right context, whether it is for landslides or other areas of instability. These apps can also be applied in the context of different infrastructures in cities, which can be affected by flood for example, and can also reveal where maintenance is not appropriate, permitting cost saving review of, and early modification of maintenance strategies. In the case of flood, as Copenhagen is a complex city, there is need for detailed elevation information to

be able to model flood events with appropriate precision. This provides an innovative diagnostic tool for the city, using available data to highlight flood risk areas requiring further investigation. In terms of scale, of course when used at detailed neighbourhood level this has to be complemented with local information.

From an urban planning point of view the potentials in combining heat assessments with nature based solutions support a variety of planning strategies including those related to cooling corridors, green routes as recreational routes, and active travel transportation links in the city. Notable in this context are the CURE climate change adaptation related apps applied in San Sebastian via green roof scenarios providing examples of cross-cutting apps developed on the basis of interlinking green roof potentials strategy with heat assessments to prioritize some areas or buildings. Methodologically this applies the thermal comfort app supporting simulation, and a thermal app able to simulate different scenarios, and addressing different urban planning related questions. This provides a very good example of interlinking nature based solutions and thermal comfort. But similar crosscutting app based solutions providing an integrated assessment are widely applicable to different policy challenges as the essential components of the socio-economic and environmental dynamic of cities are fundamentally interlinked, and accordingly integrated planning solutions must be identified and applied.

3.4 CURE Future Development

The natural extension of these questions concerning the added value of CURE apps concerns the future, and the additional capabilities or products related to CURE apps that are of high priority? How should these apps and its relation to Copernicus and DIAS be evolved in the future, and what are the most promising and emerging decision-making support methodologies that will guide this evolution?

3.4.1 Digital Twin Solutions

The digital twin, potentially can offer major impact for urban planning decision-making. The idea of the digital twin is to have everything at the same place that's harmonized, allied with apps that are integrated, for example CURE green roofs app, combining local data to be complemented by Copernicus. And that's something that could really be effective because it's not just Copernicus. Copernicus data can enhance the decision making process up to a certain level, but beyond that point it's necessary to integrate with local data. So combining these two sources of urban intelligence together, to have a place where local data is integrated with Copernicus, constitutes the key added value of the digital twin environment.

Questions arise therefore, for example, should we build a digital twin for the neighbourhood that targets the net-zero question, that builds on the CURE apps? And which also brings in the existing decision-making related assessment functionalities of cities, so advancing integration beyond cross-cutting between Copernicus, and which offers full functionality for the key components of a planning decision-making system. In this respect it's necessary to look beyond

the state-of-the-art, addressing critical questions including what is the carbon impact of alternative developments in cities at neighbourhood scale?

3.4.2 Evolution and Urban Change

In considering the future development of CURE apps it's also essential to understand the focus on digitalization, and digitalization as a process, as another way of organizing work. So, it's really a change agent and it is necessary to consider that cities are at different stages on the pathway towards digitalization. Gardner has made a very simple ladder of implementation progressing data maturity, starting with descriptive, then diagnostic, then predictive, and finally prescriptive. Simple progression but not that straightforward, from a city perspective, or indeed for any organization. Because every step includes organizational change, when considering the use of existing city data, already there is organizational skill, as the data needs to exist and it's necessary to apply this data to other kinds of data.

So, if CURE tools aim to optimize for implementation, it also needs to look at the organizational place where the data needs to fit. And this ability to identify the value added is very much a change agent perspective. Where it is necessary to have organizational change, it's necessary to have data in the front, and have other types of people in the front. Hence the need to focus on different types of leadership, ensuring that special parts of the organization are provided that provide the data, as part of the digitalization process for organizations, recognising different levels of maturity of users.

Working with cities in implementing digital transformation, the issue of communication arises in the implementation of a digitisation process and here there are challenges in ensuring an effective development dialogue between end user urban planning communities and the technology community. In fact there is still a big gap between the technology offer and the end user requirement, and project experience on these issues has demonstrated the valuable role of intermediate parties, that can bridge between the technology offer and what cities are looking for.

From the technical perspective satellite information is still in full evolution, but the resolution is still not optimal for addressing in cities, although improving. But urban planners are really asking for high resolution data to be able to work at street level and that remains a challenge. Certainly the future of Copernicus is unknown. For example, there are hundreds of Cubesets in planned satellites supporting greatly increased resolution. There are new SME's that are launching Cubesets with thermal capabilities, and providing thermal imaging at 3x3 meter resolution. So, it may be possible in five to ten years from now, if Copernicus adopt and collect all this data and include it in the portfolio, to have type of spatial resolution with temporal scales capable of dealing with urban problems according to planners requirements.

3.4.3 Core versus Downstream

Furthermore, in respect of the future of Copernicus and the future of CURE and its identity in relation to Copernicus, a central question concerns the extent to which CURE is "core service"

or how much “downstream service”. There is no clear answer as CURE started as a “core service” and yet downstream applications are required to demonstrate the usefulness of CURE. This is clear in the example of the CURE flood app using the hydrological case. In the urban environment of course, it is necessary to compliment the hydrologic model with a hydraulic one. And for the hydraulic model, very detailed data for time scales is required. That means an SME that is active in this domain can use the “core service” offer of CURE, the hydraulic case, and then parameterize the hydraulic model using CURE as input. So this is the scenario of CURE as a “core service”, to include CURE in the Copernicus operational portfolio. On the other hand, it is necessary to develop “downstream” examples to demonstrate to cities the CURE products. But for the future, it will be necessary to clarify the development direction, which may be supporting both “core” and “downstream” services as mutually supportive and essential components of EO enhanced urban governance and decision-making process.

4 CURE DEMONSTRATION WORKSHOPS – EUROPEAN LEVEL DISCUSSIONS

The Monday workshop engaging with the European level communities including the European Commission, Copernicus Entrusted Entities, Climate KIC, the Covenant of Majors, URBACT, ESPON, and EARSC, demonstrated the capabilities of the CURE apps and the CURE portal. The workshop concluded with roundtable discussion on the CURE added value in relation to the ongoing activities of the European level stakeholders represented in the workshop.

DG Regional and Urban Policy, European Commission - the Policy Development and Economic Analysis unit of DG Regional and Urban Policy prepares the annual Cohesion policy, a Cohesion Report every 3 years under the Treaty. The report assesses trends in socio-economic and territorial cohesion across the EU, and is actively seeking enhanced data and intelligence concerning the impacts of EU investments in Cohesion policy, a demand that may be supported by the CURE apps. For example, one third of Cohesion fund investments are linked to climate action. To support the effective investment of the fund in climate action, the provision of enhanced spatial data regularly updated and covering the entire EU is a top priority. The immediate question in this respect is how to further operationalize this CURE app support for cohesion fund investment assessments? In addition to these Cohesion fund related opportunities for CURE apps additional potentials exist in relation to a number of other areas including:

- Implementation of EU Urban Policies – here better data on environmental sustainability in cities is critically important. In particular the deployment of Copernicus supported spatial data and environmental indicators, as with CURE, enables the necessary regular monitoring of EU urban policy implementation;
- CO2 Emissions and Heat Loss in Buildings - the European Social Climate Fund will provide direct subsidies to families, to reduce CO2 emissions from buildings, where households and the residential sector incorporate buildings responsible for approximately 20% of greenhouse gas emissions. High quality spatial data is essential for the effective distribution of these subsidies, which is currently unavailable;
- Urban Heat Islands – much is known about urban heat islands, but there is a great need to operationalise this data into practice, to provide timely data on the impact of urban heat islands on the economy, on employment, on people, on hospitals, on schools, and other facilities, on homes for the elderly, so to promote rapid and effective action that is extended across as many cities in Europe as possible. Here also DG Employment are very interested to gain better data on the impacts of urban heat island on labour productivity;
- Renewable Energy – the key demand here is to identify regions with a high potential in renewables, including solar, wind, green roofs and other renewables, and to understand how these regions can actually help in making cities climate neutral.

DG Environment, European Commission – as part of the urban dimension, DG Environment is responsible for the Green Capital Awards. The awards have been provided to cities for over 10 years and currently support a network of 50 cities. The CURE apps can be most interesting to all Green Capital Award cities as these and all other European cities face increasing demands in regard to the transition to net zero communities. In part this is a question of decisions regarding the competing alternatives whether to invest in green roof solutions, or alternatively in line with the solar strategy of DG Energy, the promotion of solar panel investments. So what is the trade-off between solar and green roofs and sustainable cities? Furthermore, this is not always a question of simple choice as new obligations are arising including, for example, the mandatory provision of solar roofs by 2026 for commercial and public buildings exceeding 250 m², and by 2029 for all new residential buildings. The CURE portfolio of assessment tools can greatly assist in supporting the complex decision making processes surrounding these green transition investments.

Climate-KIC – support for CURE from Climate KIC depends on the CURE development path. One obvious option is that CURE solutions are integrated into Copernicus Services. Also options arise for the more commercial development of the CURE apps, in which case a key question concerns what is missing to do that? Climate KIC can facilitate the commercial development of the CURE apps with an accelerator, based on domain expertise as part of the net-zero cities consortium, and furthermore the Climate KIC Space team are promoting a European project "Protect", aiming to prepare pre-commercial procurement for the development of services in different domains, including urban. The core idea is to bring together cities and regions and other public bodies interested in developing adaptation or mitigation services together with service developers.

URBACT - speaking from the perspective of the URBACT program, which is a program that aids the exchanges between city authorities in order to for them to produce integrated action plans, substantial added value is evident in operationalising the CURE apps in the development and delivery of integrated action plans. For example, in the initiation of any action planning, the strategic direction of the action plan must be based on a clear overview of issues and potentials that can be that can be greatly enhanced by the integration of the CURE apps in that action planning process. From this, of course, a number of questions arise, for the city authorities not involved in the CURE project what's needed for them to take up these applications? What kind of capacity building or training is needed for the cities to effectively use these applications? Beyond this there are opportunities, for example, within the URBACT program, in the January 2023 call for city networks. The principal idea is that cities come forward with a project idea, and team up with other cities across Europe, in order to propose an idea for a network. In these initiatives there can be strong potential for cities applying CURE apps in the action planning process, with support from the URBACT team of experts.

European Centre for Medium Range Weather Forecasts (ECMWF) - are operating the Copernicus climate change service and the Copernicus atmosphere monitoring service based

on ECMWF data. So of particular interest are the use cases for this data developed in relation to city planning decision-making process co-produced with local stakeholders. Here some questions arise, first, are these applications dynamic or are they static demonstrators? Because this is a big difference. A second question concerns the management of the full data value chain and the engagement with the local players and the end users? So, it's good to see that DLR and Tecnalia and others are involved in the local developments, as this is really crucial. The involvement of local players, the cities, the private sector, universities and research institutes, is critical because they often have the links with local authorities and with cities. Third, how do you deal with the downscaling and with integration of high-resolution local data? ECMWF have prepared many use cases and it's always an issue, and not easy to resolve. Further associated questions arise including - How to promote quality assurance? How has it been taken into account? How to explain the underlying uncertainty, as there is a lot of uncertainty. And how do you ensure support for capacity building, making sure that people understand how to undertake the interpretation.

FORTH (CURE Coordinator) - All these are issues and questions are being discussed in the CURE consortium. Concerning the first issue, several CURE applications are dynamic. Some are not, mainly because they depend on third-party data for input. The CO2 application for example needs data from flux tower measurements for calibration. Most of CURE applications depend on Copernicus Services and satellite data and they are dynamic. That's why the applications are dockerized and have been deployed on the cloud, on DIAS. Concerning local implementation by SMEs, universities and the other entities in cities, this has to do with our discussion, on how much of CURE is “core” and how much it is “downstream”. So, our plan is to provide the “core” service by selecting and integrating all components from Copernicus Entrusted Entities and then the “downstream” service developers can use the “core” service to develop tailored services for specific cities. However, we can also develop “downstream” applications for cities, as we have done for the 3 thematic examples showcased today during this demonstration. Regarding the spatial scale issue, mature downscaling methodologies, already validated or evaluated, have been deployed in CURE. For example, the methodology, deployed in the Local Scale Surface Temperature Dynamics Application, results in products of 100 m x 100 m spatial resolution from the original 1 km x 1 km resolution and published and validated several years ago. There is a difficulty in uncertainty estimation. Of course, the different spatial and temporal scales within CURE is an issue that complicates this estimation. However, we have used in the past, for example, the Monte Carlo approach for estimating the uncertainty of our products. Uncertainty estimations are not available so far in the CURE portal, but we plan to include similar metrics, because we understand it is important to have these estimates for proper product use, based on feedback from user consultation. For this reason, we have engaged local authorities in the project from the beginning, to better understand and adapt the users’ requirements and we propose to establish links between the CURE project and the new European Missions.

Last but not least, the **Copernicus Entrusted Entities,** such as EEA and ECMWF, are getting important feedback from CURE for their services, which is included in our deliverables. For example, in preparing the interface to access the information provided by Copernicus Core Services, we faced several difficulties in developing an automatic interface connected to cloud. We have developed the front office, accessing the different information sources provided by ECMWF, EEA and other entities, but these sources are continuously updated. So we need to change continuously our applications and continue to change our data streams. We report this issue to support development of stable solutions that are always working, despite changes and updates.

5 CURE NEXT STEPS - CONCLUDING REMARKS

In conclusion it is clear that both Friday and Monday workshops generated a very substantial amount of important feedback will be given significant review in the further development of the CURE stakeholder engagement process. Immediately it can be concluded however that cities do need more and better data, but also there is a clear need for improved decision-making tools and methodologies to deploy this data in decisions concerning cities political priorities to deliver investment actions concerning climate adaptation and mitigation, as well as healthy communities, and these investments are actually huge and urgent. One way forward maybe via the Copernicus Urban Atlas, because it is well accepted and well used all over Europe. A main takeaway here, is that providing cross-cutting European data sets and tools, tailored for local urban decision making by local downstream developers, makes good economic, social as well as environmental sense.

It's also clear that competition exists in relation to these CURE initiatives including, for example, the Google engine. But the risks associated with committing to external, albeit friendly platform providers, do put in potential jeopardy the major investments on which cities will become increasingly dependent to effectively address the grand challenges of the 21st-century. So it is critical to maintain support for the development community in building excellent European alternatives using the Copernicus data.

Returning to the immediate tasks concerning the next steps for CURE. The aim is to finalize the CURE system involving further technical development, and beyond this to focus on delivery of the exploitation strategy, and defining the key exploitable results, including how to promote the CURE system to support policies at the European level, as well as the 100 Climate Neutral and Smart Cities Mission.

6 CURE DEMONSTRATION WORKSHOPS - CONCLUSIONS AND ADDED VALUE

The workshops aimed to demonstrate how the CURE cross-cutting applications can be operationalized for urban planning, identify the specific added value of the CURE cross-cutting applications, and consider how the CURE apps used by the project front-runner cities are applicable to cities more widely.

The question of the added value of CURE apps, addressed by the workshop, concerns effectiveness in relation to specific urban planning end-user information and intelligence requirements that support the complex decision-making process of urban planning. The CURE umbrella of cross-cutting apps consisting of 11 specific but interlinked applications, use Copernicus core products from up to 4 different Copernicus core services (CLMS, CAMS, C3S, EMS) as main input information integrating with third-party data, in situ observations and modelling as well as socio-economic data. The basis for this CURE added value assessment is the urban governance model developed by Smarticipate (Smart Services for Calculated Impact Assessment in Open Governance: Horizon 2020) and applied in CURE incorporating three interlinked governance principles:

- Open – governance process and decisions that foster citizens engagement improving the quality of decision-making for public institutions;
- Integrated – assessment of urban complexity supporting enhanced decision-making in a framework of interconnected strategic policy objectives where policy co-benefits and "win-win" solutions are sought;
- Interoperable – concerning the commonality of the drivers of change at global and pan-European levels that impact cities, supporting the requirement for generic modular systems of urban governance in which smart city governance solutions are applied universally to the cities of Europe.

The perspective of this governance model is a response to the reality that urban planning is moving from a centralised top-down application towards engagement with bottom-up solutions within top-down governance frameworks, to make governance process and decisions open, and to foster stakeholder engagement improving the quality of decision-making. Socio-economic and technological developments in combination are driving the emergence of this new generation of open government services. ICT is a key enabler in making this possible as open governance promotes the opening up of structures and public organisations supporting the development of transparency, accountability and trust, embodied in the interconnection of open data and open process delivering open governance service.

Open Governance - CURE added value is identified from an open governance perspective in offering an enhanced visualisation providing a powerful communication tool to aid decision making, with data visualizations simply representing and conveying complex ideas to both

expert and lay audiences. More effective communication between urban planning communities and between urban planning and citizens and other stakeholders effects engagement, can gain political support for planning transitions, and assist in mobilising behavioural change as compliment to integrated planning (top-down and bottom-up combined).

Integrated Assessment - Integrated assessment of urban complexity supporting enhanced decision-making is central to the functionality of CURE apps in relation to thematic integration and the cross-cutting assessment of city socio-economic, environmental and spatial ecosystems. CURE apps address the need for data and enhanced intelligence in relation to multi-dimensional impact assessment in relation to socio-economic and environmental factors in the spatial context of the city neighbourhood seeking policy co-benefits and win-win solutions. For example, air quality and health; green roof/green infrastructure assessments supporting adaptation targets including heat impact, active travel, air quality and flood risk. CURE apps also support temporal integration, providing greater frequency of observation overcoming the limitations of legacy systems with typically low frequency of data generation, in providing comparable and frequent timeseries data. Hence responding to the dynamics of rapid transition of the socio-economic systems of the city, particularly in the context of post-covid new normal city living, and urban planning addressing transition to net-zero communities e.g. 15 minute city.

Interoperable Systems - CURE apps clearly provide fundamental input in respect of interoperability of planning systems. In particular the apps support city by city comparabilities, benchmarking with other cities and gaining from other cities experience using comparable data eg Copernicus Urban Atlas. At the same time CURE apps facilitate spatial interoperability developing scalable solutions that enhance cross-border interoperability setting city planning in a city-region context, and overcoming political and administrative barriers to assess simultaneously, and on comparable basis, city-neighbourhood, city-wide and city region.

Next Generation Decision Support - CURE apps also aim to drive decision-making innovation providing integrated data and intelligence supporting the development of the next generation of integrated planning decision support tools. Indeed, the major challenges arising in planning and transition to “new-normal” and carbon neutral cities emphasise the limitations of existing urban governance models and the urgent need for new solutions in the “new-normal” context. This dynamic is prompting the redefinition of the design principles and operational rules for “new urban governance” including urban planning. These challenges also emphasise the urgent need to develop the next generation of decision support systems supported by ICT, and including Digital-Twin solutions, which are gaining momentum in building sustainable future cities. The set of Copernicus-based applications developed by CURE provide example of the integrated functionality required to support Digital-Twin enabled decision making. CURE applications support integrated assessment and decision-making support for urban resilience.

Deploying Copernicus enabled functionalities, these applications promote the implementation of climate change mitigation and adaptation as well as healthy cities solutions.

Overall it's clear the CURE workshops provided an invaluable exercise in stakeholder engagement promoting a sharing of views and understanding of different perspectives, and generating an ongoing dialogue on the most effective deployment of CURE applications solutions, and beyond contributing to the wider debate concerning the integration of Copernicus derived intelligence in support of urban planning decision-making process.

ANNEX 1: PARTICIPANT INFORMATION SHEET

Researchers: Kamran Soomro, David Ludlow, Joanna Bushell and Zaheer Khan

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http://www.cure-copernicus.eu/

Copernicus for Urban Resilience in Europe (CURE):
CURE Stakeholder Workshop - Participant Information Sheet

You are invited to take part in the Copernicus for Urban Resilience in Europe (CURE) full-day workshop on 14th October part of the research taking place in the project. In anticipation of your participation, it is important for you to understand why the study is being done and what it will involve. Please read the following information carefully and if you have any queries or would like more information please contact David Ludlow, Faculty of Environment and Technology, University of the West of England, Bristol at David.Ludlow@uwe.ac.uk.

Who is organising and funding the research?

The CURE project (http://www.cure-copernicus.eu/) is funded by the European Commission under Horizon 2020 programme – Grant # 870337. The CURE consortium has 10 partners from 9 countries, and it is led by Nektarios Chrysoulakis from IDRYMA TECHNOLOGIAS KAI EREVNAS (FORTH), Greece. David Ludlow, Kamran Soomro and Zaheer Khan from the University of the West of England, Bristol are leading the stakeholder demonstration and evaluation.

V.2, Professor David Ludlow, 5 October 2021

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UWE University

What is the aim of the research?

Figure 1: CURE Cross-Cutting Applications

The CURE project aims to develop 11 applications in the domain of urban sustainability, mainly for the themes of climate change adaptation/mitigation, energy and economy and healthy cities and social environments as depicted in Figure 1. To meet this challenge, information from more than one Copernicus Core Service, namely the Land Monitoring Service (CLMS), the Atmosphere Monitoring Service (CAMS), the Climate Change Service (C3S) and the Emergency Management Service (EMS) as well as 3rd party data will be used. These applications will provide new decision-making support intelligence for urban planning based on Copernicus remote sensing data, so effectively supporting strategies for resilience planning at local and city scales, towards the implementation of the Sustainable Development Goals and the New Urban Agenda for Europe.

The main research question to be addressed through the CURE Stakeholder Workshop is: 'What is the added value of the CURE cross-cutting applications for urban planning?'

To answer the above question a full-day workshop (online and in-person) is taking place on 14 October 2022, to which you have been ~~invited.~~ This workshop will provide detailed information about the CURE project as well as the CURE cross-cutting applications and engage in dialogue with focused groups of participants. The aim of the dialogues will be to collect information that can help ascertain the added value that the CURE applications provide for urban planning in cities. More specifically, the dialogues will result in an assessment of the potential impact of the CURE applications as well as an identification of further needs and requirements for their extension. The information collected through the workshop will be anonymized so it cannot be attributed to any individual.

We also need to inform workshop participants that the workshop will be recorded in two ways: through audio and video recording for the online meeting, audio only for the in-person meeting and in various written forms to produce CURE project research data. During the workshop we will also take a few screengrabs and photos for use in our research communication and dissemination activities.

We anticipate that most of the information gathered during the workshop dialogues will be collective. Nevertheless, any individuals who are referred to during the workshop will be anonymised in the evaluation and analysis process.

V.2, Professor David Ludlow, 5 October 2021

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CURE

As such, due to the collective nature of the information produced during the dialogues, information provided will not be able to be removed from the study, unless it is clearly identifiable as pertaining to the individual concerned. An announcement at the start of the workshop will inform online participants that the recording will take place and for any remote participants who do not wish to be video recorded to turn off their cameras so they can be omitted from the screengrabs and video recordings.

The results of the workshop data will be analysed and reported and available publicly from the project website. The anonymised results may also be used in conference papers and peer-reviewed academic papers and presentations.

Why have I been invited to take part?

You are invited as a professional and/or potential user of the selected CURE applications to contribute your experience, views and/or application specific requirements at the CURE Stakeholder Workshop.

Do I have to take part?

It is up to you to decide whether to take part. If you do decide to take part, **please give your consent by submitting this form** regarding the use of the information that you provide. As data collected during the workshop will be anonymised and no longer be personally attributable, participants cannot withdraw from the research after the workshop, whether attending remotely or in person. However, during the workshop participants will have the option of requesting the removal of any personally identifiable information.

What will happen to me if I take part and what do I have to do?

You will be taking part in dialogues during the CURE Stakeholder Workshop organised by UWE, Bristol on 14 October 2022. There will be two main events; a demonstration session in the morning where you will be shown the CURE cross-cutting applications. The demonstration will be given by the CURE application developers followed by a Q&A session where you will have an opportunity to ask questions. This will be followed by dialogue cafes in the afternoon where participants will be considering the added value of the CURE cross-cutting applications. Remote participants will not be taking part in the dialogue cafes and only in-person attendees will participate. The CURE project team are all experienced in the subject matter and any of the issues that may arise. Key points from these discussions will be recorded anonymously and used for further analysis. If you are attending in person, the discussion will be audio recorded for analysis purposes and if attending online, both audio and video will be recorded. The analysis will be completely anonymised and not identifiable to you.

What are the benefits of taking part?

The project directly addresses the urgent need for enhanced planning decision making support, to be supported via intelligence, tools and methodologies that meet the urban sustainability challenges. Your participation will assist in gaining understanding of stakeholder requirements via their evaluation of the CURE Copernicus applications to be applied across European cities.

V.2, Professor David Ludlow, 5 October 2021

What are the possible risks of taking part?

We do not foresee or anticipate any risk to you in taking part in the CURE Stakeholder Workshop. The research team are experienced in both conducting stakeholder workshop activities as well as the subject area. The workshop has been designed with these considerations in mind.

What will happen to your information?

All information provided will remain confidential and completely anonymised after the workshop. The anonymised data will be ~~analysed~~ and the research findings will be documented. Hard copy research material will be secured as per the University's Data security provisions as well as the Data Protection Act 2018 and General Data Protection Regulation requirements. The hard copy research material will be securely destroyed by the end of the project ~~i.e.~~ December 2022.

Where will the results of the research study be published?

A report will be written containing the research findings as CURE project deliverable D5.3 – Demonstration and Evaluation Final Report. Once approved by the European Commission, this deliverable will be publicly available from the CURE project website. Also, journal/conference papers informed by findings of the research detailed above are anticipated. Anonymous and non-identifiable direct quotes may be used for publication and presentation purposes.

Who has ethically approved this research?

This CURE Stakeholder ~~Workshop has~~ been provided with ethics consent by the CATE Faculty Research Ethics Committee.

What if something goes wrong? Or What if I have more questions or do not understand something?

If you have any concerns, queries or would like any further information about the CURE research project please contact in the first instance:

CURE Researcher: Prof David Ludlow, University of the West of England, Coldharbour Lane, BS16 1QY, Bristol, United Kingdom, Email: david.ludlow@uwe.ac.uk; Tel: +44 (0) 117 32 83223.

V.2, Professor David Ludlow, 5 October 2021

ANNEX 2: WORKSHOP AGENDAS

CURE

Demonstration Workshop Agenda

Council for European Municipalities and Regions

Square de Meeûs, 1
B-1000 Brussels, Belgium

Friday 14 October 2022

09.30	– 10.00	Registration	
10.00	– 11.00	**Session 1**	
		Welcome and Introductions	
		Nektarios Chrysoulakis, CURE Coordinator	
		Massimo Ciscato, Health and Digital Executive Agency (HaDEA), European Commission	
		Pedro Bizarro, CEMR (Council for European Municipalities and Regions)	
		Laura Hetel, DG Research and Innovation, European Commission	
		CURE Overview – Nektarios Chrysoulakis, FORTH	
		Plan for the Workshop – David Ludlow, UWE	
11.00	– *11.30*	*Coffee Break*	
11.30	– 13.00	**Session 2**	
		CURE in Action	
		Presentation and demonstration of CURE system – structured according to 3 thematic examples of urban planning requirement.	
		Q&A Session	
13.00	– *14.00*	*Lunch*	
14.00	– 16.00	**Session 3**	
		CURE Dialogue Café	
		Discussion on CURE added-value for existing city intelligence driving decision-making.	
		Dialogue Café Feedback – Rapporteurs	
		CURE Next Steps - Birgitte Holt Andersen, CWare	

CURE

Demonstration Workshop Agenda

Council for European Municipalities and Regions

Square de Meeûs, 1
B-1000 Brussels, Belgium

Monday 17 October 2022

09.30	–	10.00	Registration
10.00	–	11.00	**Session 1**
			Welcome and Introductions
			Nektarios Chrysoulakis, CURE Coordinator
			Pedro Bizarro, CEMR (Council for European Municipalities and Regions)
			Francesca Somma, DG DEFIS, European Commission
			Laura Hetel, DG Research and Innovation, European Commission
			CURE Overview – Nektarios Chrysoulakis, FORTH
			Plan for the Workshop – David Ludlow, UWE
11.00	–	*11.30*	*Coffee Break*
11.30	–	13.00	**Session 2**
			CURE in Action Presentation and demonstration of CURE system – structured according to 3 thematic examples of urban planning requirement.
			Q&A Session
			Conclusions and CURE Next Steps - Birgitte Holt Andersen, CWare
13.00	–	*14.00*	*Lunch*

ANNEX 3: DIALOGUE CAFE METHODOLOGIES

2nd CURE Demonstration Workshop

14.00-15.30 CURE Dialogue Café

Discussion on CURE added-value for existing city intelligence driving decision-making.

Methodology: Moderated semi-structured discussion in the main room

Moderators: Giorgos and David

Reporters: Jo and Kamran

CURE app developers: Zina (AP01, AP09), Mattia (AP02), Tomas (AP05, AP06), Alessandra (AP10), Dirk (AP07, AP08), Birgitte (AP11)

Guidelines:

Moderators introduce their CURE colleagues, explain the participatory process, address the underneath main and supporting questions, and coordinate both face-to-face and online dialogue considering that all themes should be discussed. After responding/discussing each question, they can devote 5 minutes to participants for writing down post-it notes.
Reporters record the responses and discussion with the support of audio and MS Teams.
CURE app developers showcase their apps, if needed based on the discussion and there is remaining time.
Participants engage in discussions around the underneath questions. They write down their thoughts on post-it notes and stick them to flip chart paper (following figure).

CURE Dialogue Café	Challenges addressed – Policies/strategies supported	Additional capabilities/products/apps needed
Climate Change Mitigation (Heat and CO2 apps)		
Climate Change Adaptation (Nature-Based Solutions and Flood/Subsidence apps)		
Healthy Cities (Health, Thermal Comfort and Air Quality apps)		

Questions for participants:

1. **Which specific challenges are or could be addressed with products of CURE apps in your city?** (+ questions for Climate Change Mitigation, Climate Change Adaptation and Healthy Cities themes if needed)

   For supporting dialogue: Are there any policies/strategies of your city you are aware of, where CURE apps can support improved decision-making? (+ questions for Heat and CO2; Nature-Based Solutions and Flood/Subsidence; and Health, Thermal Comfort and Air Quality apps if needed)

2. **Which additional capabilities or products related to CURE apps would be of high priority for your city?** (+ questions for Heat and CO2; Nature-Based Solutions and Flood/Subsidence; and Health, Thermal Comfort and Air Quality apps if needed)

   For supporting dialogue: Would you need additional apps for enhancing the resilience of your city? What would you need for improving its current state of resilience? (+ questions for Climate Change Mitigation, Climate Change Adaptation and Healthy Cities themes if needed)

Process and responsible persons:

Time	Task		Responsible persons
14.00-14.05	Introduction	Introducing CURE colleagues and explaining the participatory process	Giorgos
14.05-14.45	1st question dialogue	Addressing the question	Giorgos
		Addressing supporting questions	David
		Moderating live discussion	David
		Moderating online participants	Giorgos
		Taking notes of the dialogue	Jo and Kamran
		Writing down post-it notes (last 5 minutes)	Giorgos
		Exploring CURE apps (if needed)	Zina and Tomas
14.45-15.25	2nd question dialogue	Addressing the question	Giorgos
		Addressing supporting questions	David
		Moderating live discussion	David
		Moderating online participants	Giorgos
		Taking notes of the dialogue	Jo and Kamran
		Writing down post-it notes (last 5 minutes)	Giorgos
		Exploring CURE apps (if needed)	Zina and Tomas
15.25-15.30	Break	Rapporteurs prepare Dialogue Feedback	