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CITY MINDED
City Monitoring and Integrated Design for Decarbonisation

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2ND CITY DECARBONISATION ITINERANT WORKSHOP - REPORT

1-5 MARCH 2021, ROME

Responsible Partner:

ROMA TRE UNIVERSITÀ DEGLI STUDI | DIPARTIMENTO DI ARCHITETTURA

Table of contents

1. Introduction

The 2nd City Decarbonisation Itinerant Workshop consisted in a virtual workshop carried out on the Teams platform and organized by the University of Roma Tre in combination with the 3rd Project Management Meeting.

The objective of the workshop was to put together project partners (teachers, researchers, or trainers), students, and local stakeholders in order to address common onsite challenges and define collaborative urban decarbonisation roadmaps for the Torrino-Mezzocammino neighbourhood in Rome through a 'learning-by-doing' method.

The workshop was divided into training and co-working sessions; each day 1-3 persons (teachers, researchers, or trainers) from each partner organization presented a training session to implement a site-specific urban decarbonisation roadmap for the selected neighbourhood. After the training seminars, each partner organized a co-working session with practical exercises to be done by the students.

On the first day, in order to better understand the target area, some relevant stakeholders were involved: the Torrino-Mezzocammino Consortium (that, having carried out the construction works of the target neighbourhood, was able to provide valuable insights on the transformations in the area) and the local neighbours' association. The results of a survey aimed at assessing the inhabitants' perception of their neighbourhood completed the presentation of the target area. Other presentations served to frame it into the overall dynamics and issues of the city of Rome, providing an overview of the transformations of the urban area between the city centre and the littoral, and of the vulnerability to climate change of the city as a whole.

Regarding the participants, UNIROMA3 succeeded in involving 24 students, of which nine PhD students, eleven students from the Bachelor's degree in architecture, three from the Master's degree in architectural design, and one from the Master's degree in engineering.

2. Agenda

Day 1 – March 1st

Time	*Name of the presentation*	*Responsible partner*
10:00	Registration of the participants	
10:05	Welcome speech	IRENA
10:10	Introduction and opening of the Workshop - The CITYMINDED project: urban sustainability, decarbonisation and climate change	UNIROMA3
10:30	Rome by the sea (Mario Cerasoli, Romina D'Ascanio - UNIROMA3)	UNIROMA3
11:00	Stakeholders presentations • Mr Maurizio Nicastro, Consorzio Torrino Mezzocammino • Mr Daniele Pluchino and Mr Mattia Palatta, Comitato di Quartiere Torrino Mezzocammino • Ms Enrica Giaccaglia and Mr Marco Mauti, University of Roma Tre – Dept. of Architecture • Mr Flavio Camerata, U-Space s.r.l. Open discussion	UNIROMA3
12:30	Training session: Place-making framework • Next stop: Torrino Mezzocammino?	UNIROMA3
13:00	Lunch Break	
14:00	Training session: Place-making framework • Ecological networks & Green infrastructure • Urban and Landscape design	UNIROMA3
15:00	Break	
15:15	Co-working session	UNIROMA3
17:30	Presentation and discussion of group work results	UNIROMA3
17:45	Conclusions	UNIROMA3
18:00	End of day 1	

Day 2 – March 2nd

Time	***Name of the presentation***	***Responsible partner***
14:00	Registration of the participants	
14:05	Training session: Assessment and analysis of vulnerability associated with climate change • Theoretical introduction: Vulnerability to Natural Hazards in a Climate Change Context • Methodological introduction: Vulnerability Index calculation and representation	UPO
14:50	Break	
15:00	Co-working session	UPO
17:00	Presentation and discussion of group work results	UPO
17:45	Conclusions	UNIROMA3
18:00	End of day 2	

Day 3 – March 3rd

Time	***Name of the presentation***	***Responsible partner***
14:00	Registration of the participants	
14:05	Training session: Carbon accounting and carbon footprint mitigation	UNISI
14:50	Break	
15:00	Co-working session	UNISI
17:00	Presentation and discussion of group work results	UNISI
17:45	Conclusions	UNIROMA3
18:00	End of day 3	

Day 4 – March 4th

Time	***Name of the presentation***	***Responsible partner***
14:00	Registration of the participants	
14:05	Training session: Energy Efficiency and Renewable energy technologies in the active service of the City decarbonisation processes	IRENA and MIEMA
15:30	Break	
15:45	Co-working session	IRENA and MIEMA
17:30	Presentation and discussion of group work results	IRENA and MIEMA
17:45	Conclusions	UNIROMA3
18:00	End of day 4	

Day 5 – March 5th

Time	***Name of the presentation***	***Responsible partner***
14:00	Registration of the participants	
14:05	Welcome speech	IRENA
14:10	Wrap up of the performed activities	UNIROMA3
14:30	Presentation and assessment of the workshop results (with the participation of partners and students)	UNIROMA3
15:30	Final discussion and lessons learnt	UNIROMA3
16:00	Conclusion and end of the City Decarbonisation workshop	UNIROMA3

3. Participants

Name and Surname	***Organization***	***Day 1***	***Day 2***	***Day 3***	***Day 4***	***Day 5***
Partners						
Andrea Poldrugovac	IRENA	X	X	X	X	X
Antonio Franković	IRENA	X	X	X	X	X
Riccardo Maria Pulselli	UNISI	X	/	X	/	X
Matteo Maccanti	UNISI	X	X	X	X	X
Valentina Niccolucci	UNISI	X	/	X	/	X
Massimo Gigliotti	UNISI	X	X	X	X	X
Michela Marchi	UNISI	X	X	X	X	X
Morena Bruno	UNISI	/	/	X	/	/
Anna Laura Palazzo	UNIROMA3	X	/	X	X	X
Federica Di Pietrantonio	UNIROMA3	X	X	X	X	X
Romina D'Ascanio	UNIROMA3	X	X	X	X	X
Lorenzo Barbieri	UNIROMA3	X	X	X	X	X
Francesca Paola Mondelli	UNIROMA3	X	X	X	X	X
Mario Cerasoli	UNIROMA3	X	/	/	/	/
Josefina López Galdeano	UPO	X	X	/	/	/
Pilar Paneque Salgado	UPO	X	X	/	/	/
Jesus Vargas Molina	UPO	X	X	/	/	X
Diane Cassar	MIEMA	X	X	X	X	X
Stakeholders						
Maurizio Nicastro	Consorzio Torrino Mezzocammino	X	/	/	/	/
Daniele Pluchino	Comitato di Quartiere Torrino Mezzocammino	X	/	/	/	/
Mattia Palatta	Comitato di Quartiere Torrino Mezzocammino	X	/	/	/	/
Marco Mauti	UNIROMA3 – Department of Architecture	X	/	/	/	/
Enrica Giaccaglia	UNIROMA3 – Department of Architecture	X	/	/	/	/
Flavio Camerata	U-Space s.r.l	X	/	/	/	/
Domenico Cecchini	National urban planning institute – Lazio regional section (INU Lazio)	X	/	/	/	/
Students						
Ambrosio Francesca	UNIROMA3 – PhD	/	X	/	/	/
Anis Castillo Ester Teresa	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Armpara Sophia	UNIROMA3 – PhD	X	X	X	X	X

Borghini Marta	UNIROMA3 – Master's degree in architectural design	X	X	X	X	X
Cappuccio Camilla	UNIROMA3 – Master's degree in architectural design	X	X	X	X	X
Castiglione Francesco	UNIROMA3 – Master's degree in architectural design	X	X	X	X	X
Chiappini Vittoria	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
D'Alessandris Lapo	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
D'Asero Francesco	UNIROMA3 – PhD	X	X	X	X	X
Del Gizzo Alisee	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Le Xuan Sara	UNIROMA3 – PhD	X	X	/	/	/
Lugni Carolina Claudia	UNIROMA3 – PhD	X	X	X	X	X
Manieri Sofia	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Merlonghi Luca	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Mette Ivana	UNIROMA3 – PhD	X	X	X	X	X
Moscoloni Sofia	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Palazzini Cristina	UNIROMA3 – PhD	X	X	X	X	X
Paolantonio Giada Rose	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Rinaldi Martina	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Sciarretta Federico	UNIROMA3 – Master's degree in engineering	X	X	X	X	X
Tabacchi Isabella	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X
Trulli Luca	UNIROMA3 – PhD	X	X	X	X	X
Vacca Elisabetta	UNIROMA3 – PhD	X	/	X	/	/
Vetere Irene	UNIROMA3 – Bachelor's degree in architecture	X	X	X	X	X

4. Report from the workshop

Preliminary considerations: structure of the workshop, sequence of the modules, participation

The structure of the Rome workshop was very similar to the one implemented in Siena: a first half-day dedicated to the presentation of the hosting city and of the target neighbourhood, followed by the training and co-working sessions conducted by the hosting organization; three half-days dedicated to the training and co-working sessions conducted by the other partners; and a final half-day dedicated to a wrap-up of the results achieved and of the problems incurred, which involved both partners and participating students.

The same procedure was applied to each 'block' of training and co-working session (that is, to each Module): first, a series of presentations on the 'topic of the day' (reflecting each partner's expertise) delivered during a plenary and ending with a Q&A moment; afterwards, students were divided into groups and each group worked in a different virtual room, assisted by one delegate from the partner in charge of the session and (if needed) by one delegate of UNIROMA3. Once the group work finished, students and partners' delegates returned to the main room and a spokesperson for each group presented the results achieved in a plenary, triggering further discussion.

Since this time the hosting organization was UNIROMA3, the first Module was dedicated to the Place-making framework. This allowed establishing a clear connection with most of the topics addressed during the stakeholders' session, and provided a general territory-based framework for the following modules.

UNIROMA3 succeeded in involving 24 students, of which nine PhD students, eleven students from the Bachelor's degree in architecture, three from the Master's degree in architectural design, and one from the Master's degree in engineering. The different level and background of participants was a value added for the workshop, allowing for a certain degree of knowledge transfer during the co-working sessions.

Case Study

The Torrino-Mezzocammino neighbourhood lies in the south-western part of the city of Rome, just outside Rome's ring road, known as Grande Raccordo Anulare (GRA). *Torrino* (small tower) is a historical place name originating from a nearby neighbourhood, while *Mezzocammino* literally means halfway, because the area is located in the middle of the route between the city centre and the port of Ostia. A small pier for the overnight stop of commercial boats was located on the river in the vicinities of the neighbourhood.

Ever since the 1930s the area was supposed to be developed as a residential area, but it was not until the late 1990s that a consortium of landowners was established, allowing the preparation of a development plan for the area. The first inhabitants moved in in 2008, with most works still ongoing, both on the amenities and on the houses. The neighbourhood covers around 190 ha. As of March 2021, some areas are still being developed.

The neighbourhood features a rectangle of roads at its centre, enclosing a large open space, still awaiting to be developed into an urban park. Other parks are already open and feature benches, open-air gym equipment, playgrounds, and even the remnants of an ancient Roman road. One of the corners of the rectangle features a roundabout below the ground level. The walls of the roundabout are painted with the pictures of famous Italian comic book characters, as reflected by the street names, honouring comic book writers and designers. On top of the roundabout is a cluster of supermarkets, shops and restaurants. Other shops and amenities are located on the main roads.

Torrino Mezzocammino is well connected to the surrounding road system: apart from the ring road, via Ostiense/del Mare and via Cristoforo Colombo connect it to the city centre and to the seaside. What lacks is the public transport connection: despite being bordered by the metro-like Roma-Lido railway, the neighbourhood has no station, nor it is expected to be built soon. Bicycle paths cross all parks and footpaths are large and well maintained, so the inhabitants can easily move around the neighbourhood sustainably. The only setbacks are the long distances and the lack of a connection to the Tiber and to the cycle path that runs along it. Nevertheless, the area is full of promise: good maintenance of the parks and amenities, and better public transport and cycle connections can make it a good standard for future neighbourhoods.

Figure 1. Aerial view of the Torrino-Mezzocammino neighbourhood

Figure 2. Location of the Torrino-Mezzocammino neighbourhood

Local Stakeholders Engagement

For this workshop, UNIROMA3 involved the following stakeholders:

- Mr Maurizio Nicastro from the Torrino-Mezzocammino Consortium, which was in charge of the works for the neighbourhood's construction. His presentation focused on the development process of the area, from the first parcelling plan of 1942 to the starting of the construction works in 2004, and focused on the equipment of the neighbourhood in terms of public areas (squares and parks), mobility infrastructure (roads and cycle paths), and public facilities (schools), highlighting the current difficulties of the Municipality to manage and maintain public spaces.
- Mr Daniele Pluchino and Mr Mattia Palatta from the local neighbours' association. Their presentation highlighted some important features of the target neighbourhood, such as the relatively young population, the liveliness of social life, the central role of the central park as a place for social interaction. The speakers also pointed out the importance of the voluntary work of their association that organizes social activities, mobilizes inhabitants and local enterprises, promotes the collective care and maintenance of public spaces, and maintains collaborative relationships with the local public administration (*Municipio*).

- Ms Enrica Giaccaglia and Mr Marco Mauti, from the University of Roma Tre – Dept. of Architecture. They presented the results of a survey aimed at assessing the inhabitants' perception of their neighbourhood. The survey was conducted through questionnaires, focused on three main themes: the relationship with the parks within the neighbourhood; the relationship with the Tiber River; and the identification of weaknesses and potentials of the area. The results of the survey show that the population of the neighbourhood is very young in comparison to the average of the city of Rome; that the community is very satisfied and proud of its parks and open spaces, and would appreciate a better accessibility to the Tiber along with the riverside rehabilitation; that the improvement of public transportation and cycle paths would increase the quality of life in the area.
- Mr Flavio Camerata, from U-Space s.r.l., who provided an overview on climate change adaptation planning, and presented the Climate Vulnerability Map of Rome as the result of a Roma Tre/ENEA joint research project implemented between 2012 and 2014. The Map provides a subdivision of the different areas of the city into classes of vulnerability to climate change, especially focusing on three climate-related hazards: high summer night temperatures, rainwater flooding, and river flooding.

The stakeholders' speeches were introduced by a lecture given by Prof. Mario Cerasoli and Dr. Romina D'Ascanio from the Department of Architecture of the Roma Tre University. The presentation provided an analysis of the macro-sector between Rome and the sea along the Tiber River and some infrastructures at metropolitan scale. The features of this area and its neighbourhoods, their criticalities and their values were presented. Finally, a framework was given both on traditional urban planning tools and on bottom-up processes such as the Tiber River Contract.

Training sessions

Place-making framework - UNIROMA3

The team made three presentations on the 1st of March:

- "Next stop: Torrino Mezzocammino?" by Dr. Lorenzo Barbieri.
- "Ecological Networks and Green Infrastructure" by Dr. Romina D'Ascanio.
- "Urban & Landscape Design" by PhD candidate Francesca Paola Mondelli.

The first lecture was structured differently than the one held in Siena, during the first decarbonisation workshop: students were not introduced to planning topics because as architecture students they already had some knowledge from their previous studies. Therefore, the lecture focused on the mobility issues of the Torrino-Mezzocammino neighbourhood, which would also be a topic in the co-working session.

The presentation looked at mobility within the whole city of Rome, in the southern sector of the capital and within the neighbourhood itself. Torrino-Mezzocammino is well connected through the main roads that border it: via Ostiense/del Mare, via Cristoforo Colombo and the Grande Raccordo Anulare ring road. A local railway with a metro-like service runs parallel to via Ostiense, but there is no station in the vicinity of the neighbourhood. One bus line connects Torrino-Mezzocammino to nearby areas, reaching one metro station. The line was established in 2012, but has been extended until midnight only in recent years. The neighbourhood has many bicycle lanes, but no connection to the rest of the city.

The lecturer went on to present the open issues in Torrino-Mezzocammino. First of all, there are many parking spaces, but they are often relegated in large, derelict areas far from houses and shops. Although there are many bicycle lanes and sidewalks are large and mostly well kept, this is a neighbourhood designed for cars: the distances between houses and public services are long, and the neighbourhood is low density. This makes Torrino-Mezzocammino a place with unfulfilled potential: better public transport and bicycle connections would greatly improve it.

Finally, the presentation focused on the future perspectives for the neighbourhood. The central section of the park is yet to be developed. Once it is open, it will provide a much needed bicycle and pedestrian connection in the heart of the neighbourhood, allowing closer links between houses and shops. Public transport is another important topic: with the construction of a station postponed indefinitely, new, faster connections to the city need to be provided, such as bus lanes or a tram service. The COVID-19 pandemic also puts the local amenities of Torrino-Mezzocammino at the centre of the debate. The inhabitants, forced at home or in their vicinities during the first lockdown, learned to appreciate the large parks and many shops.

The second presentation was aimed at explaining the concept of Ecological Networks within spatial planning and the new approach to Green Infrastructure.

On the ecological perspective, Ecological Networks (EN) can be considered as an interconnected system of habitats whose biodiversity needs to be safeguarded. Thus, the focus goes on animal and plant species that are potentially threatened. In this case, the geometry of the network has a structure based on the recognition of core areas, buffer zones and corridors that allow the exchange of individuals in order to reduce the extinction risk of local populations. The EN is a tool aimed to mitigate habitats fragmentation and to ensure the permanence of the ecosystem processes and the connectivity for sensitive species.

Examples of planning of ecological networks were brought, both at metropolitan and local level (Metropolitan Plan of Rome, 2010 and General Plan of Roma Capitale, 2008).

If ecological networks follow a mainly biological and ecological approach, green infrastructure represents an innovative way in which the benefits to communities produced by nature are taken into account in spatial planning. The concept of EN has evolved over the years into Green Infrastructure in a more comprehensive framework. Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services (EU, 2013).

Green Infrastructure were explained in detail, especially with references to the scientific literature on their multifunctionality and transcalarity features.

Green Infrastructure (GI) serves the interests of both people and nature and has the potential to tackle several problems simultaneously in alternative to traditional grey infrastructure. The GI approach provides multiple functions and benefits to the communities, matching ecological, social, cultural and economic issues at different scale.

Furthermore, the French ‘trame verte et bleue’ strategy was explained as a good practice to take GI in spatial planning. It is a spatial planning tool covering the entire national territory, with the core objective of stopping the decline of biodiversity by conserving and restoring ecological continuities to ensure provision of ecosystem services.

Finally, in order to give some insight for decarbonisation at urban scale using GI, some examples of nature-based solutions were given.

The third presentation focused on landscape and urban design strategies for urban decarbonisation. The presentation was divided into five parts.

In the first part, a definition of landscape was provided, underlining how it is structured through the interaction between nature and history. From this broader definition, we moved

on to include the everyday landscapes, and therefore the concept of proximity, through reference to Article 2 of the European Landscape Convention.

In the second part, we focused on providing a dimension of proximity, applying the different radius of influence (from the widest one of 1 Km to the narrowest one of 200 m) on the Torrino Mezzocammino neighbourhood. While recognizing the importance of everyday landscapes for a good urban quality, the results of a questionnaire addressed to the population were also presented. It was about the experience of neighborhood public space during the COVID-19 quarantine, in March 2020.

In the third part, we presented a famous good practice in the design of public space of proximity at European level: the case of the "Ville du quart d'heure" (15-minutes city) in Paris. This is an urban regeneration strategy that aims to put the inhabitant at the centre of design, by improving the functional mix of the neighbourhood, increasing the amount of green space, and encouraging bicycle and pedestrian mobility, to the detriment of the car.

In the fourth part, the structure of the target area was described, in order to evaluate the applicability of the model of the 15-minutes city on the Torrino-Mezzocammino neighbourhood. The landscape of the district was described by breaking it down into its four main components: orography and hydrography, as far as natural systems are concerned; infrastructure and urban fabric, as far as anthropic systems are concerned. In order to allow a deeper analysis of the neighbourhood during the co-working session, a preliminary analysis conducted in the previous months within the course of urban policies at the University of Roma Tre was presented to the students. It was then highlighted the provision of services, the recognition of central places, the existing road network, the travel time to reach the different public spaces of the neighbourhood. All these elements are useful to build and implement the network of proximity in Torrino-Mezzocammino in order to reduce the use of the car.

Finally, some perceptions of the neighbourhood were presented to the students through the collection of photos and videos taken during a site visit.

Assessment and analysis of vulnerability associated with climate change - UPO

Climate change forecasts predict an increase in the frequency and intensity of natural hazards in Italy, among the most serious droughts, floods, and heat waves (IPPC, 2014). The objective of this workshop is to make an approach to the hybrid nature of risks, in which the interaction between natural events and social processes are related to generate risk situations.

A theoretical introduction was made on the need to turn risk management strategies towards prevention, mitigation, and adaptation strategies. Vulnerability assessment and analysis have become one of the main tools for preventing and mitigating natural hazards effects on society,

economy, and environment (UNISDR, 2015; EEA, 2018). The UPO contribution aimed to introduce students in both theoretical and operational assessment and analysis of vulnerability associated with climate change.

The workshop specially focused on: 1) Setting up a method that allow students to understand the different components and dimensions of vulnerability. What and why is important to analyze; 2) Introducing students to different research techniques, tools, and data sources; 3) Training compound index calculation, representing, comparing, and analyzing results; and 4) Highlighting the importance not only to measure vulnerability but also to analyze it.

Carbon accounting and carbon footprint mitigation - UNISI

UNISI presentation consisted in the "Urban Carbon Accounting – Torrino Mezzocammino" delivered by Dr. Matteo Maccanti, on 5th March 2021.

The Carbon Accounting Methodology and the case study were presented to the students.

This procedure is inspired by the IPCC standard methodology for GHG emissions inventory of Nations and has a dual role: to assess the Carbon Footprint (CF) of urban neighbourhoods, and to estimate the effects, in terms of Carbon Footprint mitigation, of action plans aiming at carbon neutrality. The methodology presented is based on the one developed as part of the EU FP7 City-Zen Project (Pulselli et al., 2018, 2019a, 2019b, 2021) which aimed to establish a general approach for urban neighbourhood retrofitting in European cities for decarbonisation including the monitoring of carbon emissions and the estimate of the effects of mitigation measures. This methodology was also tested during the 1st City Decarbonisation Itinerant Workshop of the CITY MINDED project, carried out in Siena in November 2020.

First, a brief explanation on what is the carbon footprint and how it is calculated was made, also highlighting how data collection and elaboration usually takes place and which Emission Factors were used for this work.

After that, the specific data for the neighbourhood regarding the consumption of electricity, fuel for heating and cooling, and fuel for cars, as well as waste and water management, were presented.

The assessment focussed on the Torrino Mezzocammino neighbourhood: a simplified carbon accounting framework was conceived, for assessing the CF of the area and the CF mitigating effects of integrating decarbonisation scenarios, covering residential energy demand, fuel use for mobility, waste and water management, food consumption and carbon uptake by urban ecosystems. The assessment also allowed for profiling the typical household of the neighbourhood as a functional unit for assessing the impact of the neighbourhood and the

mitigation scenario, and for comparing results with those of the previous workshop. The ex-ante evaluation of the effects of mitigation strategies concerning different spatial scales (from neighbourhood to households, down to individuals) and temporal horizons (short-, medium-, long-term mitigation measures) was performed (these mitigation measures mainly refer to Pulselli et al., 2019).

The Carbon Footprint of the Torrino Mezzocammino neighbourhood was also presented and visualized in terms of virtual forestland equivalent, i.e. the equivalent surface of forest that would be needed to absorb carbon emissions generated within the area. In the end, a dynamic representation of the "decarbonisation" plan for city neighbourhoods by 'crunching' the virtual forestland was carried out.

Energy Efficiency and Renewable energy technologies in the active service of the City decarbonisation processes - IRENA & MIEMA

The energy agencies IRENA and MIEMA presented the following topics on the 4th March:

- "Energy Efficiency in the active service of the City decarbonisation processes" by Andrea Poldrugovac, IRENA
- "Renewable Energy technologies in the active service of the City Decarbonisation processes", by Diane Cassar, MIEMA

The first presentation focused on the topic of energy efficiency, with particular focus on the building stock of the Torrino-Mezzocammino neighbourhood and its energy-efficient improvement by sharing the knowledge about energy efficiency, by detecting potential problems and identifying solutions during the Co-working session and by defining energy efficiency measures which will act as an integral part of the urban decarbonisation roadmap for the target neighbourhood.

The presentation was divided into six chapters: presentation of the working group, energy efficiency in the active service of the city decarbonisation process, energy efficiency measures, nearly zero-energy buildings, energy refurbishment of heritage buildings and how to finance renovations. The focus of the presentation was on how to achieve energy-efficient buildings in the target neighbourhood.

Among different energy consumers in the urban areas, buildings were chosen since the building stock is responsible for approximately 40% of EU energy consumption and 36% of the greenhouse gas emissions. Buildings are the single largest energy consumer in Europe, and it is worth noticing that about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient. Unfortunately, only about 1% of the building stock is renovated each year. These numbers will have to change rapidly in the following years if the

targets set in the EU Green Deal are to be achieved. One of the latest and most important initiatives, the “Renovation Wave”, was presented, which represents a flagship initiative of the EU Green Deal and of the Next Generation EU recovery plan. The ambition of the Renovation Wave is to rapidly double the current renovation rate of buildings to boost climate protection and circularity while creating thousands of new jobs. To achieve planned targets, it is necessary to implement relevant energy efficiency measures, which were presented to the students in five typical categories, aimed to reduce heating demand, cooling demand, energy requirements for ventilation, energy use for lighting and energy used for heating water. The theoretical session was concluded with presenting what are “Nearly zero-energy buildings (NZEB)”, how to conduct energy refurbishment of heritage buildings and how to finance the renovations.

The second presentation focused on the integration of renewable energy systems within the urban environment. Six main topics were presented: urban energy systems and the urban energy strategy; renewable energy technologies; prosumers and self-consumption; urban micro-grids and energy communities; identification of different building typologies and challenges to energy renovation; and an overview of the energy auditing processes.

A number of best practices from Malta and other countries in relation to the integration of RES for self-consumption were also presented. These included building-integrated photovoltaic systems, PV facades, solar parking shading devices and geothermal heat pumps.

Photovoltaic technologies (conventional panels and BIPV), micro-wind and combined heat and power systems were presented as possible solutions to be integrated in different buildings types within the target neighbourhood of Torrino-Mezzocammino. The potential of energy storage solutions and smart micro-grids was also discussed to further maximise self-consumption of energy produced through renewable energy technologies within the buildings.

Co-working sessions

UNIROMA3

Description of the exercise

The co-working session introduced the concepts of decarbonisation and urban environment and used the tool of community mapping in order to set a place-making framework to plan and design green infrastructure for decarbonisation at local scale. The team adopted a wide perspective on decarbonisation, by including those aspects that highlight its connections to other topics:

- town planning, because the structure of a city can influence decarbonisation;
- climate change, because the reduction of greenhouse gas emissions mitigates its effects;
- green infrastructure, as their employment serves as a means to achieve decarbonisation.

Community mapping can be defined as a way to make citizens express their views on the development of their neighbourhood. It is a set of approaches and techniques that combines the tools of modern cartography with participatory methods to record and represent the spatial knowledge of local communities.

The co-working session aimed to produce a territorial analysis on the three aspects highlighted in the training session: infrastructure (private mobility, public transport, cycling), open spaces (green areas, agricultural areas, natural areas) and public spaces (squares, centralities, parking lots). Therefore, the students were divided into three groups, where they worked together on two qualitative exercises:

- The first one had a more graphic aspect. In order to set an urban scenario for the neighbourhood of Torrino-Mezzocammino using a satellite map, we asked students to highlight three main features: barriers (natural and artificial), connections (ecological, mobility and visual) and key elements (criticalities and values), and to devise possible solutions to the problems they highlighted in the previous analysis.
- The second one was a more critical thinking exercise: we asked students to develop a SWOT analysis in terms of landscape perception and interpretation.

Results

Overall, the results were interesting: unlike the participants in the 1st workshop in Siena, these students had a background in architecture and town planning, which allowed them to look at the neighbourhood with different, somewhat biased eyes. They focused on specific, minor issues (such as the use of some building materials) rather than simply looking at issues of connectivity. While this hindered them during the analysis, it helped them in finding solutions,

which they found remembering projects they had consulted before or searching the internet. This also helped in compiling the SWOT analysis. The students were satisfied with the session, as it allowed them to collaborate with one another on familiar topics, as well as to learn new skills and be able to employ them in this exercise.

Figure 1. Sample results of the first exercise: territorial analysis and proposal of a solution

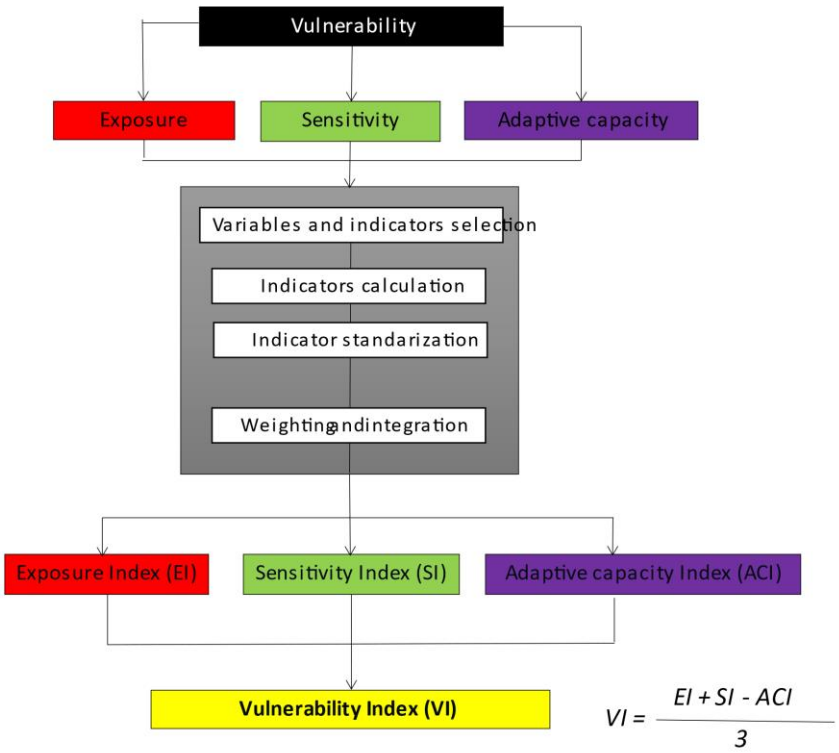
UPO

Description of the exercise

The exercise proposed completed the theoretical introduction. It was divided into three complementary parts: vulnerability assessment, vulnerability analysis and results debate.

The starting point was the risk equation (risk = hazard * vulnerability). To assess vulnerability, we adopted the methodological framework proposed by Intergovernmental Panel on Climate Change (IPCC) (2012, 2014)[1] which defines vulnerability based on three main components: Exposure, Sensitivity, and Adaptive capacity. Figure 1 shows the methodological proposal to assess vulnerability.

Figure 1. Methodological framework



[1] IPCC (2012) Managing the risks of extreme events anddisasters to advance climate change adaptation. In: Field CB, Barros V, Stocker TF, Qin D, DokkenDJ, Ebi KL, Mastrandrea MD, Mach KJ, Plattner G-K, Allen SK, Tignor M, Midgley PM (eds) Available from Cambridge University Press.

IPCC (2014) Summary for policymakers. In: Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC,Girma B, Kissel ES, Levy AN, MacCracken S, Mastrandrea PR, White LL (eds) Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge.

To calculate each component, a set of variables and indicators was selected, based on two criteria: 1) availability of data; 2) that were diverse enough to capture the multidimensional nature of vulnerability (social, natural, economic, institutional, and technological) and allow students to train different tools and research techniques and data. Tables 1, 2 and 3 present the set of indicators selected of each component.

Table 1. Exposure variables, indicators, and units of measure.

	Variable	Indicator	Unit of measure
Exposure	Population	**Population exposed** (Total county population/total region population)	%
	Housing stook	**Housing stock exposed** (Total county houses/total region houses)	%
	Green areas	**Green areas exposed** (Total green areas/total area)	%

Table 2. Sensitivity variables, indicators, and units of measure.

	Variable	Indicator	Unit of measure
Sensitivity	Population	**Individual relative poverty incidence** (Individual regional relative poverty incidence/individual national relative incidence)	%
	Population	**Dependent population** (population under 16 and over 65/ total population)	%
	Housing stook	**Substandard housing** (County rotten windows, floors buildings/National rotten windows, floors buildings)	%
	Housing stook	**State of the Building** (number of poor or very poor buildings)/(number of total residential buildings)	%
	Green areas	**Green urban areas** (Green urban areas/inhabitants)	%

Table 3. Adaptive capacity variables, indicators and units of measure.

	Variable	Indicator	Unit of measure
Adaptive capacity	**Climate change planning**	**County adaptation plan** Document review	**0-1**
	Emergency planning	**County emergency plan** Document review	**0-1**
	Education	**Educational level** Primary education, lower secondary education or upper secondary education	**%**
	Climate change and natural risk perception	**Climate change and Risk Perception** Survey	**0-1**
	Institutional Trust	**Institutional Trust** Survey	0-1

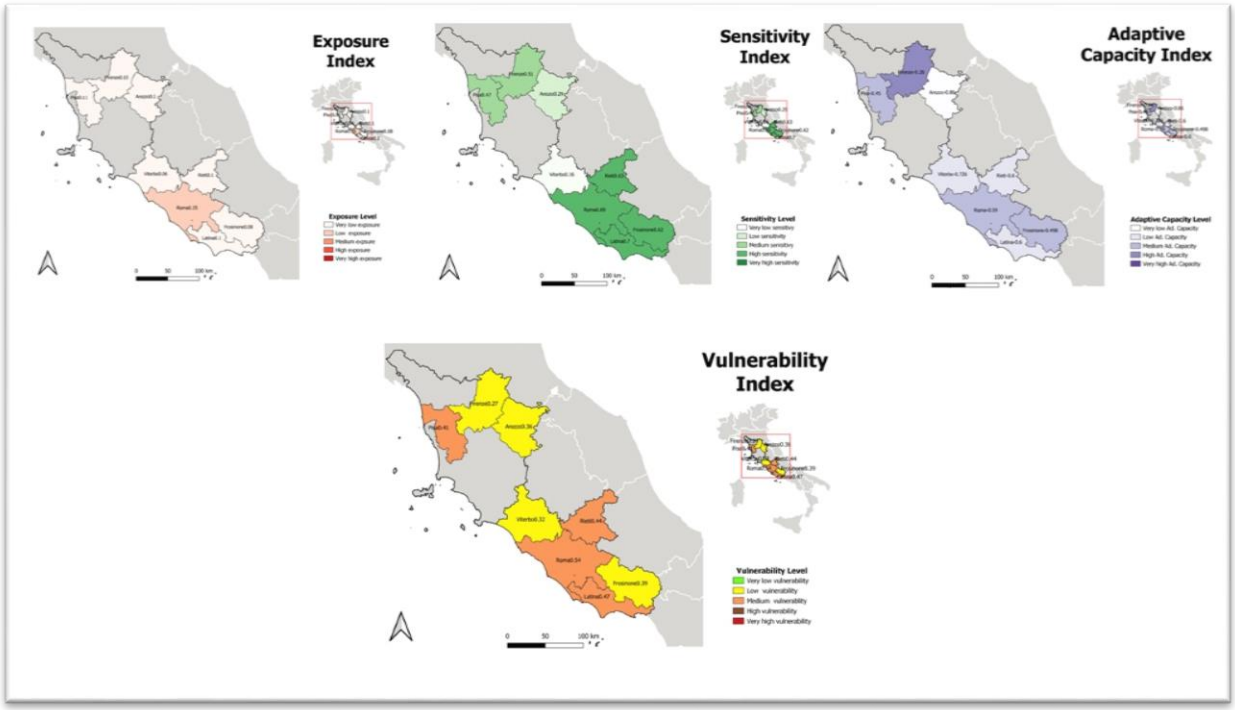
Once the indicators of each component were calculated, we used the triangle structure of vulnerability (adapted from Liu *et al.* 2013[2]) to analyse the contribution of each component to the final vulnerability value. Finally, the results were presented.

Results

Figure 2 shows the vulnerability assessment results for each study case (exposure index, sensitivity index, adaptive capacity index and the final vulnerability compound index). We included also results obtained from the 1st City Decarbonisation Workshop in Siena (Italy), where we used the same methodology, so we can have an overview of the work yield in the whole project.

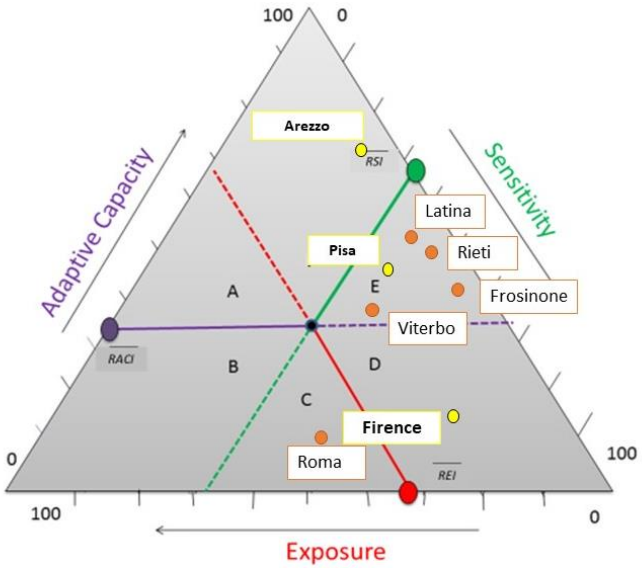
[2] Liu X, Wang Y, Peng J, Braimoh A, Yin H (2013) Assessing vulnerability to drought based on exposure, sensitivity and adaptive capacity: a case study in middle Inner Mongolia of China. Chin Geogr Sci23(1):13–25.

Figure 2. Vulnerability Index results



As shown in figure 2, exposure presents low results in the eight study cases; however, sensitivity index presents higher results in all cases. Adaptive capacity presents high differences between the study cases. This component introduces those important social and institutional variables, which are more difficult to measure (risk perception, institutional trust, and climate change adaptation). Figure 3 shows the vulnerability structure triangle results.

Figure 3. Vulnerability structure triangle results.



UNISI

Description of the exercise

The exercise proposed aimed at:

1) Quantifying the Carbon Footprint (CF) of the Torrino Mezzocammino neighborhood;
2) Quantifying the virtual equivalent forest area, needed to absorb GHG emissions;
3) Discussing potential policies and simulating the CF mitigation of the neighborhood paying more attention to photovoltaic and wind power.

Students were divided into 3 Working Classrooms and each group nominated a group leader/spokesperson. Students had about 2 hours to collectively develop the exercises, tutored by UNISI staff. At the beginning, students were provided with an Excel file, containing the basic information needed for the calculations. At the end of the exercise, students met in the Common Classroom to talk about the results obtained in each group.

The CF of the neighborhood was inventoried, considering the emission sectors of origin, divided into impact sub-categories (Figure 1).

Figure 1: Emission sectors and impact sub-categories.

Emission sectors	Impact sub-categories
1) Energy	✓Transport ✓District Heating ✓Electricity production and consumption ✓Waste incineration
2) Waste	✓Landill ✓Composting plants ✓Wastewater treatment plants
3) Agriculture, Forestry and Other Land Uses (AFOLU)	✓Green areas uptake

Emissions were calculated, applying the following equations:

$$CF_i = AD_i \times EF_i \quad \text{(Eq. 1)}$$

$$CF_{TOT} = \sum_{i=1}^{n} CF_i \quad \text{(Eq. 2)}$$

where:

CF_i= GHG emissions in one year (kg of pollutant);

AD_i = activity data (consumption of an energy source, e.g. use of gasoline of transport);

EF_i = emission factor per unit of activity and per specific pollutant.

The virtual equivalent forest areas, needed to absorb the GHG emissions, were estimated considering a removal rate of 1.3 kg CO_2 $(m^2)^{-1}$.

The Excel file also provided a list of possible mitigation policies, indicating the consumption savings, the policy penetration in the population and the potential electricity production from renewable sources. Students discussed the benefits of these policies and simulated the CF mitigation due to the implementation of some of them. In particular, they hypothesized the installation of photovoltaic (PV) panels and wind turbines, identifying the possible installation sites and the potential electricity production.

Results

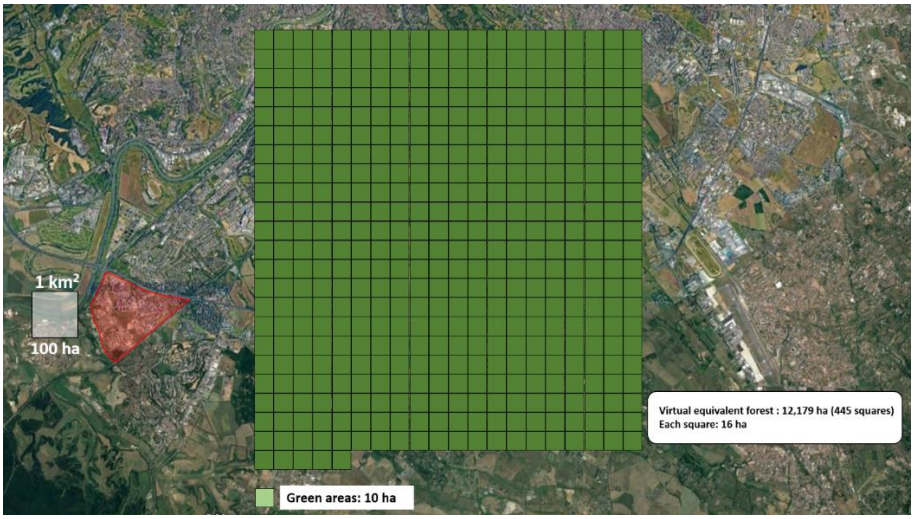
The CF of Torrino Mezzocammino is reported in Table 1, indicating that mobility had the greater impact (50%), followed by electricity consumption (25%) and district heating (15%).

Table 1: CF of the Torrino Mezzocammino neighborhood.

ACTIVITY SECTORS	t CO_2eq	%
ELETTRICITY	**17,318**	**25%**
Residential	6,220	9%
Tertiary	10,099	15%
Public lighting	999	1%
ENERGY (natural gas for district heating)	**12,968**	**15%**
Residential	12,968	15%
MOBILITY	**33,866**	**50%**
SOLID WASTE	**6,318**	**9%**
WASTEWATER	**288**	**0.4%**
TOTAL	**68,220**	**100%**
FOOD proteic diet	27,971	29%
FOOD balanced diet	18,143	21%
FOOD balanced diet + local food	10,584	13%
UPTAKE	**-138**	**-0.2%**

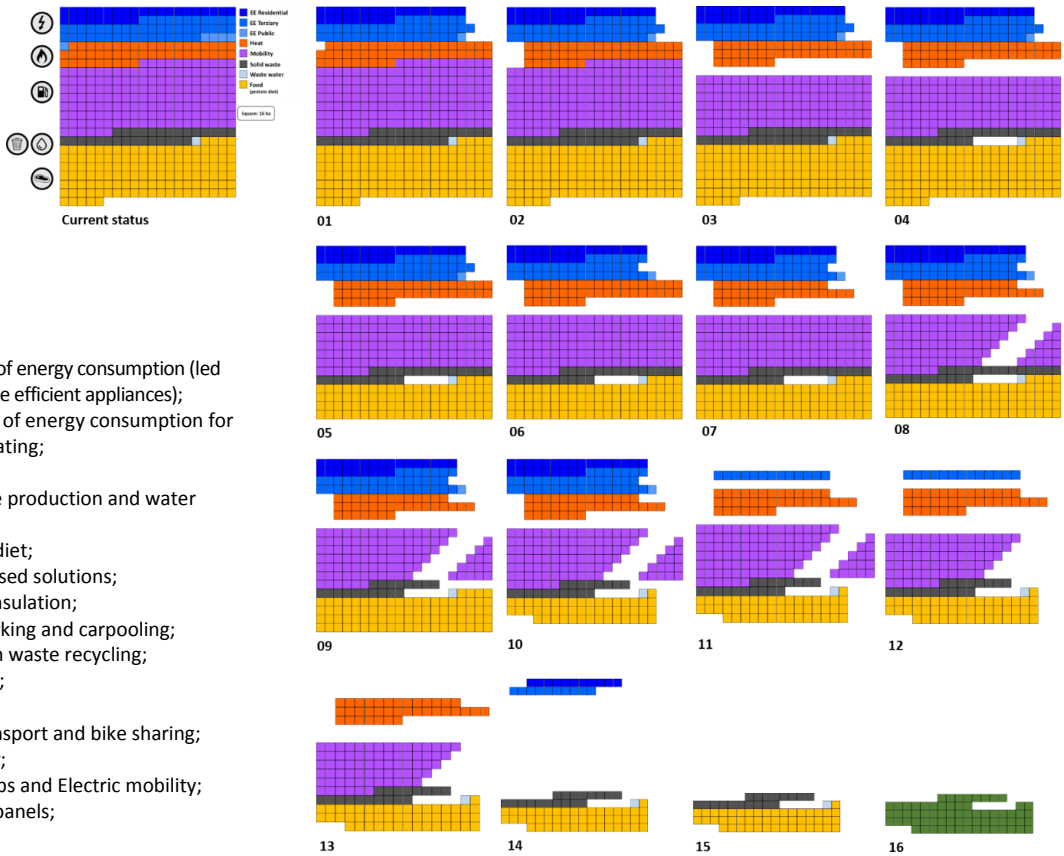
The virtual equivalent forest area of the neighborhood is 12,179 ha, compared to 43 ha of existing green urban areas, which correspond to 10 ha of virtual forest equivalent (Figure 2).

Figure 2: Virtual equivalent forest area of the Torrino Mezzocammino neighborhood



The CF mitigation due to the chosen environmental policies is shown in Figure 3. The most beneficial policies are the electricity production from PV panels and the transition to a decarbonized electric system, to achieve carbon neutrality.

Figure 3: CF mitigation of Torrino Mezzocammino neighborhood



Note:
01) Reduction of energy consumption (led lamps and more efficient appliances);
02) Reduction of energy consumption for residential heating;
03) Bicycles;
04) Less waste production and water consumption;
05) Balanced diet;
06) Nature-based solutions;
07) Thermal insulation;
08) Smart working and carpooling;
09) Increase in waste recycling;
10) Local food;
11) PV panels;
12) Public transport and bike sharing;
13) PV canopy;
14) Heat pumps and Electric mobility;
15) Other PV panels;
16) Uptake.

Students identified and measured on Google Earth the surfaces available to install PV panels and wind turbines (Figure 4).

The installation of PV panels on the roofs of residential buildings was suggested, along with the construction of a noise barrier along the “Grande Raccordo Anulare”, covered with PV devices. Thus, the installation of 7087 m^2 of PV panels was simulated, with the production of 1417 MWh of electricity, mitigating the neighborhood’s CF of 3%.

Additionally, the installation of a 4 MW wind turbine was hypothesized in the south-eastern part of the neighborhood, trying to avoid the trajectories of grey herons. This turbine would be able to produce 4000 MWh of electricity, mitigating the CF of the area of 9%.

Figure 4: Location of PV panels (yellow boxes) and wind turbines (red point)

IRENA & MIEMA

Description of the exercise

The exercise with the students was divided into seven tasks, each following and complementing the previous one. Students were divided into three groups. The first task was to select a target building or a target zone. Each group was asked to select a different building type or a group of buildings within the Torrino-Mezzocammino neighbourhood. The first group had to select a school building, the second group an office building or commercial premises and the third group a residential area (a block of apartments or a group of houses in a street). The second task was to identify the main energy consumers within the building/s chosen, to list the three highest energy consumers according to the group's opinion and to explain the reasons for the choice. The third task was related to the proposal of energy efficiency or renewable energy interventions. Based on the highest energy consumers identified as part of the second task, each group was asked to propose what energy efficiency measures may be implemented in the building/s to reduce the consumed energy and improve the energy performance. Depending on the building characteristics, students were asked also to propose any renewable energy technologies that can be included. The fourth task was focused on detecting possible challenges that will make the energy improvement difficult both for the energy efficiency measures and for renewable energy sources (financial, social, legal or technical barriers to energy renovation). In the fifth task, based on the challenges and barriers identified, students had to propose solutions to overcome them. A more practical task was the sixth one, which was related to the estimation of the potential energy generated yearly by the installation of photovoltaic (PV) panels on the selected building. Each group was asked to measure the area that can be used for the installation of PV on the selected building/group of buildings through Google Maps. Then they had to estimate the size of the PV system that can be fitted on to the roof (kWp), and calculate the potential energy generated yearly. Each group prepared a short presentation with all the results of the above-mentioned tasked and presented them to the professors and the audience of the workshop.

Results

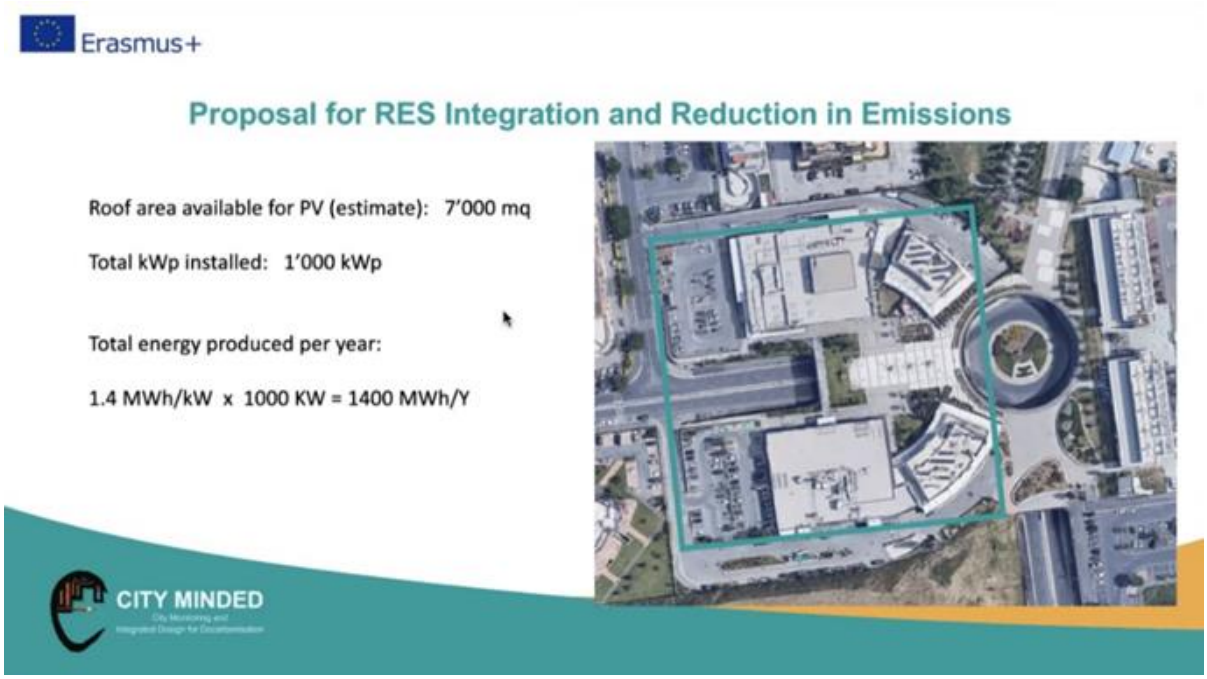
The first group selected the Fiume Giallo School Complex, which is composed of primary and secondary school. The school complex has three building blocks, linked together with corridors. As the highest energy consumers within the building, the group identified the heating and cooling system, lighting and electrical equipment and water. Proposals for energy efficiency improvement/RES included PV panels on the roof and parking lots, rainwater collecting systems, electric vehicles (EV) charging stations, vegetation and green areas as external shading systems, and the use of nature-based solutions as a waterproofing system (rain gardens). The main barriers identified were lack of funds for new technologies,

maintenance costs of green areas, lack of charging stations for EV, very high temperature in summer (heat island), water waste problem and waterproofing of the surfaces. Proposed solutions included the use of funds for new technologies, encouraging students to participate in the maintenance of the green areas, installation of EV charging stations, afforestation of green areas and use of rain gardens and green walls and increase of environmental awareness by conducting educational campaigns.

The second group focused on a very big shopping mall (6,000 sq. m.) located right in the centre of the neighbourhood. It is made up of four buildings that host different facilities and the main energy consumers identified included HVAC systems, lighting and electricity for all the appliances and systems. Proposed solutions included a roof-mounted PV system, LED lighting, solar thermal panels on the outdoor parking and a new heating pump. The group also emphasized the importance of good behaviour as an instant and free of charge way to reduce energy consumption. Some of the proposals of good behaviour included optimization of the lighting and optimization of indoor temperature during the summer or winter period. Barriers to energy renovation included aesthetic problems related to the PV installation, financial problems, legal problems (related to the ownership rights of the buildings), obsolete comfort standards and technical problems. Awareness campaigns, incentives and financial loans, and the need for more specialized and qualified workers were presented as possible solutions to overcome the barriers.

The third group studied a building complex with an area of around 36,941.00 sq. m. of which around 20,000.00 sq. m. is green area. The complex forms an open courtyard and the intended use is mainly residential. The highest energy consumers, in this case, were electrical equipment, heating and domestic hot water. Proposed energy measures included PV and solar panels due to the high energy consumption, use of LED lighting and afforestation due to the unfavourable orientation of the buildings (north-south). Identified barriers were mainly related to the possible disagreement of the residents to introduce changes in the environment or on the buildings. As a potential solution, the group proposed the organization of an educational campaign to present long term benefits for the residents.

Figure 1. PV Installation Potential for a Residential complex in Torrino-Mezzocammino



The presentations of all three groups showed that the students obtained a good understanding of energy efficiency and renewable energy within the urban context, and of how to identify the correct solutions for different building categories. A particularly important point that was highlighted is the importance of focusing on buildings located in the urban areas, both in terms of energy efficiency improvement as well as for the installation of renewable energy technologies in the buildings, to minimise the use of green areas for energy production.

Wrap-up session

The wrap-up session carried out on the last day included an open discussion and joint assessment on the results of the workshop, which involved both partners and participating students.

The most important remarks can be summarized as follows:

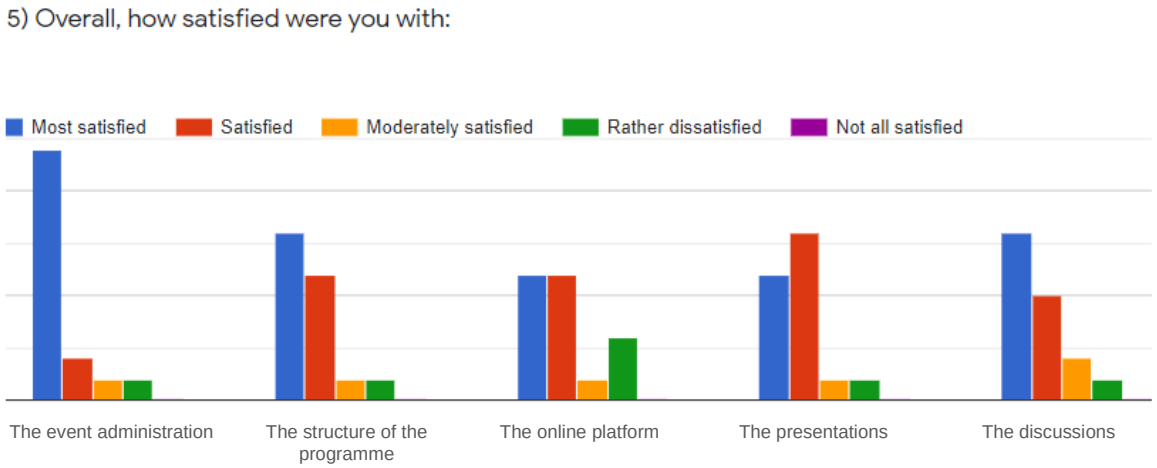
- The different backgrounds of students participating in the first two workshops make their approach to the co-working sessions extremely different: this is both a value added and a challenge for partner organizations, since it entails a continuous adaptation and tailoring of the contents and procedures of the modules.
- The online mode proved very challenging for both partners and students. Nonetheless, the procedure adopted proved effective in the end, promoting successful interaction and collective work.
- Participating students managed to think about all the different aspects of decarbonisation, making meaningful connections among the different modules and with the contents presented by the stakeholders, and exploiting them to make reasonable and wide-range proposals to reduce the carbon footprint of the target neighbourhood.
- Students found it interesting to address themes that are only marginally treated in university courses, and that were presented in a simple and communicative way; moreover, they appreciated to be guided in the use of external data and information (i.e. statistical data) that they are not used to search for and exploit.
- Students lamented that the short duration of the sessions and the online mode made it difficult to go into more depth on the project topics, and to present the results of the co-working sessions in a more accurate and captivating way.
- Students also observed that the groups were too large, preventing a smooth and more inclusive implementation of the co-working sessions.

The evaluation questionnaires for students

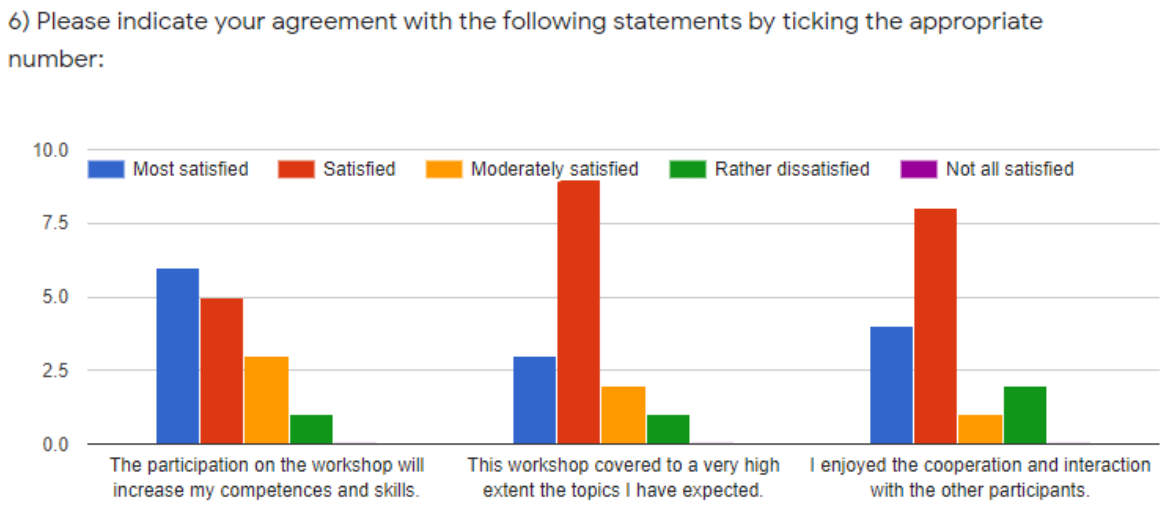
At the end of the workshop, an online satisfaction questionnaire was submitted to the participating students (based on a model previously used by UNISI), specifying that its compilation was mandatory to achieve the certificate of attendance and the related credits.

An analysis of all the 15 filled-in questionnaires confirmed the outcomes of the wrap-up session. In particular:

- The overall satisfaction for the main features of the workshop was high, with some peaks of positive judgement for the event administration (70% of the students declared to be ‘most satisfied’ with this aspect) and for the discussion (53% ‘most satisfied’), as shown in the following chart:



- The evaluation of the usefulness and interest of the experience was positive, as well as the judgement on the cooperation and interaction with other participants (see chart below). Summing up for each sub-question the two higher possible scores, one notices that 70% of the students believes that the participation on the workshop will increase their competences and skills; that for the 80% of them, the workshop covered to a very high extent the topics they had expected; and that the same percentage enjoyed the cooperation and interaction with the other participants.



- Only one out of the 15 students involved had already participated in similar workshops.
- The students identified as main strengths of the workshop:
  - The clearness and usefulness of the teaching and of the materials provided.
  - The internationality and different backgrounds and approaches of the partner organisations, which allowed for interaction between different disciplines, and mutual

learning among students with different backgrounds and ways of working within the co-working sessions.

  - The opportunity to address a wide range of topics and tools, very important in the contemporary world and in the job market and not normally treated in regular courses.
  - The opportunity to link scientific matters to urban planning and architecture, which allowed imagining new scenarios.

- On the other hand, some weaknesses and margins for improvement were pointed out, for instance:
  - More time could be dedicated to certain topics, in order to go into more detail (i.e. on carbon accounting) and to end up with a more developed and specific output (i.e. a small urban project for improving the neighbourhood). Some students would have appreciated more information on sustainable technologies, or a focus on how to search statistical data (i.e. on the ISTAT website).
  - It would have been better to provide all the materials for the working sessions on the first day, and to further subdivide working groups, also to ease interaction among students. Moreover, provision of more specific data on the target neighbourhood would have been appreciated.
- For the majority of the students the most difficult part of the workshop was the module on the assessment of vulnerability associated with climate change (66%), followed by the one on carbon accounting (24%). This result was quite predictable, since these topics were less familiar for participating students.

Final remarks

In conclusion, the workshop was very appreciated by the participating students, which demonstrated a good level of involvement and especially valued the relevance of the topics addressed, and the interactive, international and interdisciplinary dimensions of the experience. Moreover, the format adopted can be considered innovative.

Though far from optimal, the online mode allowed for a satisfactory level of collaboration among students, and the structure of the workshop agenda and the organization of the modules seem to be effective. Minor adjustments could regard the size of the working groups.

Since it would not be possible to dedicate more time to certain subjects, some effort could be done in the future to prepare and deliver training materials in advance, to further stimulate students and better prepare them to the co-working sessions.