Call: HORIZON-CL5-2022-D4-02

(Efficient, sustainable and inclusive energy use)

Topic: HORIZON-CL5-2022-D4-02-03

Type of Action: HORIZON-RIA

Proposal number: 101123293

Proposal acronym: SINCERE

Type of Model Grant Agreement: HORIZON Action Grant Budget-Based

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Proposal ID **101123293**

Acronym **SINCERE**

1 - General information

Fields marked * are mandatory to fill.

Topic	HORIZON-CL5-2022-D4-02-03	Type of Action	HORIZON-RIA
Call	HORIZON-CL5-2022-D4-02	Type of Model Grant Agreement	HORIZON-AG

Acronym: SINCERE

Proposal title: The second life of modern period architecture: Resilient and adaptive renovation towards net-zero carbon heritage buildings

Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &

Duration in months: 36

Fixed keyword 1: Energy efficient buildings

Free keywords: *HBIM/Digital-Twin, low-carbon restoration mortars, Self-healing, radiative cooling, BIPVs, thermal insulation, LCA/ LCC, Climate change scenarios, Social Awareness, Architectural Values*

Abstract *

Today, 19th and 20th c. modern period buildings are the trademark of numerous European cities, forming a great part of EU Built Heritage, reflecting and shaping the identity of our local, national and multinational societies. Considering that historic buildings are ineffective in terms of energy consumption for heating and cooling, among the biggest restoration and renovation challenges is to enhance the energy performance of historic buildings.
SINCERE aims to elucidate the values of Built Heritage and provide the tools for optimizing the carbon footprint and energy performance of historic buildings, towards the requirements of net-zero-carbon-buildings, by utilizing innovative, sustainable, and cost-effective restoration materials and practices, energy harvesting technologies, ICT tools and socially innovative approaches.
SINCERE adapts a multi-scale concept, from material-, to building-, to neighbourhood- to city-scale, applied on the three main parts of buildings: structure, external envelope (opaque), and transparent parts, implemented at different time-frames, in order to provide decision making tools to the stakeholders involved in the process, considering the full-service life of the buildings, including restoration, operation, monitoring and maintenance phases. Energy performance in terms of retrofitting materials and solutions will be optimized according to the buildings' unique structural, architectural, functional and materials characteristics, their environmental setup, as well as local future climate change scenarios. SINCERE will provide a palette portfolio of sustainable restoration options that will be evaluated by H-BIM/H-DT tools in order to enable the selection of optimum solutions and the planning of necessary adaptation actions. SINCERE will also focus on raising awareness and empowering Europeans to promote the concept of preservation CH buildings by disseminating the obtained results through national and international scale activities.

Remaining characters 5

Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under any EU programme, including the current call? ○ Yes ◉ No

Please give the proposal reference or contract number.

Administrative forms

Proposal ID **101123293**

Acronym **SINCERE**

Declarations

Field(s) marked * are mandatory to fill.

1) We declare to have the explicit consent of all applicants on their participation and on the content of this proposal. *	☒
2) We confirm that the information contained in this proposal is correct and complete and that none of the project activities have started before the proposal was submitted (unless explicitly authorised in the call conditions). *	☒
3) We declare: - to be fully compliant with the eligibility criteria set out in the call - not to be subject to any exclusion grounds under the EU Financial Regulation 2018/1046 - to have the financial and operational capacity to carry out the proposed project. *	☒
4) We acknowledge that all communication will be made through the Funding & Tenders Portal electronic exchange system and that access and use of this system is subject to the Funding & Tenders Portal Terms and Conditions. *	☒
5) We have read, understood and accepted the Funding & Tenders Portal Terms & Conditions and Privacy Statement that set out the conditions of use of the Portal and the scope, purposes, retention periods, etc. for the processing of personal data of all data subjects whose data we communicate for the purpose of the application, evaluation, award and subsequent management of our grant, prizes and contracts (including financial transactions and audits). *	☒
6) We declare that the proposal complies with ethical principles (including the highest standards of research integrity as set out in the ALLEA European Code of Conduct for Research Integrity, as well as applicable international and national law, including the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights and its Supplementary Protocols. Appropriate procedures, policies and structures are in place to foster responsible research practices, to prevent questionable research practices and research misconduct, and to handle allegations of breaches of the principles and standards in the Code of Conduct. *	☒
7) We declare that the proposal has an exclusive focus on civil applications (activities intended to be used in military application or aiming to serve military purposes cannot be funded). If the project involves dual-use items in the sense of Regulation 2021/821, or other items for which authorisation is required, we confirm that we will comply with the applicable regulatory framework (e.g. obtain export/import licences before these items are used). *	☒
8) We confirm that the activities proposed do not - aim at human cloning for reproductive purposes; - intend to modify the genetic heritage of human beings which could make such changes heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed), or - intend to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer. - lead to the destruction of human embryos (for example, for obtaining stem cells) These activities are excluded from funding. *	☒
9) We confirm that for activities carried out outside the Union, the same activities would have been allowed in at least one EU Member State. *	☒

The coordinator is only responsible for the information relating to their own organisation. Each applicant remains responsible for the information declared for their organisation. If the proposal is retained for EU funding, they will all be required to sign a declaration of honour.

False statements or incorrect information may lead to administrative sanctions under the EU Financial Regulation.

2 - Participants

List of participating organisations

#	Participating Organisation Legal Name	Country	Role	Action
1	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRI1	Greece	Coordinator	
2	UP2METRIC IDIOTIKI KEFALAIOUCHIKI ETAIREIA	EL	Partner	
3	Elias Messinas	IL	Partner	
4	RIMOND ENGINEERING PROCUREMENT ANDCONSTRUCTI	IT	Partner	
5	POLITECNICO DI MILANO	IT	Partner	
6	UNIVERSIDAD DE NAVARRA	ES	Partner	
7	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTY	EL	Partner	
8	TITAN CEMENT COMPANY AE	EL	Partner	
9	BEN-GURION UNIVERSITY OF THE NEGEV	IL	Partner	
10	NUROGAMES GMBH	Germany	Partner	
11	ACCIONA CONSTRUCCION SA	ES	Partner	
12	Hellenic Ministry of Culture	EL	Partner	
13	LINKOPINGS UNIVERSITET	SE	Partner	
14	MUSEum+	CZ	Partner	
15	THE UNIVERSITY OF SHEFFIELD	UK	Partner	
16	UNIVERSITY COLLEGE LONDON	UK	Partner	
17	UNIVERSITA TA MALTA	Malta	Partner	
18	NETHOOD	Switzerland	Associated	

Organisation data

PIC	Legal name
999978239	*NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"*

Short name: NCSR "D"

Address

Street	END OF PATRIARCHOU GRIGORIOU E AND 27 NE
Town	AGIA PARASKEVI
Postcode	15341
Country	Greece
Webpage	www.demokritos.gr

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	no
Research organisation	yes

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	12/05/2016 - no
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

Department 1

Department name	INN - Archaeological and Building Materials	☐ not applicable
	☒ Same as proposing organisation's address	
Street	END OF PATRIARCHOU GRIGORIOU E AND 27 NE	
Town	AGIA PARASKEVI	
Postcode	15341	
Country	Greece	

Department 2

Department name	INN - Materials for Nanolithography and Organic Electronics	☐ not applicable
	☒ Same as proposing organisation's address	
Street	END OF PATRIARCHOU GRIGORIOU E AND 27 NE	
Town	AGIA PARASKEVI	
Postcode	15341	
Country	Greece	

Department 3

Department name	INRASTES - Environmental Research Laboratory	☐ not applicable
	☒ Same as proposing organisation's address	
Street	END OF PATRIARCHOU GRIGORIOU E AND 27 NE	
Town	AGIA PARASKEVI	
Postcode	15341	
Country	Greece	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Ioannis**

Last name* **KARATASIOS**

E-Mail* **i.karatasios@inn.demokritos.gr**

Position in org. Researcher, Institute of Nanoscience and Nanotechnology

Department Cultural Heritage Research Group

☐ Same as organisation name

☒ Same as proposing organisation's address

Street END OF PATRIARCHOU GRIGORIOU E AND 27 NEAPOLEOS STREET

Town AGIA PARASKEVI

Post code 15341

Country Greece

Website https://inn.demokritos.gr/research_group/ccm/

Phone +302106503326

Phone 2 +302106503353

Other contact persons

First Name	Last Name	E-mail	Phone
Eirini	Tziviloglou	e.tziviloglou@inn.demokritos.gr	+xxx xxxxxxxxx
Mandy	Vlachogianni	mandy@ipta.demokritos.gr	+xxx xxxxxxxxx
Athanasios	Sfetsos	ts@ipta.demokritos.gr	+xxx xxxxxxxxx
Maria	Vassilopoulou	m.vasilopoulou@inn.demokritos.gr	+30 2106503269

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Ioannis	Karatasios	Man	Greece	i.karatasios@inn.demokritos.gr	Category B Senior resea	Leading	0000-0002-3482-0424	Orcid ID
Dr	Eirini	Tziviloglou	Woman	Greece	e.tziviloglou@inn.demokritos.gr	Category C Recognised	Team member	0000-0002-2935-9629	Orcid ID
Dr	Anno	Hein	Man	Greece	a.hein@inn.demokritos.gr	Category B Senior resea	Team member	0000-0002-1129-4820	Orcid ID
Dr	Stamatoula	Papaioannou	Woman	Greece	s.papaioannou@inn.demokritos.gr	Category D First stage r	Team member	0000-0002-7184-4214	Orcid ID
Dr	Maria	Vasilopoulou	Woman	Greece	m.vasilopoulou@inn.demokritos.gr	Category A Top grade re	Leading	0000-0001-8893-1691	Orcid ID
Dr	Diamanto	Vlachogianni	Woman	Greece	mandy@ipta.demokritos.gr	Category A Top grade re	Leading	0000-0001-8287-5123	Orcid ID
Dr	Athanasios	Sfetsos	Man	Greece	ts@ipta.demokritos.gr	Category A Top grade re	Team member	0000-0003-1906-8059	Orcid ID
Dr	Vassilis	Kilikoglou	Man	Greece	v.kilikoglou@inn.demokritos.gr	Category A Top grade re	Team member	0000-0003-0619-2931	Orcid ID

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☒
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☒
IPR management incl. technology transfer	☒
Public procurer of results	☒
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Papaioannou, S., Hein, A., Amenta, M., Kilikoglou, V., Gournis, D., Karatasios, I., Simulation and experimental studies of self-healing capacity in cement mortars incorporating cement-based capsules (2023) Cement and Concrete Composites, 136 DOI: 10.1016/j.cemconcomp.2022.104859*
Publication	*Papaioannou, S., Amenta, M., Kilikoglou, V., Gournis, D., Karatasios, I. 57223130205;55606200800;6701772230;6602837399;16401817800; Synthesis and integration of cement-based capsules modified with sodium silicate for developing self-healing cements, (2022) Construction and Building Materials, 316, DOI: 10.1016/j.conbuildmat.2021.125803*
Publication	*M. Vasilopoulou et al. "Photonic nanostructures mimicking floral epidermis for perovskite solar cells", Cell Reports Physical Science, 3, 9, 2022, 101019*
Publication	*M. Vasilopoulou et al. "Free-standing nanopaper electrode for all-printed super-flexible perovskite solar cells" published on Research Square. DOI: https://doi.org/10.21203/rs.3.rs-296909/v1*
Publication	*D. Vlachogiannis, A. Sfetsos, I. Markantonis, N. Politi, S. Karozis, N. Gounaris, Quantifying the occurrence of multi-hazard under climate change, Applied Sciences, 12, no. 3: 1218, 2022. DOI:10.3390/app12031218*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
AKEISTHAI 2018-2022 (MIS5031866)	*“AKEISTHAI - Self-healing and self-sensing nano-composite conservation mortars” is a 36 months research project funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund). Grand agreement: T1EDK-03069 (Project coordinator I. Karatasios). funding: €845,000*
PlaCe MSC-ITN 2021-2025 (GA no. 956410)	*MSC-ITN Training the next generation of archaeological scientists: Interdisciplinary studies of pre-modern Plasters and Ceramics from the eastern Mediterranean. ESR 10 project "From Roman to Green cement - Technological developments and social aspects", will explore the influence of different cultures on the architecture and mortars technology in the eastern Mediterranean region, aiming to compare and evaluate the building evolution and technological solutions chosen. Supervisor: I. Karatasios*
HELIOKERAMOS 2019-2023 (MIS 5066858)	*HELIOKERAMOS aims to the development, for industrial production, of a new type of multifunctional roof-tile with a photovoltaic system of organic solar cells (OSC) for energy production, embedded on its surface. The roof-tile will be redesigned by maintaining its traditional form in order to accommodate the OSCs and the microsctructure will be modified in order to decrease its thermal conductivity without much change in mechanical properties.*
HE-MISSION-ICARIA	*ICARIA aims to promote the use of asset level modelling to achieve a better understanding on climate related tangible direct and indirect impacts produced by complex, cascading and compound disasters and the related risk reduction provided by suitable, sustainable and cost-effective adaptation solutions.ICARIA focuses on both critical assets and infrastructures that were not designed to consider potential climate changes that can increase the unplanned outages and failures, and housing.*
C2IMPRESS	*The C2IMPRESS project aims to bring a radical paradigm shift to disaster and hazard research and innovation with a novel ‘place and people’ centred integrated multi-hazard risk and resilient assessment framework. It offers an ensemble of innovative revolutionary models, methods, frameworks, tools and technologies that are holistic and robust enough to provide appropriate fine-grained spatiotemporal qualitative and quantitative data, locally appropriate solutions and better prediction*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Structural characterization	*Differential Thermal Analysis (DTA), Thermogravimetric Analysis (TGA), and process inspection equipment, X-ray Diffractometer (XRD - SIEMENS D500), Transmission Electron Microscope (Philips CM20 with EDX), X-ray Photoelectron Spectroscopy (XPS), Electron Paramagnetic Resonance Spectroscopy (BRUKER)*
XPS/UPS facility	*Photoelectron spectroscopy (XPS/UPS) facility is available at the Host Institution. It is relevant to the proposed work on conducting transparent cellulose where the degree of reduction of polyoxometalate components is expected to be related to the derived conductivity.*
Chemical Lab and Mechanical testing	*Mercury and Nitrozen porosimeters for high and low pressure analysis, Hielscher UIP1000hd Ultrasound Device, CV Electrochemical Impedance Spectrometer, UV-Vis spectrometer with Integrated Sphere (DRS), UV-2100 Shimadzu, Physical, mechanical testing of building materials*
EREL	*High Performance Cluster -Blizzard with 96 nodes equipped with 32GB of RAM each (total of 3TB of RAM) and intel XEON E3 CPUs with 45.5 TFlops theoretical performance in single precision calculations.*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

Administrative forms

PIC	Legal name
920816151	*UP2METRIC IDIOTIKI KEFALAIOUCHIKI ETAIREIA*

Short name: UP2METRIC PRIVATE COMPANY

Address

Street	MICHAIL MELA 21
Town	ATHINA
Postcode	115 21
Country	Greece
Webpage	www.up2metric.com

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	no
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	31/12/2016	- yes
SME self-assessment	31/12/2016	- yes
SME validation	unknown	

Departments carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ◯ Woman ◉ Man ◯ Non Binary

First name* **Christos**

Last name* **Stentoumis**

E-Mail* **christos@up2metric.com**

Position in org. Director

Department UP2METRIC IDIOTIKI KEFALAIOUCHIKI ETAIREIA

☒ Same as organisation name

☒ Same as proposing organisation's address

Street MICHAIL MELA 21

Town ATHINA

Post code 115 21

Country Greece

Website http://www.up2metric.com/computer-vision-ai/

Phone +306976946775

Phone 2 +302130456435

Other contact persons

First Name	Last Name	E-mail	Phone
Ilias	Kalisperakis	ilias@up2metric.com	+30 697 3069908

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Christos	Stentoumis	Man	Greece	christos@up2metric.com	Category B Senior resea	Leading	0000-0001-9972-1761	Orcid ID
Dr	Ilias	Kalisperakis	Man	Greece	ilias@up2metric.com	Category B Senior resea	Team member	0000-0002-3328-093X	Orcid ID
Prof	Lazaros	Grammatikopoulos	Man	Greece	lazaros@up2metric.com	Category A Top grade re	Team member	0000-0002-3858-1352	Orcid ID
Ms	Anisa	Kook	Woman	Greece	anisa.kouka@up2metric.com	Category D First stage r	Team member		

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☐
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☒
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Symeonidis, S., et al. (2021). xR4DRAMA: Enhancing situation awareness using immersive (XR) technologies. 2021 IEEE International Conference on Intelligent Reality (ICIR), 1–8.*
Publication	*Pistola, T., et al. (2021). Creating immersive experiences based on intangible cultural heritage. 2021 IEEE International Conference on Intelligent Reality (ICIR), 17–24.*
Publication	*Kalisperakis, I., Mandilaras, T., El Saer, A., Stamatopoulou, P., Stentoumis, C., Bourou, S., & Grammatikopoulos, L. (2020). A modular mobile mapping platform for complex indoor and outdoor environments. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLIII-B1-2, 243–250*
Software	*MapARAI. Augmented Reality mobile app (Android and IOS) for outdoor environments with AI features that supports location-based data collection and retrieval. The app received the first award at the 2022 IEEE 2nd International Conference on Intelligent Reality (ICIR 2022).*
Service	*Object detection API (commercial service) for real-time detection of a library of objects deployed in Android mobile phones for inventory management in Hadaya Engineering & Metal Services LLC (UAE) factories.*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
xR4DRAMA. H2020-ICT-55-2020 (IA)	*Extended Reality For DisasteR management And Media plAnning aims at enhancing situation awareness through XR and AI technologies. up2metric supports the tasks related to Computer Vision on wearable devices, Augmented Reality (leader in xR WP) and geospatial information integration in the platform development. (https://xr4drama.eu/).*
MindSpaces. EC H2020-ICT-32-2018 – STARTS (2019-22	*MindSpaces aims to create a novel approach to urban and architectural design by generating 3D-VR immersive and emotion-adaptive 'neuro-environments' that will help in designing emotionally-relevant urban spaces. The emotional aspects of an environment will be captured through the use of mobile EEG headsets, wearable bracelets/watches, and other physiological sensors that will be embedded with a VR-headset, so as to allow capturing the neuro-feedback of a VR-experience.*
CHROMATA Greek National Research (2020-2023).	*The project aims at preserving the intangible cultural heritage, which requires innovative solutions that can handle such forms of content. The main purpose is to design and implement an interactive platform that gathers elements of the intangible cultural heritage from available sources and supports creating virtual and augmented reality indoor and outdoor environments that revive intangible heritage and create new spatial and virtual transcripts. up2metric builds the authoring tool for the VR.*
PROTEAS Greek National Research (2020-2023).	*The project aims at introducing the public to the art conservator's work and, through this, in the materials and techniques employed, the historical context of a work of art, and the message and expression of the creator. The main objective is to develop an automated platform of innovative analytical systems based on imaging and spectroscopic techniques that, via combined protocols for in-situ application, will integrate and upgrade the current documentation and conservation methodology.*
SOUP Greek National Research (2018-2021)	*SOUP aims to modernize Greek greenhouse cultivations, by reducing their dependence on manual labour and agrochemicals, through the following technologies: 1. machine vision to identify the relevant parts of the plant by a network of visual sensors (RGB & hyper spectral cameras); 2. robotic mechanisms to automate labor-intensive tasks such as pest management and harvesting. up2metric's role is developing the software for 3D reconstruction, infections and visual navigation.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Mixed reality / Augmented reality / Virtual realit	*Oculus, Samsung gear, MS HoloLens, iPad, and Tablets*
Dedicated processing h/w	*Nvidia Jetson and Google Coral for processing at the edge.*
State-of-the-art computer hardware	*Processing large amount of visual data in deep learning algorithm training and 3D mapping algorithms in our private ML cluster*
Visual and 3D data acquisition equipment	*Drones, along with a variety of RGB, machine vision and multispectral cameras, and housings for underwater capturing. The company also possesses ground sensors for fasmatic signatures' validation on the field, programmable 360 camera, ToF camera, ego-motion sensors, GNSS, lidar and surveying eq.*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? ○ Yes ◉ No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
888170607	*Elias Messinas*

Short name: ECOAMA

Address

Street	Rachel Imenu 15
Town	Jerusalem
Postcode	9314517
Country	Israel
Webpage	https://ecoama.com

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	no
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	29/12/2021 - yes
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ◯ Woman ◉ Man ◯ Non Binary

First name* **Elias**

Last name* **Messinas**

E-Mail* **elias@ecoama.com**

Position in org. Principal

Department Elias Messinas

☒ Same as organisation name

☒ Same as proposing organisation's address

Street Rachel Imenu 15

Town Jerusalem

Post code 9314517

Country Israel

Website https://ecoama.com

Phone +972544286998

Phone 2 *+xxx xxxxxxxxx*

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Elias	Messinas	Man	Israel	eliasmessinas@gmail.com	Category B Senior resea	Leading		

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☐
Technology developer	☐
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☒
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Messinas, E. 2022. The Synagogues of Greece: A Study of Synagogues in Macedonia and Trace: With Architectural Drawings of all Synagogues of Greece. Foreword by Samuel D. Gruber. ISBN 979-8-8069-0288-8 paperback.*
Other achievement	*Messinas, E. 2021. Assessment of existing conditions and scenarios for sustainable development of the island of Aegina, Greece. Master dissertation for the 'Environment and Development' Multidisciplinary academic program at the National Technical University of Athens, Greece. Grade: Excellent.*
Publication	*Messinas, E., Kouinoglou, D., Ed. 2021. ECOWEEK The Book#2: 15 Paths to Sustainability – From Innovation to Social Design. ISBN 9786188311220 paperback.*
Publication	*Messinas, E., Price, D., Ed. 2016. ECOWEEK The Book#1: 50 Voices for Sustainability. ISBN 9786188311206 paperback.*
Other achievement	*Messinas, E. et al. 1995. Conservation of the Synagogue of Veroia - Identification Phase Report. Getty Conservation Institute Library.*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
Database for Hellenic Ministry of Culture	*Jewish buildings and cultural heritage registry (2022-2023). Leading management and organization in creation of the first comprehensive Jewish heritage registry of Jewish architecture and monuments in Greece in the Archaeological Registry mapping system, for the National Archive of Monuments of the Hellenic Ministry of Culture. With over 400 new entries include documentation, architectural drawings, photographs, maps, online exhibition, a publication, and a physical exhibition.*
Green Campus' at Holon Institute of Technology	*Sustainability at HIT (2022-2023) Holon Institute of Technology (HIT), is a multidisciplinary academic institution, offering degrees in science, engineering, design and management and a registered 'Green Campus' in Israel since 2011. EM in collaboration with the HIT Logistics Dept., is planning the strategy for implementation of a sustainability actions program - including public awareness and on-campus activities to engage student and faculty communities.*
Second prize for design studio	*Second Prize in Israel Green Building Council 'Low Carbon Future' Academic Competition (2021). Student team tutors EM and Tzameret Harel Kanot in second year design studio in education and sustainable design, of the Interior Design Department, Design Faculty of Holon Institute of Technology. The studio included design process, lectures on materials focusing on urban mining and reuse of materials for the upgrade of existing school facilities and urban educational environments.*
Online sustainable design workshops	*ECOWEEK (2020). Program organized by EM online due to COVID restrictions. Event engaged hundreds of young professionals from Israel and Europe, included 18 speakers from 12 countries, 11 online design workshops, and a virtual exhibition and catalogue, in partnership with EUNIC Israel. Partners included the Embassy of Greece, the Ministry of Environment and Climate Change of Greece, the Czech Center, Goethe Institute Tel Aviv, Instituto Italiano di Culture, the Austrian Cultural Forum, etc.*
Green building consulting for Israeli Ministry	*Consulting for the Ministry of Environmental Protection of Israel (2011-2016). EM engaged in the Ministry in the capacity of green building consultant in multiple assignments, including re-assessment of city planning guidelines to encourage green buildings, research on environmental hazards to buildings and building interior environments, energy performance assessment of government buildings and sustainable upgrades of public space, involving partners, such the agency for government buildings.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Basic infrastructure	*Windows 10 with McAfee antivirus protection and WD backup. Office management (MS Office and Adobe), cloud services (Office 365, Dropbox, Google G Suite, Dropsend, Jumbomail, WeTransfer), remote access (FortiClient) and remote communication and meeting (Zoom, SKYPE, Teams Miro, Slido).*
Management	*Management software (ASANA, Easy Forms, Doodle), and geographic information systems (such as ArcGIS).*
Architectural drafting	*Architectural drafting and building performance evaluation software (AutoCAD, SketchUP, SEFAIRA, Energy Plus Software and Energy Star Portfolio Manager).*
Internet and social media	*Internet browsers (Chrome, IE, Edge) and social media platforms (Whatsapp, Viber, FB, Instagram, Linkedin, Tweeter, Upstream, YouTube), publication platforms (Academia, ISSUU, Wix) and public participation tools (Smart Survey, Padlet).*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? ○ Yes ◉ No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
914997412	*RIMOND ENGINEERING PROCUREMENT ANDCONSTRUCTION MANAGEMENT SRL*

Short name: RIMOND SRL

Address

Street	VIA PORLEZZA 16
Town	MILANO
Postcode	20123
Country	Italy
Webpage	http://www.rimond.it

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	no
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	07/11/2011 - yes
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Mr

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Stefano**

Last name* **Converso**

E-Mail* **stefano.converso@rimond.com**

Position in org. Head of R&D Department

Department Innovation Lab

☐ Same as organisation name

☐ Same as proposing organisation's address

Street via Giovanni da Castelbolognese, 81

Town Rome

Post code 00153

Country Italy

Website https://rimond.com/innovation-lab/

Phone +390694523537

Phone 2 +393392251213

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Hamed	Abbasi	Man	Iran (Islamic Rep	hamed.abbasi@rimond.com	Category D First stage r	Team member	0000-0002-6521-8268	Orcid ID
Dr	Ivana	Veselinova	Woman	North Macedoni	ivana.veselinova@rimond.com	Category D First stage r	Team member	0000-0002-9000-5942	Orcid ID
Dr	Lorenzo	Pirone	Man	Italy	lorenzo.pirone@rimond.com	Category B Senior resea	Team member	0000-0001-6630-8305	Orcid ID

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☐
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☐
Technology developer	☒
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Article on the Digital Twin system developed for the monitoring of performance of the ZEB home prototype developed for the Solar Decathlon 2012 International Competition. Tonelli C, Converso S (2014). Digital mirror: a method to shape Smart Citizenship. ENERGY AND BUILDINGS, vol. ENB5008, ENB-D-14-00023, ISSN: 0378-7788, doi: DOI information: 10.1016/ j.enbuild.2014.04.032*
Publication	*"S. Converso, C. Tonelli, G. Bellingeri "More documentation, less automation. A strategy of user involvement in domotics at Solar Decathlon 2012". in: EAAE Transactions on Architectural Education no 61, 2013* *A paper showing the strategy developed to involve users in the management of energy exemplified by the home prototype developed with Roma Tre University*
Publication	*Paper in a Scientific Conference of Advanced Building Skins, on the experience of a façade panel for building refurbishment towards energy efficiency, embedding a thermodynamic panel to combine passive and active effects. Tonelli C., Converso S. (2015). Symbiosis between solar technologies in the building envelope. In: Advanced building skins. p. 161-169, Munich:Economic Forum, ISBN: 978-3-98120538-1, Bern CH, 3-4 November 2015*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
REZBUILD	*In the REZBUILD project (Grant ID 768623): RIMOND contributed to the Digital Twin of a refurbishment ecosystem for deep NZEB renovation to diverse residential renovation typologies and interconnecting both, building renovation stages and stakeholders. This methodology was applied to three completed interventions in demo sites in Italy, Norway and Spain, monitored by the fulfilment of three KPIs: 60% of primary energy reduction, 30% reduction of installation time, 12 years of payback.*
SMART LIVING	*Research conducted under Grant by Italian Region Lombardy for the development of innovative digital systems applied to Facility management (FM) of complex Healthcare buildings. The Research produced an innovative Digital Twin interface that was used as a bridge between FM standard software and Open BIM Models, published in a shared, web-based environment. The research provided an integrated system based on a new organizational model centered on the figure of the client resident FM Agent.*
REDREAM	*RIMOND developed the social user interface software for the REDREAM Project (Grant ID: 957837) that enables the effective participation of the consumers and prosumers in the energy market. It develops a strategy for the creation of a value generation chain based on demand response tools and energy/non-energy services capable of enabling consumers to participate in the energy market. The project is exemplified by the constitution of energy communities in Italy, UK, Spain, Croatia.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
RIMOND HUB - Custom Open BIM Digital Twin	*RIMOND developed the "Rimond Hub" : a software service based on Open BIM technology, that provides an environment for comprehensive Facility Management: from Documentation to Maintenance, down to IoT data hosting and building occupancy regulation*
MTI - Open BIM Digital Twin Software	*MTI – Modeling Tower Information Client: INWIT – ICT Wireless Infrastructure National Provider. Widely used Open BIM data infrastructure and user interface for the management of over 18.000 BTS (Base Transceiver Station).* *The System is based on locally sourced and provided BIM models.*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? ○ Yes ◉ No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

Administrative forms

PIC	Legal name
999879881	*POLITECNICO DI MILANO*

Short name: POLIMI

Address

Street	PIAZZA LEONARDO DA VINCI 32
Town	MILANO
Postcode	20133
Country	Italy
Webpage	www.polimi.it

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	yes
Research organisation	yes

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	13/01/2022	- no
SME self-assessment	unknown	
SME validation	25/02/2009	- no

Departments carrying out the proposed work

Department 1

Department name	Department of Civil and Environmental Engineering	☐ not applicable
	☒ Same as proposing organisation's address	
Street	PIAZZA LEONARDO DA VINCI 32	
Town	MILANO	
Postcode	20133	
Country	Italy	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title _____ Gender ○ Woman ◉ Man ○ Non Binary

First name* **Liberato** Last name* **Ferrara**

E-Mail* **liberato.ferrara@polimi.it**

Position in org. associate professor

Department POLITECNICO DI MILANO ☒ Same as organisation name

☒ Same as proposing organisation's address

Street PIAZZA LEONARDO DA VINCI 32

Town MILANO Post code 20133

Country Italy

Website *Please enter website*

Phone +390223994387 Phone 2 +393803676750

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Prof	Liberato	Ferrara	Man	Italy	liberato.ferrara@polimi.it	Category B Senior resea	Leading	0000-0002-6826-9917	Orcid ID
Dr	Estefania	Cuenca Asensio	Woman	Spain	estefania.cuenca@polimi.it	Category C Recognised	Team member	0000-0002-0810-9743	Orcid ID
Dr	Francesco	Lo Monte	Man	Italy	francesco.lo@polimi.it	Category C Recognised	Team member	0000-0003-4397-6591	Orcid ID
Mr	Giacomo	Rizzieri	Man	Italy	giacomo.rizzieri@polimi.it	Category D First stage r	Team member	0000-0002-2392-1684	Orcid ID
Mr	Marco	Davolio	Man	Italy	marco.davolio@polimi.it	Category D First stage r	Team member	0000-0002-1512-1177	Orcid ID

Administrative forms

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☐
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☒
IPR management incl. technology transfer	☒
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Cuenca, E., D'Ambrosio, L., Lizunov, D., Tretjakov, A., Volobujeva, O. and Ferrara, L.: "Mechanical properties and self-healing capacity of Ultra High Performance Fibre Reinforced Concrete with alumina nanofibers: tailoring Ultra High Durability Concrete for aggressive exposure scenarios", CEMENT AND CONCRETE COMPOSITES, April 2021, paper 103956, 17 pp. https://doi.org/10.1016/j.cemconcomp.2021.103956*
Publication	*Lo Monte, F. and Ferrara, L.: "Tensile Behaviour Identification in Ultra-High Performance Fibre Reinforced Cementitious Composites: Indirect Tension Tests and Back Analysis of Flexural Test Results", MATERIALS AND STRUCTURES, 2020, 53:145, pp. 1-12, https:/doi.org/10.1617/s11527-020-01576-8.*
Publication	*Lo Monte, F. and Ferrara, L.: "Self-Healing Characterization of UHPFRCC with Crystalline Admixture: Experimental Assessment via Multi-Test/Multi-Parameter Approach", Construction and Building Materials, vol. 33, May 2021, paper 122579, pp. 1-12, https://doi.org/10.1016/j.conbuildmat.2021.122579.*
Publication	*Bos, F., Menna, C., Pradena, M., Kreiger, E., Leal da Silva, W.R., Rehman, A.U., Weger, D., Wolfs, R.J.M., Zhang, Y., Ferrara, L. and Mechtcherine, V.: "The Realities of Additively Manufactured Concrete Structures in Practice", Cement and Concrete Research, vol. 156, paper 106746, https:11doi.org/10.1016/j.cemconres.2022.106746*
Publication	*Al-Obaidi, S., Davolio, M., Lo Monte, F., Costanzi, F., Luchini, M. Bamonte, P. and Ferrara, L.: "Structural validation of geothermal water basins constructed with durability enhanced ultra high performance fiber reinforced concrete (Ultra High Durability Concrete)", Case Studies in Construction Materials, Volume 17, December 2022 Article number e01202, https://doi.org/10.1016/j.cscm.2022.e01202*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
ReSHEALience *H2020 GA 760824*	*Project Coordinator: Rethinking coastal defence in Green energy service infrastructure through enhanced durability high performance cement-based materials on advanced cement based materials for long-lasting infrastructures in extremely aggressive environments (EAE).* *Advanced cement based materials and durability based design methodology to promote lower use of resources guaranteeing the same structural performance and longer service life even and verification in six full scale pilots in EAE.*
SMARTNCS *MSCA-ITN GA 860006*	*Deputy Coordinator-WP leader: Self-healing multifunctional advanced repair technologies in cementitious systems.* *Training a a new generation of creative and entrepreneurial early-stage researchers (ESRs) in prevention of deterioration of (i) new concrete infrastructure by innovative, multifunctional self-healing strategies and (ii) existing concrete infrastructure by advanced repair technologies, evaluated in a life cycle analysis/cost perspective.*
MINRESCUE *RFCS GA 899518*	*WP leader: From mining waster to valuable resources: a new concept for circular economy. Developing innovative concepts for managing, recycling and upcycling waste geomaterials generated by coal mining activities across Europe. Validating a strategy to upgrade CMWGs as constituents in sustainable construction materials and products, hence with improved environmental footprint and life cycle cost savings. Validation in one full scale pilot.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)

Testing Lab Materials Buildings and Structures	*Structural testing (area of 6500 m2). Reaction frame wall for structure mock-ups up to 6 m high under up to 2000 kN cyclic horizontal load at the maximum height under 2500 kN max vertical load).*
Testing Lab Materials Buildings and Structures	*Material testing: state of the art for testing materials and structural elements under quasi static loading (maximum forces ranging from as low as 0.01 N and up to 5000 kN) and under cyclic loading (capacity 30 kN frequency 6 Hz).*
Testing Lab Materials Buildings and Structures	*Material fresh state and durability testing: ICAR rheometer, freeze and thaw cycle chambers, salt fog chamber. Equipment for Mercure Intrusion Porosimetry, X-ray diffraction, thermo-gravimetry analysis, SEM and X-ray CT-scan.*
Laboratory of Computational Mechanics	*Integrated computational environment for research in computational mechanics and scientific computing. Houses different workstations and servers for parallel and distributed computing solutions of computationally intensive problems.*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

Administrative forms

PIC	Legal name
999641746	*UNIVERSIDAD DE NAVARRA*

Short name: UNIVERSITY OF NAVARRA

Address

Street	CAMPUS UNIVERSITARIO EDIFICIO CENTRAL
Town	PAMPLONA
Postcode	31080
Country	Spain
Webpage	www.unav.es

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	yes
Research organisation	yes

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	01/07/1983	- no
SME self-assessment	01/07/1983	- no
SME validation	unknown	

Departments carrying out the proposed work

Department 1

Department name	Department of Chemistry	☐ not applicable
	☐ Same as proposing organisation's address	
Street	Irunlarrea 1	
Town	Pamplona	
Postcode	31008	
Country	Spain	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Prof. Gender ○ Woman ◉ Man ○ Non Binary

First name* **José Ignacio** Last name* **Alvarez**

E-Mail* **jalvarez@unav.es**

Position in org. Full Professor

Department Department of Chemistry ☐ Same as organisation name

☐ Same as proposing organisation's address

Street Irunlarrea 1

Town Pamplona Post code 31008

Country Spain

Website https://www.unav.edu/web/departamento-de-quimica

Phone +34948425600 *Phone 2* *+xxx xxxxxxxxx*

Other contact persons

First Name	Last Name	E-mail	Phone
Helena	Baigorri	hbaigorri@unav.es	+xxx xxxxxxxxx

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Prof	JOSÉ IGNACIO	ÁLVAREZ	Man	Spain	jalvarez@unav.es	Category A Top grade re	Leading	0000-0001-9170-7404	Orcid ID
Prof	ÍÑIGO	NAVARRO	Man	Spain	inavarro@unav.es	Category A Top grade re	Team member	0000-0003-1863-0580	Orcid ID
Prof	JOSÉ MARÍA	FERNÁNDEZ	Man	Spain	jmfdez@unav.es	Category A Top grade re	Team member	0000-0003-3684-8778	Orcid ID
Ms	ANDREA	RUBIO	Woman	Spain	arubioa@unav.es	Category D First stage r	Team member	0000-0003-1144-8970	Orcid ID
Mr	VÍCTOR	TENA	Man	Spain	victortena.tena@gmail.com	Category D First stage r	Team member	0000-0003-2194-8944	Orcid ID

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☒
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☐
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*González-Sánchez JF, Taşcı B, Fernández JM, Navarro-Blasco I, Alvarez JI. Improvement of the depolluting and self-cleaning abilities of air lime mortars with dispersing admixtures. J Cleaner Prod 2021; 292: 126069,1-17*
Publication	*Groot C, Veiga R, Papayianni I, Van Hees R, Secco M, Álvarez JI, Faria P, Stefanidou M. RILEM TC 277-LHS report: lime-based mortars for restoration–a review on long-term durability aspects and experience from practice. Mater Struct 2022; 55: 245, 1-33*
Publication	*González-Sánchez JF, Fernández JM, Navarro-Blasco I, Alvarez JI. Improving lime-based rendering mortars with admixtures. Constr Build Mater 2021;271:121887, 1-2*
Publication	*González-Sánchez JF, Taşcı B, Fernández JM, Navarro-Blasco I, Alvarez JI. Combination of polymeric superplasticizers, water repellents and pozzolanic agents to improve air lime-based grouts for historic masonry repair. Polymers, 2020, 12(4), 887*
Publication	*A. Rubio-Aguinaga, J.M. Fernández, I. Navarro-Blasco and J.I. Alvarez "Obtaining of repair lime renders with microencapsulated phase change materials: Influence of the substrates, mechanical and durability studies" in V. Bokan Bosiljkov, A. Padovnik, T. Turk, P. Štukovnik (Editors) "Proceedings of the 6th Historic Mortars Conference – HMC 2022", University of Ljubljana, Ljubljana, Slovenia, 2022, p 634-648. ISBN: 978-961-6884-77-8*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
TERRA-CYCLE	*Excavated soil from urban areas becomes construction raw material (Terra-Cycle): Quality test plan of earth building materials, Ministerio de Ciencia e Innovación (Madrid, ES) Part of GRANT_NUMBER: Proyectos de Transición Ecológica TED2021-129705B-C33 Terra-Cycle*
LIMORTHER	*NEW LIME MORTARS WITH ADMIXTURES AND MICROENCAPSULATED PHASE CHANGE MATERIALS TO IMPROVE ENERGY EFFICIENCY AND THERMAL COMFORT OF THE ARCHITECTURAL HERITAGE (LIMORTHER) 2021-09 to 2025-08 | Grant Ministerio de Ciencia e Innovación (Madrid, ES) GRANT_NUMBER: PID2020-119975RB-I00*
MULTIFICON	*High efficiency multifunctional nano coatings for decontamination of volatiles and protection of porous substrates Gobierno de Navarra (Pamplona, Navarra, ES) GRANT_NUMBER: PC143*
RECURBAN	*Multifunctional coatings with photocatalytic and hydrophobic effect for environmental decontamination and protection against humidity in urban areas Gobierno de Navarra (Pamplona, Navarra, ES) GRANT_NUMBER: PC065*
OPTIMORTAR	*Optimization of new lime restoration mortars by the combined action of admixtures and pozzolanic materials Ministerio de Economía y Competitividad (Madrid, ES) GRANT_NUMBER: MAT2015-70728-P*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)

DSC, XRD, thermal conductivity equipment FOX 50	

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
998802502	*ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS*

Short name: CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS CERTH

Address

Street	CHARILAOU THERMI ROAD 6 KM
Town	THERMI THESSALONIKI
Postcode	57001
Country	Greece
Webpage	WWW.CERTH.GR

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	no
Research organisation	yes

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	14/12/2022 - no
SME self-assessment	unknown
SME validation	04/03/2009 - no

Departments carrying out the proposed work

Department 1

Department name	Information Technologies Institute	☐ not applicable
	☒ Same as proposing organisation's address	
Street	CHARILAOU THERMI ROAD 6 KM	
Town	THERMI THESSALONIKI	
Postcode	57001	
Country	Greece	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Stefanos**

Last name* **Vrochidis**

E-Mail* **stefanos@iti.gr**

Position in org. Researcher C (Senior Researcher)

Department Information Technologies Institute

☐ Same as organisation name

☒ Same as proposing organisation's address

Street CHARILAOU THERMI ROAD 6 KM

Town THERMI THESSALONIKI

Post code 57001

Country Greece

Website www.iti.gr

Phone +30 2311257754

Phone 2 *+xxx xxxxxxxxx*

Other contact persons

First Name	Last Name	E-mail	Phone
Christina	Moskachlaidi	christina.moskachlaidi@iti.gr	+xxx xxxxxxxxx
Sotiris	Diplaris	diplaris@iti.gr	+xxx xxxxxxxxx
Evangelia	Pouliou	certh@certh.gr	+xxx xxxxxxxxx
Maria	Papadopoulou	marpap@iti.gr	+xxx xxxxxxxxx

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Stefanos	Vrochidis	Man	Greece	stefanos@iti.gr	Category A Top grade re	Leading	0000-0002-2505-9178	Orcid ID
Dr	Ioannis	Kompatsiaris	Man	Greece	ikom@iti.gr	Category A Top grade re	Leading	0000-0001-6447-9020	Orcid ID
Dr	Sotiris	Diplaris	Man	Greece	diplaris@iti.gr	Category B Senior resea	Leading	0000-0002-9969-6436	Orcid ID
Mr	Spyridon	Symeonidis	Man	Greece	spyridons@iti.gr	Category C Recognised	Team member	0000-0003-3170-1750	Orcid ID
Dr	Makrina Viola	Kosti	Woman	Greece	mkosti@iti.gr	Category C Recognised	Team member	0000-0002-0027-0153	Orcid ID
Mrs	Nefeli	Georgakopoulou	Woman	Greece	nefeli.valeria@iti.gr	Category C Recognised	Team member	0000-0002-0729-8992	Orcid ID

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*S. Symeonidis, G. Meditskos, S. Vrochidis, K. Avgerinakis, J. Derdaele, M. Vergauwen, M. Bassier, A. Moghnieh, L. Fraguada, V. Vogler, Y. Shekhawat, L. Wanner, M. Marimon, K. Valsamidou, P. Koulali, A. Tellios, J. Wuyts, E. Lopez, "V4Design: Intelligent analysis and integration of multimedia content for Creative Industries", in IEEE Systems Journal, 2022, DOI:10.1109/JSYST.2022.3217655*
Publication	*S. Andreadis, I. Gialampoukidis, V. Sitokonstantinou, B. Coloru, H. Vervaeren, E. López, V. Kalogirou, P. Syropoulou, E. B. Kosmatopoulos, S. Vrochidis, E. Li Santi, G. Vingione, I. Kompatsiaris, "CALLISTO: Copernicus Artificial Intelligence Services and data fusion with other distributed data sources and processing at the edge to support DIAS and HPC infrastructures", Big Data from Space 2021, 18-20 May 2021, Virtual (accepted for publication)*
Publication	*G. Meditskos, Z. Vasileiou, A. Karakostas, S. Vrochidis and I. Kompatsiaris, "A Pattern-based Semantic Lifting of Cloud and HPC Applications using OWL 2 Meta-modelling", Special Session on High Performance Services Computing and Internet Technologies, International Conference on High Performance Computing & Simulation (HPCS 2020), Barcelona Spain, 10-14 December 2020. OPEN ACCESS*
Publication	*S. Mille, S. Symeonidis, M. Rousi, M. Marimon Felipe, K. Stavrothanasopoulos, P. Alvanitopoulos, R. Carlini Salguero, J. Grivolla, G. Meditskos, S. Vrochidis and L. Wanner, "A Case Study of NLG from Multimedia Data Sources: Generating Architectural Landmark Descriptions", in WebNLG+: 3rd Workshop on Natural Language Generation from the Semantic Web, (INLG 2020), 15-18 December 2020.*
Publication	*M. Rousi, G. Meditskos, S. Vrochidis, I. Kompatsiaris,"Supporting the Discovery and Reuse of Digital Content in Creative Industries using Linked Data", 15th IEEE International Conference on Semantic Computing, (ICSC 2021), 27-29 January, 2021*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
xR4DRAMA	*H2020-ICT-55-2020 :Extended Reality For DisasteR management And Media plAnning (https://cordis.europa.eu/project/id/952133)*
V4Design	*H2020-ICT-20-2017 : Visual and textual content re-purposing FOR(4) architecture, Design and video virtual reality games (https://cordis.europa.eu/project/id/779962)*
SUN	*HORIZON-HORIZON-CL4-2022-HUMAN-01-14: Social and hUman ceNtered XR (https://cordis.europa.eu/project/id/101092612)*
XRECO	*HORIZON-HORIZON-CL4-2021-HUMAN-01-06: XR mEdia eCOsystem (https://cordis.europa.eu/project/id/101070250)*
MindSpaces	*H2020-ICT-32-2018:MindSpaces - Art-driven adaptive outdoors and indoors design (https://cordis.europa.eu/project/id/825079)*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Computational capacity	*MKLab has built an infrastructure of considerable computational capacity (400+ cores, 600 +GB RAM, 100+TB storage) and developed a sophisticated distributed architecture for data collection and indexing, as well as a variety of cutting edge data mining and retrieval algorithms.*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
958280267	*TITAN CEMENT COMPANY AE*

Short name: TITAN CEMENT COMPANY AE

Address

Street	HALKIDOS STREET 22A
Town	ATHINA
Postcode	111 43
Country	Greece
Webpage	www.titan-cement.com

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	no
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	11/11/1924 - no
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

Department 1

Department name	Group Research Innovation & Quality (GRIQ)	☐ not applicable
	☐ Same as proposing organisation's address	
Street	Titan Cement Group / Kamari Plant	
Town	P.O.Box 18, Elefsina	
Postcode	192 00	
Country	Greece	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ◯ Woman ◉ Man ◯ Non Binary

First name* **Marios**

Last name* **Katsiotis**

E-Mail* **m.katsiotis@titan.gr**

Position in org. Group Innovation & Quality Manager

Department Head of Group Research, Innovation & Quality Department/ Group Innovation and

☐ Same as organisation name

☒ Same as proposing organisation's address

Street HALKIDOS STREET 22A

Town ATHINA

Post code 111 43

Country Greece

Website Website:www.titan-cement.com

Phone +30 210 553 7925

Phone 2 *+xxx xxxxxxxxx*

Other contact persons

First Name	Last Name	E-mail	Phone
Despoina	Papargyriou	d.papargyriou@titan.gr	+30 210 553 7921

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Marios	Katsiotis	Man	Greece	m.katsiotis@titancement.com	Category A Top grade re	Leading		
Dr	Despoina	Papargyriou	Woman	Greece	d.papargyriou@titancement.com	Category B Senior resea	Team member		
Dr	Vasileios	Michalis	Man	Greece	v.michalis@titancement.com	Category B Senior resea	Team member		
Mr	Dimitrios	Michelis	Man	Greece	d.michelis@titancement.com	Category C Recognised	Team member		
Mrs	Katerina	Issari	Woman	Greece	k.issari@titancement.com	Category C Recognised	Team member		

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*K. Sideris, P. Manit, E. Chaniotakis, "Performance Of Thermally Damaged Fibre-Reinforced Concretes", Construction and Building Materials 23 (3) 2009, 1232-1239.*
Publication	*"Performance of natural sorbents during calcium looping cycles: A comparison between fluidized bed and thermo-gravimetric tests", Energy and Fuels 27 (10) 2013, 6048-6054.*
Publication	*K. Atsonios, P. Grammelis, S.K. Antiohos, N. Nikolopoulos, E. Kakaras, "Integration of calcium looping technology in existing cement plant for CO2 capture: process modeling and technical considerations", Fuel (153) 2015, 210-223.*
Publication	*N. Mavropoulou, N. Katsiotis, J. Giannakopoulos, K. Koutsodontis, D. Papageorgiou, E. Chaniotakis, M. Katsioti, P.E. Tsakiridis, "Durability evaluation of cement exposed to combined action of chloride and sulphate ions at elevated temperature: The role of limestone filler", Construction and Building Materials (124) 2016, 558-565.*
Publication	*P.E. Tsakiridis, M. Samouhos, A. Peppas, N.S. Katsiotis, D. Velissariou, M. S. Katsiotis, M. Beazi, "Silico- Aluminous Bottom Ash Valorisation in Cement Clinker Production: Synthesis, Characterisation and Hydration Properties", Construction and Building Materials (126) 2016, 673-681.*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
ROBETARME (Horizon Europe, GA: 101058731)	*A Digital Twin coupled with simulation tools, advanced decision-making and task-planning skills will facilitate fast and greener shotcrete automation. RobetArme will be evaluated on four diverse construction sites, i.e. tunnels/culverts (BYCN), bridges posttensioned boxes (ARUP), beams & piles of buildings (CEAS) and ground support walls (BYCN), assessing its autonomous shotcreting abilities.*
RECODE (Horizon2020 SPIRE, GA: 768583)	*In RECODE, CO2 from the flue gases of a cement rotary kiln is captured and used for the production of value-added chemicals and materials, utilizing a circular-economy-approach. A dedicated pilot plant has been installed and operated in 2022 at TITAN Kamari plant, demonstrating CCUS at TRL6.*
CARMOF (Horizon2020, GA: 760884)	*CARMOF focuses on carbon capture at TRL 6 by using optimized structured adsorbents in combination with pressure swing adsorption. The technology will be demonstrated at TITAN Kamari plant in 2022.*
LIGHTCOCE (Horizon2020, GA: 814632)	*LIGHTCOCE focuses on the upscaling and testing of multifunctional lightweight concrete and ceramic materials by providing open access to SMEs and Industry to a single entry point ecosystem consisting of dedicated Pilot Lines and Test Beds.*
3BUILD (GSRI Programme, T1EΔK-04775)	*3BUILD aims in developing a novel 3-D printer able to construct buildings of any size and level of complexity using specially developed reinforced or unreinforced mortars for this application.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Rheometer (ICAR Plus)	*Concrete and mortars rheology*
Mixer (Pan mixer DZ 120V)	*Concrete and mortars mixer*
CO2 chamber (Memmert ICH 750C)	*Concrete and mortars durability*

X-Ray Diffraction Spectrometer (Bruker D8 Advance)	*Raw materials, clinker and cement characterization. Quantification of mineral phases*
X-Ray Fluorescence Spectrometer (Bruker SRS300)	*Raw materials, clinker and cement characterization. Quantification of oxides*
Laser Scattering (CILAS 1064 LD)	*Particle size analysis*
Thermal Gravimetric Analysis & Differential Scanni	*Weight change and thermal energy produced during materials heating*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
999846222	*BEN-GURION UNIVERSITY OF THE NEGEV*

Short name: BGU

Address

Street	.
Town	BEER SHEVA
Postcode	84105
Country	Israel
Webpage	www.bgu.ac.il

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	yes
Research organisation	yes

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	19/05/2016	- no
SME self-assessment	19/05/2016	- no
SME validation	01/10/2008	- no

Departments carrying out the proposed work

Department 1

Department name	Department of Civil and Environmental Engineering	☐ not applicable
	☒ Same as proposing organisation's address	
Street	.	
Town	BEER SHEVA	
Postcode	84105	
Country	Israel	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Prof.

Gender ◉ Woman ○ Man ○ Non Binary

First name* **Alva**

Last name* **Peled**

E-Mail* **alvpeled@bgu.ac.il**

Position in org. full professor- department chair

Department Department of Civil and Environmental Engineering ☐ Same as organisation name

☒ Same as proposing organisation's address

Street .

Town BEER SHEVA

Post code 84105

Country Israel

Website *Please enter website*

Phone *+xxx xxxxxxxxx*

Phone 2 *+xxx xxxxxxxxx*

Other contact persons

First Name	Last Name	E-mail	Phone
Lori	Liss	lori@bgu.ac.il	+xxx xxxxxxxxx

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Prof	Alva	Peled	Woman	Israel	alvpeled@bgu.ac.il	Category A Top grade re	Leading	0000-0003-0978-8589	Orcid ID

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☐
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☐
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*A. Alatawna, L Nahum, R. Sripada, M. Birenboim, O. Regev, A. Peled, Textile-reinforced mortar: Durability in salty environment, Cement and Concrete Composites 130 (2022) 104534. https://doi.org/10.1016/j.cemconcomp.2022.104534*
Publication	*R. Haik, A. Peled & I. A. Meir, 2021, Thermal performance of alternative binders lime hemp concrete (LHC) building: comparison with conventional building materials, Building & Research Information, DOI: 10.1080/09613218.2021.1889950*
Publication	*L., Nahum, E., Gal and A., Peled, 2020, Tensile behavior of fabric-cement-based composites reinforced with non-continuous load bearing yarns, Construction and Building Materials, Vol. 236, 117432.*
Publication	*R. Haik, A. Peled, I.A. Meir, 2020, The thermal performance of lime hemp concrete (LHC) with alternative binders, Energy & Buildings, Vol. 210, 109740*
Publication	*R. Haik, G. Bar-Nes, A. Peled, I.A. Meir, 2020, Alternative unfired binders as lime replacement in hemp concrete, Construction and Building Materials Vol. 241, 117981*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
Development of novel non-conventional sustainable	*This research dealt with the development of sustainable building materials based on lime hemp concrete (LHC) by replacing some or all of the lime with different dosages of alternative unfired binders, namely, clay, limestone or basalt. The work explored the mechanical and thermal properties of the different materials as compared to conventional building materials, for small scale and full-scale building including the LCA of those materials as part of a building.*
Ultrahigh performance fabric (textile) reinforced	*This research developed a new class of textile reinforced concrete (TRC), by combining the advantages of two types of reinforcement in one composite: nanofillers (NFs) such as carbon nanotubes (CNT), graphene and nano-silica on one hand, and textile fabrics of carbon on the other. Two directions were explored: (i) textile fabric filling and coating with NFs, and (ii) cementitious matrix filled with NFs. The fabric-matric bond strengths and TRC mechanical performances were studied.*
H2020-ReSHEALience	*The project dealt with the development of ultra-high durable concrete for coastal infrastructures, by developing and designing innovative materials including the use of textiles and nanotechnology approaches, and their adaption to different application technologies under various exposure conditions.*
Waste to Resource – Development of Environmentally	*This research dealt with the development of novel geopolymeric building materials bases on "zero waste" objective with high durability to sea water environment. The binding materials were of recycled industrial waste (Fly ash, oil shale ash, sewage sludge ash etc.). The work explored range of material combinations considering chemical physical and mechanical aspects.*
Evaluation of three-dimensional fabrics as hydraul	*The research deals with a novel production process of Textile (3D fabric) Reinforced Concrete (TRC), the dry cementitious powder casting, in which the 3D fabric is first impregnated through its whole depth with dry cementitious powder (without water), followed by wetting from the top surface of the element, with the fabric assisting homogeneous water distribution until entire concrete hardening. Parameters related to the water flow through the TRC, and its mechanical performance are studied.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Closed loop uniaxial INSTRON test system	*For testing mechanical performance as, tensile, compression, bending and others, including a set-up of high-resolution camera for crack monitoring during testing and image analysis.*
Acoustic emission (AE) testing set	*The AE is used as a nondestructive test method to detect fracture processes of different materials. The AE examinations can conduct structure under normal and extreme service conditions, which include monitoring of micro- and macro-crack development in concrete due to loading scenarios as well as en*
Isothermal calorimeter (TAM Air by AS Instruments)	*To study chemical reaction including hydration of different building materials*
A center for advanced Nano-Technology	*This centre includes among others: Scanning Electron Microscopy of high-resolution equipped with Energy-Dispersive X-ray Spectroscopy (EDS) instrument and a Back-Scattered Electron (BSE) as well as BET (Specific Surface Area), TGA (Thermogravimetric Analysis), XRD (X Ray Diffraction Analysis) and mo*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
969034463	*NUROGAMES GMBH*

Short name: NUROGAMES GMBH

Address

Street	SCHAAFENSTRASSE 25
Town	KOLN
Postcode	50676
Country	Germany
Webpage	www.nurogames.com

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	no
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	31/12/2020	- yes
SME self-assessment	31/12/2020	- yes
SME validation	15/05/2006	- yes

Departments carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Mr

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Yash**

Last name* **Shekhawat**

E-Mail* **yash.shekhawat@nurogames.com**

Position in org. Project Manager

Department NUROGAMES GMBH

☒ Same as organisation name

☐ Same as proposing organisation's address

Street Schaafenstrasse 25

Town Cologne

Post code 50676

Country Germany

Website www.nurogames.com

Phone +49 221 398 808 40

Phone 2 *+xxx xxxxxxxxx*

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☐
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☒
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☒
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	• *Yash Shekhawat, Jens Piesk, Holger Sprengel, Ignacio Dominguez Gomez, Felipe Vincens, Sonia Castro Carillo, Panagiotis Trakas, Panagiotis Karkazis, Theodore Zahariadis, Marios Touloupou, Marios Touloupou, Evgenia Kapassa, Dimosthenis Kyriazis, George Zilouris, Anton Roman Portables, "Orchestrating Live Immersive Media Services Over Cloud Native Edge Infrastructure", 2019 IEEE 2nd 5G World Forum*
Publication	*Y. Shekhawat, S. Symeonidis et al., "xR4DRAMA: Enhancing situation awareness using immersive (XR) technologies," 2021 IEEE International Conference on Intelligent Reality (ICIR), Piscataway, NJ, USA, 2021, pp. 1-8, doi: 10.1109/ICIR51845.2021.00010.*
Publication	*J. Derdaele, Y. Shekhawat and M. Vergauwen, "Exploring Past and Present: VR Reconstruction of the Berlin Gendarmenmarkt," 2018 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), Munich, Germany, 2018, pp. 287-292, doi: 10.1109/ISMAR-Adjunct.2018.00088.*
Publication	*Y. Shekhawat, K. Avgerinakis et al., "V4Design for Enhancing Architecture and Video Game Creation," 2018 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), Munich, Germany, 2018, pp. 305-309, doi: 10.1109/ISMAR-Adjunct.2018.00091.*
Publication	*Y. Shekhawat et al., "Orchestrating Live Immersive Media Services Over Cloud Native Edge Infrastructure," 2019 IEEE 2nd 5G World Forum (5GWF), Dresden, Germany, 2019, pp. 316-322, doi: 10.1109/5GWF.2019.8911681.*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
Xr4drama	*The EU-funded xR4DRAMA project aims to create a solution that will improve the situational awareness of those user groups who are responsible for handling disasters, man-made crises or public events. The groups range from first responders, local authorities and security forces to media companies and event planners.*
CALLISTO	*CALLISTO provides a highly interoperable Big Data platform between DIAS infrastructures and Copernicus users, where the outcomes of optimised-on-HPC machine learning solutions on satellite data are semantically indexed and linked to crowdsourced, geo-referenced and distributed data sources, and served to humans in Mixed Reality environments, allowing virtual presence and situational awareness in any desired area of interest, augmented by Big Data analytics and deep learning solutions*
MindSpaces	*Horizon 2020 STARTS Programme: MindSpaces aims to create a novel approach to urban and architectural design by generating 3D-VR immersive and emotion-adaptive 'neuro-environments' that will help in designing emotionally-relevant urban spaces. The emotional aspects of an environment will be captured through the use of mobile EEG (Elecroencephalography) headsets, wearable bracelets/watches, and other physiological sensors, so as to allow capturing the neurofeedback*
V4Design	*V4Design will develop a platform that provides architects, video game creators and designers of any expertise with innovative tools including VR tools necessary to enhance and simplify the creative phase of the designing process.*
PRECINCT	*PRECINCT (Preparedness and Resilience Enforcement for Critical INfrastructure Cascading Cyberphysical Threats and effects with focus on district or regional protection) aims to connect private and public CI stakeholders in a geographical area to a common cyber-physical security management approach which will yield a protected territory for citizens and infrastructures*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Software development	*Unity and unreal game engines with compatible hardwares. Nuroengine, Visual studio code*
Hardware	*Dev kits for HTC Vive, Oculus rifts, Android VR, Physical servers, 5g testbeds*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? ○ Yes ◉ No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
999812854	*ACCIONA CONSTRUCCION SA*

Short name: ACCIONA

Address

Street	AVENIDA DE EUROPA 18 PARQUE EMPRESARIAL
Town	ALCOBENDAS
Postcode	28108
Country	Spain
Webpage	acciona-construccion.com

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	no
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	10/02/1997 - no
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

Department 1

Department name	R&D Center	☐ not applicable
	☐ Same as proposing organisation's address	
Street	Valportillo Segunda, nº8	
Town	Alcobendas	
Postcode	28108	
Country	Spain	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Jose**

Last name* **Vera Agullo**

E-Mail* **jose.vera.agullo@acciona.com**

Position in org. Group Manager

Department R&D Center

☐ Same as organisation name

☐ Same as proposing organisation's address

Street Valportillo Segunda, nº8

Town Alcobendas

Post code 28108

Country Spain

Website acciona-construccion.com

Phone +34670508418

Phone 2 +34917912020

Other contact persons

First Name	Last Name	E-mail	Phone
Francisco Javier	Bonilla Diaz	franciscojavier.bonilla.diaz@acciona.com	+34670408362

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	JOSE	VERA-AGULLO	Man	Spain	jose.vera.agullo@acciona.com	Category B Senior resea	Leading	0000-0001-7967-2149	Orcid ID
Dr	RAUL	PINA-ZAPARDIEL	Man	Spain	raul.pina.zapardiel@acciona.com	Category B Senior resea	Team member	0000-0002-2831-7531	Orcid ID
Ms	MARÍA	CASADO-BARRASA	Woman	Spain	auroramaria.casado.barrasa@acciona.com	Category B Senior resea	Team member	0000-0002-2814-8467	Orcid ID
Mrs	ROSA MARIA	LAMPLE CARRERAS	Woman	Spain	rosamaria.lample.carreras@acciona.es	Category B Senior resea	Team member		
Mrs	AMAIA	GOMEZ SAN MARTIN	Woman	Spain	amaia.gomez.sanmartin@acciona.com	Category B Senior resea	Team member	0000-0002-9145-4395	Orcid ID

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☐
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☒
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☒
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Real-scale applications of waste in cement-based materials in building. Innovative Sustainable Materials for a Circular Economy. Woodhead Publishing Series in Civil and Structural Engineering, pages 681-713, 2021*
Publication	*Calcium aluminate based cement for concrete to be used as thermal energy storage in solar thermal electricity plants. Cement and Concrete Research 82, 2016*
Publication	*Green Cast demonstration of innovative lightweight construction components made of recycled ash for sustainable buildings. International Journal of Research in Engineering and Technology, 3 (13), 2014*
Publication	*Durability of concrete exposed to sea water at early age: floating dock method for construction of caissons. ICCS 2016*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
Project RE4	*REuse and REcycling of CDW materials and structures in energy efficient pREfabricated elements for building REfurbishment and construction (Grant n: 723583)*
Project Ecobinder	*Development of insulating concrete systems based on novel low CO2 binders for a new family of eco-innovative, durable and standardized energy efficient envelope components (grant n. 637138)*
Project Lorcenis	*Long Lasting Reinforced Concrete for Energy Infrastructure under Severe Operating Conditions (grant n 685445)*
Project Endurcrete	*New Environmental friendly and Durable conCrete, integrating industrial by-products and hybrid systems, for civil, industrial and offshore applications - EnDurCrete (grant n 760639)*
Project Marewind	*MAterials solutions for cost Reduction and Extended service life on WIND off-shore facilities (grant n 952960)*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Mortar and concrete laboratory	*Fully equipped laboratory with all equipment and tools needed for concrete R&D activities and consultancy works. Main equipment: humidity and climate walk-in chambers, flexural and compression presses, concrete mixers (250 and 50 liters), permeability test, occluded air, workability tests, shrinkage*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
884076140	*Hellenic Ministry of Culture*

Short name: Ypiresia Neoteron Mnimeion kai Texnikon ergon Dodekanisou

Address

Street	Odos Ippoton
Town	Rhodes
Postcode	851 00
Country	Greece
Webpage	https://www.culture.gov.gr/en

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	15/12/2022 - no
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

Department 1

Department name	Ypiresia Neoteron Mnimeion kai Texnikon ergon Dodekanisou	☐ not applicable
	☒ Same as proposing organisation's address	
Street	Odos Ippoton	
Town	Rhodes	
Postcode	851 00	
Country	Greece	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title: Mrs

Gender: (•) Woman ( ) Man ( ) Non Binary

First name*: **Aikaterini**

Last name*: **Manousou Ntella**

E-Mail*: **amanousou@culture.gr**

Position in org.: deputry chief of Department

Department: Ypiresia Neoteron Mnimeion kai Texnikon ergon Dodekanisou

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Odos Ippoton

Town: Rhodes

Post code: 851 00

Country: Greece

Website: www.ynmdo@culture.gr

Phone: 003022410 34024 -27

Phone 2: 003022410 34024 -26

Other contact persons

First Name	Last Name	E-mail	Phone
Evaggelia	Kaka	ekaka@culture.gr	+xxx xxxxxxxxx
Nektaria	Dasakli	ndasakli@culture.gr	+xxx xxxxxxxxx
Stefania	Fachouridou	sfachouridou@culture.gr	+xxx xxxxxxxxx

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Mrs	Aikaterini	Manousou Ntella	Woman	Greece	amanousou@culture.gr	Category A Top grade re	Leading		
Mrs	Evaggelia	Kaka	Woman	Greece	ekaka@culture.gr	Category B Senior resea	Team member		
Mrs	Nektaria	Dasakli	Woman	Greece	ndasakli@culture.gr	Category B Senior resea	Team member		
Mrs	Stefania	Fachouridou	Woman	Greece	sfachouridou@culture.gr	Category B Senior resea	Team member		

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☒
Civil society representative	☒
Policy maker or regulator, incl. standardisation body	☐
Research performer	☐
Technology developer	☐
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☒
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☒
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
Restoration of the Neoclassical School of Rhodes	*A complete restoration of the Neoclassical School of the Medieval City of Rhodes and enhancement of the surrounding archaeological site, for cultural activities, is under way (Phases I & II). The neoclassical school building (19th century) occupies an area of ⊠⊠1000 square meters, with the rooms developing around a central atrium with a perimeter gallery. Access is through two entrances, the main entrance with a characteristic porch.*
Restoration of historical house in Rhodes city	*The historical-preserved house, in Marasi of Agios Georgios Ano, in the city of Rhodes , is under complete restoration to house a museum, concerning the historical neighbourhoods of the greek population (Marasia), during the Ottoman occupation of the island (1522-1912). It is a simple broad-fronted house ("makrynari"), with auxiliary buildings (oven, kitchen) and an outdoor area with a typical arrangement in a courtyard, with a cistern and a well, and a garden.*
Restoration of the Customs building- Rhodes port	*The Customs building, in the touristic port of Rhodes, is a characteristic example of the materials and technicques of early use of concrete, as it was built during the Italian occupation of the island (1912- 1945). The restoration includes construction and reinforcement work in the oxidized by the sea, iron parts of the concrete, as well as and restoration of the facades.*
Restoration of Vouvalio house in Kalymnos island	*The historical-preserved house,in Kalymnos island, built and owned by Vouvalis in the 19th century houses a folklore museum. The restoration focuses on the preservation of fabric, metal, stone and ceramic objects and artworks, as well as the preservation of wood sculptures, portable images and paintings.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

Administrative forms

PIC	Legal name
999852236	*LINKOPINGS UNIVERSITET*

Short name: LIU

Address

Street	CAMPUS VALLA
Town	LINKOPING
Postcode	581 83
Country	Sweden
Webpage	www.liu.se

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	yes
Research organisation	yes

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	17/01/2022	- no
SME self-assessment	unknown	
SME validation	28/10/2008	- no

Departments carrying out the proposed work

Department 1

Department name	Department of Physics, Chemistry and Biology (IFM)	☐ not applicable
	☒ Same as proposing organisation's address	
Street	CAMPUS VALLA	
Town	LINKOPING	
Postcode	581 83	
Country	Sweden	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Prof.

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Feng**

Last name* **Gao**

E-Mail* **feng.gao@liu.se**

Position in org. Head of the Optoelectronics Unit

Department Department of Physics, Chemistry and Biology

☐ Same as organisation name

☒ Same as proposing organisation's address

Street CAMPUS VALLA

Town LINKOPING

Post code 581 83

Country Sweden

Website www.liu.se

Phone *+xxx xxxxxxxxx*

Phone 2 *+xxx xxxxxxxxx*

Other contact persons

First Name	Last Name	E-mail	Phone
Evgenia	Izosimova	evgenia.izosimova@liu.se	+xxx xxxxxxxxx
Feng	Wang	feng.wang@liu.se	+xxx xxxxxxxxx
Kirstin	Kahl	kirstin.kahl@liu.se	+xxx xxxxxxxxx
Agneta	Jansson	agneta.jansson@liu.se	+xxx xxxxxxxxx

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Prof	Feng	Gao	Man	China (People's	feng.gao@liu.se	Category A Top grade re	Leading	0000-0002-2582-1740	Orcid ID

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☒
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☐
IPR management incl. technology transfer	☒
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Science, 2022, 377, 495-501. In this paper, we developed a new doping strategy for spiro-OMeTAD that could avoid post-oxidation by using stable organic radicals as the dopant and ionic salts as the doping modulator (referred to as ion-modulated radical doping) for highly stable perovskite devices without sacrificing device efficiency.*
Publication	*Nature Photonics 2019, 13, 418-424.We greatly enhance the performance of perovskite optoelectronic devices through rational molecular passivation.*
Publication	*Nature Electronics 2020, 3, 156-164. In this paper, we propose a dual-functional perovskite diodes with well passivated perovskite films.*
Publication	*Nature Communications 2021, 12, 361. We develop a vapour-assisted crystallization technique to largely mitigate local compositional heterogeneity and ion migration in mixed halide perovskites.*
Publication	*Nature 2019, 571, 245-250. Here, we incorporate ionic liquids into the perovskite film to suppress the ion migration and thus significantly boost the stability of perovskite solar cells.*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
H2020 ERC Staring Grant SHINING	*This project focuses on the development and understanding of stable perovskite materials and devices for light-emitting applications.*
H2020 Doctor training ITN PERSEPHONe	*This Marie Sklodowska-Curie doctoral network project aims to develop perovskites for photonic applications.*
Solar-ERA HESTPV	*This Solar-ERA project aims to develop lead-free perovskite solar cells with high efficiency and excellent stability.*
H2020 RISE PEOPLE	*This Marie Sklodowska-Curie staff exchange project aims to develop metal halide perovskites for different applications, including solar cells, LEDs, and transistors.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Device fabrication	*Solar cells can be prepared and characterized under inert conditions in a modern device lab in which solution processing can be combined with metal vacuum evaporators, all integrated with extended glove box systems.*
Device chacterization	*Characterization is based on IV characteristics, impedance spectroscopy, pulsed techniques, and dedicated low-temperature high vacuum probe station. An ultrasensitive (9 orders of magnitude) setup for EQE measurements allows identification of trap states.*
Spectroscopy	*Spectroscopic infrastructure: Absorption and (time-resolved) fluorescence spectrometers operating in UV-vis-nearIR.*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

Administrative forms

PIC	Legal name
888949226	*MUSEum+*

Short name: MUSEum+

Address

Street	Maltezske namesti 1
Town	Praha
Postcode	118 01
Country	Czechia
Webpage	www.museum-plus.cz

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	08/10/2021 - yes
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

Department 1

Department name: Curatorial Departement ☐ not applicable

☐ Same as proposing organisation's address

Street: Vítkovická 3335/15

Town: Ostrava

Postcode: 70200

Country: Czechia

Department 2

Department name: Strategic Development Unit ☐ not applicable

☐ Same as proposing organisation's address

Street: Vítkovická 3335/15

Town: Ostrava

Postcode: 70200

Country: Czechia

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Jakub**

Last name* **Jareš**

E-Mail* **jakub.jares@museum-plus.cz**

Position in org. Head

Department Curatorial Departement

☐ Same as organisation name

☐ Same as proposing organisation's address

Street Vítkovická 3335/15

Town Ostrava

Post code 70200

Country Czechia

Website www.museum-plus.cz

Phone +420776017950

Phone 2 *+xxx xxxxxxxxx*

Other contact persons

First Name	Last Name	E-mail	Phone
Leszek	Jodlinski	leszek.jodlinski@museum-plus.cz	+48 601 085 269

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Jakub	Jareš	Man	Czechia	jakub.jares@museum-plus.cz	Category B Senior resea	Leading	0000-0003-0472-2951	Orcid ID
Dr	Leszek	Jodliński	Man	Poland	leszek.jodlinski@museum-plus.cz	Category B Senior resea	Team member	0000-0002-3751-1539	Orcid ID

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☐
Technology developer	☐
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☒
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☒
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
3D Model	*3D scans of the number 4 and 6 blast furnaces in Dolni Vitkovice, Ostrava have been made, along with the casting hall between them, the future seat of the MUSEum+. The outcome is 3D informational model of the building.*
Feasibility Study	*MUSEum+ is newly founded state museum aiming to reconstruct industrial heritage in Ostrava, Dolní Vítkovice. MUSEum+ applies for financial support from Just Transition Fund and for this purpose elaborated detailed feasibility study including sustainability goals of the institution.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
ICE Consortium partnership	*MUSEum+ has been contacted by ICE Consortium (Innovation by Creative Economy, led by Fraunhofer-Gesellschaft) for future cooperation in KIC on Culture and Creativity. The letter of intent confirmed future associated partnership of MUSeum+.*
Consortium of the MUSEum+	*MUSEum+ is supported by the members of its consortium, among them are Ministry of Culture of the Czech Republic, Zentrum für Kunst und Medien in Karlsruhe, Ostrava University. Consortium consults the achievements and next steps of the project.*
Future Museum research group	*MUSEum+ is member of the "Future Museum" research project led by Museum Booster based in Vienna.*
Partnership with UCEEB	*Partnership with University Center for Energy Efficient Buildings of the Czech Technical University*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? ○ Yes ◉ No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
999976881	*THE UNIVERSITY OF SHEFFIELD*

Short name: USFD

Address

Street	FIRTH COURT WESTERN BANK
Town	SHEFFIELD
Postcode	S10 2TN
Country	United Kingdom
Webpage	www.shef.ac.uk

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	yes
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	12/01/2022	- no
SME self-assessment	19/05/2016	- no
SME validation	29/09/2008	- no

Departments carrying out the proposed work

Department 1

Department name	Department of Civil and Structural Engineering	☐ not applicable
	☐ Same as proposing organisation's address	
Street	Sir Frederick Mappin Building, Mappin St	
Town	Sheffield	
Postcode	S13JD	
Country	United Kingdom	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Dr

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Giacomo**

Last name* **Torelli**

E-Mail* **g.torelli@sheffield.ac.uk**

Position in org. Lecturer

Department Department of Civil and Structural Engineering, University of Sheffield

☐ Same as organisation name

☐ Same as proposing organisation's address

Street Sir Frederick Mappin Building, Mappin Street

Town Sheffield

Post code S13JD

Country United Kingdom

Website Please enter websitehttps://www.sheffield.ac.uk/civil/people/acad

Phone +447478297450

Phone 2 *+xxx xxxxxxxxx*

Other contact persons

First Name	Last Name	E-mail	Phone
Alexandre	Fletcher	civil-research@sheffield.ac.uk	+xxx xxxxxxxxx
Nicholas	Cupit	research.eds@sheffield.ac.uk	+xxx xxxxxxxxx

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Dr	Giacomo	Torelli	Man	Italy	g.torelli@sheffield.ac.uk	Category D First stage r	Team member	0000-0002-0607-695X	Orcid ID

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☒
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☒
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Torelli, G., Mandal, P., Gillie, M., & Tran, V.-X. (2016). Concrete strains under transient thermal conditions: A state-of-the-art review. Engineering Structures, 127, 172–188. https://doi.org/10.1016/j.engstruct.2016.08.021*
Publication	*Torelli, G., Gillie, M., Mandal, P., & Tran, V. X. (2017). A multiaxial load-induced thermal strain constitutive model for concrete. International Journal of Solids and Structures, 108, 115–125. https://doi.org/10.1016/j.ijsolstr.2016.11.017*
Publication	*Torelli, G., Mandal, P., Gillie, M., & Tran, V.-X. (2018). A confinement-dependent load-induced thermal strain constitutive model for concrete subjected to temperatures up to 500 °C. International Journal of Mechanical Sciences, 144, 887–896. https://doi.org/10.1016/j.ijmecsci.2017.12.054*
Publication	*al Hamd, R. K. S., Gillie, M., Warren, H., Torelli, G., Stratford, T., & Wang, Y. (2018). The effect of load-induced thermal strain on flat slab behaviour at elevated temperatures. Fire Safety Journal, 97. https://doi.org/10.1016/j.firesaf.2018.02.004*
Publication	*Torelli, G., Gillie, M., Mandal, P., Draup, J., & Tran, V. X. (2020). A moisture-dependent thermomechanical constitutive model for concrete subjected to transient high temperatures. Engineering Structures, 210, 110170. https://doi.org/10.1016/J.ENGSTRUCT.2020.110170*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
Research Grant	*EPSRC Grant EP/V007025/1* *Principal Investigator: Giacomo Torelli 2021* *£413,824 - Three-dimensional electrical tomography for imaging large concrete members* *Description: the project aims to develop advanced algorithms to image large concrete elements in 3D using electrical tomography.*
Research Grant (PhD Scholarship)	*EPSRC ICASE PhD Studentship with EDF Energy* *Lead Supervisor: Giacomo Torelli 2021* *£120,000 - of which £35,000 EDF Energy support*
Research Grant (PhD Scholarship)	*EPSRC ICASE PhD Studentship with the National Nuclear Laboratory* *Lead Supervisor: Giacomo Torelli 2021* *£115,000 - of which £30,000 NNL support* *Description: the project aims to develop robust numerical methods to assess heat transfer and mechanical damage in cementitious materials.*
Research Contract	*Game Changers Feasibility Study - Feasibility project* *Principal Investigator: Giacomo Torelli 2021* *£10,000 - co-funded by Sellafield Ltd. and Dounreay Site Restoration Ltd.* *Description: the project aimed to determine the feasibility of controlling heat-induced spalling to remove layers of contaminated concrete from existing nuclear structures.*
Research Contract	*Game Changers Proof of Concept Grant* *Principal Investigator: Maurizio Guadagnini,* *Co-Investigators: Giacomo Torelli, Shan-Shan Huang, Kypros Pilakoutas 2021* *£135,000 - co-funded by Sellafield Ltd. and Dounreay Site Restoration Ltd.* *Description: the project aims to develop a new technology to control heat-induced spalling to remove layers of contaminated concrete from existing nuclear structures.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
ShARC (Sheffield Advanced Research Computer)	*Sheffield's High Performance Computing Cluster, typically offering more than one order of magnitude more resources than current high-performance desktop workstations. See main details below:* *- Worker nodes: 121* *- CPU cores: 2024* *- Total memory: 12160 GiB* *- GPUs: 40* *- Fast network filesystem (Lu*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
999975620	*UNIVERSITY COLLEGE LONDON*

Short name: UNIVERSITY COLLEGE LONDON

Address

Street	GOWER STREET
Town	LONDON
Postcode	WC1E 6BT
Country	United Kingdom
Webpage	http://www.ucl.ac.uk

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	yes
Research organisation	yes

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	01/02/2022	- no
SME self-assessment	unknown	
SME validation	30/05/2008	- no

Departments carrying out the proposed work

Department 1

Department name	Department of Electronic and Electrical Engineering	☐ not applicable
	☐ Same as proposing organisation's address	
Street	Torrington Place	
Town	London	
Postcode	WC1E 7JE	
Country	United Kingdom	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Prof.

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Ioannis**

Last name* **Papakonstantinou**

E-Mail* **i.papakonstantinou@ucl.ac.uk**

Position in org. Professor of Photonics and Nanofabrication

Department Electronic and Electrical Engineering

☐ Same as organisation name

☐ Same as proposing organisation's address

Street Torrington Place

Town London

Post code WC1£7JE

Country United Kingdom

Website www.ucl.ac.uk

Phone +442076777302

Phone 2 *+xxx xxxxxxxxx*

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Prof	Ioannis	Papakonstantinou	Man	Greece	i.papakonstantinou@ucl.ac.uk	Category A Top grade re	Team member	0000-0002-1087-7020	Orcid ID

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☐
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☐
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☐
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*C. Sol, M. Portnoi, T. Li, K. L. Gurunatha, J. Schläfer, S. Guldin, I. P. Parkin, and I. Papakonstantinou, "High-Performance Planar Thin Film Thermochromic Window via Dynamic Optical Impedance Matching," ACS Appl. Mater. Interfaces 12, 8140–8145 (2020). Dynamic glazing for solar heat gain reduction and AC consumption mitigation.*
Publication	*S. K. Laney, T. Li, M. Michalska, F. Ramirez, M. Portnoi, I. P. Parkin, and I. Papakonstantinou, "Bioinspired Multifunctional Glass Surfaces Through Regenerative Secondary Mask Lithography," Adv. Mater., 202102175 (2021). Advanced multifunctional glazing for building energy efficiency*
Publication	*M. Portnoi, T. J. Macdonald, C. Sol, T. S. Robbins, T. Li, J. Schläfer, S. Guldin, I. P. Parkin, and I. Papakonstantinou, "All-Silicone-based Distributed Bragg Reflectors for Efficient Flexible Luminescent Solar Concentrators," Nano Energy 70, 104507 (2020). Active windows with solar electricity generation capacity.*
Publication	*Lecointre, P., Laney, S., Michalska, M., Li, T., Tanguy, A., Papakonstantinou, I., & Quéré, D. Unique and universal dew-repellency of nanocones. Nature Communications, 12(1), 4–12 (2021). Advanced surfaces for the control of humidity.*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
EENSULATE	*Development of innovative lightweight and highly insulating energy efficient components and associated enabling materials for cost-effective retrofitting and new construction of curtain wall facades. Funded by Horizon2020*
ERC-StG-IntelGlazing	*Development of multifunctional glass surfaces for solar heat gain modulation, self-cleaning and antimicrobial capabilities.*
ERC-PoC-PoC	*Development of polysiloxane radiative cooling coatings with self-cleaning capability.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
London Centre of Nanotechnology	*Extensive cleanroom facilities*
Wet chemistry lab	*autoclaves, vacuum ovens, fume hoods, schlenk lines and other equipment for the production of coatings and membranes*
Characterization lab	*FE-SEM, TEM, XRD, XPS, NMR, FTIR, UV-Vis-NIR, spectrometric ellipsometry, AFM, Raman and other equipment*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

PIC	Legal name
999887059	*UNIVERSITA TA MALTA*

Short name: UNIVERSITY OF MALTA

Address

Street	TAL OROQQ
Town	MSIDA
Postcode	2080
Country	Malta
Webpage	www.um.edu.mt

Specific Legal Statuses

Legal person	yes
Public body	yes
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	yes
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	30/09/2015	- no
SME self-assessment	30/09/2015	- no
SME validation	unknown	

Departments carrying out the proposed work

Department 1

Department name	Faculty for the Built Environment	☐ not applicable
	☐ Same as proposing organisation's address	
Street	Tal-Qroqq Msida Campus	
Town	Msida	
Postcode	MSD2080	
Country	Malta	

Main contact person

This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in the step "Participants" of the submission wizard.

Title Prof.

Gender ○ Woman ◉ Man ○ Non Binary

First name* **Ruben Paul**

Last name* **Borg**

E-Mail* **ruben.p.borg@um.edu.mt**

Position in org. Associate Professor

Department Faculty for the Built Environment, University of Malta

☐ Same as organisation name

☐ Same as proposing organisation's address

Street Tal-Qroqq Msida Campus

Town Msida Malta

Post code MSD2080

Country Malta

Website https://www.um.edu.mt/profile/rubenpborg

Phone +356 79055680

Phone 2 +356 2340 2872

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier
Prof	Ruben Paul	Borg	Man	Malta	ruben.p.borg@um.edu.mt	Category B Senior resea	Leading	0000-0002-5298-4609	Orcid ID

Role of participating organisation in the project

Project management	☒
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☒
Co-definition of research and market needs	☒
Civil society representative	☐
Policy maker or regulator, incl. standardisation body	☐
Research performer	☒
Technology developer	☒
Testing/validation of approaches and ideas	☒
Prototyping and demonstration	☒
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☐
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Publication	*Ruben Paul Borg, Estefanía Cuenca, Enrico Maria Gastaldo, Liberato Ferrara, 2017, Crack sealing capacity in chloride-rich environments of mortars containing different cement substitutes and crystalline admixtures, Journal of Sustainable Cement Based Materials, Taylor and Francis, Volume 7, Issue 3, Published online: 07 Dec 2017, DOI: 10.1080/21650373.2017.1411297.*
Publication	*Christine Farrugia, Ruben Paul Borg, Liberato Ferrara, Joseph Buhagiar, 2019, Application of Lynsinibacillus sphaericus for Surface Treatment and Crack Healing in mortar, Frontiers in Built Environment Journal, 5:62, April 2019, doi: 10.3389/fbuil.2019.00062*
Publication	*Hodul, J.; Žižková, N.; Borg, R.P., 2020, The Influence of Crystalline Admixtures on the Properties and Microstructure of Mortar-Containing By-Products. Buildings International Journal, 2020, 10, 146. doi.org/10.3390/buildings10090146*
Publication	*Ruben P. Borg, Estefania Cuenca, Roberto Garofalo, Fabrizio Schillani, Milena L. Nasner and Liberato Ferrara, 2021, "Performance assessment of Ultra High Durability Concrete produced from Recycled Ultra High Durability Concrete", Frontiers in Built Environment, doi: 10.3389/ fbuil.2021.648220*
Publication	*J Hodul, J Hodná, L Mészárosová, RP Borg, 2022, Experimental Comparison of Efficiency of Water-Soluble and Solvent Hydrophobic Agents for Concrete, Buildings Journal, 12 (11), 1857*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
ReSHEALience HORIZON 2020 Project	*Grant agreement ID: 760824: ReSHEALience development of Ultra High Durability Concrete (UHDC) and a Durability Assessment-based Design (DAD) methodology for structures, to improve durability and predict their long-term performance under Extremely Aggressive Exposures.*
CESBA Med INTERREG Med Project	*Urban and Building Sustainability Assessment Methods. Deveopemtn of Assessment tools and their application for a Euro - Med assessment method.*
BEACON Built Env leArning for Climate adaptation	*Climate adaptation - Identifification of skill gaps and the development of learnign tools for climate adaptation in the built environment.*
Re_CON Recycled Concrete	*Development of low-impact Geopolymer concrete and alkali activated concrete based on industrial byproducts and waste recycled material.*
SARCOS Project	*Self Healing as Preventive Repair of Concrete Structures (COST Project). Self healing concrete methodologies and assessment of materials. Round robin testing for self healing materials.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
Materials & Civil Engineering Lab University Malta	*Materials in Civl Engineering Laboratory, material characterisation, durability of concrete, self heaing, structural engineering.*
Water Tower Research Station Materials and SCH	*Research Station based on a 1930 water tower restored using advanced techniques and strengthening using UHPC and TRC, sensor network system for structural health monitoring, durability monitorign and environmental monitoring .research station.*

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? (•) Yes ( ) No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

Administrative forms

PIC	Legal name
933116042	*NETHOOD*

Short name: NETHOOD

Address

Street	LIMMATSTRASSE 209
Town	ZURICH
Postcode	8005
Country	Switzerland
Webpage	http://nethood.org

Specific Legal Statuses

Legal person	yes
Public body	no
Non-profit	yes
International organisation	no
Secondary or Higher education establishment	no
Research organisation	no

SME Data

Based on the below details from the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

SME self-declared status	27/01/2015 - no
SME self-assessment	unknown
SME validation	unknown

Departments carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Researchers involved in the proposal

Title	First Name	Last Name	Gender	Nationality	E-mail	Career Stage	Role of researcher (in the project)	Reference Identifier	Type of identifier

Role of participating organisation in the project

Project management	☐
Communication, dissemination and engagement	☒
Provision of research and technology infrastructure	☐
Co-definition of research and market needs	☐
Civil society representative	☒
Policy maker or regulator, incl. standardisation body	☐
Research performer	☐
Technology developer	☐
Testing/validation of approaches and ideas	☐
Prototyping and demonstration	☐
IPR management incl. technology transfer	☐
Public procurer of results	☐
Private buyer of results	☐
Finance provider (public or private)	☐
Education and training	☒
Contributions from the social sciences or/and the humanities	☒
Other If yes, please specify: (Maximum number of characters allowed: 50)	☐

List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.

Type of achievement	Short description (Max 500 characters)
Other achievement	*The L200 space in Zurich, https://nethood.org/l200, was co-founded by NetHood as the outcome of 3 years of transdisciplinary research in two complementary EU Horizon 2020 projects MAZI and netCommons, with both scientific impact through publications in the Journal of Peer Production and the magazine Derive, and also social impact with the L200 association counting more than 130 members and numerous activities, after 5 years of continuous operation.*
Publication	*Antoniadis, P. (2019). The organic Internet as a resilient practice. In Trogal et al. (eds), Architecture and Resilience: Interdisciplinary Dialogues. New York: Routledge. https://library.oapen.org/handle/20.500.12657/27508.*
Other achievement	*Exhibition - NetHood produced the netCommons' methodological guide for participatory design processes for empowering communities with technology, featured at the exhibition OPEN SCORES, panke.gallery, Berlin, 2019. https://monoskop.org/log/?p=22321*
Other achievement	*Panayotis Antoniadis, Toward a Federation of Hybrid Spaces, presented in the New Public Festival's All-Star World Cafe. https://newpublic.org/festival/event/783/all-star-world-cafe-what-if-the-future-of-our-public-lives-online-looked-like, among world experts from Stanford University, MIT, GitHub, Guild for Future Architects, and more.*
Publication	*Antoniadis, P. & Pantazis, A. (2021). P2P learning. In: M. O'Neil, C. Pentzold & S. Toupin (Eds.), The Handbook of Peer Production (pp. 197-210). Malden, MA: Wiley-Blackwell.*

List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal.

Name of Project or Activity	Short description (Max 500 characters)
EuComMeet – DG CONNECT, Horizon2020, 2021-2024	*EuComMeet follows a Multi-stage, Multi-Level, Multi-Mode, Multi-Lingual and Dynamic Deliberative approach conceived as a flexible, interactive, easy-to-use and scalable up model for deliberative processes, integrated with innovative technology related to automated moderation and automated translation in multiple languages to be implemented in 5 EU countries. NetHood joined the project in February 2022 to develop the hybrid deliberation platform based on jit.si and nextcloud open source tools, at*
C4R – Cultures for Resilience - Creative Europe	*C4R aims to strengthen the action of a wide range of actors (citizens, professionals of the creative and cultural sector, public administrations, local associations) working on environmental and urban resilience issues. NetHood develops a federated web platform as a sustainable and resilient way to collective produce and filter content online, at TRL6. See https://nethood.org/rsf/*
CROCHET - Strengthening Croation-Swiss Partnership	*CROCHET was a knowledge exchange programme between Switzerland and Croatia (2019-2020) on the topics of cooperative housing, community centers, and municipal services. NetHood organized two research visits in Zurich around these topics summarized in two comprehensive reports.*
MAZI - DG CONNECT, Horizon2020 CAPS framework, 201	*MAZI developed a DIY networking toolkit for enabling citizens to easily install and customize local wireless networks according to their own needs. NetHood led the Interdisciplinarity workpackage and the Zurich pilot in the Kraftwerk1 cooperative housing and living project*
NetCommons - DG CONNECT, Horizon2020 CAPS framewor	*netCommons promoted and supported Community Networks as a sustainable and empowering paradigm for building networking infrastructures as a commons. NetHood led of the dissemination workpackage and the tasks on participatory design of local applications and community currencies. It played a key role in the development of a novel participatory design and education process for the case of the Sarantaporo.gr Community Network.*

Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work.

Name of infrastructure of equipment	Short description (Max 300 characters)
	NetHood is a member of the Kraftwerk1 cooperative and has access to its shared facilities like the rooftop community space, Dachraum. NetHood plays a leading role in the management of the L200 association (President and Vice-President positions) and the corresponding space at Langstrasse 200
	in Zurich, http://langstrasse200.ch, one of the most vibrant neighbourhoods of the city, District 5. L200 can be used as a venue for events of different size (up to 60 people); as a place for networking between a wide variety of projects
	and initiatives on sustainability, ecology, housing, facilitation, digital sovereignty, and more; as an info point for the public; as an exhibition space; as a permanent display through its street windows. NetHood members are also in the managing board of the Stadtufer cooperative, https://stadtufer

Gender Equality Plan

Does the organization have a Gender Equality Plan (GEP) covering the elements listed below? ○ Yes ◉ No

Minimum process-related requirements (building blocks) for a GEP

- **Publication:** formal document published on the institution's website and signed by the top management
- **Dedicated resources:** commitment of human resources and gender expertise to implement it.
- **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators.
- **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.
- **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:
    - work-life balance and organisational culture;
    - gender balance in leadership and decision-making;
    - gender equality in recruitment and career progression;
    - integration of the gender dimension into research and teaching content;
    - measures against gender-based violence including sexual harassment.

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3 - Budget

No.	Name of beneficiary	Country	Role	Personnel costs/€	Subcontracting costs/€	Purchase costs - Travel and substistence /€	Purchase costs - Equipment/€	Purchase costs - Other goods, works and services/€	Internally invoiced goods and services/€ (Unit costs-usual accounting practices)	Indirect costs/€	Total eligible costs	Funding rate	Maximum EU contribution to eligible costs	Requested EU contribution to eligible costs/€	Max grant amount	Income generated by the action	Financial contributions	Own resources	Total estimated income
1	National Center For Scientific	EL	Coordinator	408 500	0	15 000	23 000	15 000	0	115 375.00	576 875.00	100	576 875.00	576 875.00	576 875.00	0.00	0.00	0.00	576 875.00
2	Up2metric Idiotiki Kefalaiouchiki	EL	Partner	229 500	0	15 000	8 000	4 000	0	64 125.00	320 625.00	100	320 625.00	320 625.00	320 625.00	0.00	0.00	0.00	320 625.00
3	Elias Messinas	IL	Partner	164 500	0	10 000	5 000	8 000	0	46 875.00	234 375.00	100	234 375.00	234 375.00	234 375.00	0.00	0.00	0.00	234 375.00
4	Rimond Engineering Procurement	IT	Partner	247 500	0	15 000	5 000	0	0	66 875.00	334 375.00	100	334 375.00	334 375.00	334 375.00	0.00	0.00	0.00	334 375.00
5	Politecnico Di Milano	IT	Partner	220 000	0	15 000	0	16 000	0	62 750.00	313 750.00	100	313 750.00	313 750.00	313 750.00	0.00	0.00	0.00	313 750.00
6	Universidad De Navarra	ES	Partner	220 000	0	15 000	0	4 000	0	59 750.00	298 750.00	100	298 750.00	298 750.00	298 750.00	0.00	0.00	0.00	298 750.00
7	Ethniko Kentro Erevnas Kai Technologikis	EL	Partner	225 000	0	15 000	3 000	10 000	0	63 250.00	316 250.00	100	316 250.00	316 250.00	316 250.00	0.00	0.00	0.00	316 250.00
8	Titan Cement Company Ae	EL	Partner	214 500	0	15 000	0	10 000	0	59 875.00	299 375.00	100	299 375.00	299 375.00	299 375.00	0.00	0.00	0.00	299 375.00
9	Ben-gurion University Of The Negev	IL	Partner	175 500	0	10 000	0	4 000	0	47 375.00	236 875.00	100	236 875.00	236 875.00	236 875.00	0.00	0.00	0.00	236 875.00

10	Nurogames Gmbh	DE	Partner	222 720	0	15 000	0	4 000	0	60 430.00	302 150.00	100	302 150.00	302 150.00	302 150.00	0.00	0.00	0.00	302 150.00
11	Acciona Construccion Sa	ES	Partner	234 000	0	10 000	0	11 000	0	63 750.00	318 750.00	100	318 750.00	318 750.00	318 750.00	0.00	0.00	0.00	318 750.00
12	Hellenic Ministry Of Culture	EL	Partner	69 000	0	6 000	0	4 000	0	19 750.00	98 750.00	100	98 750.00	98 750.00	98 750.00	0.00	0.00	0.00	98 750.00
13	Linkopings Universitet	SE	Partner	228 000	50 000	10 000	0	4 000	0	60 500.00	352 500.00	100	352 500.00	352 500.00	352 500.00	0.00	0.00	0.00	352 500.00
14	Museum+	CZ	Partner	67 600	0	10 000	0	0	0	19 400.00	97 000.00	100	97 000.00	97 000.00	97 000.00	0.00	0.00	0.00	97 000.00
15	The University Of Sheffield	UK	Partner	201 000	0	10 000	4 500	9 500	0	56 250.00	281 250.00	100	281 250.00	281 250.00	281 250.00	0.00	0.00	0.00	281 250.00
16	University College London	UK	Partner	252 000	75 000	15 000	0	21 000	0	72 000.00	435 000.00	100	435 000.00	435 000.00	435 000.00	0.00	0.00	0.00	435 000.00
17	Universita Ta Malta	MT	Partner	126 500	0	10 000	0	7 500	0	36 000.00	180 000.00	100	180 000.00	180 000.00	180 000.00	0.00	0.00	0.00	180 000.00
18	Nethood	CH	Associated	0	0	0	0	0	0	0.00	0.00	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			TOTAL	3 505 820	125 000	211 000	48 500	132 000	0	974 330.00	4 996 650.00		4 996 650.00	4 996 650.00	4 996 650.00	0.00	0.00	0.00	4 996 650.00

4 - Ethics & security

Ethics Issues Table

1. Human Embryonic Stem Cells and Human Embryos			Page
Does this activity involve Human Embryonic Stem Cells (hESCs)?	○ Yes	◉ No	
Does this activity involve the use of human embryos?	○ Yes	◉ No	
2. Humans			**Page**
Does this activity involve human participants?	○ Yes	◉ No	
Does this activity involve interventions (physical also including imaging technology, behavioural treatments, etc.) on the study participants?	○ Yes	◉ No	
Does this activity involve conducting a clinical study as defined by the Clinical Trial Regulation (EU 536/2014)? (using pharmaceuticals, biologicals, radiopharmaceuticals, or advanced therapy medicinal products)	○ Yes	◉ No	
3. Human Cells / Tissues (not covered by section 1)			**Page**
Does this activity involve the use of human cells or tissues?	○ Yes	◉ No	
4. Personal Data			**Page**
Does this activity involve processing of personal data?	○ Yes	◉ No	
Does this activity involve further processing of previously collected personal data (including use of preexisting data sets or sources, merging existing data sets)?	○ Yes	◉ No	
Is it planned to export personal data from the EU to non-EU countries? Specify the type of personal data and countries involved	○ Yes	◉ No	
Is it planned to import personal data from non-EU countries into the EU or from a non-EU country to another non-EU country? Specify the type of personal data and countries involved	○ Yes	◉ No	
Does this activity involve the processing of personal data related to criminal convictions or offences?	○ Yes	◉ No	
5. Animals			**Page**
Does this activity involve animals?	○ Yes	◉ No	
6. Non-EU Countries			**Page**
Will some of the activities be carried out in non-EU countries?	○ Yes	◉ No	
In case non-EU countries are involved, do the activities undertaken in these countries raise potential ethics issues?	○ Yes	◉ No	
It is planned to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)?	○ Yes	◉ No	
Is it planned to import any material (other than data) from non-EU countries into the EU or from a non-EU country to another non-EU country? For data imports, see section 4.	○ Yes	◉ No	
Is it planned to export any material (other than data) from the EU to non-EU countries? For data exports, see section 4.	○ Yes	◉ No	
Does this activity involve low and/or lower middle income countries, (if yes, detail the benefit-sharing actions planned in the self-assessment)	○ Yes	◉ No	
Could the situation in the country put the individuals taking part in the activity at risk?	○ Yes	◉ No	
7. Environment, Health and Safety			**Page**

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Does this activity involve the use of substances or processes that may cause harm to the environment, to animals or plants.(during the implementation of the activity or further to the use of the results, as a possible impact) ?	○ Yes	◉ No	
Does this activity deal with endangered fauna and/or flora / protected areas?	○ Yes	◉ No	
Does this activity involve the use of substances or processes that may cause harm to humans, including those performing the activity.(during the implementation of the activity or further to the use of the results, as a possible impact) ?	○ Yes	◉ No	

8. Artificial Intelligence			Page
Does this activity involve the development, deployment and/or use of Artificial Intelligence? (if yes, detail in the self-assessment whether that could raise ethical concerns related to human rights and values and detail how this will be addressed).	◉ Yes	○ No	7

9. Other Ethics Issues			Page
Are there any other ethics issues that should be taken into consideration?	○ Yes	◉ No	

I confirm that I have taken into account all ethics issues above and that, if any ethics issues apply, I will complete the ethics self-assessment as described in the guidelines How to Complete your Ethics Self-Assessment ☒

Ethics Self-Assessment

Ethical dimension of the objectives, methodology and likely impact

The following two objectives are related to the use of AI algorithms:
Objective #2. The platform will be structured as a hub to host continuous monitoring tools for the performance of the building envelope in association with HBIM and DT, for providing feedback on: e.g. the maintenance needs of passive cooling paints and membranes (cleaning needs or hydrophobicity reduction alerts) and predict replacement requirements (reduced performance). This will be the specific work of evolution of the common digital twin environment towards a specific H-Twin environment, tailored around the notion of time-based evolution of object status and segmentation, to take into account the specificity of historical fabric materiality.
Objective #6. Design choices at a material level have a direct and coupled impact on the mechanical, thermal and mass transfer properties of the resulting structures. Hence holistic but practice-oriented design and analysis methods are needed to ensure carbon savings are achieved throughout the whole life cycle of a structure.
In the light of this, SINCERE aims to build on state-of-the-art multiscale and multiphysics modelling and design methods by (i) combining new experimental evidence with advanced physics-based modelling tools, developing high fidelity models and thus gaining a deep understanding of the relationship between mix composition, individual properties of the constituents and resulting thermal-hygral-mechanical performance of the materials (ii) combining the experimentally validated high fidelity models with machine learning algorithms to enable fast and reliable parameter identification and material design.
The experts and users of SINCERE will be notified that they are using an AI-assisted system upon registering to the SINCERE platform. The general public will be notified that the climatic hazards are forecasted based on an AI system upon using the application.
The consortium partners that are responsible will apply trustworthy AI methodologies (fairness, accountability, transparency), not only to obtain quality results and monitor the path to these results, but also to help the not ICT experts and the general public to understand how results are created by AI. This approach, on the one hand, will provide the researchers clear, informed and human-understandable answers to foresee if a solution is wrong, while, on the other hand, will help the non-experts understand how AI works in the SINCERE project.
Moreover, the platform and the data collected will be hosted in EU and it will be cyber-secured, under the supervision of NCSRD in collaboration with POLIMI and U2M. Environmental data collected on site will be logged in a secure way, although they are not sensitive data. The xR tools (it does not use any AI algorithms) will be secure and no data will be collected, but the users will be notified that the results they are seeing are from an ICT platform that exploits AI algorithms.
Finally, a detailed data management plan will be developed and considered for the implementation of the project.

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Compliance with ethical principles and relevant legislations

The use of AI is mainly used as a support tool and not as a substitute of human decision, in order to better estimate the climate changes and forecast environmental and physical hazards. Any failure in the algorithms, although difficult as the Platform has foreseen to exploit multiple approaches and methodologies to answer key questions, will have minimum effect on society and environment. Also, the use of the Platform and the provided results will be reviewed by humans at the end of the process. Hence, a wrong estimation of hazards will be an issue for society, but since this estimation is not real-time and applies to long term mitigation actions, its impact is minimum and many layers of decision-making processes exist before any wrong results affect the society.

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Administrative forms

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Security issues table

1. EU Classified Information (EUCI)[2]			Page
Does this activity involve information and/or materials requiring protection against unauthorised disclosure (EUCI)?	○ Yes	◉ No	
Does this activity involve non-EU countries which need to have access to EUCI?	○ Yes	◉ No	
2. Misuse			**Page**
Does this activity have the potential for misuse of results?	○ Yes	◉ No	
3. Other Security Issues			**Page**
Does this activity involve information and/or materials subject to national security restrictions? If yes, please specify: (Maximum number of characters allowed: 1000)	○ Yes	◉ No	
Are there any other security issues that should be taken into consideration? If yes, please specify: (Maximum number of characters allowed: 1000)	○ Yes	◉ No	

Security self-assessment

Please specify: (Maximum number of characters allowed: 5000)

Remaining characters 5000

[2]According to the Commission Decision (EU, Euratom) 2015/444 of 13 March 2015 on the security rules for protecting EU classified information, "European Union classified information (EUCI) means any information or material designated by an EU security classification, the unauthorised disclosure of which could cause varying degrees of prejudice to the interests of the European Union or of one or more of the Member States".

[3]Classified background information is information that is already classified by a country and/or international organisation and/or the EU and is going to be used by the project. In this case, the project must have in advance the authorisation from the originator of the classified information, which is the entity (EU institution, EU Member State, third state or international organisation) under whose authority the classified information has been generated.

[4]EU classified foreground information is information (documents/deliverables/materials) planned to be generated by the project and that needs to be protected from unauthorised disclosure. The originator of the EUCI generated by the project is the European Commission.

5 - Other questions

THE SECOND LIFE OF MODERN PERIOD ARCHITECTURE: RESILIENT AND ADAPTIVE RENOVATION TOWARDS NET-ZERO CARBON HERITAGE BUILDINGS - SINCERE

List of participants

Participant No.	Participant organisation name	Short Name	Type*	Country
1 - Coordinator	National Centre for Scientific Research "Demokritos"	NCSRD	RTO	GR
2	up2metric P.C.	U2M	SME	GR
3	ECOAMA	ECO	SME	IL
4	RIMOND	RIMOND	IND	IT
5	Politecnico di Milano	POLIMI	HEI	IT
6	University of Navarra	UNAV	HEI	ES
7	Centre for Research and Technology Hellas	CERTH	RTO	GR
8	TITAN S.A.	TITAN	IND	GR
9	Ben Gurion University	BGU	HEI	IL
10	NUROGAMES	NURO	SME	DE
11	ACCIONA Construcción S.A.	ACCIONA	IND	ES
12	Hellenic Ministry of Culture	HMC	GOV	GR
13	LINKOPINGS UNIVERSITET	LU	HEI	SE
14	MUSEUM+	MP	NPO	CZ
15	University of Sheffield (Assoc. Country)	USH	HEI	UK
16	University College London (Assoc. Country)	UCL	HEI	UK
17	University of Malta	UM	HEI	MT
18	NetHood (Assoc. Partner)	NH	NPO	CH

* HEI: Higher Education Institution, RTO: Research & Techn. Organisation, SME: Small/Medium Enterprise, NPO: Non-Profit Organization

1 Excellence

Rationale and Relation to the work programme

According to UNESCO, cultural heritage (CH) is "our legacy from the past, what we live with today, and what we pass on to future generations". Built Heritage is indisputably of unique cultural, social, environmental, and economic value. Its existence in the modern world preserves the history and culture of each nation and offers great potential to drive climate action and contribute to a climate resilient future (EU – "Green Deal"). As a matter of fact, climate change (CC) is a reality around the world and its extent and speed of change is becoming ever more evident, causing a wide range of environmental, societal, and economic impacts. Aiming to meet the goal of passing CH to the next generations, it is essential to explore and develop tools, materials, and technologies for protecting from CC risks and enabling Built Heritage to contribute to the achievement of the Sustainable Development Goals (SDGs) as described by UN in the "2030 Agenda for Sustainable Development". The resilient and adaptive renovation of 19th and 20th century buildings provides a second life to those buildings. Hence, renovation and rehabilitation avoid unnecessary greenhouse gas (GHG) emissions, preserves the heritage capital of EU, and promotes the sustainable development of cities, including economic growth, social wellbeing, and environmental preservation, in line with circular economy rules.

1.1 Objectives and ambition

SINCERE targets to elucidate the values of Built Cultural Heritage and provide the tools for optimising the carbon footprint and energy performance of historic buildings, towards the requirements of net-zero-carbon-buildings, by utilising innovative, sustainable, and cost-effective restoration materials and practices, energy harvesting technologies, ICT tools and socially innovative approaches.

SINCERE adapts a multi-scale concept, from material-, to building-, to neighbourhood- to city-scale, applied on the three main parts of a building, i.e., structure, external envelope (opaque), and transparent parts implemented at different time-frames in order to provide decision making tools to the different stakeholders involved in the process, considering the full-service life of the buildings, including restoration, operation, monitoring and maintenance phases (Figure 1). Energy performance parameters in terms of retrofitting materials and solutions will be optimised according to the buildings' unique structural, architectural, functional and materials characteristics, their environmental setup (climate zones), as well as local future climate change scenarios. SINCERE will provide a palette portfolio of sustainable restoration options that will be evaluated by Building Information Modelling and Digital Twin for historical buildings (H-BIM and H-DT) tools, in order to enable the selection of optimum solutions and the planning of necessary adaptation actions. SINCERE will also focus on raising awareness and empowering Europeans to promote the concept of preservation of CH buildings by communicating and disseminating the obtained scientific

results through cultural activities at national and international level.

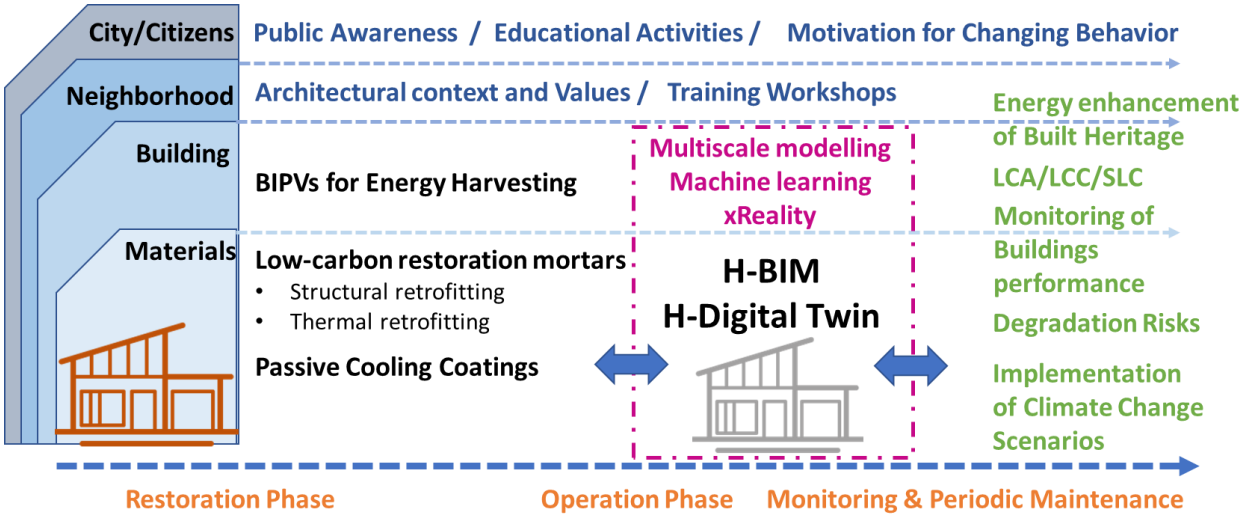


Figure 1. Different scales and actions towards net-zero energy buildings.

1.1.1 Specific Objectives

The SINCERE project focuses on seven research, technological, and societal objectives (OBJ) which are translated to the project key Results (R).

OBJ-01: Transform CH buildings to a key actor and main stage for **raising stakeholders' and citizens' awareness on renovation/reuse concept**, as a circular economy element to tackle climate change.

R1.1 Communication actions: Raise society's awareness on the importance of preserving cultural heritage as an essential factor of local identity and national cohesion, and sustainability – "Building as a stage".

R1.2 Engagement actions: Development and maintenance of an international Ecosystem of researchers, stakeholders, and citizens, to build, share and activate knowledge for preserving CH sites from CC. This ecosystem will be hosted on the federated "Building Stories" platform – "Building as a boundary object".

R1.3 Co-identification of local needs and pressures with key local stakeholders and actors, and fostering of collaboration among stakeholders, local communities, and decision-makers, through a collective creative process of giving a voice to iconic cultural heritage sites, to advocate for urgently needed actions on climate change across the CH demos.

R1.5 Empowerment actions: Citizen Science activities of co-created type to support a better understanding of the importance of science undertaken on climate change and cultural heritage by the general audience. SINCERE will develop a community to empower citizens, engage them indirectly in policy making and work towards attitude changes to improve the environment. – "Building as a laboratory".

KPIs: Reach out to at least 100000 people and organizations. 1 *Open Day Demonstration Workshops* per Pilot site, 3 training schools with onsite applications, at least 1000 professionals of different skills levels. 1 final SINCERE Conference. 1 *Professional Guide for CH Buildings.*

OBJ-02: Development of a **smart interoperable platform** integrating **H-BIM / H-DT** and **immersive XR technologies** to provide the digital tools for sustainable renovation and retrofitting of CH buildings.

R2.1 A **historical time-based 7D Digital Twin** (i.e., including the space, time-dependencies, cost analysis, sustainability and energy consumption, facility management dimensions) for real-time monitoring and interaction with CH buildings defined as "H-DT". This holds at its core the idea of managing flexibility in object segmentation, particularly focused on masonry, concrete, and mortar/plaster finishing with their degradation patterns. The H-DT will allow degradation and maintenance processes of every building component to be virtually modelled, by pairing it with sensory and visual mapping. It will also allow a holistic treatment of CH buildings through their lifecycle phases, i.e., renovation/ rehabilitation, operation, maintenance. A **Digital Twin Planner** will incorporate updated state-of-the-art models currently used in the industry to aggregate data and execute **different degradation and CC scenarios** to support **preventive maintenance** of CH buildings by strengthening the relationships between the digital model and the real world.

R2.2 A unified access point and **online management platform for all CH building's digital information** (including a dashboard and a secure data warehouse).

R2.3 A **virtual reality application** which will allow inspection and interaction with the H-DT and the SINCERE platform information in an immersive virtual environment, which enhances the situation awareness of the user and gives an improved perspective of the current situation and potential building interventions, or future predicted situations based on the H-DT models.

R2.4 An **augmented reality interface** to enhance stakeholders' in situ situational awareness, provide advanced human-machine interaction to the digital CH building and offer spatial computing capabilities to the experts to renovate, operate, and maintain it. It will overlay digital information from H-DT, such as alternative CC impacts scenarios and H-DT information, platform assessments, and historical/lifecycle information, on the real world.

R2.5 **Continuous monitoring and evaluation** of (i) energy performance of buildings and (ii) degradation risks, based on the real-time environmental data for indoors and outdoors conditions as well as on the actual performance data for restoration materials (mechanical, physical, and chemical properties).

R2.6 **Development of future response scenarios of all demo-sites**, based on meso- and macro-scale modelling, according to different shared socioeconomic pathways (SSP) scenarios and associated CC models. This multi scalability aspect is a key in BIM evolution, by allowing to nest detail levels in a hosting lightweight structure.

R2.7 **Open Building Information Modelling for historical buildings (H-BIM)**. The H-DT will be paired with authored models through the interface of Open BIM format in Industry Foundation Classes (IFC), by analysing the specific semantic assignments of historical surfaces in the Object-Oriented file structure of the interchange format. Links in that sense will be established between the SINCERE project and the related working groups of Building Smart Association, and with the Italian chapter in particular (iBIMi institute).

KPIs: H-BIM accuracy 1cm >90% of real measurements, platform (user dashboard and authoring tool) evaluation by > 50 stakeholders, H-DT integrated platform in 2 versions (M18, M28), H-DT in 4 Pilot sites, H-DT availability >99%, scalability: capable to handle at least 10x increase in data and complexity, predictive capability: <10% margin of error, XR applications evaluators >50; > 50% reduction in construction errors during renovation.

OBJ-03: Reduction of environmental impact during restoration and maintenance, by developing low-energy and low-carbon restoration **mortars**, with enhanced compatibility and service life.

R3.1 **Novel low-carbon hybrid binders**, such as sulfoaluminate-belite-rich cements (SABC), lime-calcined clay cements (LC3), and pozzolan-rich cements (PRC).

R3.2 Implementation of low-carbon hybrid binders for developing advanced **repair mortars for structural strengthening and thermal retrofitting** of historic buildings.

R3.3 **Techno-economic evaluation** of the above novel low-carbon hybrid binders, based on compatibility and performance parameters (reactivity, microstructure, strength development, durability), along with CO_2 equivalent and production cost.

KPIs: up to 30% reduced of embodied CO_2 in mortars; up to15% reduction of production temperature for cements, 3 types of novel binders for structural strengthening and thermal retrofitting mortars; 2 technologies for structural strengthening; 2 types of mortars for thermal retrofitting.

OBJ-04: Reduction of energy demands during operation of the restored CH buildings due to enhancement of building thermal performance and enhancement of the service life of repair mortars and of heritage building.

R4.1 Enable **passive cooling** with **environmentally friendly** (fluorine-free) polymer-based (polyurethane and polysiloxane) radiative cooling **coatings and membranes** for the roof-top of CH concrete buildings, as well as with hybrid materials, incorporating encapsulated PCMs in radiative cooling coatings and membranes, as a mitigation action against over-cooling.

R4.2 **Enhanced durability** of low-carbon **repair mortars** for structural strengthening, exhibiting **self-healing** properties and **rebar protection** against corrosion.

R4.3 **Enhanced thermal performance of historic buildings**, due to the use of low-carbon external renders and internal plasters, incorporating micro-encapsulated bio-based **phase-change materials** (PCMs) and **natural fibres and bio-aggregates** (Hempcrete).

KPIs: 3 technologies for thermal retrofitting of historic buildings; >30% reduction of energy demands for cooling during building operation; service life of paints/coatings > 3 years; reduction of materials surface temperature >15 °C for paints/coatings in the summer; reduction of heat transfer > 35% for plasters; 30% reduction in the volume of used material and > 40% enhancement of the life span of the repair.

OBJ-05: Enabling **solar energy harvesting** during building operation, with **green**, **low-cost**, large area fully **sustainable building integrated photovoltaics** (BIPVs.

R5.1 Development of **fully sustainable and recyclable, low-cost, flexible and easily embedded into buildings**, high efficiency **perovskite-based solar cell** and modules, able to be produced and used in (cover) large areas, able to be incorporated in building materials (BIPVs) such as glass windows, tiles and facades.

R5.2 **Replacement of the commonly applied glass substrates** coated with the highly expensive indium tin oxide (ITO), by sustainable, low-cost ultra-transparent **cellulose.**

R.5.3 **Fabrication of low-cost,** solution-processed high efficiency and **stable perovskite solar cells** by engineering appropriate perovskite absorbers and charge transport layers.

R5.4 **Incorporation of the proposed photovoltaics (PVs) in ceramic tiles, cement plasters and glass windows**, without requiring specially designed framework and equipment for the incorporation on the building envelope,

due to facile solution processing of perovskite and cellulose technologies.

KPIs: Energy harvesting efficiency> 20%; net zero total carbon emissions for the fabrication of BIPVs; incorporation of the proposed PVs in 3 types of building materials/elements (glass windows, ceramic tiles, cement plasters); transparency > 50% with efficiency >15%; service life > 15 years.

OBJ-06: Understanding the **multi-scale** and **multi-physics behaviour** of high-performance **repair mortars** and **developing fast-running numerical design tools** to achieve whole-life carbon savings.

R6.1 A transformed understanding of, and ability to **model**, **the coupled effects** of the key constituents used in the developed materials (mortars and coatings) on the resulting **mechanical, energy and durability performance**.

R6.2 A **fast-running, holistic** design **methodology** that will enable the **mix composition** of repair mortars to be **optimised** to achieve a required material performance, while minimising the whole-life carbon emissions associated with a given repair intervention.

R6.3 Integration a modelling methodology into the interdisciplinary life cycle assessment (LCA)-, life cycle cost assessment (LCC)- and **H-DT-frameworks** developed within this project to achieve informed **sustainability-driven asset management** choices.

KPIs: Embodied carbon saving of > 20 % relative to conventional mix design methods. Life-cycle carbon saving of>40 % relative to conventional design methodologies.

OBJ-07: Validation of SINCERE technologies at **4 demonstration sites - Pilots**, in Spain, Greece, Israel and Czech Republic, and assessment of **societal, economic, and scientific impact**.

R7.1 A usage scenario for each Pilot and a solid plan for **validation, demonstration** and assessing project **impact.**

R7.2 Workshops at pilot sites, **Open Labs**, and **Open Day Demonstrations**, which will evaluate several multiple usage scenarios engaging different target groups.

R7.3 Data and models of CC and its **effects on the Pilot sites** for different scenarios from single buildings to neighbourhoods across different geographic and climatic zones.

R7.4 Optimisation of digital, material, and energy harvesting solutions for CH buildings preservation.

KPIs: Multiple *Demonstration Workshops* (initially for selected experts and then *Open Days* in M22, M28, M36) > 5; 3 Heritage Buildings in extended reality (M33); Engaged participants per Pilot > 40; 50% improvement on all LCA indicators for retrofitting materials; 20% reduced LCC; Validation, demonstration and impact assessment work plan (M12, M22); Evaluation of the SINCERE platform and tools per Pilot site (D2.5 in M22, M36); Exploitation Plan and the Path to Market (M22, M36).

1.1.2 Ambition and Advances beyond the State-of-the-Art

Social awareness and preservation of built CH (TRL 3 to 5)

The EU program '100 Climate-neutral Cities by 2030 - by and for the Citizens' vision[1], puts forward a holistic approach to assist cities in implementing decarbonization strategies for energy, transport, buildings and even industry and agriculture. SINCERE aligns with the understanding that the climate emergency must be tackled within cities and by engaging citizens. In this respect, SINCERE aims to engage citizens and empower them both as a community/society and as individuals (OBJ-01). SINCERE recognises the important role that users play in the success of sustainable design and management of buildings to meet the zero-carbon targets. In the context of the ongoing Cultures for Resilience (C4R) project[2], Consortium partner NH has developed a novel federated web platform, which builds on the RSS (Really Simple Syndication) protocol, that allows the design of collaborative digital platforms, collected and filtered centrally through the RSS protocol and the use of appropriate tags. SINCERE will use and further develop this technology to create "Building Stories" platforms who will aggregate the content generated at the demo-sites, the individual blogs of CH buildings sharing their stories, and the knowledge generated through their renovation.

SINCERE is inspired by the "Cádiz Document *InnovaConcrete* Guidelines for the Conservation of Concrete Heritage"[3] with respect to its cultural, historical, aesthetic, social and technological values, providing a basis to conservation and restoration of CH concrete structures. Currently the planning, design and execution of restoration interventions of a (CH) reinforced concrete building is accomplished considering the realisation costs, and the need to provide a solution to the most urgent and serious degradation issues, while preserving the aesthetics and functionality; any holistic approach to the problem is scarcely implemented, especially when the connection with the durability of the intervention is considered. Not by chance, a survey performed in the framework of the EU-funded project CONREPNET[4] highlighted that 50% of the retrofitted concrete structures attained a "limit state" after the interventions, 25% of them after a mere 5 years' time span and 95% of them within 25 years, which is half of the

[1] https://data.europa.eu/doi/10.2777/347806
[2] https://c4r.info
[3] https://openarchive.icomos.org/id/eprint/2578
[4] https://doi.org/10.1057/palgrave.jba.2950063

target service life of most of the newly designed structures. SINCERE understands the importance of bringing CH concrete building upgrades up-to-date, with regard to heritage, maintenance and repair, while improving building performance and reducing energy use, and proposes a holistic approach to integrated retrofitting of concrete buildings, where the true multifunctional and time-extended assessed benefits of advanced materials and technologies can be authentically appreciated. Through this, and also as supported by the establishment of the New European Bauhaus (in whose 1st fair some of the SINCERE consortium partners already participated with project ReSHEALience H2020 GA760824) through active involvement of citizens and communities. SINCERE aims to a virtuous pathway, through which the built environment can contribute to create a less dependent and more resilient European economy, by guaranteeing raw material supplies, by ensuring higher materials durability, higher energy efficiency, higher degrees of materials recycling and reuse and by material-saving through optimised products by design with enhanced repair.

Structural and thermal retrofitting approach of built CH (TRL 3 to 5)

Retrofitting of existing concrete buildings in the majority of the cases tackles structural (e.g., seismic updating or upgrading) and energy performance issues separately, assigning them to the skeleton and the envelope/skin of the building respectively and then managing mutual interaction, as the result of separately performed actions. Materials for structural retrofitting are targeted primarily for their inborn mechanical characteristics, compatibility with the substrate and enhancement of the mechanical performance. Hardly any consideration has been given so far to their long-term durability, as well as to the possibility of integrating into them non-conventional functionalities, which would provide them, e.g., self-healing, enhanced durability, energy storage capacities that would enable the structural retrofitting to be conceived, designed and applied into a functionally graded context and the performance assessed within a set of adjustable time-spans (cradle-to-site/gate, to grave, to cradle). Similarly, the energy retrofitting is often, accomplished through additional skins (e.g., thermal overcoats, roof solar panels), which may affect the overall structural behaviour because of additional stiffness and dead-loads, leaving aside the end-of-life treatment of the employed materials and products, which has been scantily considered so far.

SINCERE will implement a metamaterial approach (OBJ-03, OBJ-04) to the concept and design of structural/energy retrofitting materials and products, where the composition can be formulated and the structural hierarchically designed (micro- to meso- to macro-), in order to achieve a desired set of performance at the level required by the intended engineering/architectural application/feat. This approach, already validated for mechanical and durability properties of advanced cementitious composites in the H2020 project ReSHEALience (POLIMI coordinator, BGU and UM members, with UM coordinating a pilot demonstration related to retrofitting of a CH water tower which was award-ed, among the others, the prestigious Energy Globe Award and was listed Grade 1 National Monument in 2022)[5], is exactly the opposite of the traditional approach summarised above. The integration into structural repair cementitious composites of functionalities, e.g., self-healing, corrosion inhibition of steel reinforcement, thermal insulation, will be pursued through the addition of suitable multi-scale constituents (AKEISTHAI project, NCSRD coordinator).

Further on, with a view to investigate and deeply understand the relationship between mechanical and chemo-physical properties of the constituents (including e.g., cement paste, aggregates, fibres and PCMs) and of the properties of the resulting composites, SINCERE will adopt a holistic, multi-disciplinary approach that will enable the development of computational tools for fast predictive design (OBJ-06) of tailored cementitious composites with minimum carbon footprint. Consequently, the results of the experimental characterization work performed within the project will be used together with data suitably sourced from the literature for the construction of databases, which will also serve to train and dynamically validate artificial intelligence (AI) tools (neural networks). These will feed the H-DT (OBJ-02) also with data fed from the evolution of the performance over time of the monitored pilots (OBJ-07) in the intended, and in climate change evolving scenarios (OBJ-02) for an evolutionary planning of maintenance operations. The aforesaid AI tools will also enable it to integrate into material design, as well as in the assessment of the maintenance phases, information about the embodied energy and carbon footprint.

Reduction of energy demand and solar energy harvesting in historic buildings (TRL 3 to 5)

Towards reducing energy demand in buildings during their operation, SINCERE will also consider green radiative cooling technology (OBJ-04), which holds excellent promise. However, loss of performance due to pollution, degradation from UV-radiation and chemicals, water penetration etc, can be truly challenging for the scientists. To overcome the above challenges, SINCERE will exploit EENSULATE EU project experience (GA 723868) and will draw inspiration from nature to generate technologies of multifunctional character, i.e., high heat emission, high solar reflectance, self-cleaning, durability and good adhesion. Efforts will be focused on polymer-based systems made by polyurethanes and polysiloxanes. Ultimately, the radiative cooling technologies derived in SINCERE will take the form of plastic membranes and coatings. Owed to their flexibility, light weight, and low cost, they will be easy to transport and apply on virtually any surface.

[5] https://www.um.edu.mt/newspoint/news/2022/06/the-water-tower-conservation-project-gets-two-prestigious-awards; https://www.um.edu.mt/newspoint/news/2023/01/water-tower-conservation-project-wins-international-award)

SINCERE opts on autonomous buildings with solar self-consumption using low-cost, lightweight, flexible, sustainable building integrated photovoltaics (BIPVs), designed for high-performance, ease of fabrication, use of abundant materials implemented at low temperature, which can practically be incorporated in any building component, such as glass windows and ceramic tiles, or even on curved surfaces (OBJ-05). This task will exploit initial integration results in Building materials derived by HELIOKERAMOS (MIS5066858). In terms of sustainability, this type of PVs allows the controlled disintegration at their end of life and facilitates the reduction of fast-growing waste streams on our planet. The semi-transparency of the perovskite BIPVs will attribute minimum alteration of building aesthetics, especially when incorporated in windows.

LCA/LCC in retrofitting of built CH (TRL 3 to 5)

Already codified in a series of international standards, life cycle assessment (LCA) and life cycle cost (LCC) are still regarded in the building and infrastructure construction fields, including retrofitting of cultural heritage mostly as a post-design assessment tool rather than as an integral part of the design process. Besides than comparing among two otherwise designed options the one with "optimal" environmental impacts and costs, LCA/LCC should inform the design and construction of the intended application, including retrofitting interventions, in their different stages of analysis (cradle-to-site/gate to grave-to-cradle), helping to steer the performance in the different stages of the service life towards the carbon-neutral goal and the most effective return on investment. An inborn weakness of the procedures consists, so far, in being based primarily on Environmental Product Declarations of materials and products, which are limited to a cradle-to-gate boundary. This is surely among the interests for the "first" stakeholders (client/buyer, contractor) of a construction/retrofitting work, but neglects the use stage and most of all does not address, the evolution of the building and structural performance over time, up to the end of the service life, including the recyclability of materials and products, for their "reinsertion" into the production cycle. Moreover, when social LCAs (SLCAs) are dealt with, good practices implemented by individual companies and communities, are often jeopardised by an assessment scheme, which assigns excessive weights to the overall country performance in terms of global behavioural indices. SINCERE will implement a unique approach to LCA/LCC (OBJ-06) exploiting the synergy with the results and outputs of previous projects in which the consortium partners have been involved, including ReSHEALience (GA 760824, POLIMI coordinator) and the MSCA_ITN SMARTINCs (GA 860006 - POLIMI deputy coordinator). In this approach a durability performance-based design becomes integral part of a cradle-to-grave and/or cradle-to-cradle LCA/LCC: the evolution of structural performance indicators, built by incorporating into structural design algorithms explicit durability indicators and scenario/time-evolving material properties, becomes a decision-making parameter for maintenance planning. Thus, the role of construction, use, maintenance and dismissal/recycling are clearly identified and help to conveying tailored information to the different involved stakeholders.

Digital Twins, and Multiscale and Multiphysics models for CH buildings (TRL 4 to 6)

Current research in DT for the Built CH is still in growing stage and there is a need to establish a convergent context for ongoing and future research. Two issues will be investigated to go beyond state-of-the-art perspective. The first is dynamic object segmentation. BIM must allow multiscalar object aggregation and sub-segmentation, in order to cover variability in continuous materiality typical of concrete, plaster and mortar surface. The second is the dynamic data on timing. This activity will develop a DT for CH building (i.e., a H-DT) that will follow a systematic method, which includes collecting data, creating a digital model, and simulating different scenarios. This process will start by collecting information about the building including architectural plans, physical characteristics, and historical context. Additionally, the DT will be integrated with IoT sensors for continuous monitoring and updating the model with real-time data, which can be utilized to simulate different conditions such as lighting, temperature, humidity and air quality. SINCERE will integrate real-time sensing data into an H-BIM (OBJ-02), multiplying the benefits of risk management and strategy planning tools for ongoing monitoring and maintenance planning of the building, and also will provide insights for cost-effective conservation and renovation efforts. The integration of H-BIM in a H-DT platform will enable visualisation and analysis of real-time environmental and material data, further allowing for multi-layer segmentation, specifically targeted to overcome the limitations of current BIM data structures in the field of CH. The resulting flexibility will be used for the development of a data display environment, based on surface mapping, that will use the "virtual body" of the monument to locate data in space and tag them to a BIM Object ID. SINCERE will built on previous knowledge created on V4DESIGN & MindSpaces (GA 825079 - CERTH coordinator). – OBJ-02

Extended Reality advanced human-machine interactions in a CH building's lifecycle (TRL 4 to 6)

Extended reality (XR) is a holistic approach that describes the advanced human-machine interactions (HMI) that include *Augmented Reality* (AR), *Virtual Reality* (VR), and lately Mixed Reality (MR) and plays an important role in recent research and industrial initiatives, such as the EU VR/AR Industrial Coalition, to make seamless HMI and enhance a user's *situation awareness* based on digital technologies. In particular, XR has been gradually and steadily

revolutionising and democratising architecture, engineering, and construction industry[6]. VR technology has enabled architects and engineers to create immersive 3D models of their designs, allowing them to present their ideas in a much more tangible and interactive way than ever before[7]. Achieving these requirements outdoors while providing seamless AR capabilities highlights significant technical and scientific issues in h/w and s/w regarding registration issues, locomotion, tracking, and scene meshing to name a few. These difficulties mainly relate to the accurate registration of 2D/3D content in an exact real-world position, without the use of the commonly used markers in indoor applications (marker-based AR). Furthermore, the sunlight, the inaccuracy of the global navigation satellite system (GNSS) and the 3D computer vision stereo-matching approaches, pose an overall challenge. Both AR and VR require extensive work on scribing protocols for information exchange between H-BIM, H-DT and XR applications to achieve seamless flow of data. In this framework, SINCERE envisions to develop an AR application that will be the tool to inspect all H-DT's information to the field and VR will constitute the access point for immersive understanding of the H-DT in the office. SINCERE will develop the XR continuum from in-situ (MR) to remote locations (VR) for CH buildings building upon the results of the XR4DRAMA project (GA 952133 – CERTH coordinator, NURO, U2M as XR technology partners). – OBJ-02

1.2 Overall Methodology

SINCERE will be implemented in four main pillars that will be demonstrated and validated in four demo-cases:

- Social awareness on 19th and 20th c. Built Heritage, technology perception, shared responsibility and adaptive reuse of historic buildings;
- Innovative and sustainable restoration and building materials for structural and thermal retrofitting;
- Innovative green materials and technological solutions for reduction of energy demand and energy harvesting;
- Transition from smart materials to smart buildings/cities through engagement of ICT/HBIM/BMS/DT technologies.

SINCERE workflow is structured into six WPs. WP1 is devoted to the project management and coordination, including administrative, financial, legal and data management aspects, while ensuring innovation, technical integrity, and quality of the project. WP2 encompasses the pilots that the multiple novel materials, methodologies, and digital tools will be implemented and evaluated. Within WP2 the architectural and historical context of the pilot-cases will be identified and then determine the restoration requirements of the buildings. Moreover, systematic monitoring and evaluation of the interventions will be conducted. WP3 is dedicated to the development of the software tools, services, and applications that will support the digitization of historical building throughout its lifecycle for sustainable renovation and retrofitting. The obtained results will be built upon ICT and the key-enabling technologies of MR and VR as well as H-DT and AI algorithms. Further, WP4 addresses the assessment of novel low-carbon binders and alternative reinforcements to produce advanced cementitious composites with enhanced sustainability features (e.g., self-healing and corrosion inhibition) to be used in CH retrofitting. Development, characterization, durability, and mechanical response will be tested at lab-scale, along with the recyclability of the cementitious composites, while performance optimization will be conducted via multiscale computational modelling. WP5 is devoted to the passive cooling and energy harvesting solutions that are compatible with the tradition of historic buildings. Development and lab-scale fabrication of radiative cooling materials will be followed by (larger-scale) prototype fabrication and testing. For solar energy harvesting, green, low-cost perovskite solar cells, able to be integrated in windows, facades and tiles will be developed and tested at lab-scale, along with the investigation of up-scaled fabrication. Lastly, WP6 includes the dissemination and public engagement activities to raise awareness of European citizens and create a new notion on preservation, renovation, and use of Built Heritage of the 19th and 20th century, to achieve multi-level impact and to set the first steps to commercial exploitation.

SINCERE research will be conducted with the Minimum valuable product (MVP) approach for all technologies, where the results from each development stage will be disseminated in the involved partners in order to provide feedback and accelerate the development process in a circular progressive way in a versioning perspective.

1.2.1 Development of low-carbon binders for restoration and preservation of built CH (TITAN, NCSRD, POLIMI, BGU)

Novel, low-carbon and low-embodied energy binders (BCSA, LC3, Pozzolan Rich Cements), so far produced at pilot-scale by TITAN have been studied at the level of cement pastes and/or mortars and concrete. The binders will be exploited (WP4) to produce thermal and structural retrofitting cementitious composites, including Ultra High Performance (Fibre Reinforced) Concrete (UHPC/UHPFRC), in synergy with high range of water reducing admixtures and with a broad range of textile and dispersed fibre reinforcement, to produce cementitious composites, while also guaranteeing the physical, mechanical and aesthetical compatibility with historic concrete.

The development of BCSA will be performed according to the following steps: characterization of raw materials and formulation of the raw mix, firing experiments, characterization of calcined binders (physicochemical, hydration,

[6] https://doi.org/10.1016/j.autcon.2020.103254
[7] https://doi.org/10.1016/j.aei.2020.101122

strength), modifications/optimization. The second binder (LC3) will use thermally activated clays with the aim to reduce up to 50% the clinker content in the cement. The candidate materials will be evaluated by Powder X-Ray Diffraction (PXRD) and X-Ray Fluorescence (XRF). The clay calcination profile will be monitored by Thermogravimetric analysis (TGA) and Differential Scanning Calorimeter (DSC). The bound water measurement (R3) will be performed on raw and calcined clays to evaluate the clays reactivity. Calcination conditions will be investigated at lab-scale and the optimum calcination temperature will be determined per case. The mortars compressive strength will be tested according to EN 196-1. Finally, the use of natural pozzolans in cement at up to 30% clinker substitution will be examined. The pozzolans will be characterized by Powder X-Ray Diffraction (PXRD) and X-Ray Fluorescence (XRF). Reactive Silica tests and bound water measurements (R3) will be performed to evaluate the pozzolanic reactivity.

1.2.2 Incorporation of advanced functionalities in low-carbon structural retrofitting cementitious composites and assessment of their potential for different application technologies (NCSRD, POLIMI, UNAV, USH)

The possibility and reliability of incorporating into the produced structural retrofitting materials also functionalities including self-healing and reinforcement protection (Figure 2) will be assessed (WP4) by using both commercial products and specific solutions proposed and validated in the framework of other concluded (AKEISTHAI project MIS 5031866, ReSHEALience H2020 project GA 760824) or to be concluded European projects in which the consortium is involved. Advanced cementitious composites for structural retrofitting will be produced on different scale specimens for (Textile reinforced Mortars (TRM) produced by BGU and fibre reinforced concrete/ultra-high-performance concrete (UHPC). Compatible to the cement matrix capsules will be developed consisting of an OPC-core that is enclosed in an OPC/Sodium-silicate shell. Further, encapsulated corrosion inhibitors embedded in lightweight porous particles will be incorporated in the cement matrix for reinforcement corrosion mitigation. The performance of mixes in the fresh state will be characterized in line with the EN standards. For FRC/UHPC experience from EN standards and previous relevant projects will be exploited in assessing geometry and type of specimens (e.g., 4-point bending thin prisms). Tensile and bending behaviour in the hardened state will be investigated, along with crack development and crack pattern monitoring by digital camera and a non-destructive test of acoustic emission (AE). Digital Image Correlation (DIC) will be used to evaluate cracks widths and the developed strains. Furthermore, the healing and corrosion inhibition capacity of the developed mortars will be investigated. The long-term durability performance will be assessed through a combined experimental (accelerated, and real exposure conditions tests) and numerical modelling approach to project the evolution of material mechanical and durability parameters all along the anticipated service life of the intended application and feed LCA/LCC/SLCA (WP2) evaluations and H-DT models (WP3). Application technologies other than conventional casting for self-compacting mixes and plastering for thixotropic mixes will be assessed, e.g., providing a framework for the definition of performance parameters for additive manufacturing applications (e.g., pumpability, extrudability, buildability). The recyclability potential of the produced retrofitting cementitious composites, as a result of their specific composition (new binders, low water/binder ratio, potential of delayed hydration reactions) will also be assessed (exploiting the outcomes of previously conducted research projects - see ReSHEALience GA 760824) in order to provide data for a rational extension of LCA/LCC from cradle-to-gate to cradle-to-grave and cradle-to-cradle boundaries (WP2).

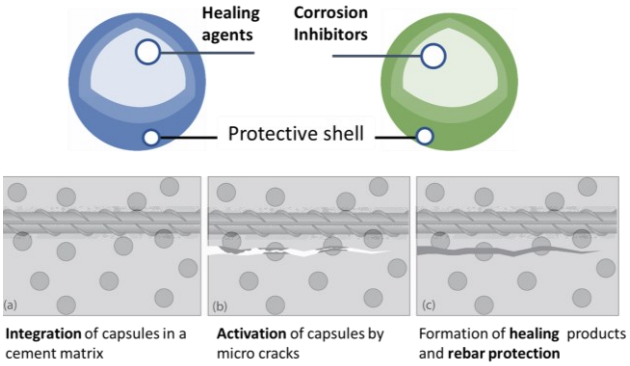


Figure 2. Encapsulated healing agents and corrosion inhibitors for elongating the lifespan of repair interventions.

1.2.3 Development of low-carbon thermal retrofitting renders (UNAV, BGU, TITAN, NCSRD, POLIMI)

The production, characterization, and assessment of the mortars with improved thermal properties will be realised (WP4) in the framework of SINCERE. Two types of repair mortars will be designed by incorporation of i) microencapsulated PCMs and ii) sustainable insulating materials. PCMs with inorganic shells fully compatible with restoration mortars (e.g., $CaCO_3$, TiO_2, SiO_2) and PCMs made from natural and sustainable materials (e.g. inorganic salts, fatty acids, sugar alcohols, and in general bio-based waste materials) will be considered. The phase change temperature and heat enthalpy of the selected PCMs, the particle size distribution and the trend to agglomerate in alkaline dispersions will be assessed, aiming to clarify the further incorporation of the PCMs in the alkaline media of the mortars, renders and plasters, and their thermal performance. Shell composition for the microcapsules will be optimised regarding compatibility with mortar matrix, distribution of the PCM inside the binder and continuity between the matrix and the PCM (adhesion). PCMs will be incorporated to the mixture, considering an incorporation up to 30% by weight of the total of solids in the mixture, and optimizing the composition for the targeted fresh state performance, compatibility with the subgrade and durability in early and log-term age. The performance and properties of PCMs will be compared to natural insulating materials such as cork, vegetable fibres, wool, light

industrial residues such as expanded clay and biomass ashes.

Sustainable insulating materials such as cork, vegetable fibres, wool, light industrial residues such as expanded clay, will be studied. UNAV and BGU will cooperate in the identification of the target compounds and their provision. For optimal compositions the chemical and phase compositions of the hemp-based mortars will be characterised by XRF, XRD and SEM/ EDS. Their compression strengths, density and thermal properties (thermal conductivity and heat capacity) in a Decagon KD2-Pro thermal analyser, exposed to different curing conditions will be investigated. Water resistance of the mortars will be examined by cycles of wetting and drying conditions prior to compression testing. The potential dissolution into water of the mortar components will also be tested by leaching tests inductively coupled plasma (ICP).

The thermal properties of the hardened mortars will be assessed as a function of the curing time. The specific heat capacity of the samples will be determined by differential scanning calorimetry (DSC) measurements. Thermal conductivity measurements and thermal resistance will be performed by heat flux metre, transient plane source (TPS) and infrared thermography for field evaluation (UNAV, NCSRD). Besides standard conditions, the thermal properties will be tested also in scenarios depicting more realistic conditions of temperature and humidity undergone by the materials. A hot-box device (pilot system) will be used to assess the potential improvement of the thermal properties in comparison with commonly used repair mortars. Determination of the resistance to accelerated climatic ageing, freezing-thawing cycles and salt-crystallisation tests (UNAV, POLIMI, BGU). Assessment of the ability of the mortars to retain thermal performance after the durability tests. The safety in the use of mortars in a fire scenario, will be studied by DSC-TG thermal decomposition of PCMs and further analyses of the degradation products.

1.2.4 Development and upscaling radiative cooling paints and membranes (UCL, UNAV)

A rational design approach will be followed, accounting for the interplay between the various physical mechanisms involved. In particular, porosity and incorporation of nano-/ micro-particles (including phase change materials) will be exploited to enhance solar reflectance, tune the wettability of the surfaces, optimise their heat emission and reinforce their mechanical robustness and resistance to UV-radiation (Figure 3a).

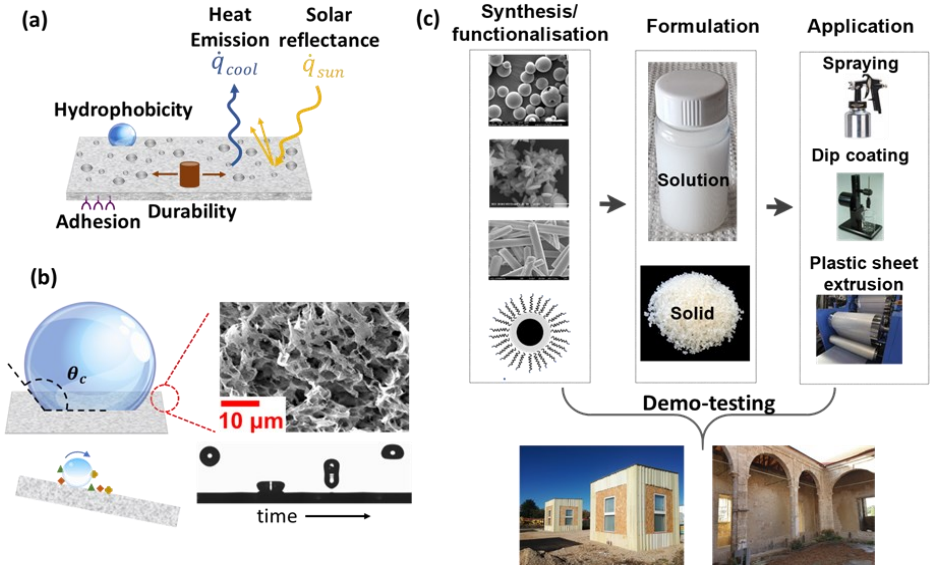


Figure 3. (a) Multifunctionality embedded in SINCERE radiative-cooling coatings/membranes. (b) Example of self-cleaning, porous membranes that will be leveraged in SINCERE to enhance lifetime. (c) Fabrication protocol and application of SINCERE radiative cooling coatings/ membranes.

Controlled porosity will be a fundamental ingredient of SINCERE systems. Porous polymeric materials tend to scatter light efficiently and so, can be utilised for efficient solar reflectors. If the polymer possesses the right phonon vibrations (which is the case for both polyurethanes and polysiloxanes), pores can enhance heat emission too, via multiple scattering of MIR radiation. Pores also lower the solid fraction of a surface, and can create super-hydrophobic surfaces, or be converted into slippery liquid infused surfaces (SLIPS) which can self-clean - (Figure 3b).

Further on, nano-/micro-particles can augment the physical properties of the polymer host or ascribe completely new properties, only found in the composite form. These particles can be synthesised with excellent size control, functionalised, and mixed at desired concentration to create controlled nanotextured surfaces that are self-cleaning. Secondly, nanoparticles are effective hardness modifiers, and will be used to enhance the durability of the coatings and the membranes. Thirdly, high refractive index nanoparticles can contribute to the light scattering process, allowing for desired levels of reflectance to be achieved with thinner layers. Fourthly, certain nanoparticles (e.g., ZnO and TiO_2) are excellent UV scavengers and can be used to enhance UV-resistance. These two nanoparticle families are also well known-for their photocatalytic activity, making them excellent candidate pigments for antibacterial and antifouling coatings. Fifthly, nanoparticles can enhance heat emission in the MIR window or suppress emission outside it (SiO_2 nanoparticles for example tend to have a very pronounced emission peak in the middle of the atmospheric transparency window). Finally, if PCMs are incorporated, then novel radiative cooling composites can be made that mitigate the effect of overcooling in the winter.

Initial modelling will be performed to extract design rules for the radiative cooling media. Optimum material parameters (such as porosity and particle concentration) will be identified which maximises performance, while minimising material use. Main target will be to create systems with thickness <200 μm, while achieving high solar reflectance (>95%) and MIR emissivity (>0.9) to satisfy the stringent requirements for radiative cooling.
Fabrication of small-scale prototypes will precede the up-scaling processes (Figure 3c). Laboratory samples of 10 cm × 10 cm will extensively be produced to optimise fabrication parameters. These include phase inversion and phase separation for inducing porosity and hydrothermal and solvothermal processes for the synthesis of the micro-/nano-particles. Material and structural characterisation techniques (FTIR, UV-Vis-NIR, SEM, TEM, XRD, AFM, Raman, water contact angle measurements) will be employed to assess the achievement of the required performance targets.
Once the fabrication parameters will have been optimised, large scale prototyping will be performed. 0.5 m x 0.5 m prototypes will allow meaningful assessment on the energy gains that can be obtained. This task will be sub-contracted to TNO Brightlands, who have the necessary equipment and know-how to accomplish such a task.
The final aim will be the production of ten large-scale prototypes that will be installed in SINCERE demo sites. Field testing requires building a bespoke sensorised set-up to acquire and record data during the outdoors testing. The experimental set-up will be equipped with various thermocouples to measure the temperature inside and outside the prototype, heat flux sensors to measure the heat transfer coefficient through the walls of the prototype, anemometer for the wind speed, pyranometer for the solar radiation and humidity sensors. Information will be collected in real-time at frequent intervals by a datalogger connected to a laptop that will store and process the data.

1.2.5 Development of solar energy harvesting BIPVs (NCSRD, LU)

Here, halide perovskite solar cells fabricated on transparent conducting cellulose free-standing electrodes will be embedded into several surfaces of the building (glass, tiles, facades etc.) to allow efficient energy harvesting at low cost and zero carbon emission. The unique flexible and colour-tunable properties of halide perovskites make them attractive for BIPVs, producing higher power conversion efficiencies under low intensity. Thus, making them ideal selection for vertical facades. The colour of perovskite cells can be tuned by varying the thickness and the composition of perovskite photo absorber. The transparency will be controlled by the thickness of the perovskite layer that can be easily adjusted by changing the precursor concentration during film fabrication. Considering the requirement of high efficiency, we will focus on 3D formamidimium (FA)-rich absorbers, because those compositions show the most promising stability by avoiding use of volatile methylammonium (MA) and additional phase complications with too much Cs. Regarding the high transparency, the bandgap of perovskites will be tuned from 2.5 eV to 1.5 eV. We will also include lead-free perovskites (e.g. those based on double perovskites, on which LU has rich experience) for the application in ceramic tiles. The energy alignment between perovskites and charge transport layers will be carefully tuned to ensure efficient charge extraction. Special attention will be given to the device physics, especially the origin of open-circuit voltage (Voc) and short-circuit current density (Jsc) losses. A good understanding of device physics will be fed back to optimise material properties and film quality for achieving high power conversion efficiency.

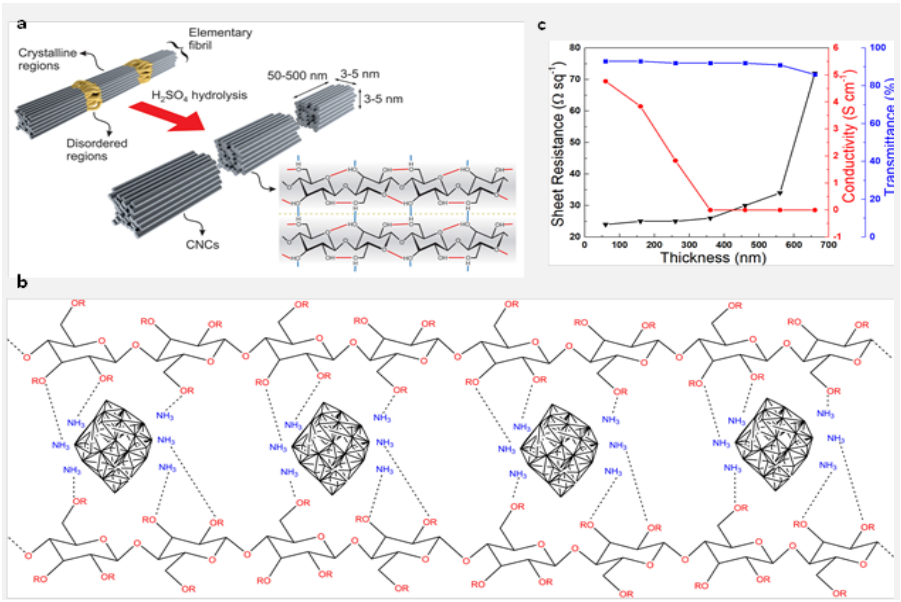


Figure 4. (a) Preparation of cellulose nanocrystals through an acidic reaction, (b) Illustration of the proposed decoration with sr-POM clusters and alignment of cellulose nanocrystals, (c) Plot of sheet resistance, conductivity, and transmittance with respect to the thickness of a CNC nanopaper with an area of 9 cm^2.

In contrast to existing PV technologies that use of glass substrates and precious metal electrodes; in SINCERE we develop transparent conducting electrodes based on cellulose nanocrystals, through an acidic reaction of the starting material (cellulose pulp) as shown in the Figure 4a. The derived nanocrystals will be used for the fabrication of ultra-transparent cellulose substrates. These will become conducting by the coordination of low-cost conducting molecular oxide clusters known as polyoxometalates (POMs) onto the cellulose nanocrystals (see Figure 4b). POMs can be easily assembled into a range of frameworks, using organic or inorganic linkers; they are capable of a very high degree of reduction (electron uptake up to 24 e- per cluster has been reported) without distorting their structure.

Highly reduced POMs present metallic properties. Conceptually, by combining these inorganic oxide materials with cellulose nanocrystals a new class of conducting cellulose:POM composite can be developed. In our preliminary results a 160 nm thick printed nanopaper exhibits 25 Ω sq-1 sheet resistance, 3.9 S cm-1 conductivity and 93% transparency (Figure 4c) which constitute an excellent electrode material for optoelectronics with no requirements for an additional substrate.

1.2.6 Computational multiphysics-multiscale material modelling in CH and integration in LCA/LCC/SLCA (POLIMI, USH, NCSRD)

The development of materials and technologies by SINCERE will be complemented by the formulation, implementation and validation of multiscale modelling and design techniques. Continuous interaction with the partners involved in the experimental activities will be effectively implemented to achieve the necessary two-way knowledge transfer between testing and modelling, leading to synergistic effects and unprecedented insights. USH, which will coordinate this activity, in collaboration with POLIMI and NCSRD, has a vast experience with modelling of thermal, transport and mechanical properties of cementitious materials. This can be well adapted to develop a fundamental understanding of the performance of the materials developed within SINCERE, as well as to formulate a holistic design and analysis tool for future development of bespoke low-carbon cementitious material. The computational tools developed within SINCERE will also allow the overall carbon footprint of the newly developed materials to be accurately quantified, considering both embodied and operational carbon, hence allowing direct comparison against the carbon footprint of equivalent conventional materials. These data will be incorporated into a Durability Based Design approach developed by POLIMI in the ReSHEALience project and will be fed to LCA (which will be performed based on ILCD Handbook and ISO 14040/14044 standards). The study will evaluate the entire renovation/conservation process starting from each innovative component and will consider material composition, material and process embodied energy, potential waste, and the durability improvement over the entire life cycle. Impact of deconstruction and recycling (Cradle-to-Cradle approach) will be accounted for, through: i) specification of LCA strategic options (all LCA phases will be assessed); ii) diversification according to constituents; iii) possibility of recycling and reuse. The economic impacts will be evaluated total costs to be incurred in the design, development, production, operation, maintenance and end of life of materials and components over their life cycle and will be compared with the costs of equivalent conventional products. Analysis of the environmental impact of the new materials and their production processes according to a life cycle approach based on the ILCD Life Cycle Cost analysis (LCC) of the developed materials and components and applications will be performed in accordance with ISO 15686-5:2008 and to the Code of Practice suggested by SETAC “Environmental Life Cycle Costing” The social impacts will be evaluated (Social Life Cycle Assessment – SLCA as per UNEP/SETAC guidelines) starting from the identification of the organization (s) involved in the material production and its (their) behaviour towards relevant stakeholder(s), e.g., workers, local communities, value chain actors also highlighting ways in which social conditions can be improved, including: human rights, work conditions, poverty, disease.
The final aim is to evaluate and put into practice strategies for sustainable improvement. Results of numerical simulations as well as of laboratory experimental tests will be used as training data for AI algorithms to support the materials design process, as well as, to feed BIM and H-DT for evolutionary damage risk assessment of the intended structural applications, to be also validated against monitoring data coming from the pilot demonstrators.

1.2.7 H-DT interoperable platform and XR immersive technologies in CH building lifecycle management (CERTH, U2M, NURO, NCSRD, USH, RIMOND)

Figure 5. CH Building lifecycle management in-situ via AR and remotely via collaborative VR.

Immersive technologies are gradually changing the way people interact with machines and digital information and SINCERE brings these technologies in the CH building renovation (Figure 5). The adoption of AI from a variety of technological domains is also affecting the XR technologies, as new capabilities emerge in space understanding, human actions, and event recognition via mobile cameras. In SINCERE, a location-based indoor and outdoor intelligent reality application will be developed for handheld devices or HMDs. The AR application will take advantage of recent advances in computer vision AI to automatically understand the scene around a user by means of automatic object detection, classification, and segmentation, as well as 3D reconstruction, and automate operation and maintenance field tasks. Machine learning techniques will be implemented for deep learning-based object detection, graph optimization for the navigation module and linear SVM models for profanity check. AR will support multiple phases of a BCH lifecycle, from previewing the initial designs for renovation in the real space to everyday

operation and maintenance tasks. On the other, a multi-user VR application will give stakeholders the opportunity to preview renovation changes and alternative scenarios in a collaborative virtual world.

These novel XR user applications will be the frontend of the historical digital twins (H-DT) that which will form the basis of all information and content organization (ad-hoc and real-time) and the predictive models (for physical properties, climate changes, etc.) being the bridge between the physical and digital world. The H-DT will have a H-BIM (of suitable level of development – LOD) as a spatial reference that will be made and regularly updated by multi-sensor reality capturing (Figure 6). Based on H-DT, the AR – AI powered – field service management application will also provide assisted navigation and guidance to the tasks, perform simulations, and validate scenarios on the field by projecting 3D digital assets on site, and leave location-based reports and notes on the field for co-workers to view on top of reality. The AR application will give the capabilities to everyday technicians to operate, monitor, and undertake maintenance tasks that would otherwise require expert knowledge and experience. Building operators will be facilitated to follow maintenance protocols, visual and georeferenced documentation of maintenance inspections and interventions. Visual inspection of the building will also be possible by projecting the 3D design on top of the actual structure, so that one can verify differences between design and *as-built*. They will also be given real-time operational data from smart IoT sensors (e.g., weather station and power consumption).

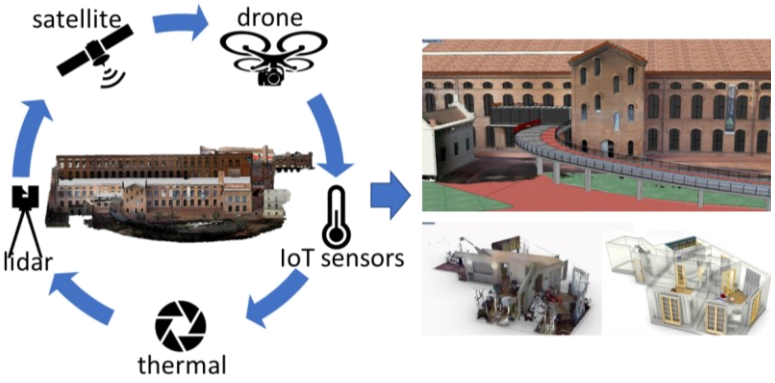


Figure 6. Reality capturing to H-BIM and H-DT.

1.2.8 Climatic models/scenarios, Risk assessment and future projections validated by historic data (NCSRD)

Within the SINCERE project high-resolution climate projections at CH site level from the CMIP6 SSP scenarios will be used. A statistical downscaling approach based on ML/AI models with bias correction to reduce uncertainties and provide enhanced capabilities for extreme events scenarios will be implemented to generate reliable and trustworthy climate models and pertinent scenarios. A novel element of SINCERE is that it will address compound climate events to CH[8] making a quantum leap forward in precisely capturing the multi-variate climate factors that impact the site degradation. The climate impacts on the CH site will be determined through an elaborate approach that will start from an extensive bibliometric review leading to the determination, by the SINCERE stakeholders, of the selection of suitable CH degradation modes for the selected sites. The selected impact models, will be further validated and quantified using data from historical observations and IoT sensors, will be used to derive customised impact models. A novel feature of SINCERE is the introduction of the synergistic climate risk uncertainty in this process, which can be induced from the climate projections and the impact assessment approaches. These climate projections – impact models will be then coupled to determine the projected climate risks in the different future horizons, considering the induced uncertainty, and also be fed into the project's H-DT for providing early warning signals towards the stakeholders.

1.2.9 SINCERE Project's Development Cycles

The SINCERE project will develop in four phases summarized in Figure 7. The four phases are:

Phase 1. Project setup. Definition of UR, use cases and scenarios, ethics issues and the social acceptance, system architecture, technical requirements, and data campaigns. Lab-testing of the materials. Testbed setup in Pilot 1. MS2

Phase 2. *Alpha* phase of the platform and development of new materials and energy harvesting solution. 1st

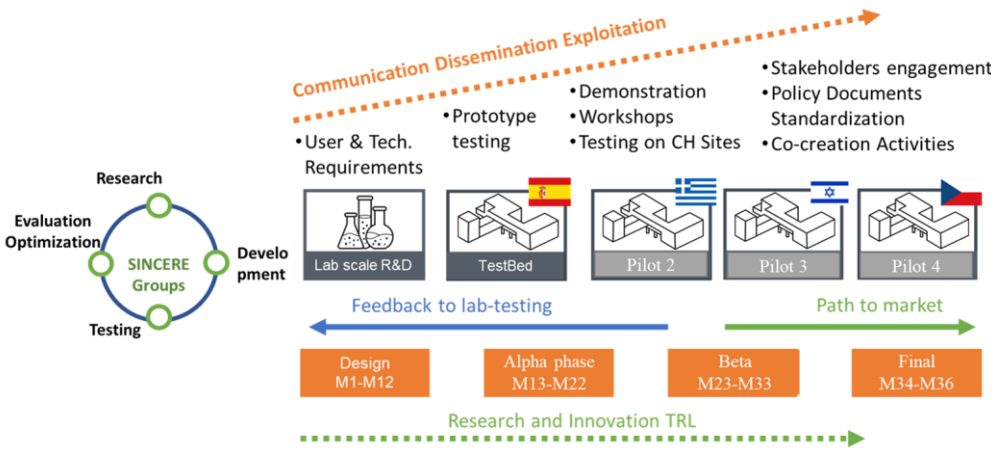


Figure 7. SINCERE Development Cycle at a glance.

[8] https://www.mdpi.com/2075-5309/13/1/198

integration cycle. Pilot 1 Testbed experimentation leads to the 1st evaluation at Pilots 2 & 4 Demonstration Workshops. Citizens' co-development activities. MS2-MS4.

Phase 3. *Beta* to *Final* version of the platform, renovation and energy harvesting solutions. Feedback from Phase 2. Evaluation on the 1st Open Day Demonstration Workshop in Pilot 3. MS4-MS6.
Phase 4. *Final* SINCERE developments evaluation in 2nd and 3rd Open Day Demonstrations at Pilots 2 & 4. SINCERE conference to present the project outcomes, and the Guides for professional implementation. MS6-MS7.

1.2.10 Description of Pilots – Demonstration Sites

Pilot No. 1: DemoPark buildings at Algete, Marid, Spain

Figure 8. Test cells at Demopark in Algete, Madrid, Spain.

The technologies that will be developed within the SINCERE project, following the designing and the laboratory-testing, will be evaluated and validated outdoors at a larger scale, on building prototypes (test cells) located in the Demopark (Figure 8) at Algete (Madrid) managed by ACCIONA. The Demopark has previously hosted the first full-scale tests on other innovative and sustainable construction materials and practices within relevant EU projects. The prototypes will serve as testbeds of the developed materials exposed in real environmental conditions and will provide useful information, regarding the practical issues arising, but also will give an insight for the overall response of the applied solutions. Four experimental test cells will be available to apply the materials and technologies and to analyse the thermal performance of the different refurbishment solutions (thermal mortars, radiative cooling coatings) and compare them with non-refurbished conventional old solutions. The North façade will be fully isolated to have no influence on the other facades. Energy harvesting materials (BIPVs) and DT for monitoring and performance evaluation will be also included in the test buildings.

Pilot No. 2: Neoclassical school building in the Medieval city of Rhodes, Greece

Figure 9. Internal view of the Neoclassical building, Rhodes, Greece.

The first Heritage demonstration site consists of the neoclassical school building, in the Medieval city of Rhodes, built at the end of the 19th century (Figure 9). The building is located in front of the Grand Master Palace, the most visited site in Rhodes, and forms a typical example of the Ottoman period architecture. The building was in operation until the late 1980s, where it was abandoned, due to serious static problems on its foundation. The building is approximately 650 m^2 and is developed around a central atrium with a perimeter gallery, with a total area of approximately 350m^2. The Department for Modern Monuments of Dodecanese (HMC) has developed and supervises a multi-phase conservation plan for the structural strengthening and restoration of the building. Phase II (2011-2015) was funded by the NSRF development programme of Greece, as a self-supervised project. During the project, all necessary interdisciplinary studies were finalized and approved (geotechnical study for strengthening of foundation, structural study for the wooden roof, architectural conservation study, environmental design and archaeological studies, facilities study and conservation study of the painted decoration). In the proposed project, the building is now on Phase I, funded by the Greek National Recovery and Resilience Plan, for the completion of the restoration works.
The building offers a unique opportunity for demonstration and evaluation of the restoration materials, energy harvesting technologies and H-BIM/H-DT tools, linking the project results with visitors from all over the world. The main technologies that will be demonstrated include: Monitoring of environmental setup and localised future climate change scenarios for risks identification, digital reconstruction in 3D, thermal insulation mortars and renders, radiative cooling coatings, transparent BIPVs for energy harvesting, energy consumption scenarios based on H-DT projections. Moreover, since the site will be operating as an open restoration site (open lab) by the HMC, several education and training activities of SINCERE will take place, in collaboration with local authorities.

Pilot No. 3: Building 3, Holon Institute of Technology in Israel

The Holon Institute of Technology was founded in 1969 in an existing site with workshop buildings, built in 1953. The institution was opened with 100 students as the Centre for Technological Education Holon (CTEH) until 2000,

affiliated with Tel Aviv University. In 2006, it became the Holon Institute of Technology (HIT). The HIT campus is located in the centre of the city of Holon and covers about 50,000 m^2, including eight educational and administrative buildings of a combined area of over 23000 m^2.

The pilot site at HIT is building no. 3 (Figure 10). A four-storey structure of a total floor area of 2200 m^2, constructed in 1972. It was renovated and enlarged in 1992 and in 2009, when an elevator core was added for accessibility. The building provides today a mixed-use of spaces for administration (offices, meeting rooms), laboratories, conference hall, and synagogue. The building is built of exposed reinforced concrete frame in the Brutalist style of exposed concrete surfaces. Other materials include aluminium windows and insulated aluminium panel roof (a later addition).

Figure 10. 1Holon Institute of Technology, Building 3, Holon, Israel.

The building was chosen as a pilot for SINCERE for its importance at several levels:

a. During its lifetime it was expanded to provide more spaces to increasing needs. The number of interventions and expansions of the original core of the building indicate that HIT has no intention - or the resources - to demolish and rebuild, but rather continue using the building. Further, using the same premises, avoids disrupting the work of the employees in the building and the smooth operation of the institution, while improving thermal comfort and indoor environment quality, while reducing the energy dependence of the building. For this reason, the pilot at HIT is an excellent example of similar buildings in Israel and elsewhere in Europe, offering a great example for CH concrete building reuse and retrofit, instead of demolition.

b. The location of HIT is in Holon, in the wider metropolitan Tel Aviv area. Its central location makes it easily accessible by light rail and public transportation, from the airport and from any geographic area of the country.

c. HIT as an institution is open throughout the day, and accessible to the wider public. Therefore, the pilot project ensures accessibility of the public and easily organized visits to the site of the pilot.

d. HIT has a faculty of Design, with Interior Design and Industrial Design departments. The departments, which will be involved with educational programs for their students, based on the SINCERE program and the pilot at HIT, will ensure that the dissemination of the SINCERE findings will be immediately integrated in the academic curriculum and therefore, effectively educate the young generation of designers in a culture of refurbishment and upgrade rather than demolition and reconstruction.

The envisioned interventions, which will include thermal insulating and structural retrofitting mortars, radiative cooling coatings and BIPVs, will offer a unique opportunity to evaluate an intensely used building and compare conditions through H-BIM/H-DT tools, before and after interventions evaluating energy production and conservation, maintenance and overall performance of the building. The educational context of the pilot, will also provide opportunities to study the pilot in real-time and engage students and faculty in the monitoring and evaluation process, reporting and dissemination.

Pilot No. 4: MUSEum+ Industrial Heriatage Building, Czech Republic

MUSEum+ is a state contributory organisation established in 2021 by the Ministry of Culture of the Czech Republic. Its task is to revitalise the blast furnaces 4 and 6 and the casting hall (brownfield) in the Lower Vítkovice area in Ostrava and transform them into a new function - an innovative museum while respecting the heritage value of the buildings (Figure 11). The blast furnaces 4 and 6 were part of the Vítkovice Ironworks, a company with a tradition of iron processing since 1828. After the closure of the plant in 1998, the blast furnaces (which were built in 1962 and 1971 respectively), together with other parts of the ironworks, were declared a national cultural monument. Several conversions of industrial buildings for cultural purposes have already taken place on the site[9], but the heart of the site in the form of blast furnaces 4 and 6 continues to deteriorate.

Figure 11. Old iron processing plant, Ostrava, Czech Republic.

The planned conversion is envisaged as a combination of revitalisation and incorporation into the listed building, using

[9] https://www.dolnivitkovice.cz/en

New European Bauhaus and SINCERE elements to determine the conversion effort, which will be sustainable and have a positive impact on reducing the carbon footprint. Plans include the creation of a 7500m^2 exhibition space, a library and study room, a children's museum, a CCI use area, a gastro zone, a depository and repository, restoration studios, etc. The total planned gross floor area including parking is over 20000 m^2. MUSEum+ submitted a feasibility study in January 2023 and will apply for support from the Just Transition Fund.
MUSEum+ differs from the other two Heritage pilots (in Rhodes and in Holon), since it is the only case with industrial character, which exhibits special structural and architectural features from the other two Heritage educational buildings. The specific pilot provides a unique chance to demonstrate the materials (structural and thermal retrofitting mortars) and technologies (BIPVs) developed within SINCERE, since the structure is located in far northern land, with significantly lower average temperatures around the year compared to the other demos that are extended around the Mediterranean. H-BIM/H-DT tools will also provide an insight on the efficiency of the restoration materials exposed to different environmental conditions (temperature, solar radiation, humidity etc.) next to the other three pilots. Moreover, the rehabilitation of the cultural monument with sustainable materials and methods, combined with its new use, of cultural and educational nature, encompasses a symbolism, which highlights the transition from a structure previously belonging to a plant with increased negative environmental impact, to a considerably eco-friendly, greener building with cultural and educational qualities.

1.2.11 Engagement of citizens and stakeholders

The communication and dissemination methodology will place at the centre the buildings of the three Heritage demo sites, as stages for storytelling, boundary objects for transdisciplinary research and laboratories for participatory and citizen science processes. Each of the three different functions will be developed in depth for each of the demo-sites and then tried out on the other two and beyond.
For this, an open federated digital platform will be designed, titled “Building Stories”, which will aggregate content created and disseminated independently by each building. The buildings will be personified and run its own separate blog and knowledge base, in 2 languages, the local language and in English. The English versions will be the ones collected through the RSS protocol, and filtered through appropriate tagging at the federated platform.
Having separated sites hosted on permanent domain names of the corresponding host institutions will ensure the long-term sustainability and impact. It will also allow for the integration of similar content from external projects which will be invited to participate and eventually build a global alliance, the “United/SINCERE Buildings Alliance” in the same spirit with the “Parliament of Things” by Bruno Latour.
It will be exactly the number of external projects that will become part of the SINCERE Buildings Alliance, the main Key Performance Indicator and clear impact of the dissemination work.
i) Building as boundary object (transdisciplinary aspect), Main demo: HIT-Israel
SINCERE develops a toolkit with interdisciplinary methods on renovation from theory to practice. Together with ECO, students of HIT and Erasmus-collaborating university students from Europe, will create case studies based on the pilot at HIT, expanding the study of applying the SINCERE pilot-interventions to different building types: from cooperative housing and existing social housing buildings common in Israel, to educational institutions, and the workplace. The students will develop these schemes within the academic, research, design clinic and student entrepreneurial projects context of social agendas, work with citizen groups, NGOs, community organisations or public schools, in order to develop concepts and models for sustainable living, working and studying. Methodologies will focus on utilising existing buildings, interior revisions and upgrading the building envelope and performance based on the SINCERE model.
The SINCERE toolkit will promote circular practices in architecture, design, interior design and building remodelling. Circular practices will be inspired and supported by the pioneer work and existing models of leading European architects in the field of circular design, such as Rau Architects, Superuse studios, The New Raw and other established and experimental practices, bridging between theory, teaching and practice. Aiming towards a transition to a Circular Economy model, will be achieved through a combined strategy between institution, student community, neighbourhood, and city. The public character of HIT, and its 6000-strong student community, will enable dissemination of the toolkit and pilot interventions from the academic institutional setting, to the urban and residential.
ii) Building as laboratory (participatory / citizen science aspect) Main demo: Rhodes- Greece
The demo in Greece serves as a laboratory for science. SINCERE develops a citizen science methodology with the co-creation format. SINCERE will gather non-experts with different backgrounds, who will act as researchers and SINCERE’s ambassadors, as well as provide inputs for the research development. The activity includes a series of workshops. The citizen scientists will follow through all the project.
iii) Building as stage (performative aspect), Main demo: MUSEum+ - Czech Republic
The MUSEum+ will help to enrich visitor’s learning in various fields, gain experiences in a new environment, and provide a unique setting for SINCERE to teach different audiences a wide range of topics.
It will be the main stage for the main playful and creative dissemination styles developed in SINCERE combining

digital technology (video, audio, H-DT) with artistic interpretations from local artists.
For example:
i) Using sound art to create an auditory experience that represents the building's perspective on the city. For example, this could involve using recordings of the building's creaks and groans, or the sound of people moving through it, to create a soundscape that gives the building a "voice."
ii) Using projection mapping to create visual representations of the building's perspective. For example, this could involve projecting images or animations onto the building's facade that show what the building sees or feels.
iii) Using interactive installations to allow people to interact with the building and "hear" its perspective. For example, this could involve creating a touch-sensitive surface on the building that responds to people's movements, or using sensors to detect people's presence and create a responsive light show.
iv) Using augmented reality technology to overlay digital information on the building, such as historical facts or personal stories, to give the building a voice, adding context and personality.
v) Using generative art or machine learning to create a virtual agent, that can represent the building and interact with people, giving them a way to communicate with the building.

1.2.12 Interdisciplinarity

Each SINCERE partner carries its own expertise in the *technological, humanitarian, or social aspects* of the proposal to accurately address the research, implementation, and dissemination activities, and brings advanced stakeholder knowledge. The latest research work that SINCERE partners have contributed in is presented in Part A. The assessment of the CC impacts on the cultural World Heritage must account for the complex interactions among natural, cultural, and social aspects. The social importance of Built Heritage lies in its testimonial values of different materials and building technologies, which link all categories in the development process, including the cultural values and social well-being of a society in the course of its history. The SINCERE project also allows for a greater connection with the technological traditions of past centuries. This allows us to become aware of our position, as another link in this chain, in the history of technique and technology; now, at the present time, from positions that are more aware of the respect for the environment and sustainability that the current situation implies. Considering CH is a core element for sustainable development, social coherence and financial development, SINCERE will elucidate the social function of Architectural Heritage in the context of sociocultural sustainability principles, drawing on the expertise of the partners (**CH stakeholders** and **architects, conservators**- MP, HMC, NH; **materials technology**, NCSRD, POLIMI, BGU, UNAV, UM; and **architecture and engineering**– ECOAMA, BGU, NH, UM and **Climate sciences** - NCSRD). Moreover, NH and ECOAMA encompasses social scientists experienced in the interrelation of Cultural Heritage with local communities and society as a whole, in the dissemination of research activities and in the co-developing Citizen's Science activities.
SINCERE research activities will be guided by the requirements posed by ECOAMA and HMC, who will connect the current restoration and excavation research and field-applied approaches with the research and the innovations proposed here. They will also coordinate the Pilots implementation along with the **authorities** and **conservators** in Greece (HMC) and Israel (ECOAMA - HIT). ECOAMA and UM have a long experience in **architectural restoration projects**. U2M is experienced in terrestrial **3D modelling** of CH from multiple sources and in developing **augmented reality** applications, while NURO and RIMOND will implement **Digital Twins** integration. NCSRD (EREL) contributes to the collection, extraction, and analysis of **environmental and climate change data**, and the secure platform integration. CERTH will work on **multimodal data fusion, semantics, interpretation, and visualisation**. NCSRD will work on different aspects of **modelling the environmental variables** and **local climate projections**, and the scaling down of these variables to the micro-scale of the CH sites. NCSRD (INN), will undertake the task of developing new **self-healing restoration mortars and corrosion inhibitors**, along with POLIMI. UCL, UNAV and BGU will propose and simulate various approaches for **thermal retrofitting** of CH buildings and adapting to the impacts of climate change and building resilience. NCSRD and LU will propose sustainable and heritage compatible solutions for **energy harvesting** through BIPVs. The cooperation among partners will be intense throughout the project duration, fostered not only by the administration structure, but even more by the work breakdown structure that inherently ensures the interdependence of tasks and the integration of the developed technologies in the platform.

Social Sciences and Humanities in SINCERE

Moreover, anthropological and social sciences research perspectives and their interaction with the technical scientific research within the SINCERE approach are explicitly taken into account i) in defining relevant tasks, such as T2.2, T2.3, T2.5, ii) via defining the user-driven Pilots, iii) by comprising Citizen's Science sub-groups for advancing research via a collaborative and public engaging methodology (T6.1-3), and iv) by exploiting knowledge from humanities in the technical research such as in T2.5 will address the effects of climate change on both tangible culture and societies, aiming to highlight the parameters that influenced migration or even collapse of civilizations, but that also motivated adaptation and resilience, trying to learn from the past. The idea is to provide context and input to innovative technologies and materials for resilience and preservation of CH. Furthermore, the SINCERE approach

will exploit current approaches and data (e.g. archaeological, historical, and architectural records) from architectural studies (HMC) and historical research (ECOAMA, UM) to support research on CC effects and sustainability of Built Heritage and contribute to the CH sites platform for storytelling and public awareness.

1.2.13 Sex and gender dimension

Equality between women and men is considered as a natural goal for all policies at all levels. However, it is a fact that women and men have different interactions with Cultural Heritage because of the lack of equality between them, historically and still today[10]. On the other hand, it is recognized that the promotion of gender equality has a role to play in the protection of Cultural Heritage, both in terms of participation of women to the process of recognition and of empowerment of women and girls against discrimination on the basis of gender.

SINCERE consortium fully supports the principle of equality and will make every effort to combine the integration of a gender perspective into all the project policies and activities with specific actions, defined in an *Ethic, Gender and Legal Guide* at T1.5. The Treaty of Amsterdam as signed by the EU (May 1, 1999) and the on-gender mainstreaming which formalises the gender commitment and the gender mainstreaming process at the European level (Council of Europe's Recommendation CM/Rec(2007)) is considered as fundamental reference. The consortium will strive to reach this objective by: (i) encouraging every individuals' participation in the activities irrespectively of sex and gender, (ii) encouraging and supporting visibility and mobility, (iii) ensuring that all research positions will be offered on an equal-opportunity basis. Moreover, all partners have in-house regulations preventing discrimination of employment opportunities for women, as well as individual GEPs. Some, (e.g., USH, NCSRD, POLIMI) also have active promotion campaigns to increase their share of female employees. These will be also activated during the project. Taking into account the Council of Europe "European Cultural Heritage Strategy for the 21st Century", SINCERE will take all possible measures during implementation, dissemination, demonstration and exploitation, for promoting gender equality, according to the following **Action plan**: (i) make LGBTQIA+ visible and encourage research results produced equally; (ii) implement -when possible- impact assessment with a gender equality perspective: assessing how everyone accesses to, use and benefit from CH and project results; iii) select an inclusive language during communication of project results and development of communication strategy and content free from stereotypes and discrimination; (iv) ensure inclusive approach and equal representation in project management and decision-making, at all levels, in all aspects of SINCERE, e.g. WP leaders; (v) implement gender inclusive budgeting: ensuring equal salaries, allocation and use of budget, without gender bias; (vi) protect family life.

SINCERE will support diversity, equity, accessibility and inclusion as essential rules to project implementation and management. The SINCERE consortium values and will support differences in the pursuit of inquiry and knowledge, mutual understanding, respect, trust, transparency, and cooperation. We are committed to creating a diverse and welcoming workplace that reflects the diversity of the communities we serve and includes individuals with diverse backgrounds and experiences. Individuals of colour, women, LGBTQIA+, veterans and persons with disabilities are encouraged to participate in all research and dissemination actions/tasks. Moreover, all qualified applicants will receive consideration for employment without regard to age, ancestry, citizenship or immigration status, colour, disability, ethnicity, familial status, gender identity and/or expression, genetic information, marital status, national origin, race, religion, sex, sexual orientation, veteran status, or any other protected status.

Although the consortium is somewhat balanced and involves women in research positions and positions of responsibility, all partners will be committed to extra measures to promote equal opportunities in their teams and increase women in leading positions. Within the work plan, the PIs, but also the WP leaders, will be responsible for managing and supervising gender equality, as well as creating equal working conditions between genders and ensuring that no discrimination occurs based on gender, sexual orientation, religion, race, disability, or social status. In case of need, the management that has training in the field of gender will have the support and advice of the NCSRD equality Committee.

Regarding the dissemination of the results, a non-sexist or androcentric language will be used, and the results of the project will always be presented in a gender-sensitive way. Social networks will be included in the dissemination of the results, with the aim of reaching a more diverse audience and trying to reduce gender inequality in dissemination. It will also participate in initiatives, such as the International Day of Women and Girls in Science with the intention of giving a prominent role to the female researchers of this project and thus contributing to the visibility of women in science. Within the training plan, special attention will be paid to young researchers to carry out training courses in gender equality, non-discrimination, and gender-based violence offered by the Equality Units of the institutions involved. This will allow young research staff to integrate the gender perspective into their own research as well as into their work environment.

1.2.14 Open science practices

Open access Horizon Europe Open Access practices[11] will be adopted in the project for data and research, as

[10] European Cultural Heritage Strategy for The 21st Century (www.coe.int/strategy21)
[11] https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/open-science/open-access

indicated in Article 29.2 of the Model Grant Agreement (MGA), and the industry intellectual property rights will be protected as from the consortium agreement. Many of the deliverables of the project will be publicly available. **Open peer review** is supported by the consortium partners that will aim at open access journals (Green or Gold path) and open access repositories as OpenAIRE[12] and Open Research Europe initiative cOALitionS[13] from the European Science Foundation. **Early and Open Sharing of research** will be served by the pre-print publications either in established publishing houses, or in well-known research repositories such as in the arxiv.org.
The HEIs and the RTOs in the consortium have explicit policies and actions to promote open science practices in their everyday research activities. The SINCERE consortium will exploit these policies and initiatives to make available the research outcomes to the community, but also gain better insights via knowledge exchange to support the project objectives. This is already a policy of consortium members, e.g., CERTH's MKLab maintains a dedicated space in code hosting and sharing platform[14] and U2M although an SME is already contributing open-sourced software developed in EU projects to the robotics vision community[15]. Furthermore, project coordinator (NCSRD) actively participates to Greece's Open Science Task Force, a collaborative bottom-up initiative of 11 national academic & research organisations and twenty-six research infrastructures & civic initiatives to draft a National Plan for Open Science and align with European Open Science Cloud[16]. **Open data** principles will be adopted (see Section 1.3.7) and SINCERE interoperable platform will also exploit Copernicus data which are open and use the WekeO that is one of the five DIAS platforms operating in the frame of Copernicus programme and are financed by EU.
Citizen Science Activities: According to RRI principles, NH will create a citizen scientist activity in the form of a *co-created project*. NH will design in T6.3 a research activity together with members of the public (Ideation, process design, data collection and analysis, dissemination of the results), which will be coupled to T4.1 and T4.3. Some members of the public will be actively involved in most or all aspects of the research processes. The results will be also presented to a citizen science meeting/festival. In this way, the general audience will obtain a better understanding of the importance of science undertaken on CC and CH. Through this activity, SINCERE will develop a community, empower citizens, and work towards attitude changes to improve the environment. Nevertheless, SINCERE will engage citizens in policy making indirectly, involving them from the beginning of the project so that they can express their unique interest in the outcomes. The citizen scientists will engage in developing novel materials and methodologies in T4.1, T4.3 and architectural and cultural investigations in WP2, learn to characterise materials in the analytical lab, simulate performances, create prototypes to validate simulations, make observations, evaluate results and present/publish their work.

1.2.15 Data management and management of other research outputs

SINCERE will produce data, but mainly will develop methodologies and tools which will be published in scientific and technological publications, as well as the Handbook for with environmentally friendly recommendations on CC adaptation and mitigation plans for practitioners, site managers, and policy makers.
User groups requirement data that will be collected anonymously from the targeted audience while encapsulating their needs in a coherent list of enumerated quantitative and qualitative information. This information will be gathered via survey at the first steps of the proposal and will lead to concrete technical requirements and platform architecture.
Ad hoc and continuously captured data in situ: Visual and geodata, environmental, chemical and other data by installed sensors and weathering processes are inserted to the platform to facilitate the analysis by the experts.
Data from online sources: Copernicus service weather data will be used.
Derived models: 3D models, DT models, weather models and other models developed through the project activities.
Data collected by the public: these are the data that users collect while using the platform of the demo-cases.
In general, any collection of personal data will be subject to the restrictions of the General Data Protection Regulation (**GDPR**) and all collected data and research outputs will be in line with the **FAIR** principles[17]. All aspects of the data will be documented by the CA to be signed by all consortium partners, based on the EU DESCA model. The processes will be monitored by T1.3 and partners will follow the *Ethics Guide* in D1.3 which will steer the *Data Management Plan* (DMP) (D1.3 in M6) following the Horizon Europe Data Management Plan template to respect the following rules: i) personal data will not be processed without any legal ground (such as the data subject's consent or legitimate interest), ii) that personal data will be securely stored to prevent third parties access without authorisation, and iii) that personal data will be anonymised. The collected data will remain private or anonymized. The SINCERE platform will be *secure by design*, as the integration will exploit the KAST platform that has been designed in the foundation of existing use cases/ «patterns» and it is development-agnostic of targeted applications to provide a secure usage and treatment of the inserted data. In addition, on top of the predefined dashboards for KAST's cluster monitoring, the platform also provides a highly available and resilient distributed Documents Storage service based on

[12] https://www.openaire.eu/ & https://open-research-europe.ec.europa.eu/
[13] https://www.esf.org/our-services/choose-your-service/scientific-platforms-administration/coalition-s/
[14] https://github.com/MKLab-ITI
[15] http://wiki.ros.org/cam2lidar/Tutorials/How%20to%20calibrate%20Lidar%20and%20Camera
[16] https://www.iit.demokritos.gr/policies-institute/national-plan-for-open-science/, https://eosc-portal.eu/
[17] https://www.go-fair.org/fair-principles/

ElasticSearch. All documents and initial and processed data created during the SINCERE implementation will be securely and safely stored in the SINCERE internal repository after its ending for a period of 5 years. Search keywords will be provided to optimise re-use possibilities. A Digital Object Identifier will be used to uniquely identify each public electronic document generated - Findable. On top of this, SINCERE will create curated and annotated datasets to assist researchers reuse them, proceed their research and to validate the results presented on the articles (underlying data) - Accessible. Data will be organised in open formats - Interoperable and stored in an open data repository (Article 29.3 of the GA), i.e. Zenodo[18] which is supported by OpenAIRE and is also searchable by re3data.org - Reusable. The public research data will be available as soon as possible after the time given to register the patents when required, minimising the embargo time. The algorithms developed will be stored in code repositories such as Github depending on the partners licensing choices. All publications will include the statement that the results were generated with the assistance of EU financial support, as indicated at Article 38.1.2 of the GA.

2 Impact

Buildings account for 40% of consumption of energy produced for heating, cooling, and lighting, and for over 30% of CO_2 emissions (operational) globally. To meet the EU targets for 2030, a 65% reduction is required of the embodied carbon in buildings. This requires improving energy efficiency in existing buildings to reduce operational carbon, applying passive energy conservation measures and the use of renewable energy, and selecting materials with low embodied carbon, while providing the necessary performance attributes. Although current debate on the contribution of Built Heritage tends to focus on technical issues, countries recognise the important role of its preservation regarding the cultivation of cultural identity across generations, the citizens 'quality of life and social and well-being.

2.1 Project's pathways towards impact

SINCERE materials, technologies and project results targets the actual needs of Built Heritage, as reflected by CH authorities and Built Heritage managers, Construction Companies, Architectural and Engineering Design offices, Renovation Industry, Owners of listed and new buildings, and Industrial Heritage sectors. These include:

- decrease the total carbon footprint of Built Heritage conservation in the cradle-to-grave approach (manufacture, application, service life, maintenance, repair, demolition);
- enhance of the energy efficiency of CH buildings and facilitate net-zero energy buildings transition in cultural heritage sector;
- provide new generation BIPVs technologies based on cheap and eco-friendly materials, as a viable solution for high efficiency, non-toxic energy harvesting;
- promote quality conservation, renovation, and rehabilitation of Built Heritage;
- enable real-time monitoring of materials conditions, risks identifications and management;
- exploit digital tools for CH preservation, energy performance and management, and
- cultivate sustainability principles and increase public awareness on CH values.

2.1.1 Topic Outcomes and Impact

EO1. Increased availability and enhanced performance, of solutions applicable to a reliable and respectful historical renovation of heritage buildings, preserving architectural and cultural identity.

SINCERE provides several innovative and sustainable materials and digital tools for respectful retrofitting of Built Cultural Heritage, at different scales and levels:

- **Material level**: i) restoration mortars with 3 types of low-carbon cements for Built Heritage using innovative but also compatible low-carbon binders, according to the building tradition of different CH buildings (BCSA, LC3, Pozzolanic cements). The proposed binders currently save 30-40% of CO_2 during production compared to OPC, by replacing the clinker by supplementary cementitious materials (CSMs) coming from waste products and reduces the production cost by approximately 25%; ii) Digital modelling tools for micro- and meso-structures combined with machine learning for tailored design of new materials with enhanced performance.
- **Building level**: i) more sustainable restoration mortars and coatings for structural and thermal retrofitting, ii) ICT tools for integrated data concerning microclimate parameters, macro-scale material models, preservation and condition and alterations through time, as well as correlation of energy performance with future climate scenarios and risk factors.
- **City level**: i) introduction of circular economy principles and re-used of building elements/components (urban mining) for the renovation and rehabilitation of CH buildings, ii) preservation of landmark buildings, enhancement of everyday life aesthetics, safer and more pleasant cities
- **Global level**: i) use of lead-free perovskite semiconductor and eco-friendly chemicals as stabilizing agents, to minimize the environmental impact and heavy metal usage in BIPVs. ii) reduction of GHGs, enabling energy

[18] https://zenodo.org/

harvesting by green and highly efficient BIPVs and reduction of consumption of natural resources for materials production and heating/cooling.

- **Public engagement and awareness level**: XR tools, technical workshops, open labs, educational material, datasets, publications and media for drawing attention to CH values, climate change impacts on cultural heritage buildings and material culture, as well as on society.

EO2. Demonstrated potential of sustainable, energy and resource-efficient historical renovation of heritage buildings.

- adaptation of low-cost solution-based fabrication procedures for producing ultra-transparent cellulose electrodes that enables the integration of green perovskite PVs on any substrate that can be compatible with architectural elements of historical buildings, such as glass, ceramics, cement.
- implementation of 3 novel types of low-carbon cements (BCSA, LC3, PRC) for the structural and thermal retrofitting of 20th century Built Heritage. Their development and use will result in i) at least 70% reduction in the consumption of natural resources, ii) at least 10% reduction of fuels consumption and iii) at least 30% reduction of total CO_2 emissions;
- development of two novel types of encapsulated additives for self-healing of conservation mortars and protection of historic concrete rebar reinforcement from corrosion, based on two types of encapsulated additives, which will result in i) at least 100% longer service life after initial cracking, compared to conventional conservation mortars, ii) 70% strength recovery. The above performance will be supported by the combination of self-healing and corrosion inhibitors, for conservation mortars used in Built CH.
- development of two types of low-carbon renders and plasters with PCMs and natural fibres (hemp) for latent heat storage and insulation, will result in:
  - for PCMs mortars, i) reduced heat flux peak (outdoor-indoor) by 20% and ii) increased latent heat storage capacity by 20%;
  - for insulated mortars, reduced thermal conductivity by 20%; and of heat transfer by 35%
  - reduced energy consumption of the building envelope >15%, based on H-BIM simulations;
- development of two types of radiative (passive) cooling coatings for concrete buildings, incorporating green
- PCMs will result in: >30% reduction of energy demands for cooling during building operation; reduction of materials surface temperature >15 ºC for paints/coatings in the summer
- development of one IoT platform for multiple data collection and interpretation and one H-BIM/ H-DT tool for automated analysis and simulation processes. Thus, tailored information to decision-makers for the conservation and instant intervention for repair will be achieved, decreasing maintenance and repair cost as well as increasing the safety of the constructions.
- reduction of the embodied carbon in the finished products/additives and extension of service life of green repair mortars, including the interaction between the building material with the microclimate, following LCA/SLCA-centred building approach.

EO3. Better protection of the value and long-term inclusiveness, accessibility and usability of cultural heritage sites.

- SINCERE supports the concept of adaptive reuse and rehabilitation of existing CH buildings and introduces the urban-mining approach for cement-based building materials and architectural elements such as windows and window frames, doors, finishes, such as floors, ceilings, fixtures and furnishes. The need for circular practices and urban-mining are already at the threshold of the business-as-usual activity in construction, as cities realize that the current model is not sustainable. The demo in Holon, is very timely in this respect, and will contribute in bringing these practices to the forefront and help shape the new mainstream construction culture and city policy
- SINCERE materials and technologies overcome the main barriers for re-usability of concrete heritage buildings and energy consuming buildings, through the following tools to fight the notion of abandonment and demolition:
  - provides low-cost and high efficiency building materials for conservation and renovation with enhanced compatibility to the historic fabric (repair mortars, thermal renders, passive cooling coatings).
  - structural retrofitting solutions create a safe and secure environment for building users, highlighting the importance of both human life and architectural values.
- the adopted communication and public engagement strategy uses the Heritage Buildings as key players, for orchestrating - **Building as stage** for raising society **awareness on the importance of preserving cultural heritage** as an essential factor of local identity and national cohesion, and also sustainability; **- Building as boundary object** for developing and maintaining an international ecosystem of researchers from different disciplines, active stakeholders and citizens, to build, share and activate knowledge for preserving CH sites from CC; - **Co-identification of local needs and pressures with key local stakeholders** and actors, and fostering of collaboration among stakeholders, local communities and decision-makers; **- Building as laboratory** (participatory / citizen science aspect) for running **Citizen Science** activities of **co-created** type to support a better

understanding of the importance of science undertaken on climate change and cultural heritage by the general audience
- By promoting the Preservation of Built Heritage via novel ICT and green materials, SINCERE contributes to the inclusive and sustainable ways of living described in the New European Bauhaus.
- Finally, the advanced properties of multi-functional materials could provide new criteria for modifying the legal or regulatory constraints for conserving and managing 20th century listed buildings and thus maximizing the economic and societal benefits for EU citizens.

EO4. More cost-effective and less disruptive modernisation and preservation of the Built Heritage environment.

- SINCERE facilitates the improvement of energy performance and thermal comfort of 19th and 20th century buildings, as well as the reduction of energy consumption and carbon emissions, without affecting their initial aesthetics and appearance. In Europe, the percentage of historical buildings older than 1945 ranges from 6.1% - 47.4% with a mean value of 23.1% of the total building stock of Europe.
- SINCERE enable energy savings during production of building/restoration materials, reduces the use of natural resources and provides longer service life. This is a major contribution for preserving both natural and built heritage, and achieve an environmental balance in human affairs, or otherwise the 'sustainable development'.
- The transparency of the proposed PVs allows minimum alteration of facades and roof tops of CH buildings, supporting at the same time the efficient energy production for adaptive modernization.
- BIPVs developed within SINCERE will be applied on the architectural elements of buildings, such as window glasses, ceramic roof tiles (19th century buildings) and renders, without affecting the roof-top of buildings or the skyline of the cities.
- Raw materials of BIPVs are green and does not incorporate heavy-metals or toxic materials.
- SINCERE thermal retrofitting mortars are designed to follow the technology and building practice of both masonry-based and concrete buildings, thus harmonize to the architectural appearance and context, yet reducing energy consumption by 40%.
- In contrast to aesthetic disruptions created by HVAC systems, the application of radiative cooling coatings can save over 65% of buildings energy consumption, which is consumed by HVAC systems, contributing to 1/3 of CO_2 emissions. Hence, radiative cooling coatings provide new, compatible modes to achieve a sustainable society.
- SINCERE xReality and building performance simulation tools offer the ability for visualizing the aesthetic impact at early design-stage, thus analysing and evaluating any conflicts or alterations in advance.

EO5. Enhanced prevention and monitoring of the Built Heritage environment.

SINCERE builds on the expertise and award-winning practices for prevention and monitoring of CH structures. Partners UM, BGU and POLIMI have been awarded for the "Water Tower Conservation Project" as Sustainable Industrial Heritage Restoration example within the H2020 project **ReSHEALience**, implementing Ultra High Durability Concrete, advanced multiphysics modelling and an advanced sensor network for structural health monitoring. Multiplying forces, SINCERE consortium moves forward and:

- enhances the sustainability of structural repair mortars, implementing low-carbon, yet durable cements
- develops an interoperable platform integrating H-BIM/H-DT technologies for providing tools not only for real-time monitoring, but also running different climate change and energy enhancement scenarios
- provides several tools for visualising in several modes (xReality) the results, thus facilitating communication, education, story-telling and citizen engagement actions.
- Provides DT and machine learning algorithms for optimizing both materials and Built Heritage performance, predicting also critical structural and degradation risks
- Informs CH stakeholders about energy performance of Buildings for better planning and maintenance
- Delivers realistic results on materials and building envelope performance, based on 3 different Use Cases in three different climate zones, from 3 buildings of different typology.
- Delivers comparative data between 2 mock-buildings renovated by SINCERE and conventional materials (ACCIONA DemoPark, Spain).

EO6. More important role of the cultural heritage in deployment, showcasing and replication of solutions for a sustainable built environment.

SINCERE applies cutting edge technologies and communication tools to demonstrate the effects of climate change on Built Heritage, which is promoted to central stages where collective awareness is transformed to collective action, promoting stakeholder participation. This democratic approach is required to unravel all relevant ethical and political perspectives of all stakeholders involved in a specific sustainability challenge (e.g., students, government, citizens, enterprises). This will enable to accelerate the transition process as a pluralistic perspective and will increase support for sustainability solutions.

SINCERE consortium encompasses 2 Cultural Heritage entities (HMC, MP) and 2 SSH actors (NH, ECO) that bring into the project 3 demo-sites that are in the process of restoration and renovation towards their adaptive reuse.

Materials, technologies and public engagement methodology of SINCERE address straightforward the main phases of adaptive reuse of cultural heritage (ARCH) buildings, preventing unnecessary carbon emissions and preserving the historic fabric of our towns and cities:

- **restoration study phase**: CIMP6 simulations will be spatially downscaled and validated at local level for producing Climate Change and Risk Indices for CH buildings.
- **restoration phase**: implementation of novel, low-carbon hybrid binders and advanced repair mortars for structural strengthening and thermal retrofitting, techno-economic evaluation based on compatibility and performance parameters, along with CO2 equivalent and production cost
- **operation phase**: energy harvesting, passive cooling, better insulation, integration of ICT/HBIM/DT technologies aiming to improve the functionality, the operational costs and sustainability of the renovated CH buildings
- **maintenance phase**: continuous monitoring with HBIM/DT tools allows data acquisition and analysis, which enable the evaluation of the building status in terms of sustainability, structural integrity and operational costs

SINCERE facilitates therefore the EU priorities for changing how Europeans consume and produce materials and energy, supporting the principles of circular economy (CE), while also supports the role of cultural heritage buildings as established drivers of socioeconomic development, urban landscape, and identity.

2.1.2 Destination Impact & Cross-cutting Priorities:

CCPs: Technological and socio-economic breakthroughs for achieving climate neutrality and the transition to zero pollution of the **building stock** by 2050, based on inclusive and people-centric R&I

SINCERE follows a 3 pillars strategy for achieving net-zero carbon Built Heritage:

A. Reduction of CO_2 emissions from building repair materials:

- Reducing consumption and demand for non-recyclable raw materials
- Reducing consumption and demand for fossil energy during cement and mortars production.

B. Incorporate circular economy principles by:

- Reuse and rehabilitation of existing CH buildings and introducing the urban-mining approach for cement-based building materials and architectural elements including windows and window frames, doors, and finishes, such as floors, ceilings, fixtures and furnishes.
- Reducing the need for material repairs and replacements during building life-cycle by developing and demonstrating more durable, longer-lasting repair and thermal mortars.
- Designing architectural repairs methods, based on adaptability (adaptive re-use), deconstruction and reuse, giving a second life (new purpose) on 19th-20th century heritage buildings.

C. Restore climate balance to achieve net zero carbon by:

- Reducing energy consumption during all phases of Built Heritage life-cycle: materials production-building repairs-operation-maintenance-management.
- Enabling long-term, high efficiency energy harvesting during the building operation phase.

CCPs: Increased energy efficiency in **industry** and reducing industry's Greenhouse Gas (GHG) and air pollutant emissions through recovery, upgrade and/or conversion of industrial excess (waste) heat and through electrification of heat generation.

SINCERE addresses one the most energy consuming industrial sectors, that of Cement production and the wider construction and building materials industry. Besides the direct focus of SINCERE on sustainable types of cements that are produced at lower temperatures, consuming lower energy and less natural resources, TITAN, participates and links consortium with 2 significant EU Projects:

i) RECODE (H2020 SPIRE, GA768583), where CO2 from the flue gases of a cement rotary kiln is captured and used to produce value-added chemicals and materials, utilizing a circular-economy-approach. A dedicated pilot plant has been installed and operated in 2022 at TITAN Kamari plant, demonstrating CCUS at TRL6.

ii) CARMOF (H2020, GA760884), which focuses on carbon capture at TRL6, using optimized structured adsorbents in combination with pressure swing adsorption. The technology will be demonstrated at TITAN in 2023.

iii) Moreover, **TITAN H2CEM** project regarding the production and use of green hydrogen for cement manufacturing, is included in the "Hy2Use" Important Project of Common European Interest (IPCEI) for the hydrogen value chain. This innovative project by TITAN Group will advance green hydrogen use towards the decarbonisation of cement manufacturing.

SINCERE foresees strong ties with those projects and common dissemination and public engagement activities.

CCPs: More energy efficient building stocks supported by an accurate understanding of buildings performance in Europe and of related evolutions.

SINCERE incorporates four demo-cases within EU, at different microclimatic zones, exhibiting different thermal and energy requirements (Spain, Greece, Czech Republic and Israel). The evaluation and monitoring of materials, technologies and building performances in those areas will provide a rich data-set regarding the thermal and energy response of buildings when different retrofitting regimes are followed. The HBIM/DT tools will allow prediction of future needs and inform stakeholders for optimum renovation scenarios. At the same time, the efficiency of

transparent, low-cost, yet highly efficiency BIPVs will be evaluated at the same conditions, allowing also better understanding for the balance between energy needs/consumption and potential for energy production. These results will support the transition to green energy production.

CCPs: Building stocks that effectively combine energy efficiency, renewable energy sources and digital and smart technologies to support the transformation of the energy system towards climate neutrality.

SINCERE adapts a multi-scale concept, from material-, to building-, to neighbourhood- to city-scale, applied on the three main parts of a building, i.e., structure, external envelope (opaque), and transparent parts implemented at different time-frames in order to provide decision making tools to the different stakeholders involved in the process. Energy performance parameters in terms of thermal retrofitting materials and energy harvesting solutions are optimised according to the buildings' unique architectural, functional and materials characteristics, their environmental setup (climate zones), as well as local future climate change scenarios. SINCERE provides a palette portfolio of sustainable restoration options that will be evaluated by H-BIM/H-DT tools in order to enable the selection of optimum solutions and the planning of necessary adaptation actions. SINCERE will also focus on raising awareness and empowering Europeans to promote the concept of preservation of CH buildings.

CCPs: Higher buildings' performance with lower environmental impacts through increased rates of holistic renovations.

SINCERE will have a high impact on boosting the efficient use of resources by moving to a clean, circular economy; its results will make it possible the implementation of target actions by the following sectors or our economy:

- "Ensuring that buildings are more energy efficient", which will also impact on the following other sectors:
- promoting environmentally friendly technologies: new construction materials, new construction technologies, new products to enhance the energy efficiency of the buildings;
- supporting industry to innovate: the project results will have a high impact on demonstrating new direction for fostering the innovation uptake of the CH conservation sector, as a niche sector in the construction industry but also able to drive innovation and covering the whole value chain in terms of materials products and processes.

CCPs: Higher quality, more affordable built environment preserving climate and environment, and safeguarding cultural heritage and ensuring better living conditions.

The evaluation and validation of SINCERE materials, energy harvesting and ICT technologies in four demo-sites, especially with the actual involvement of citizens, will support the reuse of existing heritage buildings, thus the context of urban transformations, which has attracted increasing interest in recent years, both in the face of the large availability of abandoned or underused properties. Also due to the need to identify new economic engines for urban areas that have lost their original function and their competitiveness. In that sense, SINCERE provides new, innovative materials, marketable products, new social/recycle economy concepts and ICT tools that can provide benefit both to EU citizens and CH authorities.

2.1.3 Potential barriers towards impact

Potential barriers	SINCERE mitigating measures
Lack of regulatory environment for low-carbon cements	TITAN and NCSRD will collaborate with National European Technical Assessments (ETAs) body and EN-TC committees for providing input
Urban regeneration processes are long in nature and the stakeholders involved often are difficult to reach/engage with	Communication and stakeholder engagement approach uses the Heritage Buildings as main stage for raising society's awareness; developing an ecosystem of stakeholders and citizens; running Citizen Science activities
Restoration of Historic Buildings Market is growing at a moderate step	Information and dissemination activities in Technical Fairs and Exhibitions are expected to facilitate faster growth
Lack of standards for conservation of Historic Buildings	Technical training to contractors who specialize in historic restoration for gaining the expertise to use new materials and produce excellent results

2.2 Measures to maximise impact – Communication, Dissemination, and Exploitation

2.2.1 Communication, Dissemination, and Exploitation (C/D/E) activities

Urban regeneration processes are long in nature and the stakeholders involved often are difficult to reach or engage with. SINCERE's approach for communication and public engagement uses the Heritage Buildings as key players, orchestrating - **Building as stage** for raising society's **awareness; Building as boundary object** for developing an ecosystem from different disciplines, stakeholders, and citizens; **Building as laboratory** for running **Citizen Science** activities. More specifically we have set as a clear objective of our platform the active engagement of projects and case studies outside the scope of SINCERE, and eventually the creation of a real organisation, an alliance, SINCERE website. There are numerous levels at which social impact can be achieved. SINCERE will focus to create an output to reach the first level, to empower on skill levels within the target group (SINCERE as boundary & Laboratory). On a second level SINCERE will target changes in behaviour with the user engagement workshops. Last, on third level SINCERE aims to improve the living conditions on building-neighbourhood-city level. An incremental approach will be followed, developing locally CDE processes centred around the CH sites that progressively join their individual voices in different forms: a audio stories portal, open workshops, and outputs to a common platform (see

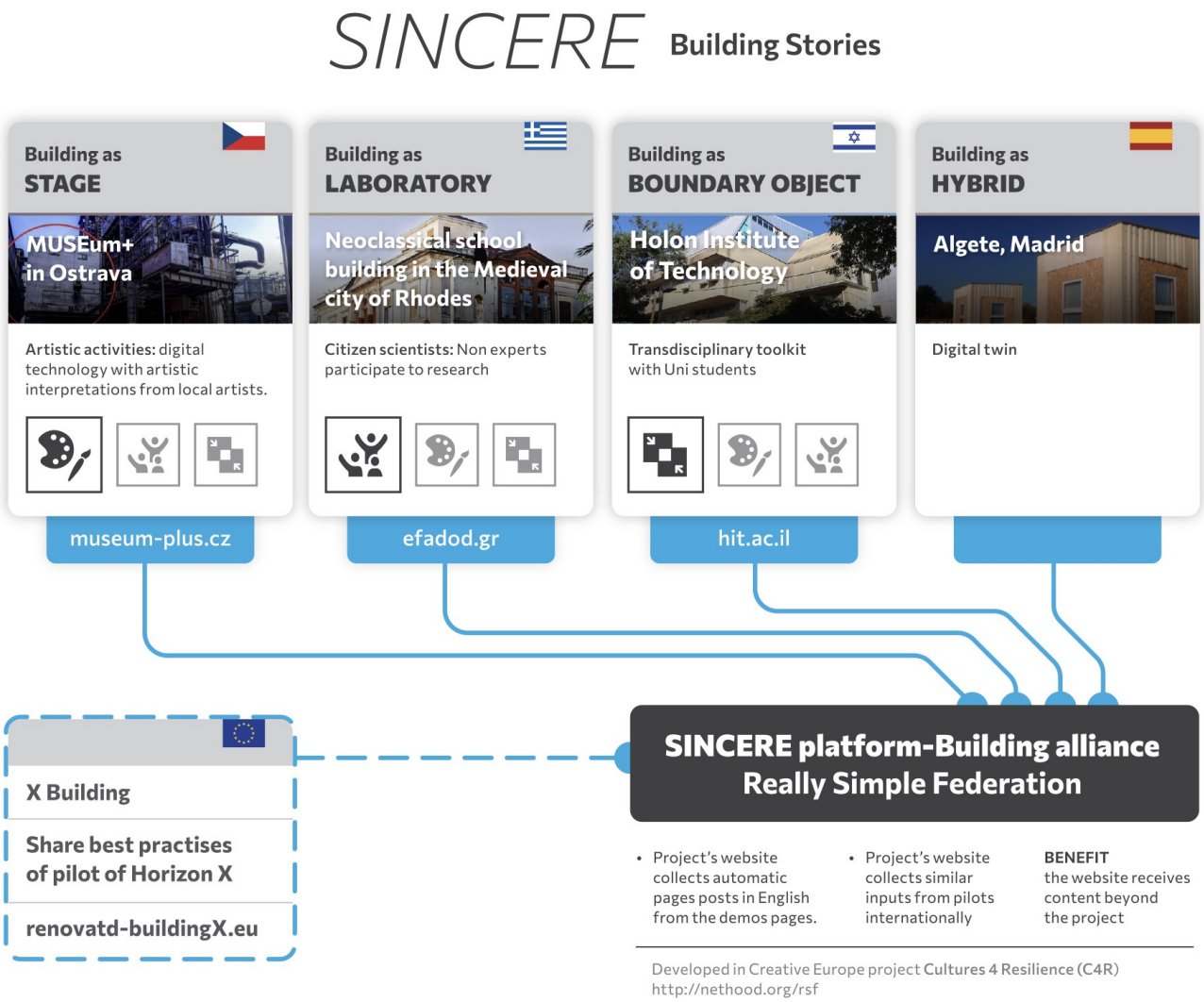


Figure 12. Communication Methodology.

Figure 12). Locally, a wide variety of co-creation processes for building individual communication and dissemination strategies will be initiated with key stakeholders based on local needs, expertise, and capabilities. This process enables tackling the challenges of the future take-up of the envisioned technology, and real needs. Also, having maximized the outreach both locally and at the European level makes individual exploitation plans more credible. The chosen strategy and main audiences, key messages, tools of communication and a set of KPIs are summarised in Table 1. **Exploitation-oriented dissemination** will enable knowledge transfer for the project innovative solutions, as well as promotion of the benefits that these solutions can provide to potential targeted end-users. The **Dissemination and Communication Plan** will be delivered in the initial stage of the project (M6, D6.1) and will be updated on annual basis. The Plan will address following questions: who the target audience is, what message will the target audience receive, how and when the message will be received. It will further define the roles and responsibilities of the project partners and it will highlight the steps to be taken to ensure proper dissemination of the generated knowledge. These steps revolve around confidentiality issues, publication of various formats, and the use of the generated knowledge. The Plan will be expanded in two directions: towards the marketing activities in order to enhance the commercial potential of the project technologies and towards the notification of project results in the local, national and transnational communities and society and EC. Each annual update will include a report of activities performed and give an overview on activities planned by project partners. Templates for tracking dissemination and communication activities performed by project partners will be provided by dissemination leader. The key messages of the project will concern technology (multiperformance, reduction of consumption of natural resources, immersive fruition of regenerated CH) developed within the project (without revealing IP sensitive information), recycling, health, safety, environmental impact, sustainability, social and economic aspects.

The target audience for SINCERE project includes:

a) Experts from CH value chain: industries (construction/renovation materials, construction chemicals, building products), universities and research institutions investigating the technologies developed by SINCERE, designers, engineers, architects.

b) Potential customers: specialized concrete markets and manufacturers of new concrete technologies (self-sensing,

self-healing and energy harvesting features), PV manufacturing companies, Building Materials, ICT companies.

c) End users: connected to any of the three demonstration sites.
d) Facilitators: EC, policy makers, financial institutions, standardization and certification bodies, urban planners, district administrative bodies, municipal authorities, European Construction Technology Platform, etc.
e) Entrepreneurs, associations, society, wide public, media.

The dissemination strategy will start stablishing interactions with **relevant stakeholders** and **cluster projects** - Tailored dissemination and communication activities will be developed in order to strengthen the cooperation with the main stakeholder communities (both at EU and member state level): EC, policy makers, professional representatives, public authorities, sectorial and industry associations, educational institutions and society in general. A link with other relevant EU co-funded projects will be established in order to improve the mutual cooperation, by exchanging information and methodologies and maximizing the synergy efforts e.g. in terms of building larger case study databases. This will enhance the attractiveness towards end user stakeholders which will not only foster future replication and market penetration of the project´s technology but also multiply the value of citizens' awareness in embodying and living the SINCERE vision and experience. Conferences, workshops, fairs, seminars and clustering events will be organized to target a wide stakeholders' audience. The project will gain feedback on on-going development activities, inputs related to research findings, existing tools, best social engagement practices and market, and input on future regulations and policies.

Students & Teachers: NH will develop an educational online activity. On top, it will deliver a workshop with invitations to schools and teachers of the pilots to share the innovations outcomes of the projects and provide inputs on activities to deliver to their students. **Public Engagement:** SINCERE's citizen science activity will engage non experts actively in the research on top of the *Open Demonstration Workshops*. **Entrepreneurs**: Synergies with EIT Culture & Creativity and other EIT communities (e.g. Climate KIC Greece-Climate KIC Accelerator programme) to develop mindsets on entrepreneurship. Collaboration with other granted HORIZON EUROPE consortiums from the same call is a priority to join forces for adaptation strategies in CC and CH.

Interaction with **scientific/higher education community** and **professionals** – will stter in the transfer of the acquired knowledge into education of a future generation of professionals and in the future market, public conscience and policy making deployment. According to the dissemination and communication strategy, the following channels and methods will be exploited, with key performance indicators shown in Table 1.

Each of the partners will bring into the project their contact network according to their role within the project, guaranteeing a range of diversified stakeholders and disseminating/communicating project info and results via their channels (websites, newsletters, press releases, social media, direct communications, invited talks).

Table 1. Dissemination and Communication Strategy

Channel/ Activity	Target groups	Description	KPI (end of project)
Project website	All	Visual identity (logo, project's template hashtags), leaflet with project's description, eco-friendly merchandised material, project's website, organic social media campaign (LinkedIn/Twitter), paid social media campaign is foreseen for the citizen science open call to maximise the outreach to thousands accounts, Created in **M3** the project website will be kept alive and maintained for at least 3 years after the project ends, available in English and local languages for Pilots, advertised through search engines, *NH, all partners.*	Logo >1 **leaflet,** 3 languages, 1>project website (inclusive for blind people), 2>**social media campaig**n, 2 project **video with storytelling**, > 30,000 number of views > 3,000 number of users
Social media	General public	Created in **M1**, weekly posts, namely Twitter, LinkedIn, Instagram, YouTube channel. *NH, all partners contribution.*	>10 storytelling blog; >1 video >2000 views > 1,000 followers > 100,000 impressions
Brochure, roll-up and presentation	Professionals in related fields EC bodies	Designed in **M4**, and regularly updated, provides general public information about the project. *Design, update and printing by NH.*	> 5,000 copies > 1,000 downloads, > 1 white paper
e-Newsletter	Professionals / identified stakeholders	Distributed among relevant stakeholders every six months (starting at **M6**) - updates, findings, and outcomes of the project. *Design and campaign by NH, all partners.*	> 1000 Subscribers and downloads
Videos	General audience	In **M4**, a **graphical video** illustrating the project objectives, technology, demonstration, partners, and social impact will be created. Towards the end of the project, the **video including interviews** with key partners, filming of the demos and technology will be produced. *Development by NH (in-house production), partners contribution (speakers).*	> 2,000 views together *Cooperation with Euronews*
Scientific publications	Scientific audience	Articles in high impact dedicated scientific peer reviewed journals with open access. *All partners*	> 5 journal publications

Magazine articles / press releases	Professionals CH Industry & general audience	Articles in dedicated popularized magazines. *All partners*	> 5 articles > 50 press releases 1> **focus group**, >40 participants
Cluster activities	Other EU projects representatives/ professionals	Clustering activities with other European related projects and European and National Platforms, associations. (co-organized/participated events, website info sharing, common newsletter). links with other projects to be selected under the call HORIZON-CL2-2022, cultivating join activities with other networks such as MSC-ITN SUB-lime projects, EIT-Raw materials etc. Events jointly organised or participated, common activities such as newsletter, webinar, website info, etc All partners	> 3 cluster events participated/organized > 1 cluster events organised. > 5 common activities
Organization of public event(s)	Professionals &gen. audience	Public workshop, involving industries representatives, end-users, EU officials and wide public. *NH, all partners.*	> 3 public workshops > 100 participants
Participation at fairs, seminars, workshops, or conferences	Professionals &general audience	Presentation and exhibition of the project at various types of events to spread awareness, disseminate the results and get feedback from plural stakeholders. Showcasing in **high schools**; **MSc/PhD courses, MOOCs**. *All partners.*	> 30 events participated

2.2.2 Exploitation

SINCERE focuses on the development of highly exploitable technologies and products for the rehabilitation of Built Heritage and the achievement of goals for net-zero energy buildings and cities. Considering the global market needs for more sustainable building materials, as well as lower energy consumption and CO2 reduction targets, there is a clear intention of the participating partners to be market ready within 5 years of project completion (depending on the position in the supply and value chain). The overall exploitation intention is to ensure continuity of the SINCERE initiative, as well as to grow and extend its scope and activities beyond the funding period, while all industrial/SME partners expect to have significant **financial benefits** from the exploitation of the project results by **strengthening their position on the niche market of Built Heritage and net-zero buildings**. Exploitation of SINCERE project results will also aim at raising interest among relevant stakeholders from sectors with interests beyond CH and of high societal impact, including, among the others, transportation infrastructures, consumer customized goods, and energy (Table 2).

Table 2. Key exploitable results of SINCERE

Key Partners	Value Propositions	Customer Segments
• Cement companies • Photovoltaic companies • Computer vision SMEs • Construction Companies • Architects, civil engineers • Conservation entities • Research & Academia • Cult. Heritage authorities	• Low-carbon binders • Green, low-cost BIPVs • Low-carbon structural retrofitting mortars • Low-carbon thermal retrofitting mortars • Self-healing and corrosion inhibition additives • Passive cooling coatings • Extended reality tools • H-BIM/H-DT tools	• Cult. & Industrial Heritage authorities • Building materials, building chemicals and Construction Companies • Architectural Design and Engineering offices, Renovation Industry • Owners of listed and new buildings • Energy providers, • Building PVs and associated sectors • Energy windows sector

IP management

IP management plan (IPMP) will focus on knowledge transfer and IP rights of SINCERE results from the onset of the project, supervised by NCSRD, as the project's IPR manager. IP Management plan will address both the Implementation and Post-Project phases. In line with Consortium Agreement and Grant Agreement, the IPMP will provide to all partners a well-defined strategy and detailed procedures on how IP will be managed, aiming at clear identification and fair allocation of IPRs and potential patent contributions, starting in M1 until M36. IPMP will establish rules for the use of foreground, side ground and background knowledge and its distribution within the project, as well as the rules for handling sensitive and confidential information. IP plan will monitor the protection of IPR within and outside the Consortium and will be integrated in SINCERE overall Communication, Dissemination and Exploitation Plans (CDEP).

SINCERE is committed to providing free open access to new research data resulting from the project being one of Horizon Europe main objectives. Therefore, SINCERE will openly make available the content and data produced within the project through a gold model and FAIR data principles. In this sense, all partners will be encouraged to share their background knowledge (knowledge is brought into the project from other activities) to improve the quality of SINCERE work. In the cases that foreground knowledge may represent a significant value for the owner(s): as a general rule, the partners that have contributed to the development will have joint ownership to the IP. The IP should be communicated to the IP Manager to prevent misunderstandings in ownership. IP issues will be carefully handled within the project, especially those that are of strategic importance to facilitate the exploitation of its solutions. The

IP-related management structure, workflows and tools will be designed with the protection and exploitation of knowledge in mind, but also to be able to satisfy multiple IPR objectives.
Key practical procedures will be adopted in the project to ensure that the security and integrity of IP is maintained, such as: **Invention Disclosure Forms (IDF), Non-Disclosure Agreements (NDA),** on time communication of foreseen **Publications**. Regarding **open access to peer-reviewed publications**, following the EC Guidelines on Open Access to Scientific Publications and Research Data. To be able to move towards turning IP into business the The Consortium will explore the whole environment in which project solutions are to be employed: the market (size, growth, segments and regions), the technologies (other solutions to the same problem) and potential competitors or partners. IPR plans will mainly move towards: maintaining a schedule of innovation produced in the course of project development and exploring the opportunity for applying for patents or declaring copyrights; creating and updating a living IPR management database to be revised and extended with new pieces of knowledge (foreground) as project implementation advances; conceiving and executing an optimal patent/IP search and filing strategy. Regarding dissemination, the partners will select the appropriate time and means of dissemination, to maintain confidentiality. To this end, Communication, Dissemination and Exploitation of the project Results (CDEP) will conform with IPR management plan, to help beneficiaries to establish the bases for their intellectual property strategy, D/E activities.

Individual exploitation routes
TITAN –is a large cement industry operating more than 20 cement plant worldwide. It intends to commercialize 3 products (A) low-carbon cements, (B) low-carbon repair mortars and (C) low-carbon thermal mortars, since the repair mortars developed within SINCERE are in company's product development roadmap. The targeted market is the general construction industry for the low-carbon cements and the preservation of CH buildings for the other two types. TITAN will target firstly the European and then U.S. market.
NCSRD – will develop further the self-healing additives that works on and holds strong background knowledge. It foresees the creation of a patent portfolio on self-healing materials that will exploit through the Innovation and Tech. Transfer Office of NCSRD, as well as through collaborations with cement, building materials and construction industry. NCSRD targets mainly the European market.
UCL –who is in charge of radiative cooling coatings has already patented the main technological results and has signed contracts with Coatings and Paint companies of EU. The SINCERE results will will support the commercialization of (A) architectural radiative-cooling coatings for passive cooling of concrete buildings in the southern Europe and (B) hybrid PCMs-radiative cooling coatings for mitigating passive cooling during winter. The targeted market is the general construction industry with focus on the preservation of concrete buildings.
ACCIONA –will benefit from the output of the project as it will acquire deeper knowledge on the field of preservation of CH buildings of modern architecture. Its target is to collaborate with the other companies of the consortium and acquire contracts for such interventions around Europe.
LINKOPING Univ. –will exploit PVs result through the spin-off LinXole, that provides innovative and sustainable technologies regarding the stability of third-generation photovoltaic cells and will be tied into the niche market of Built Heritage, where the use of conventional silicon-based PVs cannot be used due to alteration of their architectural characteristics. LinXole will focus on the commercialization of (A) perovskite and (B) organic solar cells integrated in cement-based renders, ceramic tiles and windows glasses, aiming to introduce affordable, BI-solar cells. The targeted market is the renewable energy sector, and the development of BIPVs for the European Built Heritage.
RIMOND –is an integrated design, construction, and consultancy company for the full life cycle of the built assets providing unique end-to-end solutions to their clients. It intends to exploit Heritage BIM and DT tools, introducing innovative ways to support cities/entities in monitoring and managing Built cultural heritage, using DT integrated data, artificial intelligence analytic and virtual representations. RIMOND target the EU and global market.
NUROGAMES –intends to exploit algorithms for enabling integration of different Building Performance data in DT tools, incorporating AI analytics. NUROGAMES targets the EU and global market.
up2metric –develops innovative B2B software based on key-enabling technologies (3D vision, machine learning and extended reality). It intends to exploit extended and mixed-reality technologies for supporting CH renovation projects, which forms a new market segment with augmented share. U2M targets mainly Greece and EU market.
ECOAMA –will exploit the experience gained within SINCERE, getting new expertise on restoration/renovation projects of historic concrete structures and masonry buildings. Focus will be given on HBIM and H-DT tools for monitoring and projecting the structural/ thermal/energy behaviour of historic buildings. The target market is the renovation of historic buildings.
All ACADEMIC partners will exploit the project results and demos both for education and research purposes and for consulting services, in collaboration with relevant network of industrial partners and professional organisations. PhD candidates and MSc students will be trained (for example in ReSHEALience project GA 760824, coordinated by SINCERE partner POLIMI, with BGU and UoM, all partners have trained > 10 PhD students and > 80 MSc students throughout Europe, also in synergy). All partners will participate/organize workshops to increase the awareness of wider public to the new technologies developed by SINCERE and disseminate results via publications in international open access peer-reviewed scientific journals, international conferences, open data repositories.

2.3 Summary - KEY ELEMENT OF THE IMPACT SECTION

SPECIFIC NEEDS	EXPECTED RESULTS	D & E & C MEASURES
● Keeping historic and concrete buildings out of landfill dumps by not demolishing them. ● More energy efficient EU heritage buildings. ● Reduction of energy, fuels and raw materials consumption in cement and building materials. ● Avoid of demolition for 19th and 20th century CH buildings due to lack of insulation and elevated energy consumption for heating/cooling. ● More sustainable, more compatible repair materials with extended service life ● Support Green Deal and New Bauhaus priorities. ● Accurate and meaningful monitoring of historic buildings performance towards net-zero energy ● Green, sustainable, architecturally and socially acceptable solutions for energy harvesting by BIPVs. ● Minimum alteration of architectural, historic, technological characteristics of Historic Facades and RoofTops by modern PV and HVAC systems ● Socially innovative concepts for introducing the principles of circular economy. ● Technology and Innovation perception by modern society. ● Technologically enhanced performance of building.	● Development of an open Building Information Modelling for historical buildings (H-BIM) ● types of novel low-energy and low-carbon binders for restoration mortars ● 2 types of repair mortars for structural strengthening and 2 types of mortars for thermal retrofitting of historic buildings ● 2 types of self-healing additives for repair mortars ● 2 types of encapsulated rebar corrosion inhibitors ● micro-encapsulated bio-based phase-change materials (PCMs) with adjustable to climate zone properties, ● 2 types of environmentally friendly radiative cooling coatings and membranes, enabling the passive cooling of the building envelope ● Development and demonstration in 3 demo-cases a novel, sustainable and recyclable, low-cost, flexible and easily embedded into buildings perovskite-based solar cell, able to be produced and used in large areas. ● Incorporation of the green perovskite-based solar cells 3 substrates: in ceramic tiles, cement plasters and glass windows ● Integration of a modelling methodology into the interdisciplinary life cycle assessment (LCA)-, life cycle cost assessment (LCC)- and H-DT-frameworks developed within this project to achieve informed sustainability-driven asset management choices. ● Implementation of future climate change and response scenarios of all demo-sites.	**Development of a solid plan** for validation, demonstration and assessing project impact **Engagement with national and EU regulatory bodies** for enabling/drafting targeted regulation/norms for novel low-carbon substitutes of traditional clinker. **Networking and Clustering with** EU funded projects of the same call, clusters, and Built Heritage Associations (DOCOMOMO, ICOMOS, Getty) for implementing common training and dissemination activities, as well as with relevant EU and national projects where consortium partners participate. **Dissemination towards the scientific community**: Peer reviewed publications in high ranked journals, Open Access to publications and research data, participation to conferences for scientific and professional audience, clustering activities with other EU funded projects, public dissemination, and demonstration events organization, press releases on thematic portals, dedicated training activities (Best Practices Handbook, training school, VR applications for experts, etc.). Dissemination KPIs and concrete activities described will be reached. Dissemination and Communication Plan creation and regular update. **Communication towards citizens:** Social media campaign for open calls-citizen science activity, project website creation, in-house video production, visual identity for the project, promo materials design, newsletter campaign, participation to fairs, expos, etc. Communication KPIs stated will be reached. Dissemination and Communication Plan creation and regular update. **Exploitation**: Patenting, licensing, trade secret, copyright. Exploitation workshops organization. Exploitation Plan including IPR manual creation and regular update.

TARGET GROUPS	OUTCOMES	IMPACTS
Experts from value chain: Industries, universities, and research institutions, etc. **End-users/potential customers**: Construction companies, providers of the raw materials for construction industry, public building owners and managers focusing on CH of 20th century, restorers, curators, craftspeople, architects, and other professionals in the industry, museums, cultural institutions, etc. **Facilitators**: EC, policymakers, financial institutions, municipal authorities, cultural heritage authorities, etc. **Other**: Architects (e.g. Architects' Council of Europe), designers, cultural heritage associations (e.g. Europa Nostra, International Council on Monuments and Sites, International Centre for the Study of the Preservations and Restorations of Cultural Property, Culture Action Europe, European Union National Institutes for Culture, European Historic Houses Association), high technology SMEs interested in adopting new technologies, citizens, etc.	In addition to the overall PV goal of lowering Levelized Cost of Electricity, Building Integrated PVs can bring the extra value of decentralized, point-of-use electricity generation and simultaneously fulfil, e.g., a roofing, facade or sound barrier function. Thus, enabling mass realisation of "(near) Zero Energy Buildings" by BIPV, through the establishment of structural, collaborative innovation efforts between the PV sector and key sectors from the building industry. Disruptive trends in the built environment could change the role of cement and concrete and redefine the opportunities for innovation and decarbonization in the sector. Digital tools will play a key role in building the market for building renovations focusing on energy performance. Such tools will address knowledge gaps and 'democratize' access to relevant information at different points along the value chain. Other outcomes include: • Finding additional financing and stakeholders for upscaling to TRL9. • Public awareness about the project and its results • Commercial products up to 5 years after the project completion. • Exploitable results secured with proper IP protection. • Increasing the acceptance of new materials in construction sector which is very conservative.	**Environmental**: Overcoming Barriers to deployment of low-carbon Cement and Concrete could result in the medium term to scale up the use of alternative clinker substitutes will expand the range of options for deep decarbonization of Built Heritage and Contemporary Structures. The use of alternative raw materials and industrial by-products as pozzolan will contribute on the development low-carbon, low-energy cements. This will lead to 30% reduction of CO_2 emissions and of 10% fuels released during the production process. Enhancement of life span in structural repairs by > 40%; enabling reduction of heat transfer in buildings > 35% **Economic**: Exploiting the experience and background knowledge of industrial partners (TITAN, RIMOND) during materials/technologies development, thus ensuring that quality assessment, market needs, and performance requirements are properly addressed. **Socio-Economic**: The reviving of historic concrete building with novel, compatible repair mortars, optimized by AI/machine learning algorithms, as well as the need for building and digital skills will increase the awareness of stakeholders, increase employment and fundraising. The advanced properties of multi-functional materials could provide new framework for conserving and managing listed buildings and thus maximizing the economic and societal benefits for EU citizens. **Public literacy actions** will increase the awareness of citizens on climate change effects, as well as on the multiple impact of CH conservation on society and the improvement of every-day-life, its effect on shaping social identity (provide people common references to feel attached to the territory/community), and as a source of economic development (cultural tourism).

3 Quality and efficiency of the implementation

3.1 Work plan and resources

SINCERE is proposed as a 36-month research project organised in six Work Packages (WP) - Table 3.1a includes Person-Months (PMs) and start/end, which balance between grouping the similar tasks to ensure collaboration and follow the project timeline while ensuring the required flexibility to execute the individual tasks. Figure 13 presents the program evaluation and review technique chart – *PERT chart* – and Figure 14 shows the SINCERE timeline in a *Gantt chart*. The work breakdown structure is presented in Table 3.1b: WP1 regards the administrative, financial, and technical management, as well as treating the ethics, gender and legal issues; WP2 organises the pilots, the user requirements and the evaluation, as well as the studies on the effect of climate change of cultural heritage buildings and the architectural context; WP3 regards the digitization of BCH via DT, immersive tech and AI; WP4 researches on innovative green materials to renovate and protect CH buildings; and WP5 develops novel coatings to boost energy performance. Finally, WP6 concentrates the communication and dissemination tasks, including the Citizens Science activities, and the exploitation and the sustainability plan to maximise the use of the SINCERE outcomes. SINCERE dedicates T1.4 to self-assessment processes to identify risks for the project objectives, monitor them via logging them in the *Risk Registry,* solve them via the internal communication, and report them in M12, M22 in the *Quality Assurance and Risks Mitigation Plan*. Initial risks are identified in Table 3.1e.

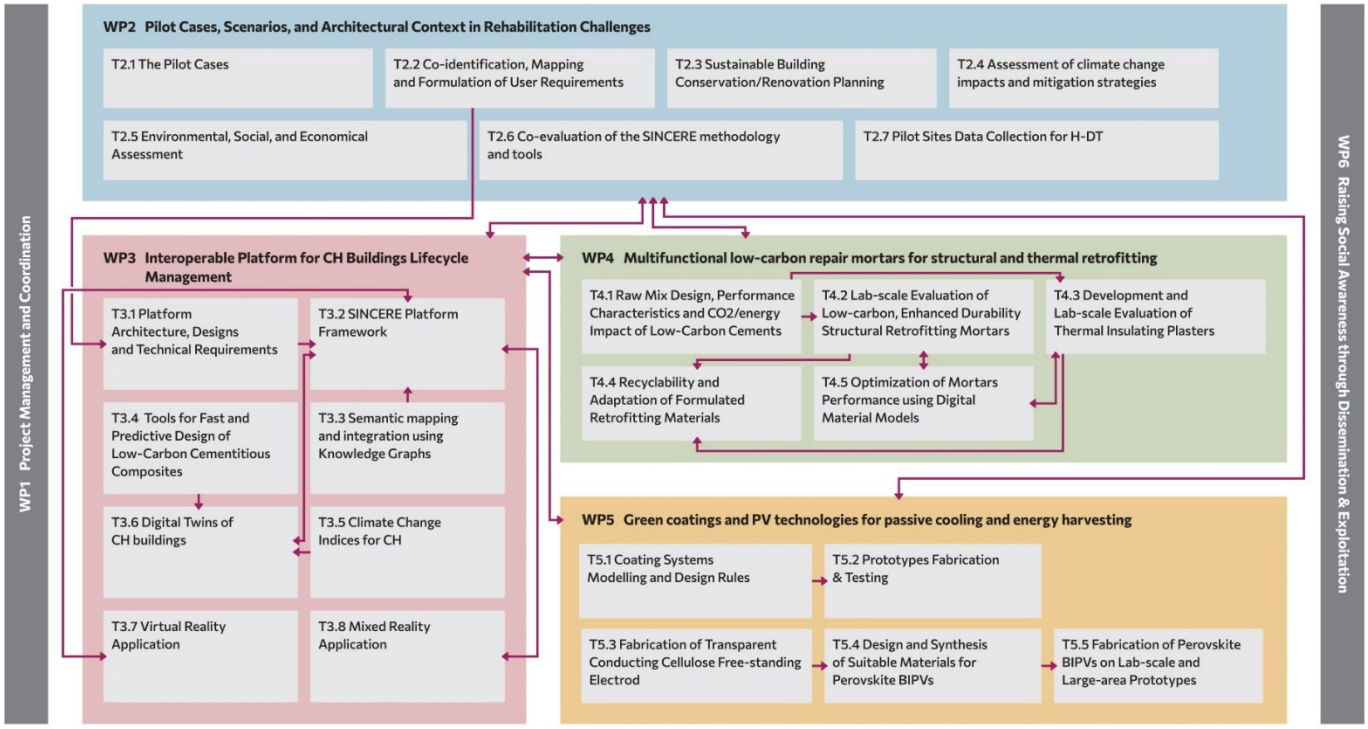


Figure 13. SINCERE PERT chart.

Table 3.1a: List of work packages

#	Work Package Title	L. #	Leader	PMs	Start	End
1	Management and coordination activities	1	NCSRD	39	M1	M36
2	Pilot Cases, Scenarios, and Architectural Context in Rehabilitation Challenges	11	ACCIONA	159	M2	M36
3	Interoperable Platform for CH Buildings Lifecycle Management	7	CERTH	153	M7	M33
4	Multifunctional low-carbon repair mortars for structural and thermal retrofitting	5	POLIMI	145	M7	M33
5	Green coatings and PV technologies for passive cooling and energy harvesting	13	LU	120	M7	M33
6	Raising Social Awareness through Dissemination & Exploitation	18	NH	148	M1	M36
		Total PMs		764		

	Work Packages and Tasks	Lead	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1	Project Management and Coordination	**NCSRD**																																				
T1.1	Project Management	NCSRD		D1.	D1.2									D1.1						D1.1																		D1.5
T1.2	Innovation Management	NCSRD						D1.3																														D1 D1.4
T1.3	Quality Assurance and Risks Management	NCSRD												D1.1										D1.1														D1.5
T1.4	Ethics, Gender and Legal Issues Management	NCSRD						D1.6																D1.6														D1.5
WP2	Pilot Cases, Scenarios, and Architectural Context in Reh	**ACCIONA**																																				
T2.1	The Pilot Cases	UM												D2.1										D2.1													D2.1	
T2.2	Co-identification, Mapping and Formulation of User Req	ECO						D2.2																D2.2														
T2.3	Sustainable Building Conservation/Renovation Planning	ECO																						D2.3														
T2.4	Assessment of climate change impacts and mitigation str	NCSRD																																	D2.4			
T2.5	Environmental, Social, and Economical Assessment	NH																																	D2.6			
T2.6	Co-evaluation of the SINCERE methodology and tools	ACCIONA																						D2.5														D2.5, D2.7
T2.7	Pilot Sites Data Collection for H-DT	RIMOND																		D2.8																		
WP3	Interoperable Platform for CH Buildings Lifecycle Mana	**CERTH**																																				
T3.1	Platform Architecture, Designs and Technical Requirem	U2M												D3.1										D3.1														
T3.2	SINCERE Platform Framework	U2M																		D3.2										D3.2								
T3.3	Semantic mapping and integration using Knowledge Gra	CERTH																		D3.2										D3.2								
T3.4	Tools for Fast and Predictive Design of Low-Carbon Ce	USH																		D3.2										D3.2								
T3.5	Climate Change Indices for CH	NCSRD																		D3.2										D3.2								
T3.6	Digital Twins of CH buildings	CERTH																		D3.2										D3.2								
T3.7	Virtual Reality Application	NURO																		D3.3															D3.3			
T3.8	Mixed Reality Application	U2M																		D3.4															D3.4			
WP4	Multifunctional low-carbon repair mortars for structural a	**POLIMI**																																				
T4.1	Raw Mix Design, Performance Characteristics and CO2	TITAN																		D4.1										D4.1								
T4.2	Lab-scale Evaluation of Low-carbon, Enhanced Durabili	POLIMI																		D4.2										D4.2								
T4.3	Development and Lab-scale Evaluation of Thermal Insul	UNAV																		D4.3										D4.3								
T4.4	Recyclability and Adaptation of Formulated Retrofitting I	UM																		D4.4															D4.4			
T4.5	Optimization of Mortars Performance using Digital Mate	USH																		D4.4															D4.4			
WP5	Green coatings and PV technologies for passive cooling	**LU**																																				
T5.1	Coating Systems Modelling and Design Rules	UCL												D5.1						D5.1																		
T5.2	Prototypes Fabrication & Testing	UCL																		D5.1															D5.1			
T5.3	Fabrication of Transparent Conducting Cellulose Free-st	NCSRD																		D5.2										D5.2								
T5.4	Design and Synthesis of Suitable Materials for Perovskit	LU																		D5.2										D5.2								
T5.5	Fabrication of Perovskite BIPVs on Lab-scale and Larg	LU																		D5.2															D5.2			
WP6	Raising Social Awareness through Dissemination & Exp	**NH**																																				
T6.1	Building as a Boundary Object	NH						D6.1												D6.1										D6.1								D6.1
T6.2	Building as a Laboratory	NH																		D6.2															D6.2			
T6.3	Building as a Stage	NH																		D6.1										D6.1								
T6.4	Exploitation and Sustainability Plan, Market Analysis and	TITAN																						D6.3														D6.3
T6.5	Standardization Activities for Novel Materials, H-BIM, a	TITAN																																				D6.4
	Milestones							MS1						MS2						MS3				MS4						MS5					MS6			MS7
	SINCERE platform versions																			alpha										beta					final			
	Workshops and Evaluation													Pilot 1 - Testbed										Pilot 2 & 4			1st Demo		Pilot 3 Demo							Pilot 2 & 4 final Demo	
			1st Year													2nd Year													3rd Year									

Figure 14. SINCERE project timeline in a Gantt chart.

Table 3.1b: Work package (WP) description

WP #	1	Lead beneficiary	NCSRD	Start Month	1	End Month	36
WP title	**Management and Coordination Activities**						

Objectives: WP1 aims to: i) Manage SINCERE and ensure compliance with the project scope, schedule, and budget. ii) Manage the administrative/financial aspects of the project including financial reporting to EC, controlling partners' financial certificates, creating, and controlling the project GA and keeping records of financial accounts. iii) Ensure SINCERE innovation, technical integrity, and state-of-the-art research. iv) Ensure the quality of project outcomes. v) Organise the project communications and manage any conflicts. vi) Treat any ethics, gender, and legal issues. vii) Develop data management mechanisms and organise IPR protection.

T1.1 Project Management [M1-M36] (Leader: **NCSRD** 6PM; Participants: all partners 1PM)
Ensure that the project is managed according to the EC rules and legal regulations. Coordinate the Consortium and stakeholders as well as plan and organise the project activities. Perform Administrative Management for the legal, contractual, and financial operations of the project including resources allocation monitoring. This task relates to the i) preparation of EC progress reports, ii) management of the distribution of all required documents (deliverables, progress reports and *Issue Registry*), iii) budget controlling and accounting, iv) coordination of meetings, v) monitoring of the time schedule, vi) provide the tools for internal communication and coordination of activities, vii) assess the work and achievements of technical and non-technical deliverables, viii) assist with conflicts resolution. The *Project Management Plan* will be issued to define the processes for all Monitor and Control activities throughout the project duration (D1.1) and a collaborative workspace to enhance collaboration will be set (D1.2).

T1.2 Innovation Management [M1-M36] (Leader: **NCSRD** 2PM, Participants: POLIMI 4PM)
Identification also in collaboration with T1.2 of pre-existing know-how and consortium agreement preparation; selection of experts for *External Advisory Board* and management of interaction strategy; identification of potential product/process/context innovation issues and coordination with other WPs for related patenting, exploitation/market strategy, dissemination and promotion activities (*IPR Plan* - D1.3) and work out at project termination guidelines for follow-up (D1.4) and include innovation results in final report (D1.5). Additionally, ensure that the partners operate according to legal and ethical framework with respect to data privacy and confidentiality. The data management approach includes i) the generation, storage, and sharing process principles -GDPR and FAIR principles-, as well as ii) the technical standards for data representation and sharing according to the Data Management Plan (*DMP Plan* - D1.3), as described in detail in Section 1.3.6.

T1.3 Quality Assurance and Risks Management [M1-M36] (Leader: **NCSRD** 2PM; RIMOND 1PM, TITAN 2PM, NH 1PM)
Quality assurance of the project activities and outcomes will follow the *Quality Plan* (dedicated section in D1.1) that will streamline i) templates and procedures for quality management, control, and reporting - *quality review checklist* and *deliverables acceptance checklist*, ii) regular assessment of the project achievements and update of *Project Registries*, iii) internal reviews for deliverables such as reports, software, and demonstrations, iv) set the main roles for (Technical Manager, WP Leaders, Task Leaders and other partners). Risk management will be tracked via a *Risk Registry* that will be regularly updated and documented in the two versions of D1.1. to v) timely identify potential risks and launch mitigation actions.

T1.4 Ethics, Gender, and Legal Issues Management [M1-M36] (Leader: **NCSRD** 2PM; {POLIMI, UCL} 1PM)
This task will i) monitor and provide the guide to ethics, gender, and legal implications. Partners will assess their research activities especially the ones including human participants, personal, which will support T1.3, and other sensitive data such as archaeological, with respect ii) to European data protection rules and ethical principles, iii) the European Code of Conduct for Research Integrity. iv) Gender balance issues will be explicitly monitored inside the consortium and v) gender issues will be assessed for their effect in research. vi) Follow Responsible Research and Innovation (RRI)[19]. This task will be reported in D1.6.

WP #	2	Lead beneficiary	ACCIONA	Start Month	2	End Month	36
WP title	**Pilot Cases, Scenarios, and Architectural Context in Rehabilitation Challenges**						

Objectives: To define the pilots under which the SINCERE novel materials, methodologies, and digital tools will be evaluated. To identify architectural context and building identity for key-restoration/rehabilitation challenges to meet the social awareness raising objectives. To systematically evaluate the SINCERE approach through 4 Pilot Use Cases (Greece, Israel, Czech Republic, Spain) (**OBJ-01**, **OBJ-07**).

T2.1 The Pilot Cases [M7-M35] (Leader: **UM** 6PM; Participants: all partners)
The end-users will detailly describe the usage scenarios of the SINCERE methodology and tools (D2.1). Four pilots are considered covering the typical activities conducted by owners, policy makers, conservators, and

[19] https://rri-tools.eu/

architects as described in the Section "Description of demonstration sites". Each pilot will include the following activities: Pilot design: structure and monitoring system; Pilot construction and commissioning; Pilot monitoring phase and data collection. UM will undertake the task of on-site construction management. All partners participate either as users, experts, or technology providers as further described in Section 1.2.10. The CH buildings will also support Demonstration Workshops for experts and Open Days Workshops for the active engagement of a selected group of citizens in the research activities for resilient and adaptive renovation.

T2.2 Co-identification, Mapping and Formulation of User Requirements [M2-M22] (Leader: **ECO** 4PM; Participants: {RIMOND, ACCIONA, HMC, MP, NH} 2PM)

This task will document and organise the functional and non-functional end-users' requirements (UR) to a coherent list that will support the needs of all the pilots and the usage scenarios regarding renovation and rehabilitation of BCH. The UR will be grouped based on the target audiences to facilitate the impact of SINCERE, exploiting a workshop parallel to the kick-off-meeting with invited guests -travel expenses covered (T6.5). ***KPIs*** will be assigned to each UR to ensure tractable and quantifiable validation of the SINCERE methodology and tools and will be thorough enough to translate into technical specifications and a platform architecture in T3.1. The URs will be documented in M12 (D2.2) (*Validation, demonstration, and impact assessment work plan*).

T2.3 Sustainable Building Conservation/Renovation Planning [M7-M22] (Leader: **ECO** 3PM, Participants: RIMOND 2PM, BGU 2PM, ACCIONA 2PM, HMC 2PM, UM 3PM, NH 2PM)

The task will make reference to recently published EU documents on the status of the EU building stock and current European regulations, building codes and standards will address each different approach of the project, regarding the materials and structural requirements, energy and environmental performance, safety and fire regulations, as well as relevant legislation regarding minimum requirements for energy production by renewable energy sources, utilisation of energy storage and sharing within the neighbourhood context in the form of microgrids and energy communities. The results will flow into D2.3 which will contain as an output also the performance targets that renovated CH buildings should meet during their lifespan.

T2.4 Assessment of Climate Change Impacts and Mitigation Strategies [M23-M33] (Leader: **NCSRD** 6PM)

This task deals with an extensive assessment of the impacts of climate change on the selected cultural heritage buildings due to individual, cascading and compounded hazards following an innovative stakeholder engagement concept of climate narratives. Initially and for the CH buildings of relevance to SINCERE, NCSRD will use relevant projected climate scenarios (T3.5) with particular reference to the climate hazards that critically expose the vulnerabilities of the CH sites (e.g., extreme temperatures and their daily variability, freeze-thaw cycles, rainfall and strong winds, flooding, sea level rise, smoke and thermal radiation from wildfires) and also synergistic effects that could lead to impacts such as thermoplastic deterioration, saltation, corrosion, biomass accumulation etc. For the selected project pilot sites climate narratives will be developed that will link downscaled climate model information, bibliometric and expert assessment of the potential impacts to the CH buildings and implemented mitigation measures (physical restoration interventions, governance schemes, accessibility, etc.). The collected data will be summarized in the SINCERE H-DT (T3.6) and will be used as communication material to the wider community (T6.3). T2.4 is reported in D2.4.

T2.5 Environmental, Social, and Economical Assessment [M23-M33] (Leader: **NH** 6PM, Participants: ECO 3PM, POLIMI 4PM)

This task will assess the impact of the SINCERE outcomes, either novel materials or digital technologies for cultural heritage buildings' renovation. The holistic assessment will consider environmental, social, and economical aspects for each pilot site. Data from life cycle analysis (LCA), life cycle cost (LCC) and social life cycle analysis (SLCA), will be updated based on the results of demonstration and pilot activities. POLIMI, as task leader, will gather the contribution from the other partners, will perform the analysis and will integrate the results. All other partners involved will provide data for the SLCA, according to their roles in the development of novel materials and digital applications. The methodology and results will be reported in D2.6.

T2.6 Co-evaluation of the SINCERE Methodology and Tools [M19-M36] (Leader: **ACCIONA** 9PM; Participants: {NCSRD, ECO, RIMOND, HMC, MP} 2PM)

Prepare the methodology and procedures to evaluate the overall SINCERE approach on the demonstrations carried out in the pilots and the target audience's feedback. This task will validate and measure the performance and the usability of the SINCERE outcomes. The KPI-based assessment in the intermediate Workshops (T6.1) and Citizen Science activities (T6.2) will allow the consortium to develop recommendations and adjust the proposed methodologies for the final developments tested in the Open Day Demonstrators and the public Guidelines (D2.7). The D2.1 and D2.2 will also be considered. Along with the novel material solutions and the proposed methodologies, the SINCERE H-DT platform will be evaluated via the KPIs derived in T2.2 to estimate their impact on real life scenarios and contrast with limitations of current rehabilitation approaches. – D2.5, D2.7.

T2.7 Pilot Sites Data Collection for H-DT [M7-M20] (Leader: **RIMOND** 12PM; Participants: NCSRD 1PM, U2M 4PM, MP 2PM)

RIMOND and U2M will record the CH buildings' interior and exterior via images and point clouds to document

the as-built situation via combined photogrammetry and terrestrial LiDAR scanning. RIMOND will make the H-BIM from the as-built and as-designed plans in typical and conventional AEC software tools, such as 3D CAD, typically used by most of the architects, and export plans in open formats, i.e., IFC and interoperable formats[20], to be accessible from the SINCERE platform and the H-DT. Environmental measurements from NCSRD. – D2.8.

WP #	3	Lead beneficiary	CERTH	Start Month	7	End Month	33
WP title	Interoperable Platform for CH Buildings Lifecycle Management						

Objectives: WP3 aims to develop software tools, services, and applications that will support the digitization of a cultural heritage building's lifecycle for sustainable renovation and retrofitting. WP3 key results will be built upon ICT and the key-enabling technologies of mixed and virtual reality as well as DT and artificial intelligence algorithms. **(OBJ-02)**

T3.1 Platform Architecture, Designs and Technical Requirements [M7-M22] **(**Leader: **U2M** 4PM; Participants: NCSRD 1PM, ECO 1PM, RIMOND 1PM, CERTH 4PM, NURO 1PM, ACCIONA 3PM)

This task will extract the technical requirements (TR) from the user requirements (D2.2) and structure them to drive the research and technological activities on SINCERE platform. These requirements are, among other specifications, the connectivity protocols and architecture of the interoperable software tools, integrated services, and data lake. It also involves specifying interconnections for the researched H-DT models, such as physical or meso-scale numerical modelling, the IoT sensors and the smart, connected green restoration materials, the energy harvesting solutions and the integration framework that will facilitate users' work and public engagement. This task will also conceptually sort out the interconnections of individual components and the flow of the large amount of heterogeneous data considering the small screens of MR and the special conditions of VR, so that the following WP3 tasks will align efficiently with the URs. The task will be reported in D3.1.

T3.2 SINCERE Platform Framework [M11-M28] (Leader: **U2M** 10PM; Participants: NCSRD 1PM, ECO 1PM, CERTH 9PM, NURO 5PM, ACCIONA 1PM)

Based on the TR (T3.1), partners will connect their tools, services, and equipment to the SINCERE platform through their interoperable interfaces. U2M will develop the cloud infrastructure (e.g. content management system, storage, integration APIs, microservices), which will facilitate real-time communication among services, and in situ and office applications, and will allow the users to visualise the IoT data in the VR and MR applications. The backend of the platform will include the 3D GIS for organising information and supporting the MR application localization, as well as the BIM server implemented by CERTH, such as openBIM and Speckle[21], supporting open formats for full data exchange among SINCERE'S components and common commercial AEC tools, and advanced features such as versioning of the BIM. The Building Management System (BMS) installed in the demo will also connect to the platform backend. NURO will develop the Authoring Tool that will enable different user groups to setup and interact with different types of building projects (renovations/rehabilitations) and create VR experiences from the Authoring tool. The tool will also be modular to allow new services to be integrated easily and open data exchange formats will allow in data sharing using APIs. The tool will also act as a project and user management tool for building project.

T3.3 Semantic Mapping and Integration Using Knowledge Graphs [M11-M28] (Leader: **CERTH** 9PM)

The goal of this task is to develop a knowledge representation schema (ontology schema) in which the data will be stored and accessed by the end-user. An extensive analysis over the data, such as environmental sensors and BIM information among others, will be performed, to understand which classes and properties need to be defined for a fine-grained representation of data. After the SINCERE ontology is constructed, we will develop a mapping mechanism that integrates the data into the ontology. The data will also be enriched with information from the semantic web as ontologies like DBpedia and BabelNet can offer important supplementary information, for example about CH buildings and sites. Developing an ontology to represent the data will bring new advantages over the information that we can exploit, e.g. information for semantic relations among different types of multimedia such as images and 3D models, and data cleaning. Finally, a mechanism will be developed to retrieve the information from the SINCERE ontology and connect to the frontend tools.

T3.4 Tools for Fast and Predictive Design of Low-Carbon Cementitious Composites [M11-M28] (Leader: **USH** 12PM; Participants: NCSRD 1PM, POLIMI 7)

A multi-disciplinary approach, combining materials science, computational mechanics and LCA analysis, will be adopted to develop tools for fast predictive design of low-carbon cementitious composites.

Subtask 3.4.1: Development of a high-fidelity mesoscale numerical modelling framework. The challenge will be to develop high fidelity models to elucidate the relationship between material properties at the constituent level (paste, aggregate, fibres, PCMs) and those observed at a macroscopic scale. This will be achieved by developing advanced mesoscale FE models capable of capturing thermo-mechanical interactions between the individual

[20] https://technical.buildingsmart.org/standards/ifc/
[21] https://github.com/opensourceBIM/BIMserver, https://speckle.systems/

constituents. Mass transport and heat transfer will be described through a high-fidelity multiphase modelling framework accounting for chemical reactions (hydration) and phase changes (evaporation). In these models, the input properties will be derived from tests performed on the constituents in WP4. The models will be validated against heat transfer, shrinkage and compressive tests performed on the developed mortars. Following model validation, the main multi-phasic features of the concrete mesoscale structure (including the properties, geometry, and volume fraction of the individual constituents) will be randomised to generate a large numerical dataset. The material models will be integrated in the macro-scale models of the DT to assess their performance and damage risk.

Subtask 3.4.2: Development of fast running continuous models for low carbon material design. A new class of fast-running continuous models applicable to large scale structures will be formulated, thus leading to a modelling framework of a type of familiar to industry. The challenge will be to capture, in a continuous setting, the effects of inclusions (aggregates, fibres and PCMs) on both the thermal and the mechanical performance of mortars. To achieve this, the results obtained through high-fidelity finite elements models, and associated environmental impacts assessed through the newly developed LCA framework (ref to other WPs), will then be fed into a dedicated machine learning model as training data for supervised learning. Such a trained model would allow rapid and accurate predictions of mechanical, thermal, and consequently sustainability performance. Such a tool will enable tailored design of cementitious composites with minimum carbon footprint.

Outcomes will be connected to the DTs (T3.6) and will be reported in D3.2.

T3.5 Climate Change Indices for CH [M11-M28] (Leader: **NCSRD** 6PM)

Global climate data available from CIMP6 simulations (Coupled Model Intercomparison Project - Phase 6) will be spatially downscaled and validated at local level by applying an AI/ML driven statistical downscaling approach[22]. The key objective is to identify the relevant hydrometeorological hazard(s) (e.g. heatwaves and cold spells, flooding, drought) for the areas of interest aiming at assessing the occurrence of hazards of different intensities in terms of probabilities or return periods under a changing climate. The work will be complemented by the analysis of compounded climate events for CH degradation[23]. The research activities will result in a portfolio of climate indices pertaining to the exposure of cultural heritage buildings to multiple and compounding hazards in a first ever attempt to link the multi-dimensional complex dynamic nature of the degradation to climate parameters. In this process the uncertainty of the climate projections will be accounted for based on error propagation models from historic onsite climate assessment. These indices will feed the DT (T3.6) (D3.2)

T3.6 Digital Twins of CH Buildings [M11-M28] (Leader: **CERTH** 20PM; Participants: NCSRD 1PM, RIMOND 5PM)

The objective of this task is to develop a 7D Digital Twin (i.e. space, time-dependencies, cost analysis, sustainability and energy consumption, facility management dimensions) for real-time monitoring and interaction with cultural heritage (CH) buildings. This H-DT will revolutionise the way CH sites are preserved and protected by providing a more accurate and comprehensive understanding of the conditions of these sites, as well as help identify and prevent potential issues before they become major problems. The H-DT will be based on Building Information Modelling (BIM) static information and will integrate real-time feeds from Internet of Things (IoT) devices, smart materials, environmental and operational data or other information from the Building Management System (BMS). It will also include physical and statistical degradation models, structural information, and prediction algorithms for conservation and maintenance. This will enable the H-DT to simulate the effects of different environmental conditions on the building materials, or to identify areas that are at higher risk of corrosion or other forms of damage. It will also include macro and local scale climatic models and methods for the overall assessment of the climate change effects on the BCH. In addition to helping predict and prevent damage, the H-DT will also be used as a DSS tool to plan and propose maintenance and restoration work throughout the building's life cycle. By visualising the building in a digital model, its condition and the predictions provided, the conservators and other professionals will have the ability to identify areas that need attention more easily and plan the most effective and efficient course of action. In summary, the Digital Twin developed in SINCERE will provide a comprehensive real-time monitoring and interaction tool for CH buildings that will allow for better preservation and protection of CH sites. Furthermore, it will enable early detection of maintenance needs, and efficient planning for their execution throughout the building's lifecycle. RIMOND will support the connection to BIM, while U2M and NURO will support the H-DT-frontend tools communications. T3.6 will connect to the platform (T3.3), and the materials modelling (T3.5), so as to aggregate information from WP4 and WP5.

T3.7 Virtual Reality Application [M11-M33] (Leader: **NURO** 18PM; Participants: ECO 1PM, RIMOND 3PM, ACCIONA 1PM)

NURO will develop a Virtual Reality (VR) application capable of visualising the full potentials of a 7D H-DT to

[22] Karozis, S., I. A. Klampanos, A. Sfetsos, D. Vlachogiannis, A Deep Learning approach for spatial error correction of numerical seasonal weather prediction simulation data, *accepted in* Big Earth Data 2023.

[23] I. Markantonis, D. Vlachogiannis, A. Sfetsos, I. Karatasios, Quantification of the impact of climate change on historical monuments in Greece, accepted 7th ARCH_RNT, October 6-8, 2022.

facilitate the BCH holistic management throughout its entire life cycle. The VR application will display live data from IoT, DSS, BIM and 3D models (point clouds, or 3D meshes in open standards) which will be homogenised in the H-DT (T3.6). It will also enable the professional users to go into a common VR scenario simultaneously and interact with the environment. The VR application will target typical commercial head-mounted displays (HMD) such as Oculus/ Meta Quest and HTC Vive. The URs derived from the discovery process in T2.2 will drive the agile development of the VR application, steered by the users participating in the task and the co-creation activities (T6.2). RIMOND will support the VR-BIM communication and along with ECO and ACCIONA will steer the VR features development. T3.7 will receive input from the H-DT (T3.6) and the platform backend (T3.3). RIMOND and ECO will support the implementation of UX features in par with the UR.

T3.8 Mixed Reality Application [M11-M33] (Leader: **U2M** 22PM; Participants: ECO 1PM, RIMOND 3PM, ACCIONA 1PM)

U2M will develop a Mixed and intelligent Reality application to support users' situation awareness via an immersive experience and facilitate field service management in the phases of renovation design, construction, facility monitoring and maintenance. The MR app will augment the physical world with the layers of valuable information available in the SINCERE H-DT and platform (T3.3, T3.6) and overlay IoT streamed information from the smart building (through the Building Management System). It will also support preview of renovation designs and simulations. Additionally, the MR app will allow location-based task management, e.g. via virtually leaving location-tagged reports and notes on the field for co-workers and managers, which can later be viewed by other users in MR, or VR. The application will also assist in automated data collection and user navigation to the tasks in charge. To spatially register the physical to digital space, position a user and navigate in indoor spaces U2M will develop a *visual positioning* toolbox that will exploit *computer vision AI* to identify objects and overlay H-DT information. The other participants will support the implementation of UX features in par with the UR.

WP #	4	**Lead beneficiary**	**POLIMI**	Start Month	7	End Month	33
WP title	**Multifunctional low-carbon repair mortars for structural and thermal retrofitting**						

Objectives: i) The assessment of novel binders and alternative reinforcements for the production of advanced cementitious composites for CH retrofitting, ii) the development and mechanical and physico-chemical/durability characterization of compatible advanced cementitious composites based on low-carbon binders and eco-reinforcement for structural and thermal retrofitting of CH, iii) the engineering of the composition of the developed materials for advanced application technologies including additive manufacturing as a further foster to sustainability signature, iv) the assessment of the recyclability potential of the retrofitting materials and iv) the synergy optimization of the multi-fold performance through computational tools. (**OBJ-3, OBJ-04, OBJ-06**)

T4.1 Raw Mix Design, Performance Characteristics and CO_2/energy Impact of Low-Carbon Cements [M7-M28] **(**Leader: **TITAN** 16PM; Participants: {NCSRD, POLIMI} 1PM)

Development and validation of hydraulic binders (BCSA, LC3, Pozzolan Rich Cements) with reduced embodied energy and CO_2 compared to CEM I to produce restoration mortars. Three different binders will be evaluated. First, the incorporation of belite sulfo-aluminate cement (BCSA), which has the potential for up to 30% CO_2 reduction, while the performance remains at par with CEM I. A binder that uses thermally activated clays with the aim to reduce up to 50% the clinker content in the cement will be also studied. Calcination conditions will be investigated at lab-scale and the optimum calcination temperature will be determined per case. The compressive strength of mortars will be tested according to EN 196-1. TITAN will also explore the valorization of natural and agri-waste pozzolans as alternative supplementary cementitious materials-SCMs along with industrial wastes (i.e., slag from electric arc furnace steel production), based on their sort and long-term (projected) availability, in view of the decarbonization objectives of cement industry. Characterization of pozzolans and their reactivity will be conducted at lab-scale, along with the influence of grinding at different blain targets on the pozzolanic reactivity will be investigated. TITAN will lead the task, in collaboration with all other partners involved in the WP for supply and characterization of binders and their incorporation into advanced cementitious composite formulation. Results will feed D4.1.

T4.2 Lab-scale Evaluation of Low-carbon, Enhanced Durability Structural Retrofitting Mortars [M7-M28] **(**Leader: **POLIMI** 6PM; Participants: NCSRD 15PM, UNAV 1PM, TITAN 6PM, BGU 12PM, ACCIONA 6PM**)**

Assessment of the performance of advanced cementitious composites for structural retrofitting, produced employing constituents from T4.1, will be performed on different scale specimens for (Textile reinforced Mortars (TRM) produced by BGU and fibre reinforced concrete/ultra-high-performance concrete (UHPC). Encapsulated inorganic healing agents (NCSRD) will be incorporated to increase the self-healing capacity, while encapsulated corrosion inhibitors will be incorporated to enhance durability. The performance of mixes in the fresh- and hardened-state will be characterised according to EN standard documents (NCSRD,POLIMI,BGU); TRM specimens with different types and number of textile layers (carbon and glass) will be used. The FRC/UHPC tensile and bending behaviour in will be investigated, along with crack-network monitoring by optical observations and non-destructive testing (NCSRD, POLIMI). Digital Image Correlation (DIC) will be used to evaluate cracks

widths and the developed strains. Functionalization through healing stimulators and corrosion inhibitor will also be assessed. POLIMI will lead the task with support from material suppliers and focusing mainly on FRC/UHPC durability and mechanical performance; collaboration of BGU on TRM and of NCSRC for microstructural advanced characterization, UM for bond UHPC, TRC on historic RC substrates and durability performance. Results will feed D4.2.

T4.3 Development and Lab-scale Evaluation of Thermal Insulating Plasters [M7-M28] (Leader: **UNAV** 18PM; Participants: NCSRD 2PM, TITAN 2PM, BGU 12PM, ACCIONA 4PM)

Suggested PCMs will be evaluated considering i) varying operating and transition temperatures depending on different climate zones and ii) thermal conductivity of PCMs, in order to guarantee optimum heat storage and release depending on the surrounding temperatures. Phase change temperature, heat enthalpy and particle size distribution and the agglomeration tendency of the PCMs in the alkaline media of the mortars will be investigated (UNAV). Thermal properties of the restoration mortars will be assessed by determination of heat transfer properties by guarded hot plate, infrared thermography, considering parameters that affect thermal properties such as i) curing time (hydration/porosity evolution) and ii) type and concentration of thermal insulation additive. Moreover, the effect of varying climatic conditions will also be examined in scenarios depicting more realistic conditions of temperature and humidity. Pilot experimental setup (hot-box design) in insulated systems will be used to estimate the performance of the mortars in real applications. Durability evaluation against different weathering conditions of the modified mortars will be performed following standard procedures (POLIMI).

Another type of low-carbon thermal mortar with hemp shives will be developed (hempcrete) (BGU). Different hemp-to-binder ratios will be investigated. By tailoring the hemp-to-binder ratio is possible to design and control the insulation and heat capacity of the building. The optimisation of mortar composition will be conducted through XRF, XRD and SEM/ EDS analyses. Compressive strength, density and thermal properties of mortars exposed to different curing environments will be also investigated, along with water resistance (exposed to wet-dry cycles). The potential dissolution into water of the mortar components will also be assessed. Results will feed D4.3.

T4.4 Recyclability and Adaptation of Formulated Retrofitting Materials [M7-M33] **(**Leader: **UM** 6PM; Participants: POLIMI 3PM, BGU 2PM, ACCIONA 5PM)

Adaptation of the achieved mix-design formulations for application using three different technologies: direct pouring of self-compacting mixes or additive manufacturing (extrusion-based applications). Use of artificially aged, recycled samples for the production of new retrofitting materials and assessment of their use on the fresh- and hardened-state performance, including long term durability and thermal.

T4.5 Optimization of Mortars Performance using Digital Material Models [M7-M33] **(**Leader: **USH** 13PM; Participants: NCSRD 5PM, POLIMI 4PM, UNAV 4PM, TITAN 1PM**)**

Based on outcomes of previous Tasks and in synergy with T3.5 USH and NCSRD will generate microstructural digital models of the mortars under development for simulating their thermo-mechanical performance using FEM. Simulated data, validated with experimental material testing, will be used as training data in a machine learning platform using a convolutional neural network (CNN) model in order to investigate the impact of individual parameters on the performance. The present task is focused on the optimization of materials taking into account different environmental conditions within expected climate scenarios, including embodied energy and CO_2 footprint and different application and end-of-life scenarios. Pattern recognition in IoT data of material conditions, which will be monitored in real-time, will be used as a tool for determining and interpreting initial structural damage. Results, together with T4.4 information, will feed D 4.4.

WP #	5	**Lead beneficiary**	**LU**	Start Month	7	End Month	33
WP title	**Green coatings and PV technologies for passive cooling and energy harvesting**						

Objectives: WP5 is led by **LU** and aims at: i) the development of innovative materials and devices, such as radiative cooling paints and membranes, transparent conducting electrodes and the ii) perovskite solar cells for integrating in windows, facades, and tiles. Radiative cooling materials aim in passive cooling and reduction of energy demands in CH buildings, while high efficiency green perovskite solar cells will enable energy harvesting from the opaque and transparent parts of CH buildings**. (OBJ-04**, **OBJ-05**)

T5.1 Coating Systems Modelling and Design Rules [M7-M20] **(**Leader: **UCL** 10PM; Participants: UNAV 6PM, HMC 2PM**)**

Computational modelling will be performed to extract design rules and critical tolerances around optimum values that will inform the fabrication tasks. Examples of algorithms to be used include finite element methods, finite difference time domain, boundary element methods, Monte-Carlo or other. Parameters such as pore density and size distribution, nanoparticle type, geometry, size distribution and concentration, surface roughness, type of polymer blends and other will be identified and optimised. The aim is to create systems that are much thinner compared to the state-of-the-art (target thickness <100 μm), while maintaining high solar reflectance (>95%) and MIR emissivity (>0.9), with surfaces structurally optimised to self-clean and be mechanically durable (target

lifetime +3 years). – D5.1

T5.2 Fabrication of Prototypes and Testing fabrication and testing [M13-M33] **(**Leader: **UCL** 24PM; Participants: NCSRD 1PM, UNAV 15PM, ACCIONA 3PM**)**

The aim of this task is to receive the designs from T5.1 and translate them into experimental prototypes. To induce porosity, scalable processes, such as thermally induced phase separation, phase inversion and micro-emulsion will be used. Nanoparticles will be synthesised by hydrothermal or solvothermal methods and functionalized with non-fluorine chains (e.g., alkyl silanes) to disperse homogeneously in the host matrix and augment its self-cleaning properties. PCMs will be fabricated by UNAV. During the development phase, small scale prototypes (10 cm x 10 cm) will be produced. Once fabrication parameters have been optimised, the prototypes will be scaled up to 0.5 m × 0.5 m by using industrially compatible processes such as spraying, dip-coating, doctor blading or plastic film extrusion. Scaling up will be outsourced to TNO-Brightlands who have the equipment and expertise required for the task. Results will feed D5.1. In addition, the production of 10 large scale prototypes will be installed in the demo sites. Both short term tests (e.g., 72h) and long-term tests (6-12 months) will be performed, which will enable slow degradation effects to be assessed as well as the system's behaviour to be tested through different seasons. Accelerated tests will be performed in environmental chambers where temperature, humidity, UV-radiation and other parameters can be cycled through multiple times to assess the durability of a technology. Such information will then be fed back to the design and fabrication tasks and, will be fed forward to the LCA. – D5.1

T5.3 Fabrication of Transparent Conducting Cellulose Free-standing Electrode [M7-M28] **(**Leader: **NCSRD** 22PM; Participant: LU 9PM**)**

The aim of this task is to fabricate fully sustainable, low-cost free-standing electrodes to replace the rigid and brittle glass substrates coated with indium tin oxide used in existing PV technologies. NCSRD has developed a method to synthesize cellulose nanocrystals from cellulosic pulp through acidic reactions. These nanocrystals are ultra-transparent (transparency over 95%) in contrast to common paper, which is based on cellulose macromolecules. The nanocrystals form a rigid network through the formation of extended hydrogen bonds which make the material very robust and stable but also flexible and easily embedded onto any surface, even the curved ones. The cellulosic ink can be processed through blade coating or roll to fabricate large area substrates. These transparent substrates can become highly conducting with minimum effect on transparency through the incorporation of super-reduced metal oxide clusters such as polyoxometalates. These small clusters can be anchored onto the cellulosic crystals through hydrogen bond interactions hence avoiding aggregation which compromises the transparency. Preliminary results have demonstrated conductivities up to 10 S/cm combined with transparency of around 94%. With judicious material selection further conductivity enhancement will be achieved. The transparent conducting cellulose free-standing electrodes have been found to be extremely stable to thermal stress, heating and upon bending and stretching. They will be used as the bottom electrode for the fabrication of perovskite solar cells for easy implementation to several building elements. – D5.2

T5.4 Design and Synthesis of Suitable Materials for Perovskite BIPVs [M7-M28] **(**Leader: **LU** 14PM; Participant: NCSRD 6PM**)**

In this task, we will focus on developing suitable perovskite and charge transport materials that can deliver highly efficient and stable devices for BIPVs. Regarding the high transparency, the bandgap of perovskites will be tuned from 2.5 eV to 1.5 eV. The pure iodide systems will realise 1.5-1.6 eV absorbers, combinations of small fractions of Cs (A-site) and Br (X-site) will achieve 1.6-1.75 eV, and for >2 eV we will utilise pure bromide systems. To further increase the stability of perovskite films, we will employ ionic liquid as an additive to manipulate the growth of perovskite film, as proved in our previous achievements. Regarding the requirement of high efficiency, the device structure will be based on the n-i-p structure by employing SnO_2 or TiO_2 as the electron transport layer and Spiro-OMeTAD as hole transport layer. A critical concern of this strategy is the poor stability of Spiro-OMeTAD. Luckily, Regarding the whole transport layer, we recently have made a breakthrough in creating instant and stable spiro-OMeTAD doping strategy using a clean doping strategy known as ion-modulated (IM) radical doping that can solve the existing trade-off between efficiency and stability. More attractively, we can easily tune the energy level of the transport layer that is critical for achieving high-efficiency devices in this project. – D5.2

T5.5 Fabrication of Perovskite BIPVs on Lab-scale and Large-area Prototypes [M13-M33] **(**Leader: **LU** 6PM; Participant: NCSRD 2PM**)**

In this task, the efficiency and stability of devices on small area devices (<2.5x2.5cm^2) will be validated by employing spin-coating technique to fabricate films. For the up-scaling, the advantage of good solubility of perovskite precursor will be exploited and scalable slot-die coating deposition methods for the target bandgap perovskites will be developed. Slot-die coating is well suited for the deposition of perovskite inks, as well as other layers in the device stack. As a pre-metered coating method, it is highly efficient in terms of materials usage and results in very low wastage levels of inks compared to other deposition methods such as spin coating or spray and screen printing. Such techniques are compatible with sheet-to-sheet and roll-to-roll large-scale manufacturing processes, thus offering advantages such as low manufacturing cost, high throughput, and continuous production. Regarding the power conversion efficiency of devices, we will pay attention to the angular dependence of

perovskite solar cell performance for the BIPV application that are mounted vertically. Durable perovskite cells are key to field operation. The stability of encapsulated cells will be evaluated under accelerated damp heat, thermal cycling, and humidity freeze tests. – D5.2

WP #	6	Lead beneficiary	NH	Start Month	1	End Month	36
WP title	Raising Social Awareness through Dissemination & Exploitation						

Objectives: i) Raise awareness, inform, and educate European citizens, academics, and professionals regarding preservation of CH 19th and 20th century buildings as key urban landmarks that preserve the character of cities, create a new notion on renovation and use of CH buildings increase the life expectancy of concrete buildings and integrate them in urban renewal projects through preservation, upgrade, and reuse. ii) Engage in research and professional training in net zero CH buildings preservation, restoration, and rehabilitation. iii) Achieve multi-scale impact through engagement of the different stakeholders, in smart materials, solutions and practices, engaging from researchers to the academia, professionals, and eventually end users towards net zero buildings, communities and cities under the prism of CC effects on BCH. iv) Set the first steps to commercial exploitation. (**OBJ-01**)

T6.1 Building as a Boundary Object [M1-M36] (Leader: **NH** 8PM; Participants: all partners)
Transdisciplinary aspect: Sets the framework of all WP6 activities through the *Communication and Dissemination Plan* (CDP) (M6) which will be updated along with activities reporting. The relevant supporting material and context will be developed. The pilot owners and NH will identify and map key local stakeholders across the three demonstrator pilots and derive an engagement plan for structured collaboration and definition of vulnerabilities and needs. SINCERE will use innovative online communication tools (a website platform) to invite the local ecosystem to Open Days Demonstrations with a walking tour format together with students and researchers from HIT to engage visitors and tourists and connect science with society. Details on C/D/E activities are given in Section 2.2.

T6.2 Building as a Laboratory [M7-M33] (Leader: **NH** 8PM; Participants: NCSRD 2PM, ECO 6PM, POLIMI 4PM, UNAV 4PM, BGU 4PM, HMC 6PM, MP 6PM, UM 4PM)
Participatory / citizen science aspect: According to RRI principles, NH will create a citizen science activity; SINCERE will gather citizens from different regions and backgrounds, who will act as researchers and SINCERE's ambassadors, as well as provide inputs for the technical WPs. Following an open initial workshop, NH will guide the participants throughout the research phases. Their results will be presented to a citizen science festival and presented to European and international portals such as ECSITE. – D6.2

T6.3 Building as a Stage [M13-M28] (Leader: **NH** 8PM; Participants: {ECO, RIMOND, HMC, MP} 4PM)
Stories can create other worlds, emotions, ideas. Telling stories is one of the most powerful means that we can influence, teach, and inspire. Each demo has its identity, its people and its culture. SINCERE will collect stories from the past, present and create the future narrative. With Future Literacy methods, will allow stakeholders to better understand the role of the future in what they see and do. Conduct workshops to collect stories, audio recordings, and an exhibition to connect the demos locally and internationally, to communicate the environmental messages. – D6.1

T6.4 Exploitation and Sustainability Plan, Market Analysis and Business Models [M13-M36] (Leader: **TITAN** 3PM; Participants {NCSRD, U2M, ECO, RIMOND, ACCIONA} 3PM, {LU, UCL} 1PM)
This task will define an *Exploitation Plan* (D6.3) that will include: i) the *business model* of the separate outcomes, ii) the *market analysis* (e.g. market need, size, prospects, and competitive products), iii) routes to market, iv) a SWOT analysis, v) an operations plan (e.g. manufacturing, marketing), vi) the legal, societal and market dependencies and barriers, vii) financial model (reasonable and coherent analysis of costs, sales, necessary revenues), viii) roadmap to achieve market ready TRL. The business model will be defined via an iterative process involving all partners to build an informed opinion for the final SINCERE outcomes. T1.3 for background and foreground IPR, but also T1.5 for legal and ethical issues will be considered. – D6.3

T6.5 Standardization Activities for Novel Materials, H-BIM, and H-DT [M21-M36] (Leader: **TITAN** 3PM; Participants: {NCSRD, U2M, ECO, RIMOND, POLIMI, UNAV, CERTH, BGU, NURO, LU, UCL, UM} 2PM)
The SINCERE's outcomes will be organized in par with current discussions on standardizing BIM (and LODs), as well as the unregulated domain of DT. A dedicated budget will be used to bring together experts, technical committees (e.g. ETA, ICOMOS ISC20c), and standardization bodies (e.g. RILEM, CEN TC346) to support this ongoing work. – D6.4

Table 3.1c: List of Deliverables

#	Deliverable name	WP #	Leader	Type[24]	Level[25]	Delivery M
D1.1	Project handbook	1	NCSRD	R	C	2, 12, 18
The *Project Handbook* contains fundamental information about project management procedures and progress.						
D1.2	Project management collaborative workspace	1	NCSRD	R	C	3
A collaborative space will be developed as an internal structure for coordination and information sharing (T1.1).						
D1.3	SINCERE Innovation Management Report	1	POLIMI	R	C	6
DPR and DMP Plans; reporting on data and innovation management (T1.2).						
D1.4	Guidelines for follow-up initiatives	1	NH	R	PU	36
The plan for the follow-up initiatives to increase the impact of the project even after its completion (T1.2).						
D1.5	Final SINCERE project report	1	NCSRD	R	PU	36
Detailing completed activities and achieved outcomes, among other details (WP5 tasks).						
D1.6	Ethics, Gender, and Legal Issues Guide	1	NCSRD	ETHICS	PU	6, 22
To assist the consortium early recognize and appropriately conform with such issues (T1.4).						
D2.1	Pilots and Scenarios Narrative	2	UM	R	PU	12, 22, 35
Description of the pilots' details, the specific UR per each pilot and the foreseen usage scenarios.						
D2.2	User Requirements	2	ECO	R	PU	6, 22
Report on the initial and final UR and their KPIs.						
D2.3	Sustainable Conservation/Renovation Planning	2	ECO	R	PU	22
Report on the existing legal framework and good practices for sustainable historical building renovation (T2.3).						
D2.4	SINCERE Storylines on CC Impacts to BCH	2	NCSRD	R	PU	33
Storyline and a database with climate change impacts and mitigation / restorative interventions (T2.4).						
D2.5	Evaluation of the SINCERE Project	2	ACCIONA	R	PU	22, 36
Validation, demonstration, and impact assessment work plan (T2.6).						
D2.6	Life Cycle Sustainability Assessment	2	POLIMI	R	PU	33
The report describes the global sustainability performance of developed solutions, (environmental, economic, and social) compared to conventional technologies (T2.5)						
D2.7	Public-Accessible Professional Guidelines	2	ECO	R	PU	36
Piloting conclusions and guidelines for design and preservation practitioners, and for preservation, upgrade, use and maintenance of CH concrete buildings. Related to T2.6.						
D2.8	3D Modelling of the pilot BCH	2	RIMOND	R	DATA	18
The digital 3D models produced from T2.7 and the collected environmental or other data.						
D3.1	Technical Requirements	3	U2M	R	PU	12, 22
A structured list of requirements and the system architecture for the overall modular digital platform. (T3.1)						
D3.2	A Digital Twin Platform for CH Buildings	3	CERTH	R, DEM	PU	18, 28
The interoperable platform and the historic digital twin models from T3.2, T3.3, T3.4, T3.5, T3.6.						
D3.3	Multi-user Virtual Reality application	3	NURO	DEM	PU	18, 33
The VR application for enhanced situation awareness for a climate resilient and adaptive renovation. (T3.7)						
D3.4	Mixed Reality app for CH buildings'	3	U2M	DEM	PU	18, 33
The MR application for immersive field tasks management in BCH and resilient and adaptive renovation. (T3.8)						
D4.1	Recommendations for alternative binders	4	TITAN	R	PU	18, 28
The different types of investigated alternative binders and guidelines for their use. (T4.1)						
D4.2	Advanced cementitious composites structural retrofitting	4	POLIMI	DEM	C	18, 28
Mix-design concept and mechanical and durability performance of TRM/UHPC retrofitting materials, T4.2.						
D4.3	Advanced cementitious composites thermal retrofitting	4	UNAV	DEM	C	18, 28
Mix-design concept and mechanical, thermal and durability performance of energy retrofitting materials, T4.3.						
D4.4	Digital life cycle-based material portfolio	4	UM	R	PU	18, 33
Related to Tasks 4.4 and 4.5.						

[24] R: Document, report (excluding the periodic and final reports); DEM: Demonstrator, pilot, prototype, plan designs; DEC: Websites, patents filing, press & media actions, videos, etc.; DATA: Data sets, microdata, etc.; DMP: Data management plan; ETHICS: Deliverables related to ethics issues.; SECURITY: Deliverables related to security issues; OTHER: Software, technical diagram, algorithms, models, etc.

[25] PU: Public, fully open, e.g., web (Deliverables flagged as public will be automatically published in CORDIS project's page); SEN: Sensitive, limited under the Grant Agreement; C: EU CONFIDENTIAL; S: EU SECRET EC No2015/444

D5.1	Passive cooling materials	5	UCL	DEM	C	12, 18, 33
Passive cooling with hybrid materials; reporting on. Related to T5.1, T5.2.						
D5.2	Novel Perovskite devices	5	LU	DEM	C	18, 28, 33
Deliver perovskite devices with high efficiency. Related to T5.3, T5.4, T5.5.						
D6.1	C/D Plan and Report on Activities	6	NH	R	PU	6, 18, 28, 36
A live document to continuously report activities to maximise impact. Includes the CDP. (T6.1, T6.3).						
D6.2	Report on Citizens Science Activities	6	NH	R	PU	18, 33
Document the SINCERE co-creative activities to bring together Citizens and Science. (T6.2)						
D6.3	SINCERE's Path to Market	6	TITAN	R	PU	22, 36
Describes the path to necessary TRL, potential Business Models and Market Analysis. (T6.4)						
D6.4	Standardization activities	6	TITAN	R	PU	36
Report on the standardization activities and results of T6.5.						

*****(Periodic EC reports are considered contractual obligations and are not included as deliverables)*

Table 3.1d: List of milestones (MS)

#	Milestone	WP	Date	Means of verification
MS1	Project setup, C/ D Plan, and UR	WP1 WP2 WP6	M6	It includes: i) Project management and quality assurance plan. ii) Ethics Guide. iii) Data management and self-assessment plan. iv) Initial user requirements. (v) Dissemination and Exploitation Plan. D1.1, D1.2, D1.3, D1.4, D2.2, D2.3, D6.1 - [Lead: NCSRD]
MS2	Pilot setup, Platform roadmap, Coat. Des.	WP1 WP2 WP3 WP5	M12	Pilot description. Analysis of CC effects BCH. Initial online and ad hoc data collection for Pilot - including material samples from sites. SINCERE platform architecture and technical requirements. Testbed (ES) setup. D1.1, D2.1, D3.1, D5.1 - [Lead: UM]
MS3	Alpha version of the SINCERE Framework	WP1 WP2 WP3 WP4 WP5 WP6	M18	Completion of the *alpha* development cycle of the project, which includes: i) Beta version of the monitoring and assessment platform. ii) Lab testing of the new self-sensing and green materials, cooling coatings, and energy harvesting panels. iii) Reporting on full dissemination actions, and Citizens Science activities. Tests in Testbed (ES). D1.1, D2.8, D3.2-D3.4, D4.1-D4.4, D5.1, D5.2, D6.1, D6.2 - [Lead: CERTH]
MS4	1st Demo Evaluation	WP1 WP2 WP3 WP6	M22	Evaluation of the SINCERE platform alpha version and the proposed materials and solutions on Pilots 2& 4 with a selected group of experts and university students in demonstration workshops. D1.2, D1.3, D2.1, D2.3, D2.4 - [Lead: NCSRD]
MS5	Beta version and Pilot 3 Demo	WP3 to WP6	M28	Evaluation of the SINCERE platform *beta* version and the proposed materials and solutions on an open day workshop international workshop. D3.2, D4.1-D4.3, D5.2, D6.1 - [Lead: RIMOND]
MS6	Final version of the SINCERE advancements	WP2 to WP6	M33	Completion of the SINCERE project development cycle. D2.4, D2.6, D3.3, D3.4, D4.4, D5.1, D5.2, D6.2 - [Lead: U2M]
MS7	Final evaluation of SINCERE key results	WP1 WP2 WP6	M36	i) Stakeholders (public and experts) Workshops in Pilots 2 & 4, SINCERE conference, and open day workshops, to evaluate and disseminate the project. ii) Final evaluation. iii) Final exploitation reports. iv) Final policy recommendations and renovation guide. ii) Public final activity report and final self-assessment. D1.4, D1.5, D2.5, D2.7, D6.1, D6.3, D6.4 - [Lead: ACCIONA]

3.2 Implementation Risks Management

Table 3.1e: Critical risks for implementation

Description of risk	WP(s) #	Proposed risk-mitigation measures / Risk Level L – Likelihood, S - Severity
Legal and Ethical concerns with respect to some clearly identified aspects of the Pilots	WP1 WP2 WP6	The consortium has in place the DMP, IPR Management plan, and the Self-Assessment Plan to treat in advance any such issues regarding the recorded data and the research activities, which will be proactively dealt with the Ethics, Gender and Legal Issues Guide. / L-Low, S-Low
Delay in the project timeline	all	Increase the monitoring activities (monthly meetings, monthly plans and

		monthly reports, specific coordinator support) PSC agrees on: i) re-allocation of resources; ii) parallel execution of tasks; or iii) re-scheduling of activities or a suitable combination of those. / L-Low, S-High
Identify the common UR across different target audiences and different Pilots	WP2 WP6	Differences among user groups will be identified during the vision development and co-creation activities in WP2 and WP6. The SINCERE outputs will be tested in different scenarios as indicated in the "Description of Pilots" section. / L-Medium, S-Medium
Data availability to build H- Digital Twins with meaningful modelling information	WP2 WP3 WP4 WP5	Multiple sources of environmental, chemical, and satellite data, among others, have been foreseen in WP3, to build a holistic platform and evaluate renovation and CC mitigation actions even with incomplete data which can be the case of many real CH buildings. / L-Low, S-Medium
Low quality of analysis, linking and interpretation of multimodal data	WP3	A variety of multimodal analysis frameworks, intelligent data ingestion and reasoning mechanisms based on ontologies and knowledge graphs. / L-Low, S-Medium
Failure to integrate all developments in the SINCERE assessment platform	WP3	Effort will be put to finalise an implementation and integration plan after the URs are defined to minimise unexpected issues. Should these arise, the industrial partners have a long-standing experience in driving complex RnD projects and redesigning the architecture if needed. / L-Low, S-High
Unexpected performance of some of the developed mortars (poor thermal performance or durability)	WP4	Different mix designs and extensive characterization of the mortars in lab. A strict supervision of the application will be carried out to prevent this problem. If necessary, an adjustment of the dosages will be carried out. / L-Low, S-Medium
Low durability of the surfaces, the ability to achieve targeted multifunctional performance with very thin layers and, lower than desired UV-stability.	WP5	Commercial additives such as UV-stabilisers (e.g., halide amine light stabilisers) and plasticisers can be exploited to reinforce UV and mechanical stability. An alternative strategy would be to first create a simpler system with just basic cooling functionality and then apply a post-fabrication treatment to alter its surface properties and improve its durability. (e.g. *Nat. Commun.* 12, 1–10, 2021, *Chem. Eng. J.* 442, 136017, 2022). / L-Low, S-High
Limited public and expert user engagement	WP2 WP6	Established KPIs from the beginning of the project; early formulation and continuous update of the C/D Plan; Encourage project partners in C/D. Long-term experience of the partners in this kind of projects is key to an efficient plan and anticipation of consequences. / L-Low, S-High

3.3 Financial Clarifications

Table 3.1f: Summary of staff effort

#	Partner	Effort (PM)						
		WP1	WP2	WP3	WP4	WP5	WP6	Total
1	**NCSRD**	12	12	10	23	31	7	95
2	**U2M**	1	7	36	0	0	7	51
3	**ECO**	1	23	4	0	0	19	47
4	**RIMOND**	2	21	12	0	0	10	45
5	**POLIMI**	6	6	7	14	0	7	40
6	**UNAV**	1	3	0	23	21	7	55
7	**CERTH**	1	3	42	0	0	4	50
8	**TITAN**	3	3	0	25	0	8	39
9	**BGU**	1	5	0	26	0	7	39
10	**NURO**	1	3	24	0	0	4	32
11	**ACCIONA**	1	23	6	15	3	4	52
12	**HMC**	1	9	0	0	2	11	23
13	**LU**	1	4	0	0	29	4	38
14	**MP**	1	13	0	0	0	12	26
15	**USH**	1	2	12	13	0	2	30
16	**UCL**	2	2	0	0	34	4	42
17	**UM**	1	9	0	6	0	7	23
18	**NH**	2	11	0	0	0	24	37
Total effort / WP		**39**	**159**	**153**	**145**	**120**	**148**	**764**
WP share		5%	21%	20%	19%	16%	19%	100%

Table 3.1g: 'Subcontracting costs' items

	Cost (€)	Description of tasks and justification
#13 LU	50000	LinXole AB will develop stable and low-cost organic transport materials in WP5 and will fabricate organic transport films by slot-die for prototyping and field-demonstration purposes, as subcontractor to LU. LinXole is a start-up company of Linkoping Univ. with patented technologies and infrastructure on scalable organic transport materials. They have developed a hole transport recipe for perovskite PV cells yielding high PCE (> 25% certified) and around 10x increase in moisture stability compared to traditional materials, which represent the highest efficiency with the best stability to date.
#16 UCL	75000	UCL will subcontract to Brightlands Materials Center at TNO (NL) the upscaling of radiative cooling coatings and paints, aiming to optimize the synthetic process for large-scale chemical reactors and produce the large-scale batches of the materials for prototyping, demonstration, and field evaluation purposes (T5.2). Brightlands Sustainable Buildings department has the required expertise and infrastructure for optimizing new solutions in coatings, pigments & colloids, polymers, and nanocomposites for applications of sunlight and solar heat in the built environment.

NH (Associated Partner) paid by the Swiss Secretariat for Education, Research, Innovation - SERI

Person month cost	€5500	**Personnel**	€ 203500	**Other**	€ 7000
Overhead rate	25%	**Travel**	€ 10000	**Funding requested**	**€ 275 625.00**
Reimbursement rate	100%	**Equipment**	€ -		

3.4 Capacity of participants and consortium as a whole

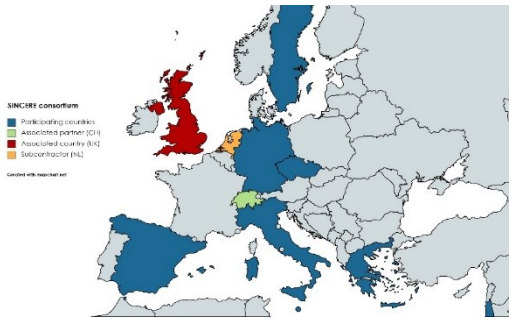


Figure 15. SINCERE consortium map.

The SINCERE consortium consists of 7 universities, 2 research institutions, 4 SMEs, 3 industries, a governmental authority and 2 NPOs, which are balanced between AEC, materials development, ICT and SSH. Participating countries are 7 EU member states, 3 European as Associated Partners (CH with separate funding) and 1 neighbouring country (IL) (Figure 15). Consortium partners will undertake a complex, but intriguing, project envisioning to promote net-zero carbon and climate change resilient BCH in Europe and beyond. They have been selected based on their high-quality profile, their academic background and professional expertise in several domains - see Section Interdisciplinarity - and their wide geographical distribution to effectively address multicultural issues in research and climatic zones differences for the evaluation of SINCERE objectives and results.

1. National Centre for Scientific Research Demokritos (NCSRD) will be the **project coordinator** and will participate with researchers from three (3) research groups: a) *Archaeological and Building Materials* (ABM), b) *Materials for Nanolithography and Organic Electronics* (MNOE) and c) *Environmental Research Laboratory* (EREL). NCSRD will be involved in three main concepts: i) interaction of microclimate with materials degradation and buildings performance under different environmental conditions, along with implementation of AI/ML driven localized climate change scenarios based on CMIP6, for supporting simulation studies in H-BIM/H-DT tools (RIMOND, CERTH, up2metric), ii) development of low-carbon, repair mortars with encapsulated self-healing and corrosion inhibitor additives, using the green binders produced by TITAN, through theoretical (meso-scale modelling of self-healing and durability) and lab-scale studies of their performance and iii) co-development with LINKOPINGS and LinXole of green, low-cost, transparent PVs, working on their optimization for integration on the architectural parts of historic buildings (glass windows, ceramic roof-tiles, renders). NCSRD has quality capacity for computer modelling, mechanical, physical, and chemical analyses of materials, including, SEM/TEM, MIP/BET, DTA/TG, XRD, XRF. NCSRD combines Archaeological and Conservation Sciences with the development of Advanced Materials and Computational Materials Science.

2. up2metric (U2M) is an SME that develops innovative B2B software based on key-enabling technologies such as 3D vision, machine learning and extended reality. One of the company's main goals is to transfer state-of-the-art knowledge from the academic fields of Computer Vision, Photogrammetry, and Remote Sensing to the market. U2M has developed solutions in commercial and research projects (EU and National) on tangible and intangible cultural heritage, infrastructure inspection, industrial automation, and precision agriculture. In SINCERE, U2M will undertake the task of developing an AR application to facilitate the BCH renovation, management, and maintenance

(WP3) and, of course, contribute to piloting and dissemination activities.

3. ECOAMA (ECO) is an SME that offers architectural design and consulting services to private and public clients with attention to the clients' needs and sustainable solutions in high quality services. In addition to architectural practice, ECO brings the nearly two-decades experience of ECOWEEK (NGO 2006-2022) in sustainable design education programs, bringing together academic learning, and hands-on placemaking, interventions, and light-construction in public space and public institutions in 17 countries. In SINCERE, ECO will collaborate with UM and NH on defining the architectural importance and conservation problems of built CH, determining the optimum conservation approach and repair planning of the demos, from the architectural concept to preliminary and final design, to detailed plans for targeted interventions.

4. RIMOND is an integrated design, construction, and consultancy company for the full life cycle of the built assets providing unique end-to-end solutions to their clients. Bringing together the best international and forward-thinking professional teams, RIMOND offers deep interdisciplinary expertise across a wide range of sectors, supporting a unified set of professional skills and competencies that is unmatched in the industry: Integrated Design, Digital Design Technology, Project & Construction Management, Construction, Real Estate Consultancy and Research. In SINCERE, RIMOND will support the digitization in construction (T2.7 & T3.6).

5. Politecnico di Milano (POLIMI) participates with the Department of Civil and Environmental Engineering, supported by the Laboratory for testing Materials, Buildings and Structures, which provides state-of-the-art equipment necessary for the testing of structures and structural elements, chemical-physical, mechanical testing of building materials environmental engineering, non-destructive monitoring and large-scale computing. The lab is also equipped with durability testing, equipment available to test the materials' performance under freeze and thaw cycles, thermal shock, salt spray tests, artificial rain on wall samples, salt crystallization and UV aging. POLIMI will lead WP4 and will also be responsible for the life-cycle analysis studies of materials and systems (T 3.4), implementation of durability evaluation and self-healing and corrosion inhibitors efficiency. POLIMI has coordinated the H2020 project ReSHEALience (GA760824) and participates in MSC-ITN SMARTINCS (GA 860006).

6. Universidad de Navarra (UNAV) is an institution that has always been committed to research, both in scientific and humanistic areas. Its ongoing commitment to research and its eagerness to improve at all levels has recently led it to join the European initiatives known as the "European Charter for Researchers" and the "Code of Conduct for the Recruitment of Researchers". The participant group, Materials & Cultural Heritage (MATCH), is focused in research of Building materials, mortars and grouts, for the rehabilitation and restoration of Cultural Heritage, Modified stones and mortars with enhancement of the thermal properties, self-cleaning features as well as the investigation and environmental valorisation of the interactions of new components in binder matrices (lime, OPC and aluminate cement), photocatalytic degradation of nitrogen oxides, NOx, and CO_2 uptake. In SINCERE, the UNAV group will oversee the development of thermal renders and plasters (PCMs) and hybrid radiative cooling coatings.

7. Centre for Research and Technology-Hellas (CERTH) is founded in 2000, is the only research centre in Northern Greece and one of the largest in the country. The Information Technologies Institute (ITI) was founded in 1998 as a non-profit organization under the auspices of the General Secretariat of Research and Technology of Greece with its head office located in Thessaloniki, Greece. The participating team of CERTH-ITI in SINCERE will be the Multimodal Data Fusion and Analytics Group (M4D) of the Multimedia Knowledge and Social Media Analytics Lab (MKLab). The team has significant experience and scientific expertise, among others, on Image and Video Analysis, Multimedia Understanding, Virtual and Augmented Reality, Artificial Intelligence (including Machine Learning and Deep Learning), Semantic Technologies and Integration of heterogeneous resources. Through the years, the team has participated in 77 European and national projects. In SINCERE, CERTH will develop the semantic integration and reasoning module and the digital twins of CH buildings (WP3).

8. TITAN S.A. (TITAN) has the know-how of materials science and is able to develop, characterize and industrialize the production of novel restoration materials. TITAN Cement Group is the largest cement and building materials producer in Greece and ranked among the top 20 producers globally (Global Cement 2017-2018). Among TITAN's main tasks are GHG emission reduction strategies, valorisation of alternative fuels and raw materials, and the development of alternative cementitious materials. The portfolio of TITAN covers the production of cement, concrete, aggregates, mortars and other building materials and the processing and industrial utilization of fly ash. TITAN will develop and optimize low-carbon binders and mortars for WP5 along with NCSRD and POLIMI (WP2) that will also be used in demonstration actions in WP2.

9. Ben-Gurion University of the Negev (BGU) is one of Israel's largest research universities. The BGU PI has wide experience in advanced building materials including cement and concrete composite materials, and particularly textile reinforced concrete (TRC), as well as alternative building materials such as hempcrete. The team at BGU has established a record in mechanical properties measurements, cracks monitoring including invisible ones inside the concrete before and during loading using acoustic emission (AE) non-destructive methods as well as microstructural and chemical analysis. In SINCERE, BGU will focus on the development of textile reinforced mortars and Hempcrete and oversee the feasibility and compatibility studies of structural reinforcement methods for both masonry-based and historic concrete heritage structures of 19th and 20th c., based on i) textile reinforcement and ii) fibre-reinforced mortars including hempcrete. BGU will be in charge for demonstration of those technologies in IL and GR, in collaboration with ECO, TITAN, UNAV and POLIMI.

10. NUROGAMES GmbH (NURO) is an independent game development and software engineering company founded in 2006 in Cologne/Germany. NURO develops gaming and serious games solutions for consumers and for the industry.

NURO covers the entire value chain of game development - from the initial idea to the final product - for all major mobile, web, PC, console, VR, AR and XR platforms with a track record of more than 14 years. In the SINCERE project, NURO will build on VR application for the digital twin using its expertise and previous work with VR, BIM modelling and environment building (WP3).

11. ACCIONA Construction S.A. (ACCIONA) is the construction business of ACCIONA group, with more than 35.000 employees, 7 billion turnover and a consolidated presence in the 5 continents. ACCIONA has its own R&D Technological Centre in Madrid with a team of more than 80 highly qualified researchers from a wide range of disciplines. The concrete research group leads the materials research in concrete and cementitious materials in the company: it has a wide experience in research projects where different types of recycled or valorised materials are incorporated into the concrete mix for improved performance, more durability or increased sustainability. Besides, it leads the in-house know-how and provides our projects with technical expertise for the optimization of the use of concrete on site. In SINCERE, they will evaluate the novel materials in the building demo park located in Madrid. ACCIONA will also perform the evaluation of the materials in 3 demo cases (WP2).

12. Hellenic Ministry of Culture and Sports (HMC); Directorate of Conservation of Ancient and Modern Monuments. HMC supervises and provides guidelines for conservation interventions in archaeological sites and monuments in Greece. They organise training courses and inform conservation practitioners on heritage risks and new technologies. HMC participates in SINCERE WP2 as a policy maker, technical workshops organizer but also as conservation specialist, evaluator/end-user for the technologies and materials to be developed within the project.

13. Linkopings Universitet (LU) is expert on inorganic- and organic-based transport layers for different optoelectronic devices, including perovskite solar cells and LEDs, detectors, as well as organic solar cells, as well as a hole transport recipe for perovskite PV cells yielding high PCE (> 25% certified). They have achieved devices with state-of-the-art stability by resolving the interaction with inorganic transport materials and perovskite layers. LU will lead WP5 to develop perovskite BIPVs at lab-scale and large-scale together with LX and NCSRD.

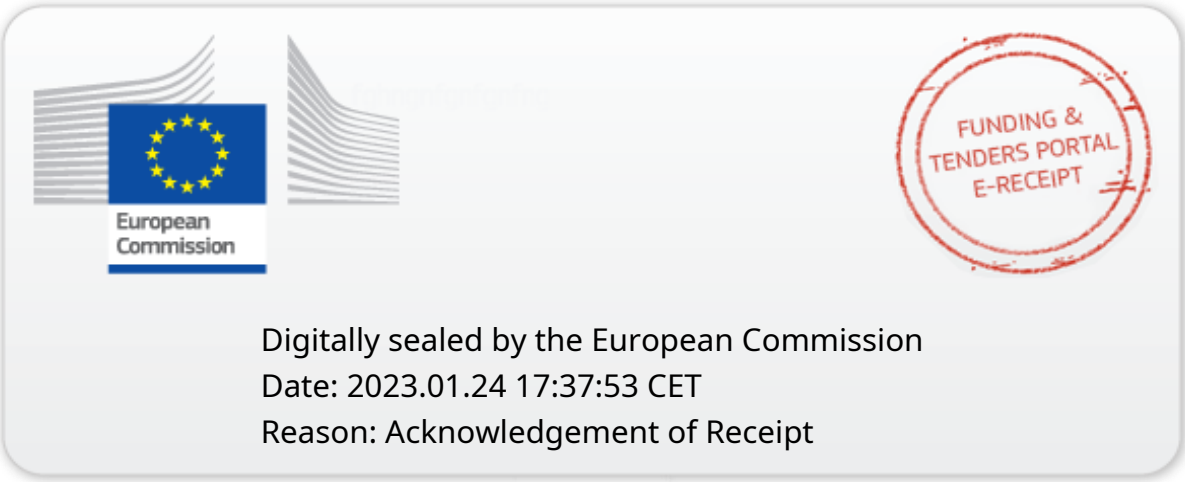
14. MUSEum+ (MP) is a state contributory organisation of the Ministry of Culture of the Czech Republic. Its main task is the preparation and implementation of the reconstruction of the former blast furnaces and casting hall of Vítkovice Ironworks in Ostrava, a national cultural monument, and a European site of industrial heritage (part of ERIH) and its transformation into a modern museum. In SINCERE, MUSEum+ has the role of an end-user/demo provider on whose venue material solutions, ICT and digital tools will be applied and explored. MUSEum+ will also be active in dissemination by raising stakeholders' and citizens' awareness at both national and European level. Finally, MUSEum+ will serve as a model example for authorities' engagement and mainstreaming the principles of environmentally conscious 20th century heritage renovations into other publicly owned buildings.

15. University of Sheffield (USH), participating with the Civil and Structural Engineering Department, is a national and international research leader in science and engineering for sustainability and resource optimisation. The world-renowned Computational Mechanics and Design group, together with the specialist expertise in cementitious materials and concrete structures provided by the Cements and Concrete research groups respectively, represent the ideal setting to develop advanced numerical approaches to modelling multi-physics problems. In SINCERE, the University of Sheffield will lead the development of numerical analysis and material design models (WP3).

16. University College London (UCL) was founded in 1826 and was the first University in England to admit any student regardless of their religious beliefs or gender. It is consistently ranked in the top-10 Universities in the World and has 30 Nobel prize winners in its ranks. The Department of Electronic Engineering, where the research in radiative cooling will take place, was established in 1885 by Professor Sir Ambrose Fleming, inventor of the thermionic valve and widely considered as the father of modern electronics and was the first Department of electrical technology in the country. UCL is fully equipped to carry out the radiative cooling tasks in SINCERE (WP4). UCL will subcontract the upscaling and optimization of production process for radiative cooling coatings to TNO, for facilitating demonstration requirements and exploiting commercialization potential.

17. University of Malta (UM) participates with the Department of Construction and Property Management, Materials Engineering and Structural Vulnerability group, which is focused on the teaching and research on construction systems and civil engineering, materials engineering and life cycle engineering including life cycle costs. UM key Infrastructures include fully equipped labs for Materials and Civil Engineering properties, Life Cycle Analysis software, Micro and Nano Electronics Laboratories. In SINCERE, UM will collaboration with architects for the renovation projects' management, i.e. the interventions actions at the demos. UM will also undertake the technical seminars for structural retrofitting in historic constructions, best practices, and past examples for the dissemination of field demonstrations.

18. Nethood (NH) is a non-profit organisation based in Zurich, founded in January 2015. The concrete outcome of NH's action research is the design and implementation of convivial tools that empower people in localities to get in contact, to learn collectively, and to self-organise around common projects. NH has strong facilitation, communication and dissemination competences, manifesting through key roles in big EU-funded projects such as technical leader (EuComMeet), interdisciplinary framework leader (MAZI), and dissemination leader (netCommons); the organisation of interdisciplinary events with high impact; the active engagement in international networks like the Internet Society (ISOC), project 7at7.digital, and key role in local civil society organisations like co-founder of the L200 collective space and board member of Neustart Schweiz. In SINCERE, NH will oversee communication and dissemination activities, and co-creation activities and living labs of the project in WP6.



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