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REPÚBLICA PORTUGUESA
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Environment, Climate Change and Low Carbon Economy Programme

'Environment Programme'

European Economic Area (EEA) Financial Mechanism 2014-2021

Final Report

29/09/2023

37_Call#2_Circular Construction in Energy-Efficient Modular Buildings

Accordingly, with the Articles 25.2.j) and 29.4 of the' Applicants Guide for Financing of Projects Supported by Environment, Climate Change and Low Carbon Economy Programme'

https://www.eeagrants.gov.pt/media/2994/applicants-guide-for-financing-eea-grants_environment-projects_28112019.pdf

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i. Detailed description

The current final report refers to the work carried out in the Circular2B project from 1/10/2020 to 28/07/2023 regarding all the activities.

The project was initially planned to finish on 30/09/2022, but due to several constraints (COVID-19 pandemic, difficulty in acquiring specific types of equipment and in hiring human resources, etc.) reported during the interim reports, the project was extended to 28/07/2023.

The donor country (SINTEF partner from Norway) had significant participation, especially in activity 3, leading the durability assessment, and in activity 6, performing the environmental analysis of the developed solutions. Also, SINTEF participated in several communication and dissemination actions developed during the whole project duration.

Following is a summary of the main actions performed in each activity:

Regarding the Management activity:

The Management Task was developed during the project duration and had the participation of all partners since it was a transversal activity. Email was the preferred communication channel,

allowing quicker information, solutions, and phone calls. As such, a significant part of the involvement between the partners was performed using these two channels. Also, several online meetings with all the partners and SGA were conducted. This activity had significant work related to administrative and financial issues, such as reporting, audits, budget adjustments and amendments, which were highly affected by the COVID-19 pandemic and Brexit. The main developed actions were:

- Supervising and updating the work carried out by the partners following the planned objectives;
- Monitoring and assessment meetings with SGA ;
- Participation in training and follow-up sessions organised by SGA;
- Collection of documentation and preparation of payment requests and project amendments;
- Involvement in local verification audits;
- Organisation and collection of the project team documentation;
- Preparation of reports (activities and progress reports);
- Organisation of meetings (online and onsite).

Evidence of the last project management actions:

- 1/06/2023: Online project meeting (evidence in "1. Project Meeting_1-06-2023).

Regarding Task A1:

Task A1 was developed between 01/10/2020 and 14/04/2021 and had the participation of UTAD and FCUP. A1 consisted of the selection, transport and storage of wastes. The number of selected wastes exceeds the initial target (six) since other materials revealed relevant properties regarding the intended product development based on the UTAD team experience. As such, ten wastes were selected: polyurethane, timber, slag, ceramic, glass (bottle and optical lenses glass), plastic, fly ash, marble and granite. The verification source (Circular2B A1 Report.pdf) was sent with the corresponding interim report at the end of the activity.

Regarding Task A2:

Task A2 was developed between 01/10/2020 and 30/11/2021 and had the participation of UTAD and FCUP. A2 consisted of the extensive characterisation of the selected wastes, physically and chemically. The experimental tests included particle size distribution, SEM, EDS, XRD, XRF, FTIR, mechanical resistance and leaching. The number of characterised wastes (ten) exceeds the initial target (six). The verification source (Circular2B A2 Report.pdf) was sent with the corresponding interim report at the end of the activity.

Regarding Task A3:

Task A3 was developed between 01/03/2020 and 31/01/2023 and had the participation of UTAD, FCUP, Dreamdomus and SINTEF. A3 consisted of the preliminary characterisation of the core insulation material formulations and finishing render solutions. This activity was developed following eight actions: preliminary formulations, optimisation of volumetric mass, nanoparticles fabrication, nanoparticles analysis, nanoparticles incorporation, durability assessment, environmental assessment and microstructural analysis. One hundred and nine formulations (67 and 42 without and with nanoparticle incorporation) for the core insulation material and 17 formulations (15 and 2 without and with nanoparticle incorporation) for the finishing render were developed, mainly exceeding the envisaged target, 40 and 6, respectively. Regarding the finishing rendering system, acrylic paint was also doped with nanoparticles to improve its performance based on previous knowledge from the FCUP team. The donor country partner – SINTEF – had a significant task related to the durability assessment action and the definition of environmental assessment requirements, which was crucial to developing activity A4. Also, the industrial partner – Dreamdomus – had a very relevant intervention regarding preparing and producing prototypes and technological aspects. The verification source (Circular2B A3 Report.pdf) was sent with the corresponding interim report at the end of the activity.

Regarding Task A4:

Task A4 was developed between 01/09/2021 and 28/07/2023 and had the participation of FEUP, UTAD and Dreamdomus. A4 consisted of the final product characterisation of the solutions developed in activity A3. This activity was designed following three main actions: hygrothermal

characterisation of the core insulation material solutions, hygrothermal characterisation of finishing render solutions and hygrothermal characterisation of the SIP panel rendering system. Regarding the first action, a detailed characterisation of the most promising formulations with and without nanoparticles was performed, measuring the thermal conductivity, specific heat and water content at different states, porosimetry, dynamic modulus of elasticity and Poisson's coefficient. A complementary characterisation, comprising water vapour permeability, capillary water absorption and adhesive strength, was performed on the formulation (with and without nanoparticles) with the best compromise between the density, the thermal conductivity and the mechanical behaviour. For the second action, a rendering system consisting of a new waste-based render and an acrylic paint incorporating SiO_2 nanoparticles and a façade cladding made of the same material as the core were tested. The façade cladding could also be painted with acrylic paint incorporating SiO_2 nanoparticles. The mechanical resistance was evaluated in terms of adhesive strength and hard body impact resistance. These two main actions allowed to define the best constitution for the SIP panel rendering system, which was the ultimate product. The SIP panel was first tested using small-scale prototypes (40x40 cm^2) and then a real-scale wall (2x2 m2) was built considering 15 cm of core insulation mortar. The small-scale prototypes were tested before and after accelerated ageing (performed in straight collaboration with SINTEF) regarding optical, hygric and mechanical properties. The real-scale prototype allowed to test the production and assembly technology and to analyse the thermal behaviour and visual aspect of the finishing render solutions.

This activity was monitored regarding the annual consumption prediction of wastes, considering the number and type of houses that Dreamdomus built per year (approximately 12 houses). As such, regarding the composition of the selected core insulation and rendering system solutions, the following wastes were used: glass, fly ash, wood and polyurethane. Considering a SIP panel with the selected core insulation material with the doped finishing coating (black acrylic paint with nanoparticles), it is possible to use around 0.2 tons of glass waste, 510 tons of fly ashes and wood wastes and 27 tons of polyurethane.

The verification source (Circular2B A4 Report.pdf) is attached to this final report.

Regarding Task A5:

Task A5 was developed between 01/03/2022 and 28/07/2023 and had the participation of FEUP. A5 consisted of the numerical assessment of the developed solutions regarding hygrothermal, thermo-mechanical and thermo-energetic analysis. Three distinct software were selected for that purpose: WUFI Pro, ABAQUS and DesignBuilder (coupled with EnergyPlus), corresponding respectively to each analysis. Four simulation models were designed regarding the target activity indicator: two using WUFI Pro software (the SIP model, project solution, and an ETICS model, since it is a very widely used façade solution), one for ABAQUS (2D model for analysis of the thermo-induced stresses) and finally a 3D model (prototype modular house) for DesignBuilder. The four simulation models correspond to the formulation analysed in numerical assessments, as defined for the A5 project indicator. The hygrothermal assessment allowed to evaluate the influence of: different façade systems, exterior coating properties and exposition to distinct climate conditions. The thermo-mechanical analysis allowed to evaluate the impact of the substrate in the development of stresses in thermal insulation mortars. The thermo-energetic assessment increased the knowledge of the project solutions regarding thermal performance and energy efficiency.

The verification source (Circular2B A5 Report.pdf) is attached to this final report.

Regarding Task A6:

Task A6 was developed between 01/03/2022 and 31/12/2022 and had the exclusive responsibility of SINTEF in straight contact with the remaining partners to obtain reliable data for the environmental analysis. A6 consisted of the environmental performance assessment of the developed solutions. The aim was to analyse the environmental performance of three formulations of the core materials for the SIP panel and compare them with a traditional SIP using EPS, which comprises four environmental analyses as proposed. The LCA was conducted based on the method described in EN 15804: 2012+A2:2019 by analysing three main life cycle modules, i.e. A1, A2 and A3, regarding the component production. The verification source (Circular2B A6 Report.pdf) was sent with the corresponding interim report at the end of the activity.

However, due to the great interest in this analysis, further studies, which were not envisaged in the beginning, were performed, such as the comparison with a traditional cementitious core and

different curing conditions (controlled and ambient curing conditions). The results were presented in the second workshop at UTAD, and the evidence was also sent along with Interim Report 9 (18. SINTEF lecture.pdf).

Regarding Task A7:

Task A7 was developed during the project duration and had the participation of all partners since it was a transversal activity regarding communication and dissemination. The following activities were performed:

- Publications and stories in the Social Networks:
  - Instagram: (evidence in "3. Posts Instagram" and https://www.instagram.com/circular2b/)
  - Facebook: (evidence in "4. Posts Facebook" and https://www.facebook.com/circular2b)
- Good Practice Guides: production of the Circular2B Good Practice Guide (evidence in section ii);
- International congresses: 3 papers prepared and accepted for NSB 2023, 4 papers prepared and accepted for CEES 2023 and 1 abstract submitted to DCE 2023 (evidence in section ii);
- Scientific papers: three submitted papers and one ready for submission (evidence in section ii);
- Thesis: 2 Master thesis related to Activities 4 and 5 (evidence in section ii);
- Workshops: the final workshop was held on 10 July at FEUP facilities (evidence in section ii);
- Participation in the R2CS – Circular Network for Sustainable Construction Circular Talks and Closing Conference, at Gaiurb Urbanismo Habitação in Vila Nova de Gaia (evidence in section ii);
- International Fairs: Participation in TEKTONICA 2023 (https://tektonica.fil.pt/?doing_wp_cron=1669393098.9121270179748535156250) (evidence in section ii).

A summary of each activity and its development stage is presented in Table 1.

Table 1: Project summary of the main actions.

ID	Activity designation	Initial date	Deadline	Current situation	Observations
1	Selection of waste	01/10/2020	14/04/2021	**Concluded**	**Opportunities/synergies**: additional residues to those initially foreseen. **Constraints**: the project started during the COVID-19 pandemic, hindering hiring HR and selecting waste availability. Overcome with the activity extension.
2	Characterisation of waste	01/10/2020	30/11/2021	**Concluded**	**Opportunities/synergies:** wide range of wastes with very relevant characteristics. **Constraints:** waste treatment and storage; existing resources entirely overtook these constraints.
3	Preliminary characterisation of formulations	01/03/2021	31/01/2023	**Concluded**	**Partner involvement: Donor country** – SINTEF – durability assessment action and the definition of environmental assessment requirements; **Industrial partner** – Dreamdomus – preparation and production of prototypes. **Opportunities/synergies:** interaction between the various interlocutors. **Constraints:** HR hiring, shipping time (equipment, consumables, other), innovative materials that involve a high iteration degree and a high number of formulations.
4	Final products characterisation	01/09/2021	28/07/2023	**Concluded**	**Opportunities:** Materials without Portland cement addition, with good mechanical and hygrothermal properties that can be incorporated into prefabricated modular panels; less plastic incorporated in the modular panels. **Constraints:** hiring HR, an innovative solution that involves a high degree of iterations, equipment failure and availability.
5	Numerical assessment	01/03/2022	28/07/2023	**Concluded**	**Opportunities:** assessing the new panels' suitability under different climatic conditions, using various simulation tools, and using coatings with other properties. **Difficulties:** hiring HR with high qualifications and skills to develop this high-difficulty task.
6	Environmental performance	01/03/2022	31/12/2022	**Concluded**	**Under the responsibility of the donor country partner – SINTEF.** **Opportunities:** Life cycle analysis of developed solutions. **Difficulties:** obtaining all the necessary data for a reliable analysis.
7	Communication and dissemination	01/10/2020	28/07/2023	**Concluded**	**Opportunities:** straight collaboration between the project partners and also with relevant parties, such as associations, public bodies, municipalities, research centres, and the industrial sector. **Difficulties:** communication, design and marketing actions, which required specialised professionals.

ii. Results achieved

The main achieved results by activity will be presented in the following and also in Table 3.

A1 Task: Several wastes were collected, transported and safely stored (a total of 10), exceeding the envisaged target number 6.

A2 Task: The ten selected wastes were fully characterised, including physical, mechanical and environmental perspectives, exceeding the envisaged target number 6.

A3 Task: This was the most challenging and motivating activity since a much higher number of formulations, mainly for the core insulation, were developed (more than 270 %). This was due to the great scientific interest and novelty around these highly porous alkali-activated materials and also with the nanomaterials. It was possible to obtain materials with a very good compromise between the mechanical and thermal properties. As such, these first results could be continuously developed and studied after the project. Also, the collaboration with the donor country allowed access to robust and reliable testing and knowledge exchange to assess durability, a crucial aspect of new products.

A4 Task: This task allowed the final development of the intended products: the core insulation material and the finishing render solutions that allowed the production of the SIP panel rendering system. This task benefited from the knowledge of the industrial partner, Dreamdomus, regarding the technological process and market needs. The significant potential of the developed solutions regarding the core material position and protection was observed from the hygrothermal and mechanical assessment. The selected formulations provided great thermal insulation characteristics and a good compromise with the mechanical resistance. The production of the prototype wall (2x2 m^2) was one of the fundamental actions of the whole project since it was linked to the main objective and required technical knowledge and production skills. The indicators related to the annual consumption prediction of incorporated wastes showed the significant potential impact of incorporating such materials in new building solutions. The modular construction sector is gaining an increasing interest in Portugal, which may also increase these values.

A5 Task: The distinct numerical assessment allowed the evaluation of the impact of the new solutions compared to other traditional systems widely used in the construction sector. This type of evaluation allowed to evaluate the impact at different levels of the system constitution according to the material properties, geometry and boundary conditions, such as climatic conditions. The new solution presented better behaviour in terms of exterior surface

condensation potential due to the high core mass and lower cooling and heating demands for specific simulation scenarios, highlighting the potential of the new solutions.

A6 Task: This task was very relevant to evaluate the impact of all materials that constitute the project products and the way they are produced and prepared. The results showed significant differences in environmental performance between the different core materials concerning their potential environmental impacts, mainly due to weight differences and the use of primary materials. Also, the new products showed an improved behaviour compared to a traditional cementitious material. However, the higher mass of the new SIP compared to the traditional SIP, with EPS, highlighted the importance of further developments, for example, by reducing the core mass. Nevertheless, it would be of great interest to evaluate the whole life cycle, from the production to the end of life, comprising the operation stage, since the new product could positively impact energy efficiency in specific locations, as noted in A5.

Regarding the A7 task and namely the Communication Plan, the following activities, not yet evidenced in the previous reports, were performed:

- International congresses:
    - Participation in NSB 2023 (attendance certificate documents: "4. NSB 2023_SINTEF" and "5. NSB 2023") and presentation/publication of the following papers:
        - Accelerated climate aging tests of structural insulated panels with waste-based core materials (presented by Lars Gulbrekken from SINTEF);
        - Improving the optical properties of finishing coatings for façade systems (presented by Ana Rita Veloso);
        - NIR reflective Paints as an Alternative for Sustainable Façade Renovation (presented by Andréa Souza).
    - Participation in CEES 2023 (attendance certificate documents):
        - Durability assessment of eco-innovative panels based on accelerated ageing tests (document "6. CEES 2023_NR);
        - Optimisation design and assessment of architectonic and eco-friendly UHPC (document "7. CEES 2023_JM);

- The influence of nanoparticles inclusion on the optical properties and hygrothermal performance of an innovative waste-based porous alkaline cement composite (document "8. CEES 2023_RV);
- Optical properties of ETICS surfaces – sensitivity to the finishing system composition (document "9. CEES 2023_AS);

o Participation and poster presentation in DCE 2023 (document "10. DCE2023 poster)

- Scientific papers:
  - o Published: "Reflectance and color tuning in TiO_2-CuO nanoparticle composition mixing", Buildings – MDPI (11. Buildings)
  - o Submitted (final stage of revisions): "Development of Highly Porous Alkaline Cements from Industrial Waste for Thermal Insulation of Building Envelops", Construction & Building Materials – Elsevier (evidence already sent);
  - o Submitted (Under review): "Impact of SiO_2, TiO_2 and ZnO nanoparticles incorporation on the thermo-optical properties of dark-coloured façade coatings", Journal of Building Engineering – Elsevier (evidence of submission in "12. JBE Submission");
  - o Submitted (Under review): "Durability and performance of opaque high-reflectance envelope systems: A systematic review", Building and Environment – Elsevier (evidence of submission in "13. BAE Submission");
  - o Submitted (Under review): Unravelling the role of TiO2 nanoparticles on the optical performance of dark colorants for coatings (14. MCP Submission)
- Master thesis:
  - o Concluded in 07/2023: "Durabilidade de argamassas eco-sustentáveis para painéis de fachada", FEUP (document " 15. Master thesis 1)
  - o Concluded in 09/2023: "Avaliação numérica do comportamento higrotérmico de paineis SIP eco-sustentáveis", FEUP (document "16. Master thesis 2)
- Participation in the R2CS – Circular Network for Sustainable Construction Circular Talks and Closing Conference, at Gaiurb Urbanismo Habitação in Vila Nova de Gaia, 25 March 2023 and 6 June 2023, respectively (evidence "17. R2CS participation");
- Participation of Dreamdomus in the International fair TEKTONIKA 2023 from 4-7 May, in Lisbon (evidence "18. TEKTONICA");

- Final Workshop of Circular2B project, at FEUP in Porto, 10 July 2023 (evidence "19. Final Workshop").

The project Communication Plan is presented. It is possible to observe that, except for the International Fairs due to reschedules related to the COVID-19 pandemic and already explained and accepted by SGA, all the actions were performed and some were overcome.

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The Communication Plan, the last version updated on October 2022, is presented in Table 2.

Table 2: Communication Plan

Communication type of action	Communication plan schedule																						
	2020												2021										
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
International fairs																							
Workshop – 1																							
International Scientific conferences (ANM)																							
Workshop - 2																							
Summer School																				X			
Scientific conference – 1																		X					
Scientific papers																							X
Scientific conference – 2																							
International meetings																							
Scientific conference - 3																							

Communication type of action	Communication plan schedule																		
	2022												2023						
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
International fairs																		X	X
Workshop – 1															X				
International Scientific conferences (ANM)							X												
Workshop - 2			X																
Summer School									X										
Scientific conference – 1																			
Scientific papers									X										
Scientific conference – 2			X			X						X							
International meetings			X								X								
Scientific conference - 3																		X	

Table 3 presents the technical execution considering the defined indicators/targets and the results. The target numbers presented in Activity 4 are related to a prediction of the number and type of houses the industrial partner builds per year (approximately 12 houses/year), if they used a SIP panel with the selected core insulation material with the doped finishing coating (black acrylic paint with nanoparticles). Owing to the results obtained in task A3, some of the wastes initially envisaged were not included in the final products formulations, leading to annual consumption predictions of 0% in some indicators of task A4, while the value is much higher than 100% for others. Also, the results of Activity 7 are related to accomplished (published) actions, which means that the previously referred submitted/accepted scientific papers are not considered in Table 3.

Table 3: Technical/Material execution

ID	Activity designation	Indicator	Current situation	Target	Result (up to now)	Technical execution	Verification source (expected / sent)
1	Selection of waste	Number of wastes collected, transported and safely stored. Each of these tasks, for each waste, is considered an 'Action'.	**Concluded**	6	10	167 %	Internal technical report at mid-term and at the end of this Activity, when the number of 'Actions' planned at the start of the project will be compared against the number of 'Actions' performed. **(Circular2B A1 Report)**
2	Characterisation of waste	Number of wastes fully characterised, including the physical, mechanical and environmental perspectives.	**Concluded**	6	10	167 %	Internal technical report at mid-term and at the end of this Activity **(Circular2B A2 Report)**
3	Preliminary characterisation of formulations	Formulation and testing of pastes for external plastering mortar	**Concluded**	6	17 (15+2)	283 %	Internal technical report at mid-term and at the end of this Activity
		Formulation and testing of pastes for the central area of the SIP		40	109 (67+42)	273 %	Internal technical report at mid-term and at the end of this Activity, when the number of 'Actions' planned at the start of the project will be compared against the number of 'Actions' performed. **(Circular2B A3 Report)**
4	Final products characterisation	annual consumption prediction* of recycled plastic in exterior finishing mortar	**Concluded**	0.7	0	0 %	Internal technical report at mid-term and at the end of this Activity **(evidence 20. Circular2B A4 Report)**

ID	Activity designation	Indicator	Current situation	Target	Result (up to now)	Technical execution	Verification source (expected / sent)
		annual consumption prediction* of blast furnace slag waste in exterior finishing mortar		5	0	0 %	
		annual consumption prediction* of C&D waste (glass and ceramic) in exterior finishing mortar		2.5	0.2	8 %	
		annual consumption prediction* of C&D waste (glass and ceramic) in the core of the modular panel		12	0	0 %	
		annual consumption prediction* of recycled solid waste **in the core of the modular panel		16	509.6	3185 %	
		annual consumption prediction* of recycled plastic in the core of the modular panel		16	26.8	168 %	
		annual consumption prediction* of solid waste incineration slag in the core of the modular panel		25	0	0	
		annual consumption prediction* of recycled timber in OSB of the modular panel		33	0	0	
		*this prediction was done taking into account the number and type of houses that the industrial partner construct per year (12 houses/year, approximately: 120 tons of modular panels, and 12 tons of exterior finishing mortar). ** fly ashes and wood waste					
5	Numerical assessment	Formulation analysed in	Concluded	4	4	100%	Internal technical report (evidence 21. Circular2B A5 Report)

ID	Activity designation	Indicator	Current situation	Target	Result (up to now)	Technical execution	Verification source (expected / sent)
		numerical assessments.					
6	Environmental performance	Environmental statement	**Concluded**	4	4	100%	Internal technical report (Circular2B A6 Report)
7	Communication and dissemination	Followers in the social networks	**Concluded**	5000	251	5%	Facebook and Instagram accounts (sent)
		Good practice guides		3	1	33%	Good practice guides (book) (evidence 22. Good Practice Guide)
		Workshops		6	6	100%	Workshop (website and photographs) (sent)
		Conferences		10	19	190%	Conferences (published papers and presence certificate) (sent)
		International fairs		2	1	50%	International fairs (photographs and presence certificate) (sent)
		Scientific papers		10	5	50%	Scientific papers (online reference)* (sent)

Some additional notes related to A7:

- The number of followers in the application stage was too ambitious, associated with the lack of knowledge in the social media field, which is expected for a scientific team;
- Regarding the Good Practice Guide, instead of producing three single books, the promoter created one guide with all the relevant information;
- The number of conference publications highly exceeded the target value;
- Four additional scientific papers were submitted and will be published soon. Also, three more scientific publications related to the formulations with nanoparticles, the hygrothermal behaviour of the new formulations and the durability and environmental assessment are being prepared. Considering these future publications, the target value will be overcome.

The total technical execution rate (TTER) of the project is estimated at 228 %, based on a weighting of the partial execution rates (PTER) to date:

$$TTER = 0.1 \times PTER(A1) + 0.1 \times PTER(A2) + 0.2 \times PTER(0.15A2.1 + 0.85A2.2) + 0.25 \times PTER \sum_{n=1}^{8}(0.125A4.n) + 0.10 \times PTER(A5) + 0.10 \times PTER(A6) + 0.15 \times PTER(0.05A7.1 + 0.10A7.2 + 0.30A7.3 + 0.25A7.4 + 0.10A7.5 + 0.20A7.6)$$

Also, all the activities were concluded according to the Project Timeline, presented in the Excel document "23. Project Timeline".

iii. Description of costs and financial impact assessment

The following tables describe the financial execution rate at different levels: the reporting period and the final financial execution of the project.

Table 4: Financial execution by activity during the reporting period

Project/ Activities	Cost (with indirect costs)		Financial execution rate (%) (compared to the overall cost)	
	Last Reporting period (RP)	Cumulative - Full project	Last Reporting period (RP)	Cumulative - Full project
Management	17 342 €	40 520 €	4%	9%
A1	0 €	12 898 €	0%	3%
A2	0 €	43 227 €	0%	10%
A3	24 529 €	96 221 €	5%	21%
A4	27 056 €	128 749 €	6%	29%
A5	38 319 €	64 054 €	9%	14%
A6	18 373 €	21 452 €	4%	5%
A7	31 243 €	42 671 €	7%	9%
Total	156 863 €	449 791 €	35%	100%

Table 5: Financial execution by partner during the reporting period

Entities	Cost (with indirect costs)		Financial execution rate (%) (compared to the overall cost/entity)	
	Last Reporting period (RP)	Cumulative - Full project	Last Reporting period (RP)	Cumulative - Full project
FEUP	47 484 €	134 654 €	11%	30%
Dreamdomus	26 859 €	66 962 €	6%	15%
UTAD	32 307 €	114 848 €	7%	26%
FCUP	2 123 €	77 038 €	0%	17%
SINTEF	48 090 €	56 290 €	11%	13%
Total	156 863 €	449 791 €	35%	100%

Table 6: Financial execution by partner/activity during the reporting period

Entities/ Activities	Cost (with indirect costs)		Financial execution rate (%) (compared to the overall cost)	
	Last Reporting period (RP)	Cumulative - Full project	Last Reporting period (RP)	Cumulative - Full project
Management				
FEUP	2 952 €	12 701 €	7%	31%
Dreamdomus	4 097 €	6 627 €	10%	16%
UTAD	4 233 €	12 197 €	10%	30%
FCUP	0 €	0 €	0%	0%
SINTEF	6 061 €	8 995 €	15%	22%
Total MNG	**17 342 €**	**40 520 €**	**43%**	**100%**
A1				
FEUP	0 €	0 €	0%	0%
Dreamdomus	0 €	0 €	0%	0%
UTAD	0 €	9 133 €	0%	71%
FCUP	0 €	3 765 €	0%	29%
SINTEF	0 €	0 €	0%	0%
Total A1	**0 €**	**12 898 €**	**0%**	**100%**
A2				
FEUP	0 €	0 €	0%	0%
Dreamdomus	0 €	0 €	0%	0%
UTAD	0 €	7 723 €	0%	18%
FCUP	0 €	35 505 €	0%	82%
SINTEF	0 €	0 €	0%	0%
Total A2	**0 €**	**43 227 €**	**0%**	**100%**

Entities/ Activities	Cost (with indirect costs)		Financial execution rate (%) (compared to the overall cost)	
	Last Reporting period (RP)	Cumulative - Full project	Last Reporting period (RP)	Cumulative - Full project
A3				
FEUP	0 €	0 €	0%	0%
Dreamdomus	4 377 €	19 097 €	5%	20%
UTAD	7 282 €	36 711 €	8%	38%
FCUP	0 €	25 760 €	0%	27%
SINTEF	12 870 €	14 653 €	13%	15%
Total A3	**24 529 €**	**96 221 €**	**25%**	**100%**
A4				
FEUP	5 989 €	56 634 €	5%	44%
Dreamdomus	15 118 €	37 971 €	12%	29%
UTAD	5 949 €	32 508 €	5%	25%
FCUP	0 €	1 636 €	0%	1%
SINTEF	0 €	0 €	0%	0%
Total A4	**27 056 €**	**128 749 €**	**21%**	**100%**
A5				
FEUP	38 319 €	63 656 €	60%	99%
Dreamdomus	0 €	0 €	0%	0%
UTAD	0 €	0 €	0%	0%
FCUP	0 €	398 €	0%	1%
SINTEF	0 €	0 €	0%	0%
Total A5	**38 319 €**	**64 054 €**	**60%**	**100%**

Entities/ Activities	Cost (with indirect costs)		Financial execution rate (%) (compared to the overall cost)	
	Last Reporting period (RP)	Cumulative - Full project	Last Reporting period (RP)	Cumulative - Full project
A6				
FEUP	0 €	0 €	0%	0%
Dreamdomus	0 €	0 €	0%	0%
UTAD	0 €	0 €	0%	0%
FCUP	0 €	0 €	0%	0%
SINTEF	18 373 €	21 452 €	86%	100%
Total A6	**18 373 €**	**21 452 €**	**86%**	**100%**
A7				
FEUP	224 €	1 663 €	1%	4%
Dreamdomus	3 268 €	3 268 €	8%	8%
UTAD	14 844 €	16 576 €	35%	39%
FCUP	2 123 €	9 975 €	5%	23%
SINTEF	10 785 €	11 189 €	25%	26%
Total A7	**31 243 €**	**42 671 €**	**73%**	**100%**
Total	**156 863 €**	**449 791 €**	**35%**	**100%**

Table 7: Financial execution by activity during the entire project duration

Project/ Activities	Cost (with indirect costs)		Financial execution rate (%)
	APPROVED	EXECUTED	
Management	45 372	40 520	89%
A1	13 087	12 898	99%
A2	44 292	43 227	98%
A3	118 089	96 221	81%
A4	146 616	128 749	88%
A5	58 074	64 054	110%
A6	22 130	21 452	97%
A7	48 730	42 671	88%
Total	496 391	449 791	91%

Table 8: Financial execution by partner during the entire project duration

Entities	Cost (with indirect costs)		Financial execution rate (%)
	APPROVED	EXECUTED	
FEUP	131 731	134 654	102%
Dreamdomus	108 314	66 962	62%
UTAD	116 465	114 848	99%
FCUP	80 081	77 038	96%
SINTEF	59 800	56 290	94%
Total	496 391	449 791	91%

Table 9: Financial execution by partner/activity during the entire project duration

Entities/ Activities	Cost (with indirect costs)		Financial execution rate (%)
	APPROVED	EXECUTED	
Management			
FEUP	12 630	12 701	101%
Dreamdomus	10 820	6 627	61%
UTAD	12 088	12 197	101%
FCUP	0	0	0%
SINTEF	9 834	8 995	91%
Total MNG	**45 372**	**40 520**	**89%**
A1			
FEUP	0	0	0%
Dreamdomus	0	0	0%
UTAD	9 133	9 133	100%
FCUP	3 954	3 765	95%
SINTEF	0	0	0%
Total A1	**13 087**	**12 898**	**99%**
A2			
FEUP	0	0	0%
Dreamdomus	0	0	0%
UTAD	7 723	7 723	100%
FCUP	36 570	35 505	97%
SINTEF	0	0	0%
Total A2	**44 292**	**43 227**	**98%**
A3			
FEUP	0	0	0%
Dreamdomus	38 569	19 097	50%
UTAD	37 801	36 711	97%
FCUP	26 716	25 760	96%
SINTEF	15 003	14 653	98%
Total A3	**118 089**	**96 221**	**81%**

Entities/ Activities	Cost (with indirect costs)		Financial execution rate (%)
	APPROVED	EXECUTED	
A4			
FEUP	56 484 €	56 634 €	**100%**
Dreamdomus	56 925 €	37 971 €	**67%**
UTAD	31 561 €	32 508 €	**103%**
FCUP	1645 €	1636 €	**99%**
SINTEF	0 €	0 €	**0%**
Total A4	**146 616 €**	**128 749 €**	**88%**
A5			
FEUP	57 674 €	63 656 €	**110%**
Dreamdomus	0 €	0 €	**0%**
UTAD	0 €	0 €	**0%**
FCUP	400 €	398 €	**99%**
SINTEF	0 €	0 €	**0%**
Total A5	**58 074 €**	**64 054 €**	**110%**
A6			
FEUP	0 €	0 €	**0%**
Dreamdomus	0 €	0 €	**0%**
UTAD	0 €	0 €	**0%**
FCUP	0 €	0 €	**0%**
SINTEF	22 130 €	21 452 €	**97%**
Total A6	**22 130 €**	**21 452 €**	**97%**
A7			
FEUP	4 943 €	1663 €	**34%**
Dreamdomus	2 000 €	3 268 €	**163%**
UTAD	18 159 €	16 576 €	**91%**
FCUP	10 796 €	9 975 €	**92%**
SINTEF	12 833 €	11 189 €	**87%**
Total A7	**48 738 €**	**42 671 €**	**88%**
Total	**496 391 €**	**449 791 €**	**91%**

v. Description of the Project's contribution to achieving the overall objectives of EEA Grants and the 'Environment Programme'

Circular2B has contributed to the Indicators of the Environmental Programme, as shown in Table 10.

Table 10: Contribution of the project to the Environment Programme

Programmatic Area (PA) | Objective	Expected result	Indicator	Base value	Base year	Target	Project contribution (up to now)	Related activities
PA11 Objective 1	Increased application of Circular Economy principles in target sectors.	Construction and demolition waste avoided by the supported sectors (%)	48.6%	2017	70.0%	30/14.5	A1, A2, A3
		Number of jobs created (disaggregated by gender, age)	0	N/D	25	5 Female: 3 Male: 2 20-25 years old: 1 25-35 years old: 3 > 35 years old: 1	All
		Tons of plastic recycled through all supported schemes/measures	0	N/D	20000	32/16.7*	A1, A2, A3
		Use of secondary materials increased in the supported sectors (%)	0.0%	N/D	15.0%	612/79*	A1, A2, A3
Output 1.4	Increased resource efficiency in the construction sector	Number of SMEs Supported	0	N/D	5	1	All
		Number of demonstration buildings constructed [1]	0	N/D	3	0	N/A
		Number of Innovative solutions for increased resource efficiency piloted	0	N/D	5	2**	A3, A4, A5, A6

* Rationale (numerator/denominator) according to the document "37Call#2_Construcao_Circular_AnexoI_indicadores"; **Core insulation and finishing render solution.

The project also contributed to avoiding CDW by incorporating 0.2 tons/year of CDW on the developed solutions regarding the expected number of constructed houses.

[1] Fulfilling a minimum of 50% circular materials and /or components constructed.

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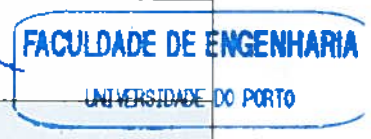
The project contributes to bilateral relations with donor countries by integrating the SINTEF (Norway) partner, who developed several key activities and relevant tasks in the project.

Projector Promotor

Name	Rui Calçada
Date and Signature	29/09/2023  
Position	Diretor da FEUP

Programme Operator – Secretary General for Environment

Name	Marco Rebelo
Date and Signature	
Position	Director of Secretary General