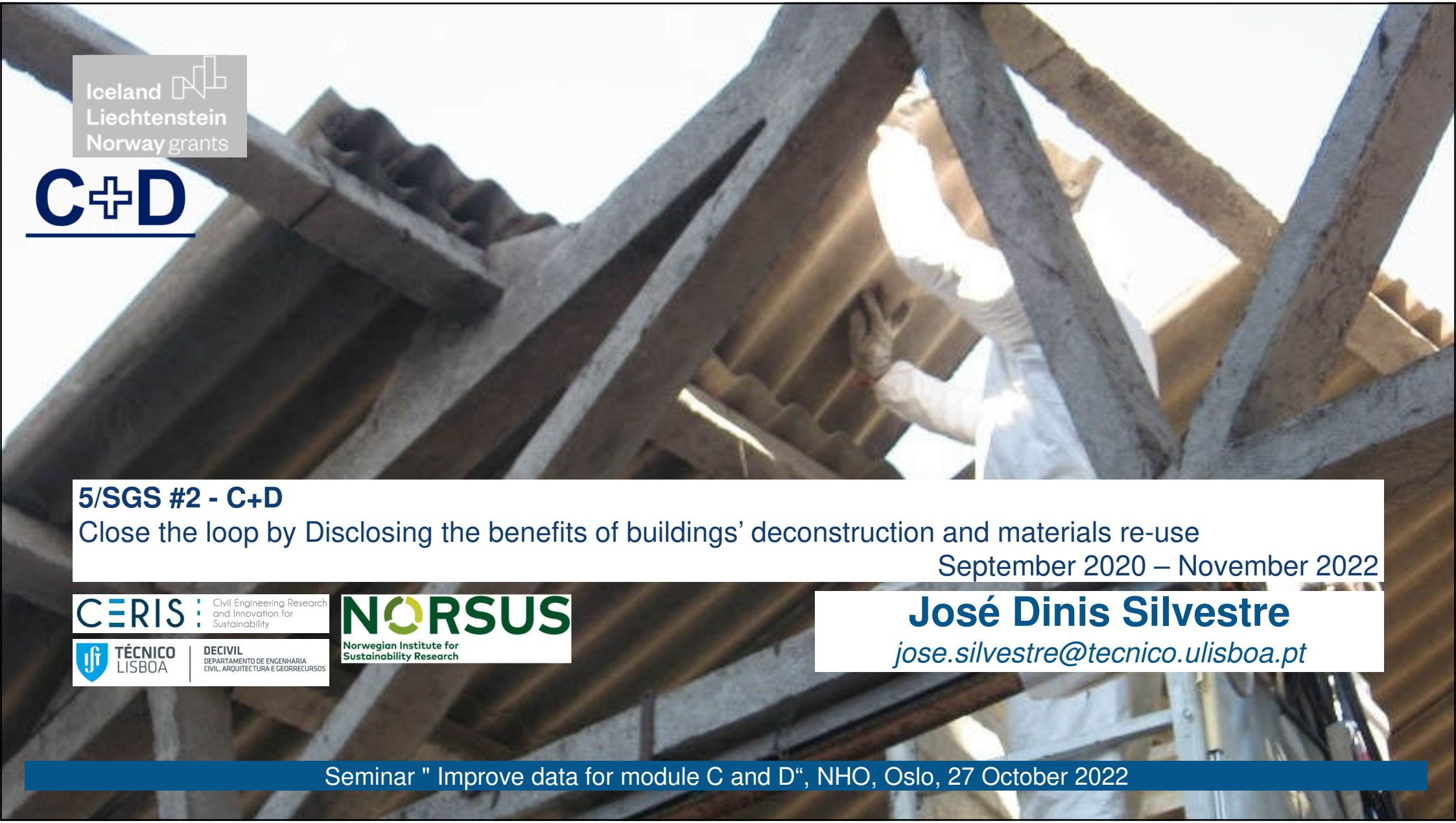


Iceland Liechtenstein Norway grants

C+D

5/SGS #2 - C+D

Close the loop by Disclosing the benefits of buildings' deconstruction and materials re-use

September 2020 – November 2022

CERIS : Civil Engineering Research and Innovation for Sustainability

TÉCNICO LISBOA | DECIVIL DEPARTAMENTO DE ENGENHARIA CIVIL, ARQUITECTURA E GEORRECURSOS

NORSUS Norwegian Institute for Sustainability Research

José Dinis Silvestre

jose.silvestre@tecnico.ulisboa.pt

Seminar " Improve data for module C and D", NHO, Oslo, 27 October 2022

Consortium

PositiveCycle group@CERIS
CERIS: Civil Engineering Research and Innovation for Sustainability
TÉCNICO LISBOA | DECIVIL DEPARTAMENTO DE ENGENHARIA CIVIL, ARQUITECTURA E GEORRECURSOS

- The C+D project is **promoted by the "Civil Engineering Research and Innovation for Sustainability" - CERIS** research centre **from Instituto Superior Técnico of Universidade de Lisboa, in Portugal,**

NORSUS
Norwegian Institute for Sustainability Research

- And has the **"Norwegian Institute for Sustainability Research" – NORSUS, from Norway,** as a **partner**.

Background

The construction sector:

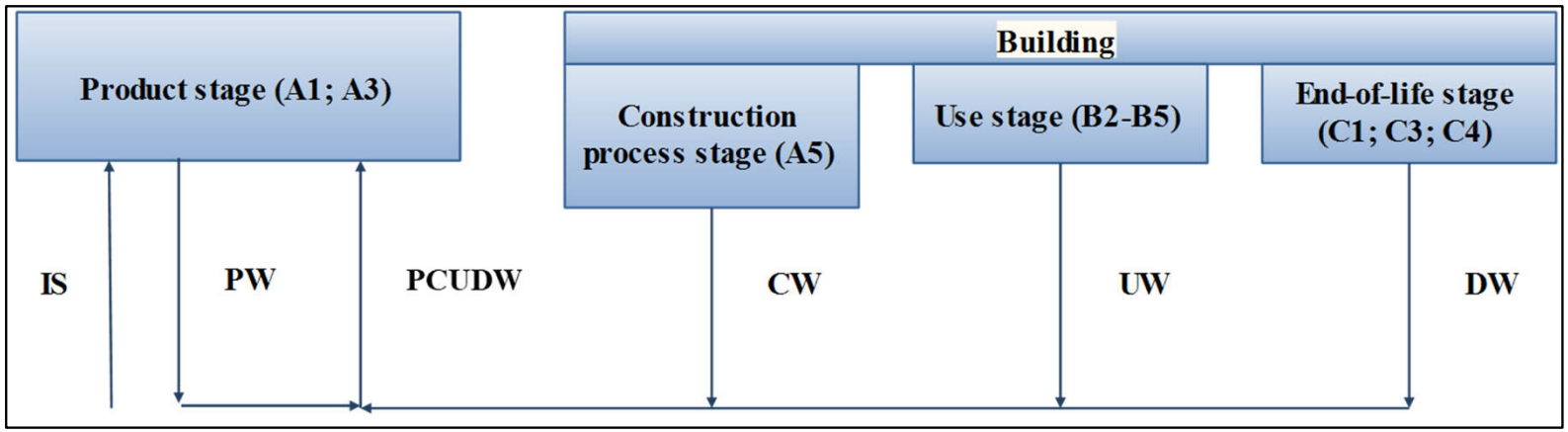
- makes an intensive use of primary resources;
- has a low level of circularity;
- has a great circularity potential.

Traditional demolition is still the most common practice in Portugal.

However, selective demolition maximizes the re-use, or at least the recycling, of demolition waste.

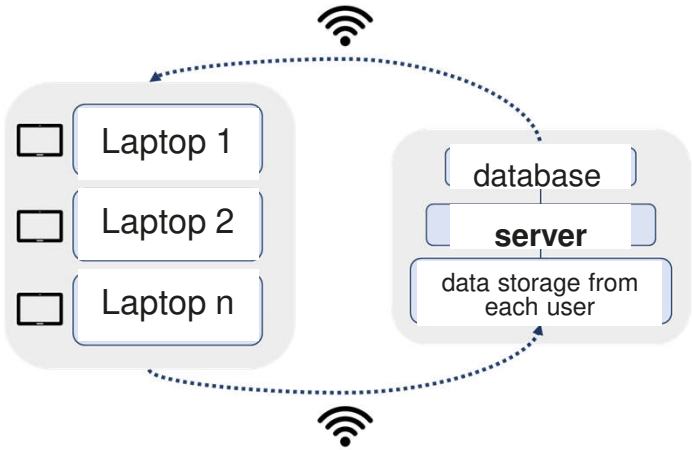
Main aim

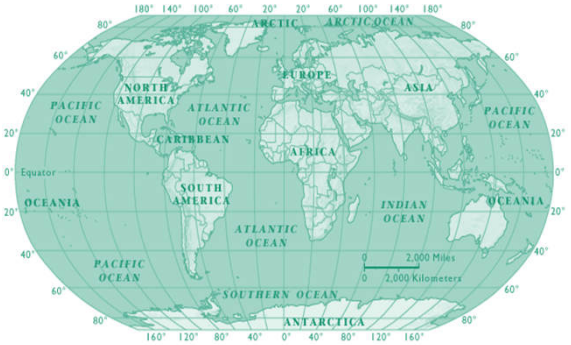
Develop the web-based **C+D platform** for calculating the **economic and environmental benefits** associated with the process of **deconstruction of buildings** and of **re-use of Construction and Demolition Waste (CDW, or C+D waste).**



Waste flows from the production of construction materials (including industrial symbiosis), and from the construction, use, and demolition of buildings

Specific objectives





- Develop the C+D platform, which will be comprehensive, upgradeable and innovative, and that will include a circularity indicator;

- Make this platform available to the public in Portugal, Norway and other countries, in Portuguese and in English, along with a handbook in the same languages.

Activities

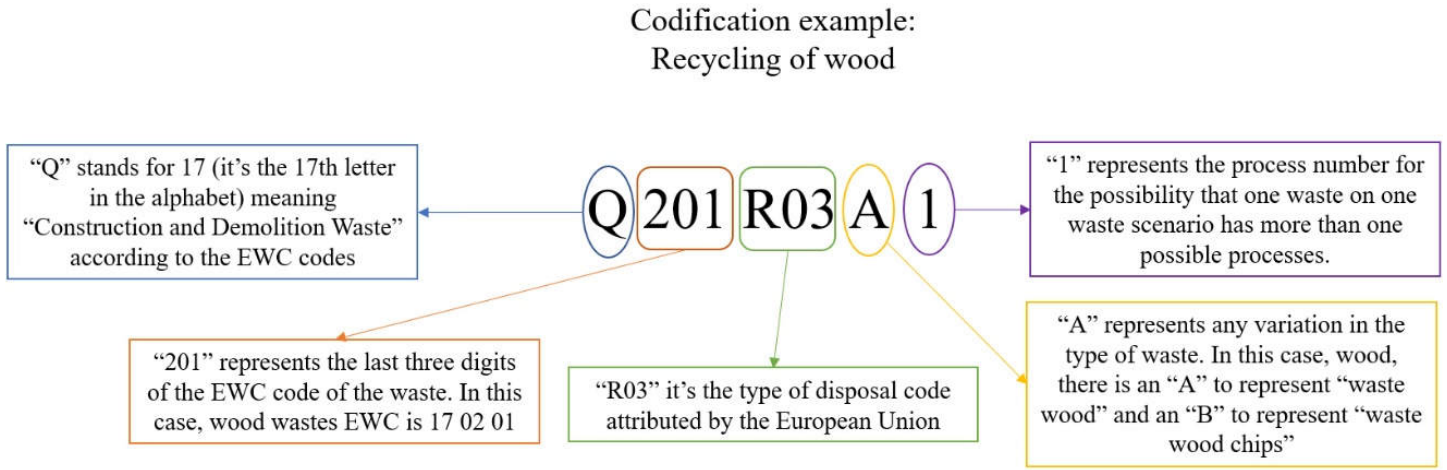
1. Development of databases of environmental and economic impacts
2. Collection of national and international data
3. Development of an indicator of the environmental and economic advantages of circularity
4. Development of the C+D platform
5. Development of the C+D handbook
6. Communication and dissemination of the results

Activities

1. **Development of databases of environmental and economic impacts**
2. **Collection of national and international data**

Results

Antunes, A.; Martins, R.; Silvestre, J.D.; do Carmo, R.; Costa, H.; Júlio, E.; Pedroso, P. (2021) **Environmental Impacts and Benefits of the End-of-Life of Building Materials: Database to Support Decision Making and Contribute to Circularity**. *Sustainability*, 13, 12659. https://doi.org/10.3390/su132212659



C+D

Close the loop by Disclosing the benefits of buildings' deconstruction and materials re-use

cplusd-platform.pt

Activities

1. **Development of databases of environmental and economic impacts**
2. **Collection of national and international data**

Results

Description	EWC	Costs: Demolition / Deconstruction / Transport / Disposal	Sorting Plant E01	Collection for Final Disposal E02	In Situ Reuse E03	Engineered landfill D05	Incineration on land D10	Use as fuel R01	Organic subs. recycling/ reclaim R03	Metal recycling/ reclaim R04	Inorganic subs. recycling/ reclaim R05
CONSTRUCTION AND DEMOLITION WASTES	**17 (Q)**										
Concrete, Bricks, Tiles and Ceramics	**17 01**										
Concrete	17 01 01	X - - X	Q101E01A1	Q101E02A1							Q101R05A1
Bricks	17 01 02	X - - -	Q102E01A1	Q102E02A1							Q102R05A1
Tiles and Ceramics	17 01 03	X - - -									
Mixture of, or separate fractions of concrete, bricks, tiles and ceramics containing hazardous substances	17 01 06 *	X - - -									
Mixture of concrete, bricks, tiles and ceramics other than 17 01 06	17 01 07	X - - -									
Wood, Glass and Plastic	**17 02**										
Wood	17 02 01	X X X X				Q201D05A1	Q201D10A1	Q201R01A1	Q201R03A1		
Glass	17 02 02	X - X -	Q202E01A1	Q202E02A1		Q202D05A1	Q202D10A1				
Plastic	17 02 03	X - X X				Q205D05A1	Q203D10A1				Q203R05A1
Glass, Plastic and Wood conctaining or contaminated with hazardous substances	17 02 04 *	X X X -									
Metals	**17 04**										
Copper, Bronze, Brass	17 04 01	X - X -				Q401D05A1					
Aluminium	17 04 02	X - X -				Q402D05A1					
Lead	17 04 03	X - - -									
Zinc	17 04 04	X - - -									
Iron and Steel	17 04 05	X - X X	Q405E01C1	Q405E02C1		Q405D05B1	Q405D10B1			Q405R04C1	
Tin	17 04 06	X - - -									
Mixed metals	17 04 07	X - X -				Q407D05A1	Q407D10A1				
Metal waste contaminated with hazardous subtances	17 04 09 *	X - X -									
Cables containing oil, coal tar and other hazardous substances	17 04 10 *	X - - -									
Cables other than those mentioned in 17 04 10	17 04 11	X - - -									
Insulation materials and Asbestos-containing construction materials	**17 06**										
Insulation materials containing asbestos	17 06 01 *	X - - -									
Other insulation materials consisting of or containing hazardous substances	17 06 03 *	X X X -									
Insulations materials other than those mentioned in 17 06 01 and 17 06 03	17 06 04	X X X X	Q604E01A1	Q604E02A1		Q604D05A1	Q604D10B1				Q604R05A1
Construction materials containing asbestos	17 06 05 *	X - - -									
Gypsum-based construction material	**17 08**										
Gypsum-based construction materials contaminated with hazardous substances	17 08 01 *	X X X -									
Gypsum-based construction materials other than those mentioned in 17 08 01	17 08 02	X X X X	Q802E01B1	Q802E02B1		Q802D05A1					Q802R05B1
Other construction and demolition wastes	**17 09**										
Construction and demolition wastes containing mercury	17 09 01 *	X - - -									
Construction and demolition wastes containing PCB	17 09 02 *	X - - -									
Other construction and demolition wastes containing hazardous substances	17 09 03 *	X - - -									
Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	17 09 04	X - - -				Q904D05A1					
MUNICIPAL WASTE	**20 (T)**										
Separately collected fractions	**20 01**										
Paper and cardboard	20 01 01	X - - X	T101E01A1	T101E02B1		T101D05C1	T101D10C1		T101R03B1		
Other municipal wastes	**20 03**										
Mixed municipal waste	20 03 01	X X X X				T301D05A1					

Working together for a green Europe

Activities

3. Development of an indicator of the environmental and economic advantages of circularity

Results

GOMES, R.; BASTOS, D.; SILVESTRE, J. D. **Development of an indicator of the environmental advantages of circularity of construction materials**. *Sustainability*. Submitted for publication January 2022

- quantify the environmental impact of the circularity potential of building materials
- considers the production (A1-A3) and end-of-life (C and D) phases of the material, and can be applied to different end-of-life scenarios
- it is divided in 3 parts, each one associated to a different stage of the material life cycle (production; service life; end of life)
- the results of each part of the expression vary between 0 and 1, and are then summed and divided by 3
- results in a value between 0 and 1, where higher values indicate greater circularity of the material

$$MECI = \frac{3-\left(\frac{GWP_{A1-A3}}{GWP_{0\%RC}}\right)-\left(\frac{GWP_{C+D}+GWP_{A1-A3}}{GWP_{worst\ disposal}+GWP_{A1-A3}}\right)-\left(\frac{LC_{build}-LC_{material}}{LC_{build}}\right)}{3}\ per\ kg\ of\ material$$

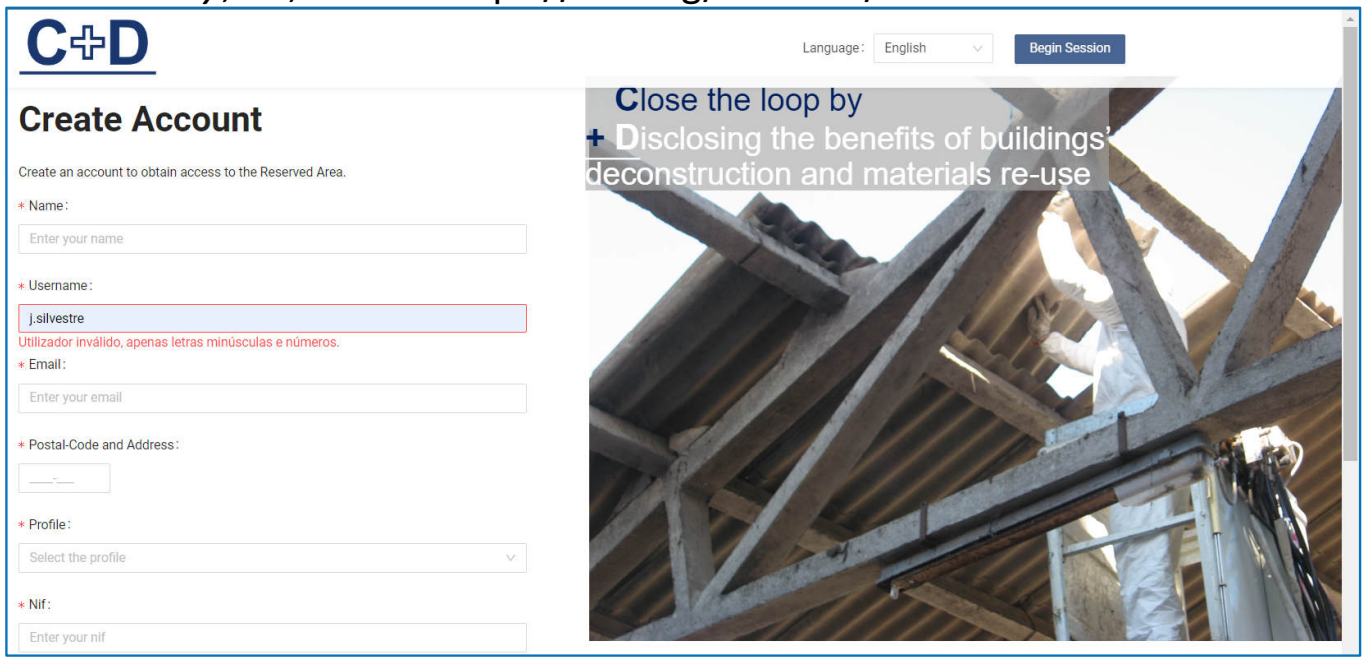
Activities

4. **Development of the C+D platform**

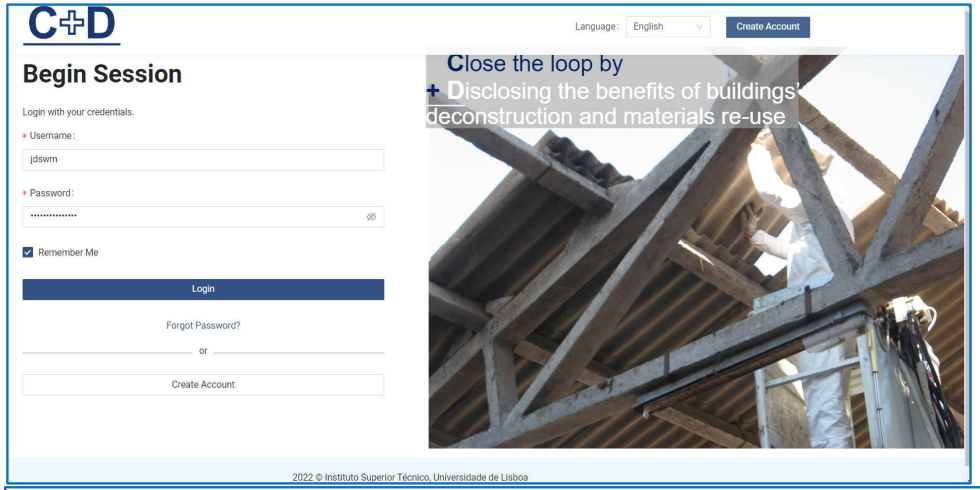
5. **Development of the C+D handbook**

Results: C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

Antunes, A.; Martins, R.; Silvestre, J.D.; do Carmo, R.; Costa, H.; Júlio, E.; Pedroso, P. (2021) **Environmental Impacts and Benefits of the End-of-Life of Building Materials: Database to Support Decision Making and Contribute to Circularity**. *Sustainability*, 13, 12659. https://doi.org/10.3390/su132212659



C+D Platform for calculating the economic and environmental benefits and impacts of CDW management



ANTUNES, A.; MARTINS, R.; SILVESTRE, J. D.; CARMO, R. do; COSTA, H.; JÚLIO, E.; PEDROSO, P. (2021). Environmental impacts and benefits of the end-of-life of building materials: database to support decision making and contribute to circularity. Sustainability. 13, 12659, DOI: 10.3390/su132212659.3

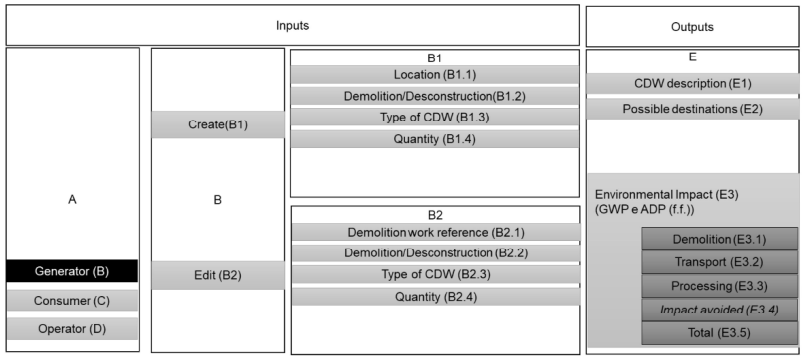


Figure 5. Online platform preview for the CDW generator profile.

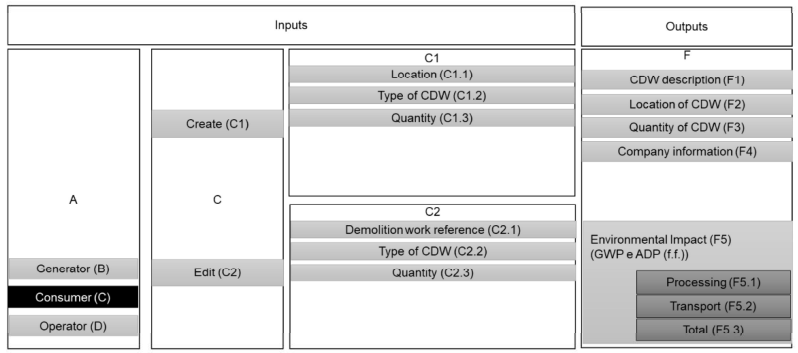


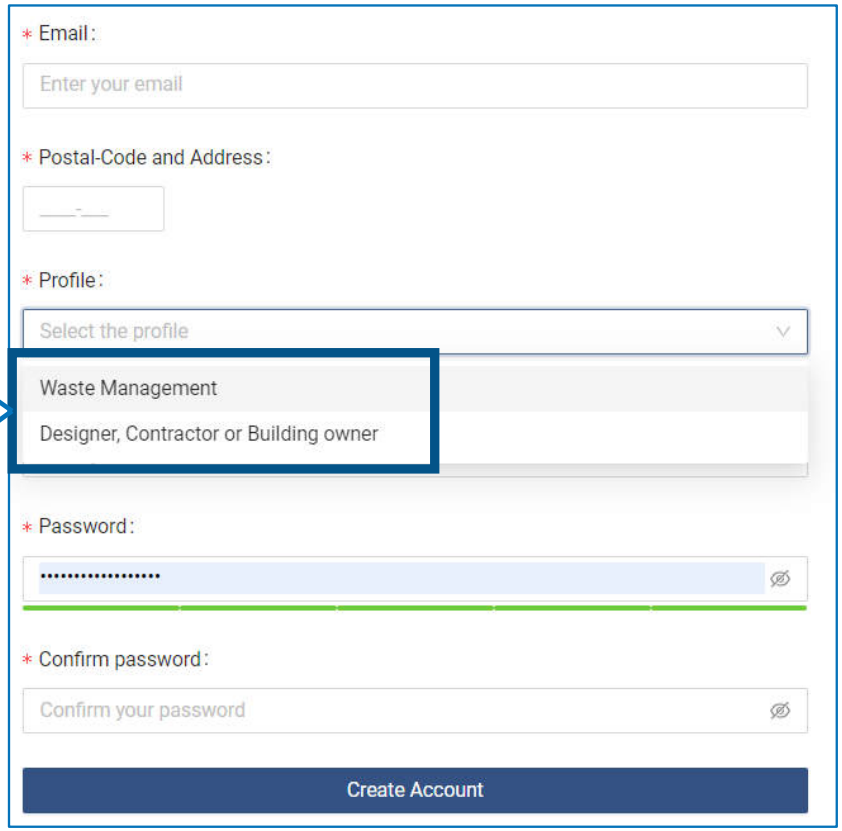
Figure 6. Online platform preview for the CDW consumer profile.

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **User registration** (subject to validation):

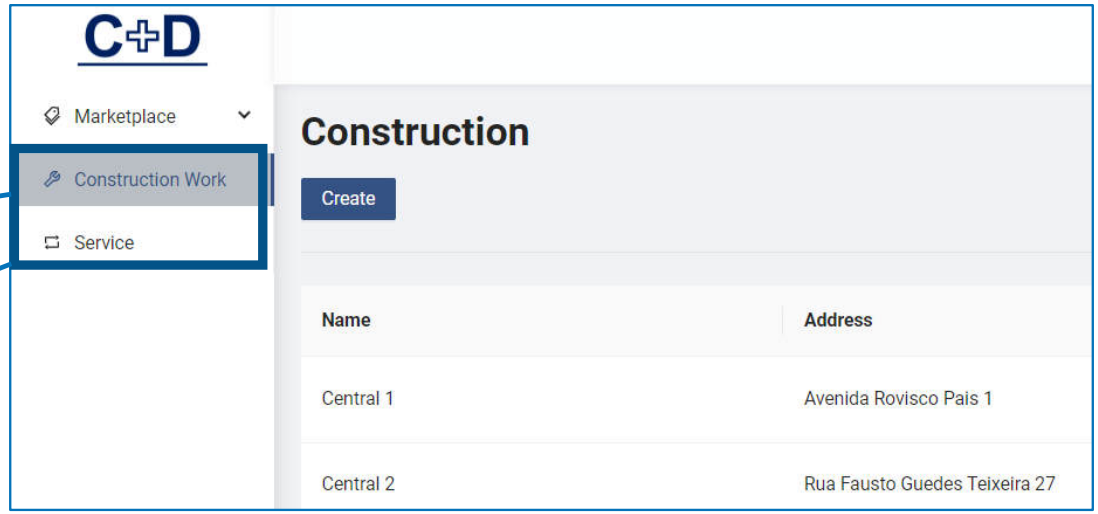
- Profile 1: buyer or seller of CDW

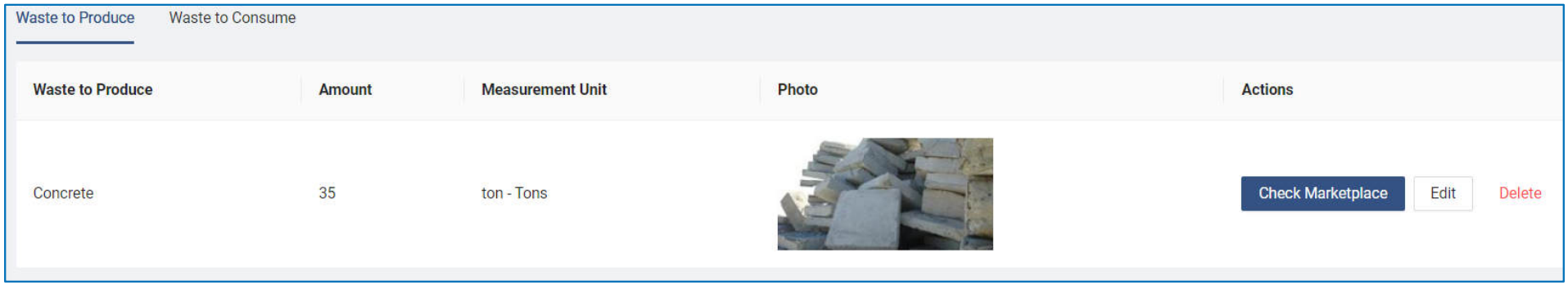
- Profile 2: producer or purchaser of CDW



C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

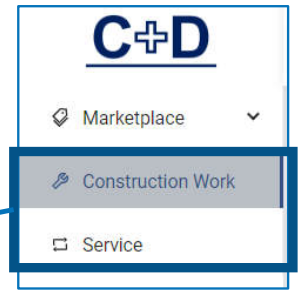
- **Profile 1 (Waste management operator- WMO):**
  - CDW seller
  - CDW buyer/services provider





C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Profile 1 (WMO):**
  - CDW seller



Check Marketplace

Details

Distance: 100

Estimated Date: **2022-09-29**

Waste

Waste Type: **Concrete**

Amount: **35 ton - Tons**

Prices

	Client	Code	Service Type	Waste Type	Distance (Km)	Environmental Impacts	Total Price (€)
+	LucianaTest	Q101R05A1	Inorganic subs. recycling/ reclaim	[illegible]	16.59	2	272933.16
+	ARIEL TESTE	Q101E01A1	Sorting Plant	[illegible]	16.20	2	35071.46

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Profile 1 (WMO):**
  - CDW buyer/services provider

Code	Waste Type	Service Type	Price (€)	Measurement Unit	Actions
D05	Iron and Steel	Specially engineered landfill	20	ton - Tons	Check Marketplace Edit Delete
D05	Concrete	Specially engineered landfill	100	ton - Tons	Check Marketplace Edit Delete
R04	Iron and Steel	Metal recycling/ reclaim	0	ton - Tons	Check Marketplace Edit Delete

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Profile 1 (WMO):**

Check Marketplace

Details

Distance: 1000

Estimated Date:

Waste

Waste Type: **Concrete**

Amount: **ton - Tons**

Prices

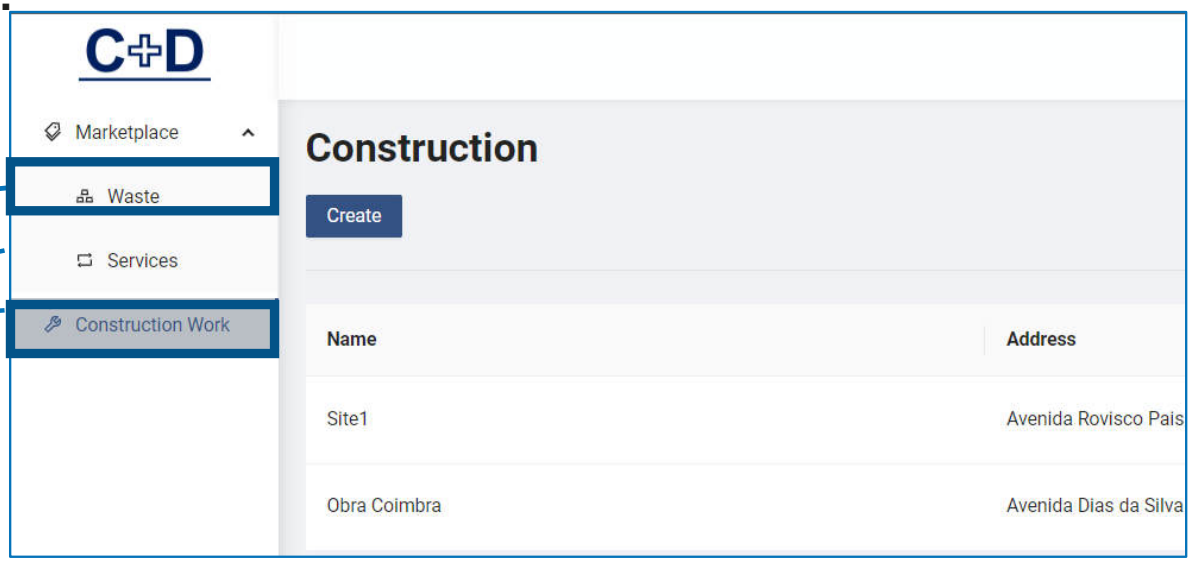
	Construction	Waste Type	Amount	Measurement Unit	Distance (Km)	Environmental Impacts	Total Price (€)
+	hjkhj	[illegible]	223	ton	154.71	1	4346.93
+	Site1	[illegible]	150	ton	153.36	1	2898.59
–	Obra Coimbra	[illegible]	1	ton	33.24	1	4.19

Shipping Price (€)	GWP Transport	NRE Transport	Client's Mail
4.19	6.65	123.00	••••••••••••••••••••••• See Email

- CDW buyer/services provider

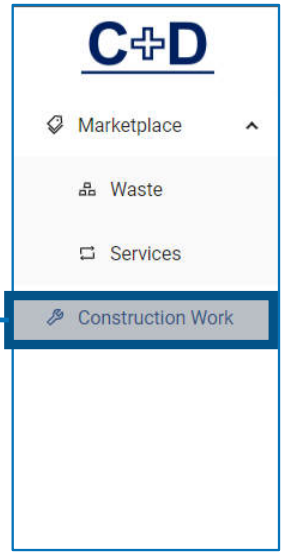
C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

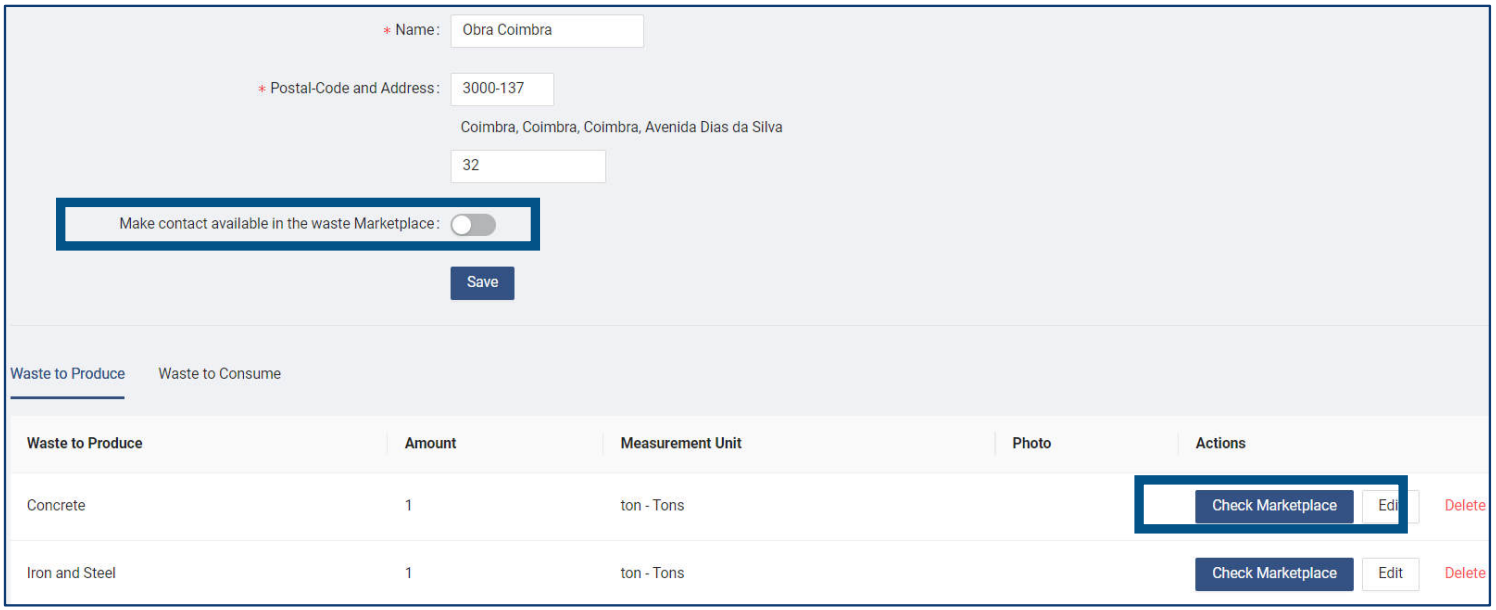
- **Profile 2 (Designer, Contractor or Owner):**
  - CDW buyer
  - CDW producer



C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Profile 2 (Designer, Contractor or Owner):**
  - CDW producer





C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Profile 2 (Designer, Contractor or Owner):**
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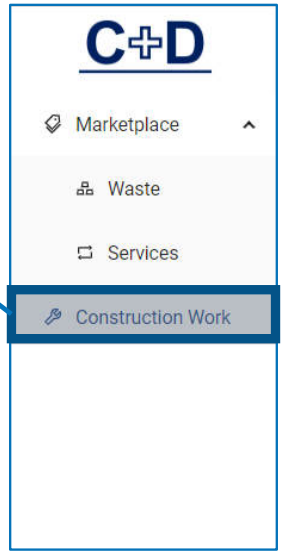

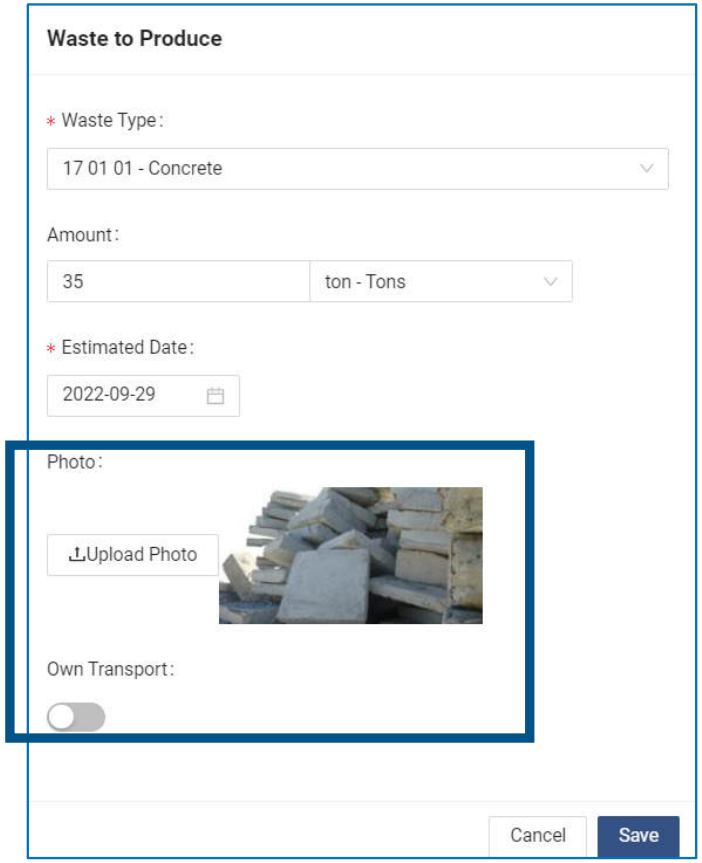

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

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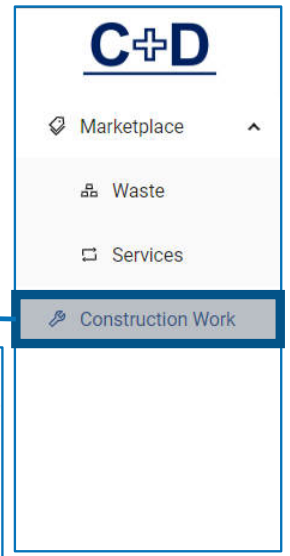


Check Marketplace

Details

Distance: 100

Estimated Date: **2022-09-23**

Waste

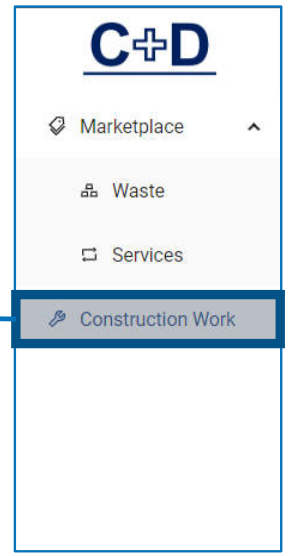
Waste Type: **Concrete**

Amount: **1 ton - Tons**

Prices

	Client	Code	Service Type	Waste Type	Distance (Km)	Environmental Impacts	Total Price (€)
+	JDSWM	Q101D05A1	Special engineered landfill	[illegible]	33.24	2	104.19
+	JDSWM	Q101R05A1	Inorganic subs. recycling/ reclaim	[illegible]	33.24	2	4.19

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management



- **Profile 2 (Designer, Contractor or Owner):**
  - CDW producer

Client	Code	Service Type	Waste Type	Distance (Km)	Environmental Impacts	Total Price (€)
JDSWM	Q101D05A1	Special engineered landfill	[illegible]	33.24	2	104.19

Prices

Shipping Price (€)	Service Price (€)	Price (€/ton)	Client's Mail
4.19	100.00	100	····· See Email

GWP Costs

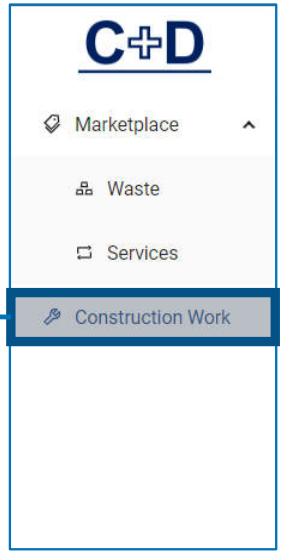
GWP Transport	GWP Service	GWP Total
6.65	10.00	16.65

NRE Costs

NRE Transport	NRE Service	NRE Total
123.00	250.00	373.00

+	JDSWM	Q101R05A1	Inorganic subs. recycling/ reclaim	[illegible]	33.24	2	4.19

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management



- **Profile 2 (Designer, Contractor or Owner):**
  - CDW producer

	Client	Code	Service Type	Waste Type	Distance (Km)	Environmental Impacts	Total Price (€)
+	JDSWM	Q101D05	Special engineered landfill	[redacted]	33.24	2	104.19
−	JDSWM	Q101R05	Inorganic subs. recycling/ reclaim	[redacted]	33.24	2	4.19

Prices

Shipping Price (€)	Service Price (€)	Price (€/m3)	Client's Mail
4.19	0.00	0	····· See Email

GWP Costs

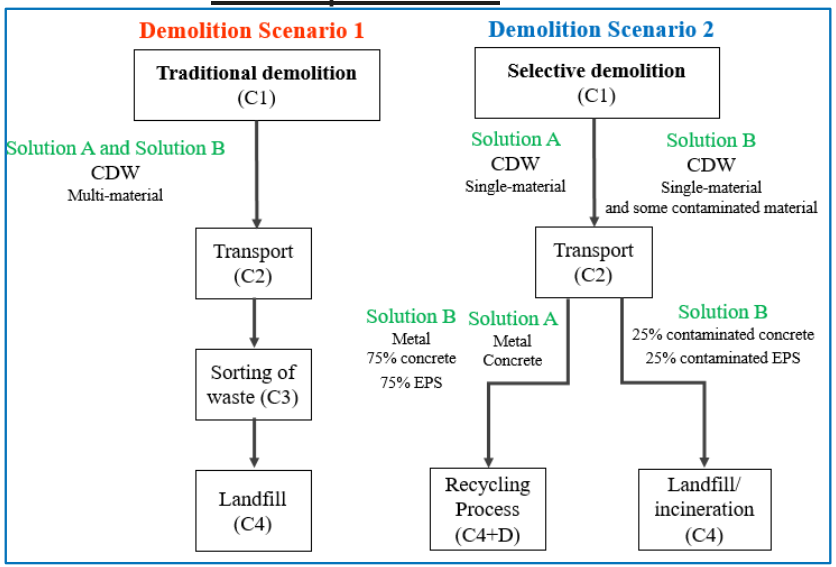
GWP Transport	GWP Service	GWP Total
6.65	-10.00	-3.35

NRE Costs

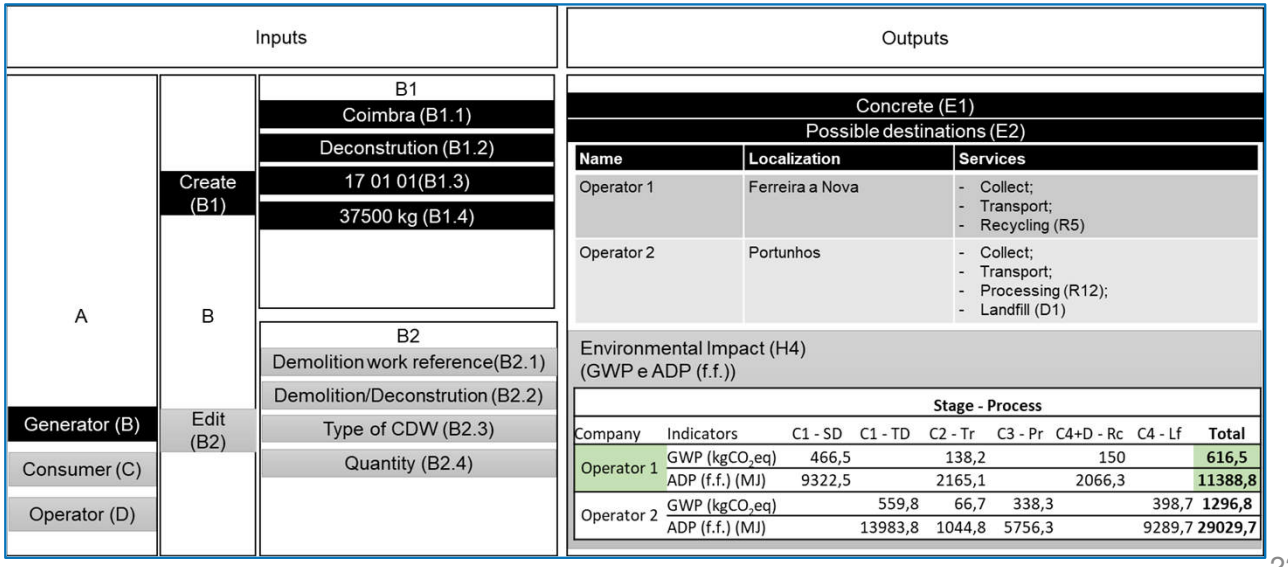
NRE Transport	NRE Service	NRE Total
123.00	-193.00	-70.00

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

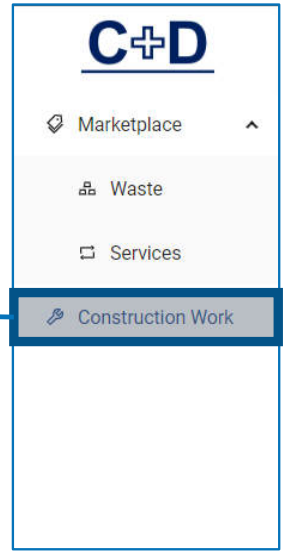
- **Profile 2 (Designer, Contractor or Owner):**
  - CDW producer



ANTUNES, A.; MARTINS, R.; SILVESTRE, J. D.; CARMO, R. do; COSTA, H.; JÚLIO, E.; PEDROSO, P. (2021). Environmental impacts and benefits of the end-of-life of building materials: database to support decision making and contribute to circularity. Sustainability. 13, 12659, DOI: 10.3390/su132212659.3



C+D Platform for calculating the economic and environmental benefits and impacts of CDW management



- **Profile 2 (Designer, Contractor or Owner):**
  - CDW producer

Client	Code	Service Type	Waste Type	Distance (Km)	Environmental Impacts	Total Price (€)
JDSWM	Q405D05B1	Special engineered landfill	iron and steel	33.24	2	24.19

Prices

Shipping Price (€)	Service Price (€)	Price (€/ton)	Client's Mail
4.19	20.00	20	····· See Email

GWP Costs

GWP Transport	GWP Service	GWP Total
6.65	60.00	66.65

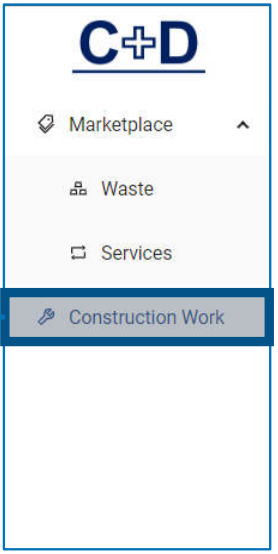
NRE Costs

NRE Transport	NRE Service	NRE Total
123.00	660.00	783.00

+	JDSWM	Q405R04C1	Metals and metallic compounds recycling/ reclaim		33.24	2	4.19

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Profile 2 (Designer, Contractor or Owner):**
  - CDW producer



	Client	Code	Service Type	Waste Type	Distance (Km)	Environmental Impacts	Total Price (€)
+	JDSWM	Q405D05B1	Special engineered landfill	iron and steel	33.24	2	24.19
−	JDSWM	Q405R04C1	Metals and metallic compounds recycling/ reclaim		33.24	2	4.19

Prices

Shipping Price (€)	Service Price (€)	Price (€/ton)	Client's Mail
4.19	0.00	0	····· See Email

GWP Costs

GWP Transport	GWP Service	GWP Total
6.65	-1730.00	-1723.35

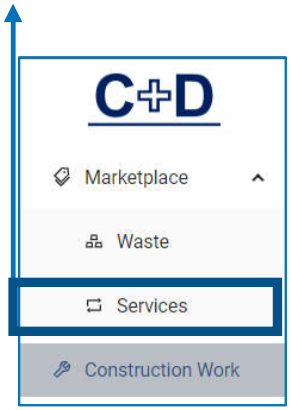
NRE Costs

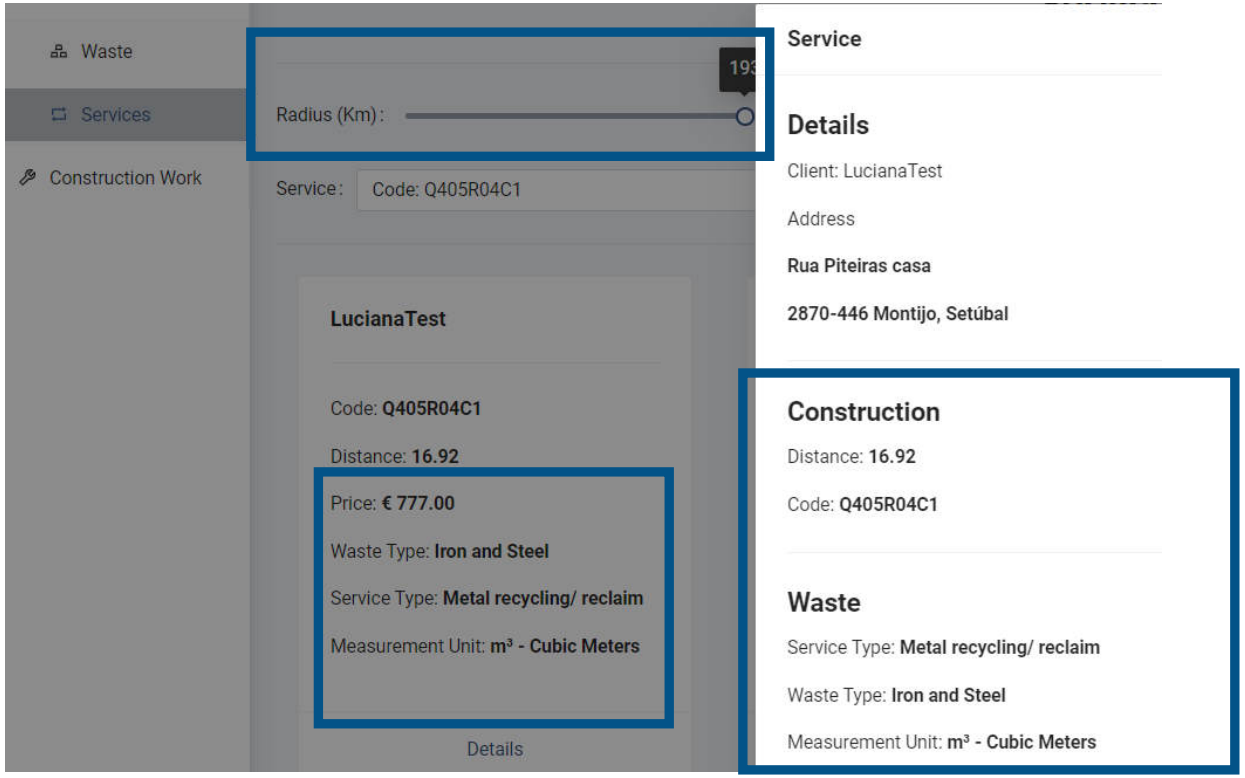
NRE Transport	NRE Service	NRE Total
123.00	-17400.00	-17277.00

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Profile 2 (Designer, Contractor or Owner):**

- CDW producer





C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Short-term developments:**

  - Ongoing **validation** process with designers, contractors, owners and CDW operators
  - Editorial and formatting **correction**
  - Presentation of all possible end-of-life options, including the **environmental and economic potential of selective demolition**
  - Integration of the **indicator of environmental and economic advantages of circularity**
  - Accounting of generated **environmental and economic savings**
  - Database **registration**
  - Finalization of the C+D platform **handbook**

C+D Platform for calculating the economic and environmental benefits and impacts of CDW management

- **Future developments:**
  - **Dissemination** of the C+D platform and handbook to their potential users
  - **C+D platform** - incorporate: impacts of the demolition operation; link to **Waste Prevention and Management Plan**; re-use of construction products
  - **Selection of the deconstruction technique** (demolition) that minimizes environmental and economic impacts
  - **Promotion of construction solutions** with greater potential for reuse (or recycling)
  - **Reduction in the production of CDW** and **increase in the recovery** of secondary materials
  - **Dissemination** of the knowledge produced in courses at university level

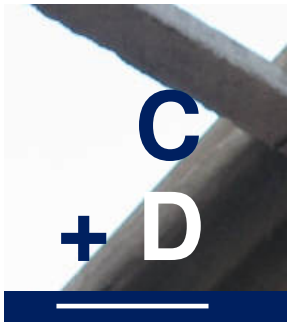
Activities

6. Communication and dissemination of the results

Results

- **Project website:** *cplusd-platform.pt*
- **News on the EEA grants website and video presentation of the project:** *youtu.be/mquqmtLCVYE*
- **Participation in Portugal Smart Cities Summitt 2020**
- **Interview for *Construção Magazine***
- **Development of the project's visual identity:**

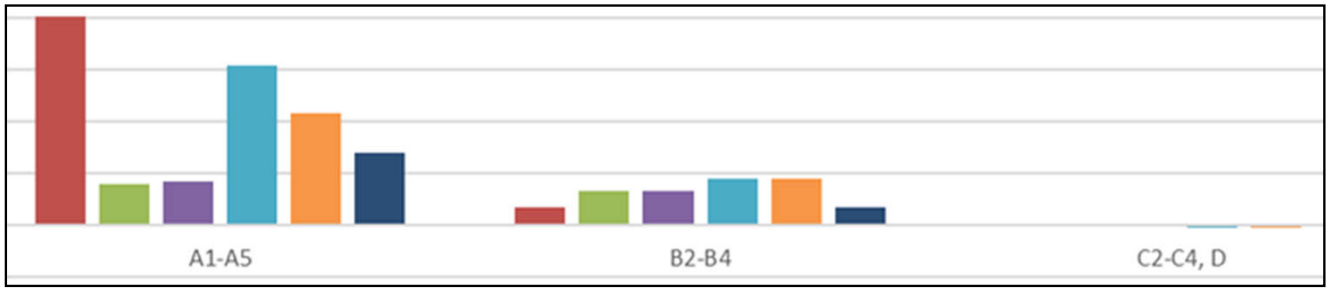
C+D C+D

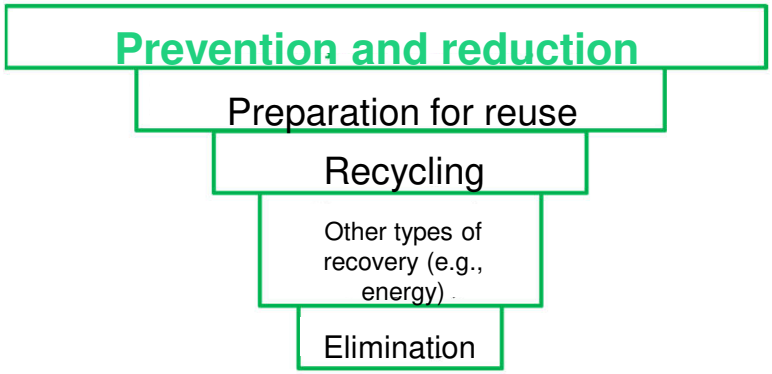


- ***Closing seminar*** *at IST, in Portugal, 27 September 2022* (more than 80 participants)
- ***Closing seminar*** *in Oslo, 27 October 2022*

Contribution to the program (1/3)

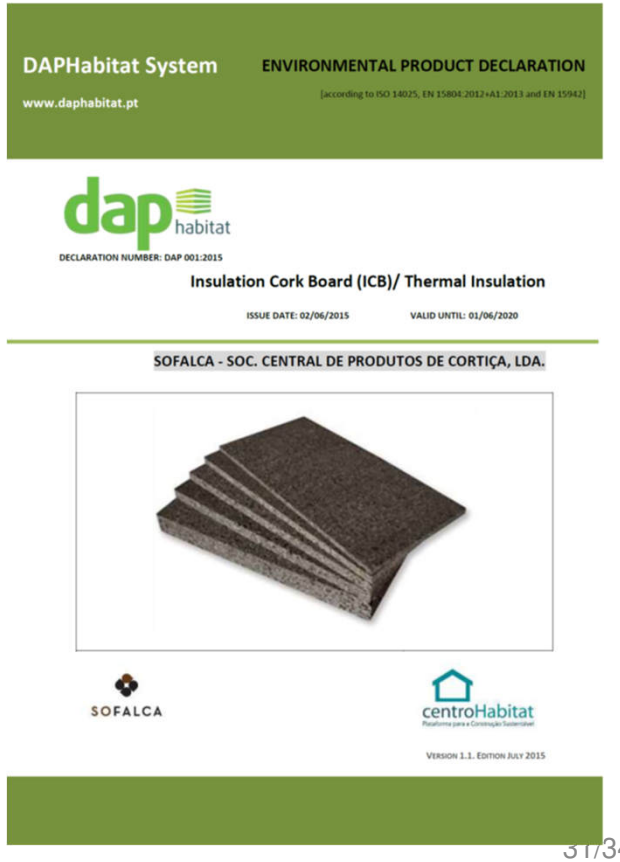
By calculating and disseminating these **environmental and economic impacts** through C+D platform to the stakeholders that can influence the decisions at the **end of life of buildings**, it is expected the **adoption of the best practices according to the principle of the waste management hierarchy.**





Contribution to the program (2/3)

The figures of the environmental **impacts at the end of life of each construction material** are also necessary to develop their **environmental Declarations and Footprints**.

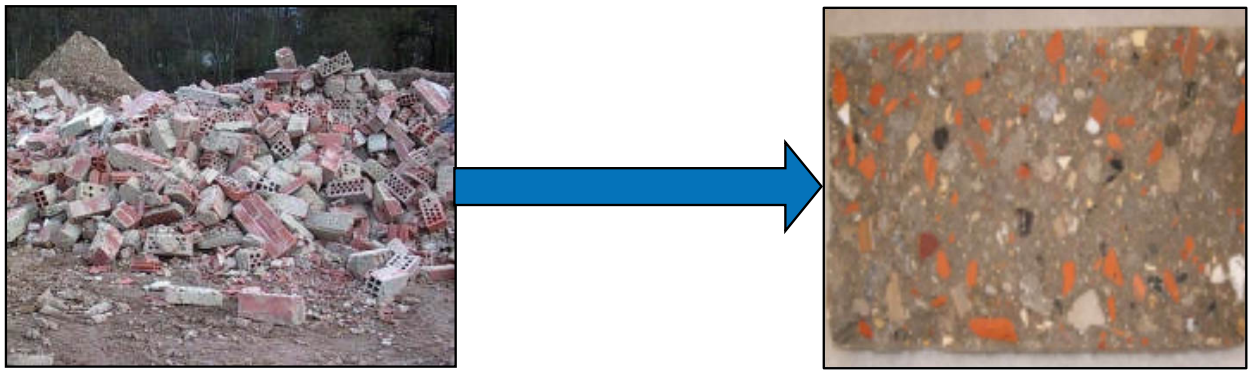

DAPHabitat System
ENVIRONMENTAL PRODUCT DECLARATION
www.daphabitat.pt
[according to ISO 14025, EN 15804:2012+A1:2013 and EN 15942]
dap habitat
DECLARATION NUMBER: DAP 001:2015
Insulation Cork Board (ICB)/ Thermal Insulation
ISSUE DATE: 02/06/2015
VALID UNTIL: 01/06/2020
SOFALCA - SOC. CENTRAL DE PRODUTOS DE CORTIÇA, LDA.
SOFALCA
centroHabitat
VERSION 1.1. EDITION JULY 2015

Contribution to the program (3/3)

The C+D project therefore promotes the **circular economy of the construction sector**

and its results will create new
business opportunities at the end of life stage of buildings

and will contribute for a **higher rate of CDW reuse**.



About the EEA Grants

Through the Agreement on the European Economic Area (EEA), Iceland, Liechtenstein and Norway are partners in the internal market with the Member States of the European Union.

As a means of promoting a continued and balanced strengthening of economic and trade relations, the parties to the EEA Agreement have established a multi-annual financial mechanism, known as EEA Grants.

EEA Grants are aimed at reducing social and economic disparities in Europe and strengthening bilateral relations between these three countries and the beneficiary countries.

For the period 2014-2021, a total contribution of €2.8 billion has been agreed for 15 beneficiary countries. Portugal will benefit from a sum of €102.7 million.

Find out more at *eeagrants.gov.pt*.

Iceland Liechtenstein Norway grants

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Programme operator:

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