

# CONFERENZA FINALE

Bolzano, KLIMAHOUSE – Sala Ceredale, 24 gennaio 2019

*“Tegole innovative per il risparmio energetico e il comfort estivo”*

Il ciclo di vita delle tegole HEROTILE

Caterina Gargari, TEALab Università di Pisa



HIGH ENERGY SAVINGS IN BUILDING COOLING BY ROOF TILES SHAPE  
OPTIMIZATION TOWARD A BETTER ABOVE SHEATHING VENTILATION



# PROGETTARE EDIFICI A ENERGIA QUASI ZERO



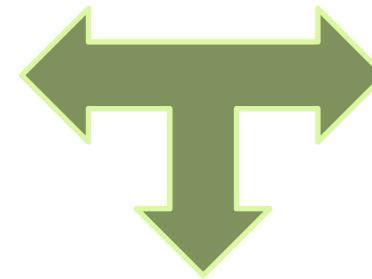
$$E \approx 0$$

## NZEB

Edifici ad Energia Quasi Zero

Il primo obiettivo è stato quello di ridurre i consumi “operativi”, ossia i consumi di energia per il funzionamento dell’edificio (riscaldamento, condizionamento, illuminazione...)

NUOVE TECNOLOGIE



NUOVI MATERIALI

NUOVE NORMATIVE  
E REGOLAMENTI

Una progettazione integrata che consideri anche le energie inglobate nei materiali da costruzione, può consentire un significativo

risparmio aggiuntivo, pari a circa il **20%** senza comportare costi aggiuntivi



# NZEB



# LC-ZEB

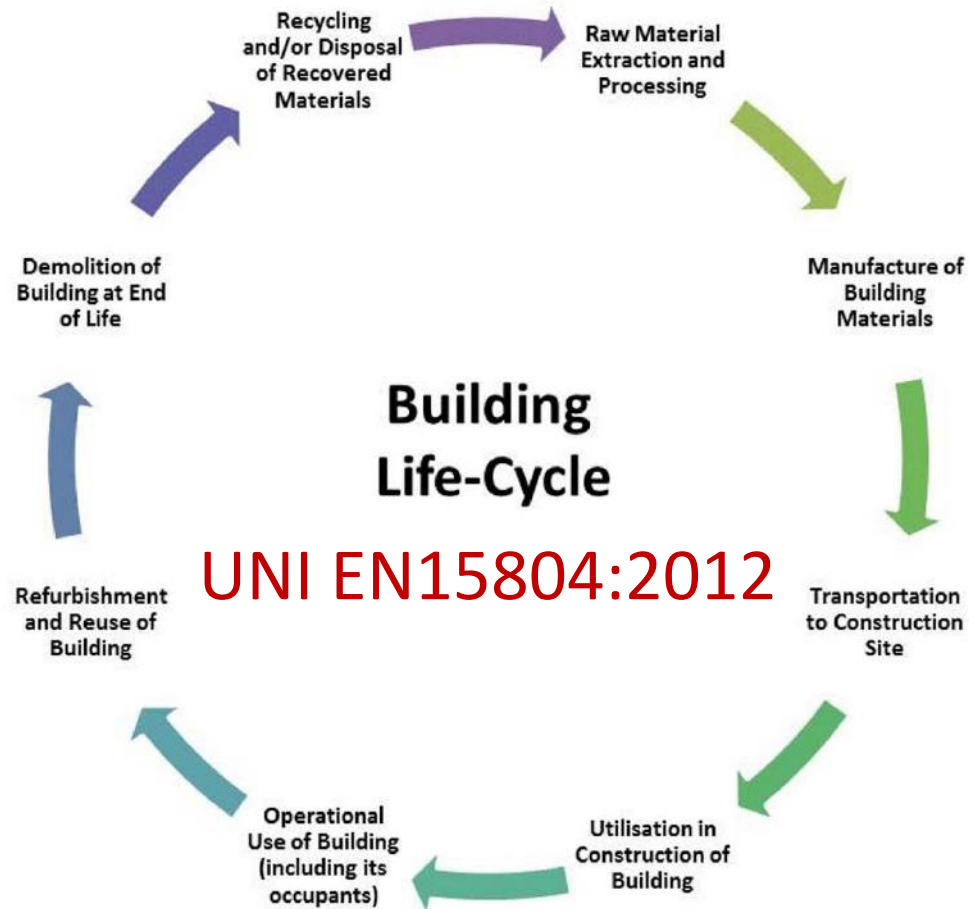
un edificio **LC-ZEB** è un edificio in cui l'**energia primaria** utilizzata nell'edificio (produzione dei materiali e dei sistemi costruttivi, gestione dell'edificio) è uguale o inferiore all'energia prodotta da fonte rinnovabile all'interno dell'edificio nel corso della sua vita utile, .

## 4.0-6.2 GJ/m<sup>2</sup>



# Life Cycle

# Assessment

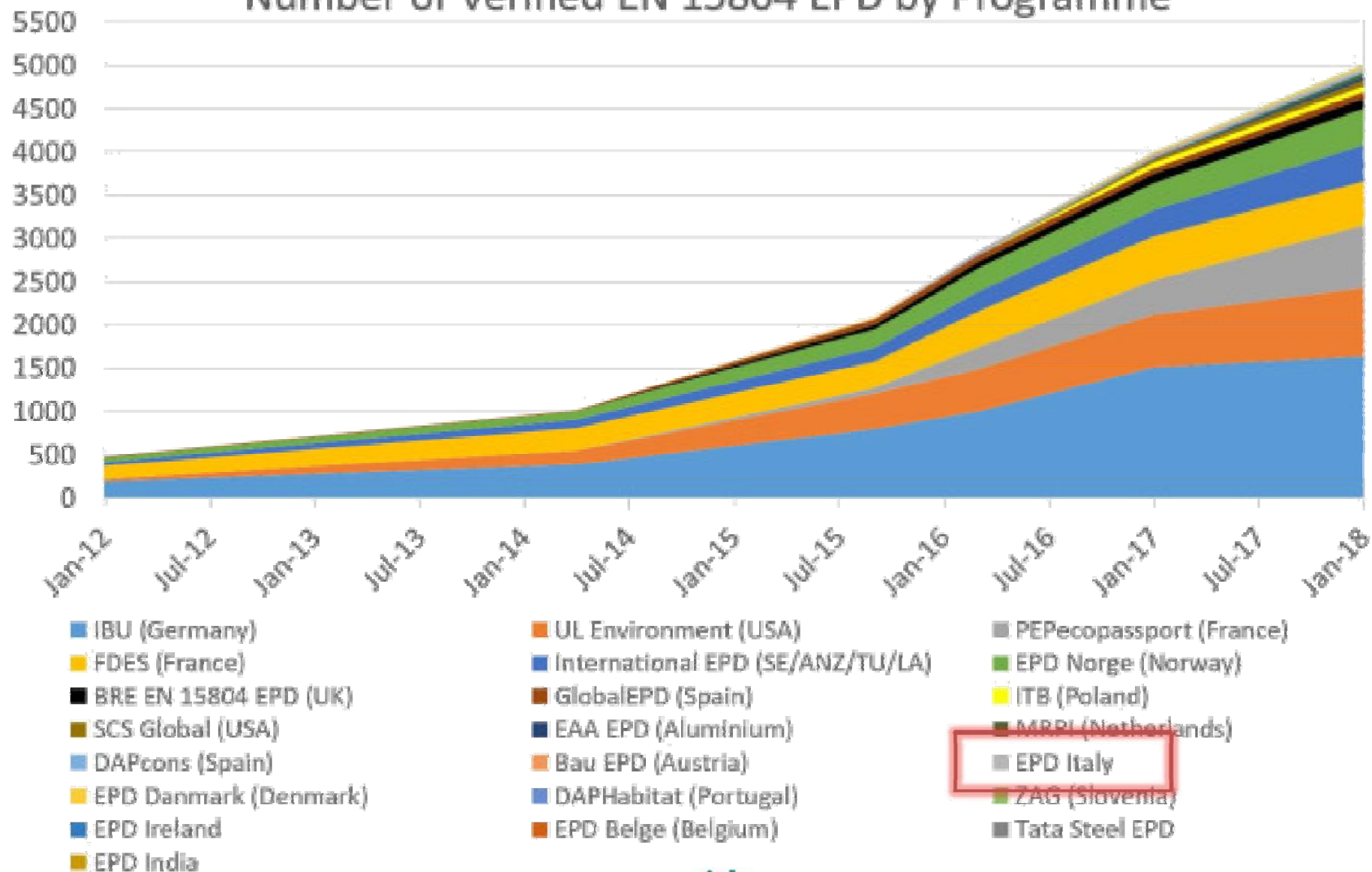


# Environmental Product Declaration

# EPD



## Number of Verified EN 15804 EPD by Programme





Life Cycle Assessment report  
 supporting the Environmental Product Declaration of Portuguese roof tile  
 according to EN 15804:2012+A1:2013 and ISO 14040:2006  
 LCA commissioner: Industrie Cotto Possagno S.p.A.  
 LCA practitioner: TEA Lab University of Pisa  
 Date: 15/01/2019

Rapporto sullo studio LCA a supporto della Dichiarazione Ambientale di Prodotto della tegola  
 Portoghese prodotta da Industrie Cotto Possagno ..... 3

1 Scopo ..... 3

2 Informazioni generali..... 3

3 Obiettivo dello studio ..... 3

4 Scopo dello studio LCA..... 4

4.1 Unità Dichiarata ..... 4

4.2 Unità Funzionale..... 4

4.3 Descrizione del prodotto..... 4

4.4 Utilizzo del prodotto ..... 5

5 Rapporto di analisi LCA ..... 6

5.1 Modulo A Produzione ..... 6

5.1.1 Fase di Approvvigionamento A1 ..... 6

5.1.2 Fase di Trasporto A2 ..... 8

5.1.3 Fase di Fabbricazione A3 ..... 10

5.2 Moduli A4-A5 Costruzione..... 20

5.3 Modulo B Uso ..... 20

5.4 Modulo B6 Consumo di energia in Uso..... 20

5.5 Modulo B7 Consumo di acqua in Uso ..... 21

5.6 Modulo C Fine vita..... 21

5.6.1 Modulo C3 Trattamento del rifiuto ..... 24

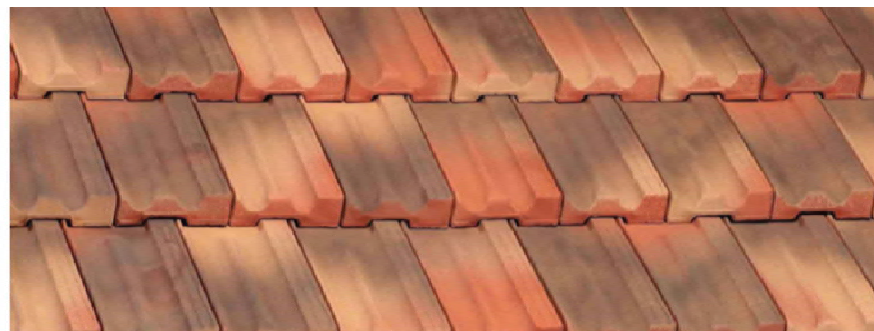
5.6.2 Modulo C4 Smaltimento ..... 25

5.6.3 Modulo D Riuso ..... 26

6 Regole di calcolo per la valutazione LCA ..... 27

6.1.1 Mix energetico ..... 27

6.1.2 Confini del Sistema ..... 29



Life Cycle Assessment report  
 supporting the Environmental Product Declaration of Marsigliese roof tile  
 according to EN 15804:2012+A1:2013 and ISO 14040:2006  
 LCA commissioner: Terreal Italia S.r.l.  
 LCA practitioner: TEA Lab University of Pisa  
 Date: 15/01/2019

Rapporto sullo studio LCA a supporto della Dichiarazione Ambientale di Prodotto della tegola  
 Marsigliese prodotta da Terreal Italia ..... 3

1 Scopo ..... 3

2 Informazioni generali..... 3

3 Obiettivo dello studio ..... 3

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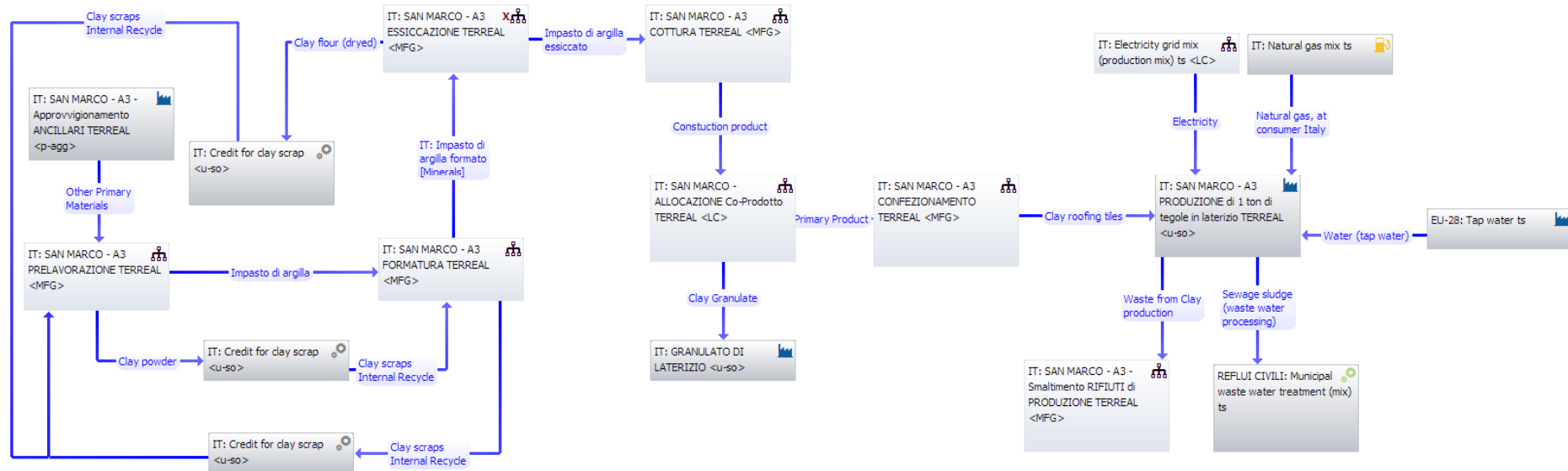
6.1.1 Mix energetico ..... 27

6.1.2 Confini del Sistema ..... 29

# Life Cycle Assessment

## A3 Manufacturing LC stage

Tegole in Laterizio SAN MARCO EN15804 A3  
 GaBi piano di processo:Quantità di riferimento



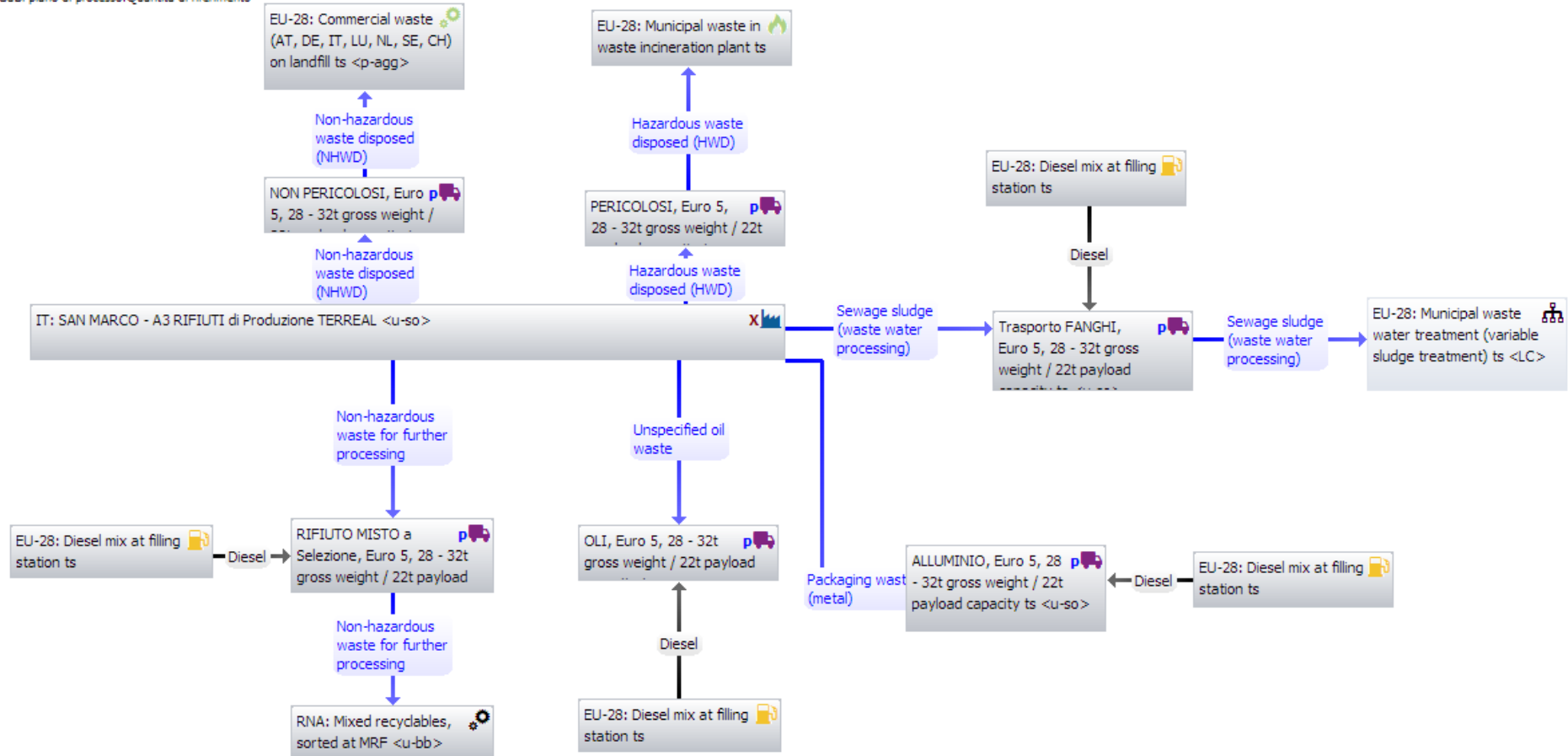


# Life Cycle Assessment

## A3 Waste disposal LC stage

### SAN MARCO - A3 - Smaltimento RIFIUTI di PRODUZIONE

GaBi piano di processo/Quantità di riferimento

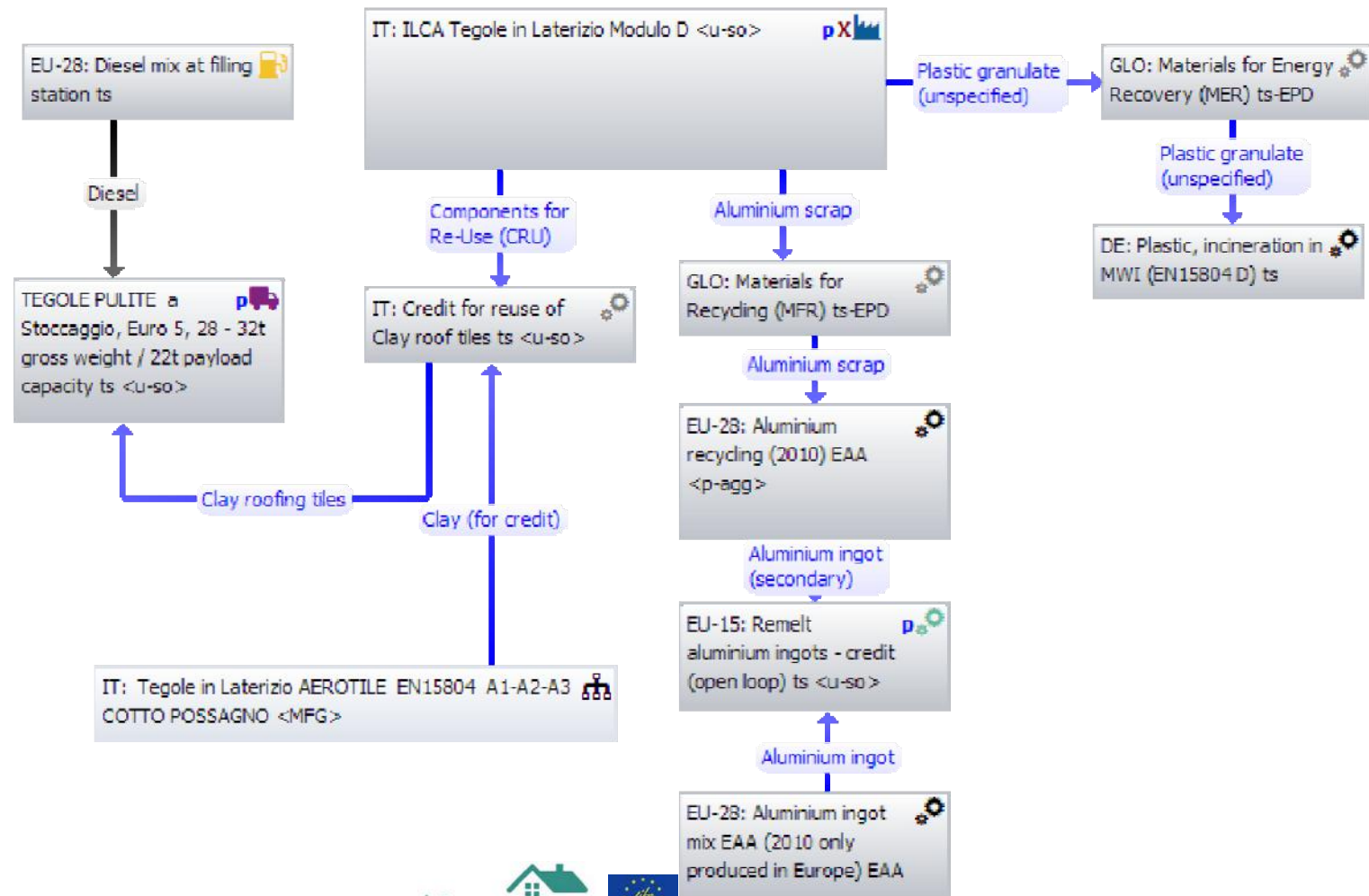


# Life Cycle Assessment

## D Benefits and Loads beyond the system boundary

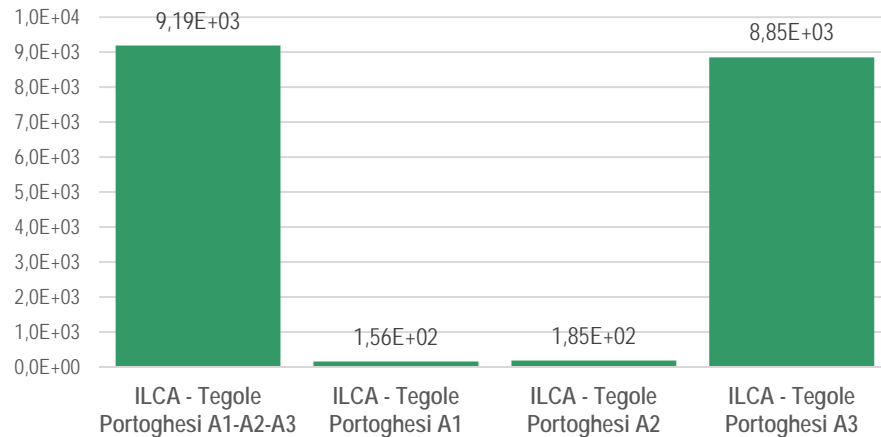
### Tegole in Laterizio AEROTILE EN15804 D

GaBi piano di processo: Quantità di riferimento

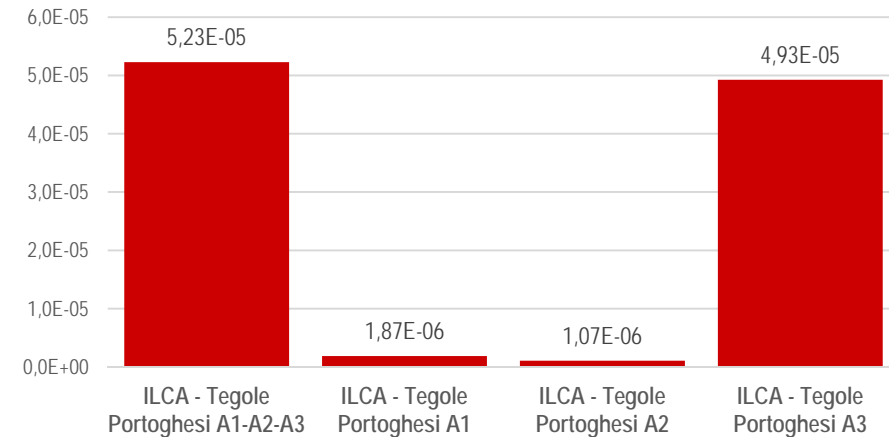


# AEROTILE Roof Tile ILCA A1-A2-A3

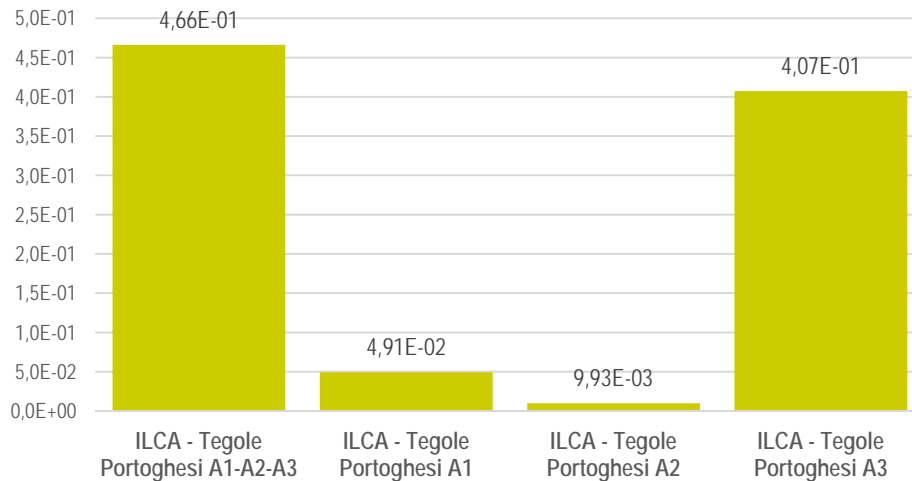
EN15804 - Abiotic depletion potential for fossil resources (ADPF) [MJ]



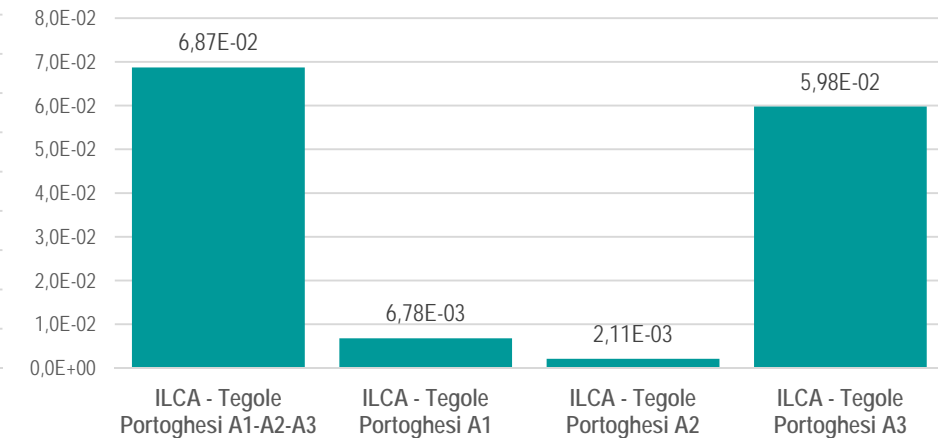
EN15804 - Abiotic depletion potential for non fossil resources (ADPE) [kg Sb eq.]



EN15804 - Acidification potential (AP) [kg SO2 eq.]

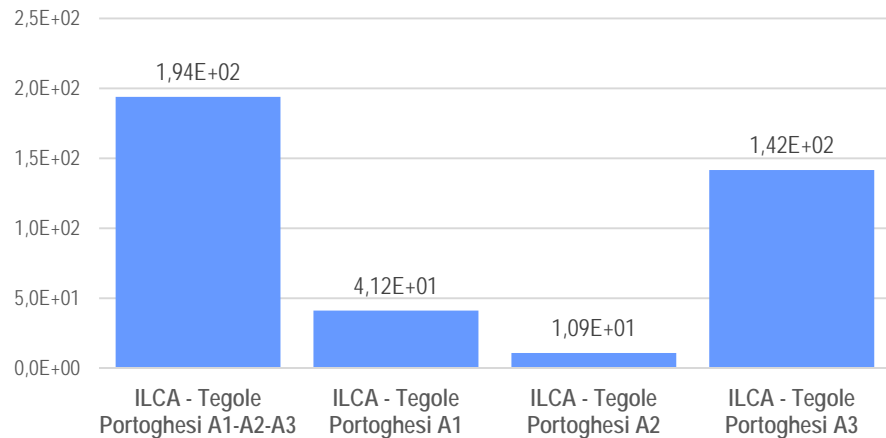


EN15804 - Eutrophication potential (EP) [kg Phosphate eq.]

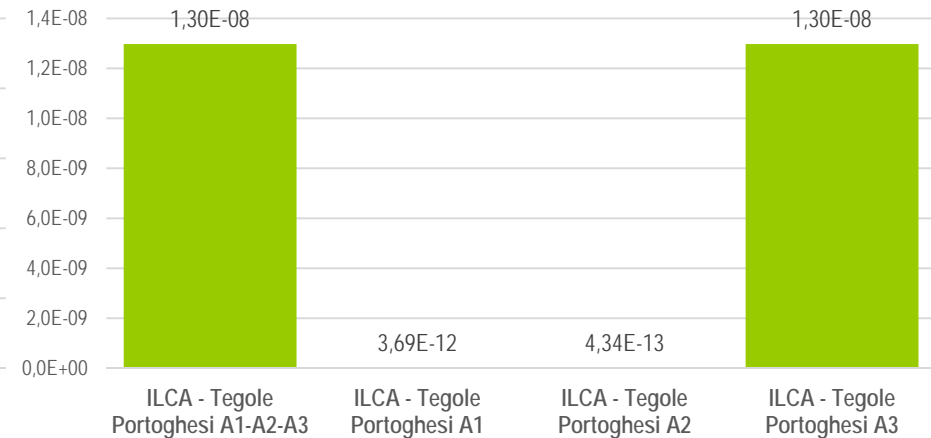


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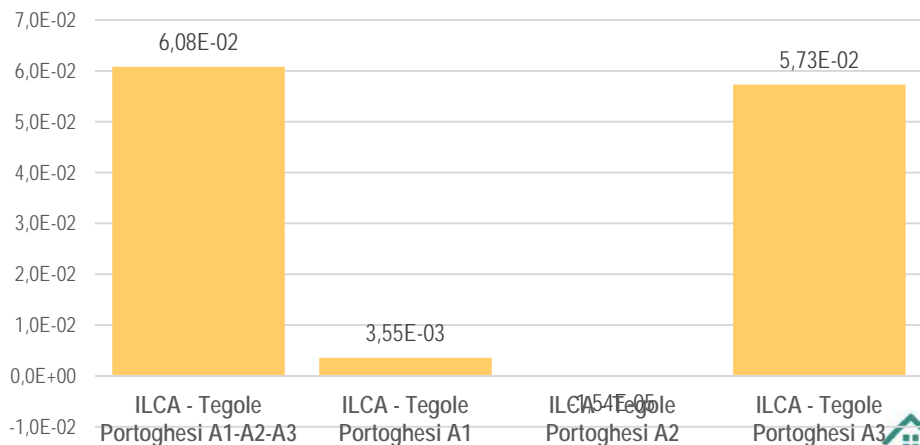
EN15804 - Global warming potential (GWP) [kg CO2 eq.]



EN15804 - Ozone Depletion Potential (ODP) [kg R11 eq.]

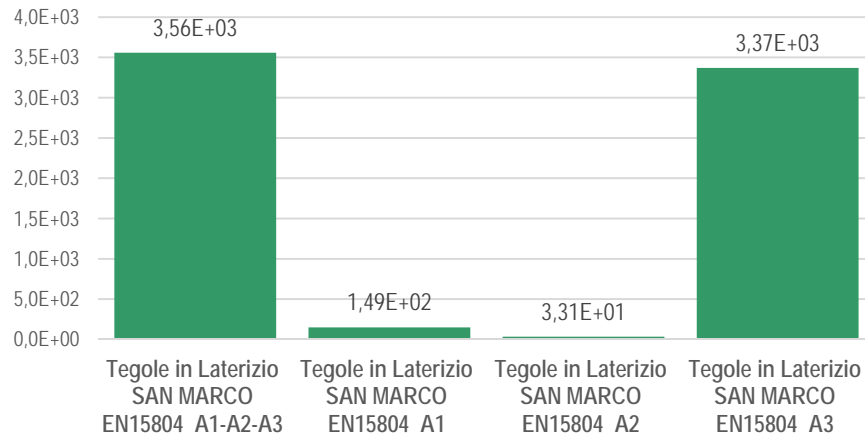


EN15804 - Photochemical Ozone Creation Potential (POCP) [kg Ethene eq.]

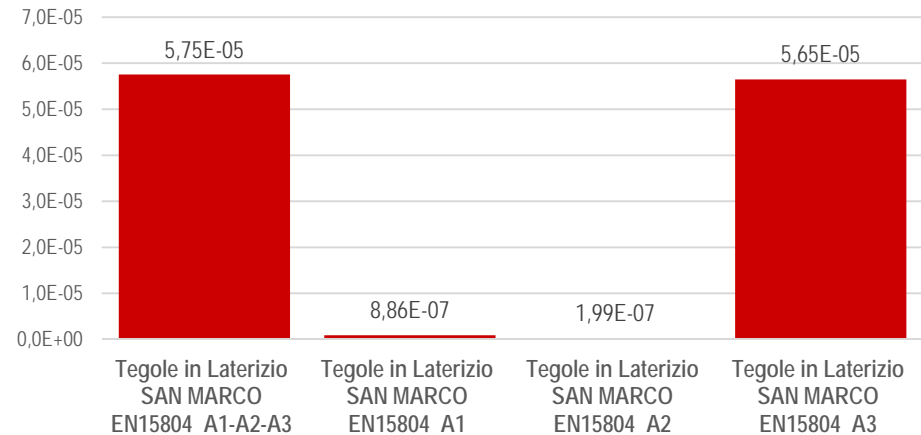


# Roof Tile SAN MARCO A1-A2-A3

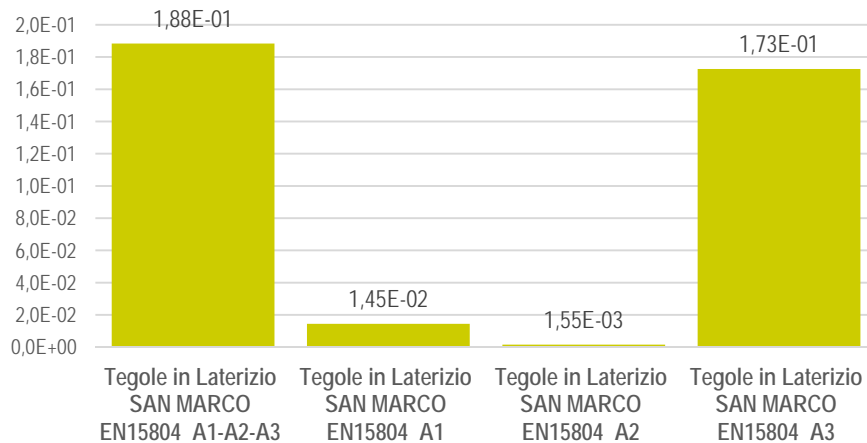
EN15804 - Abiotic depletion potential for fossil resources (ADPF) [MJ]



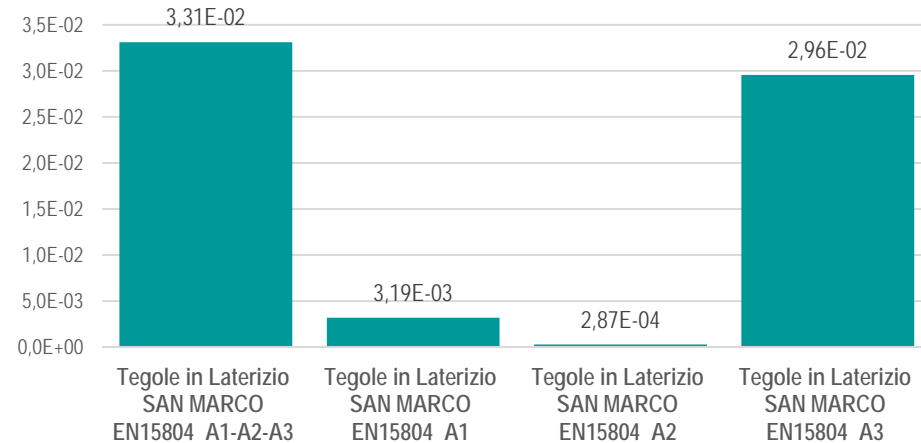
EN15804 - Abiotic depletion potential for non fossil resources (ADPE) [kg Sb eq.]



EN15804 - Acidification potential (AP) [kg SO2 eq.]

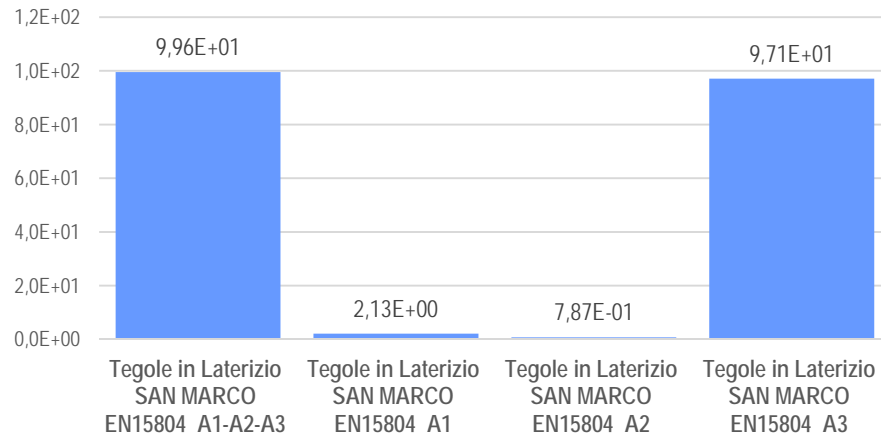


EN15804 - Eutrophication potential (EP) [kg Phosphate eq.]

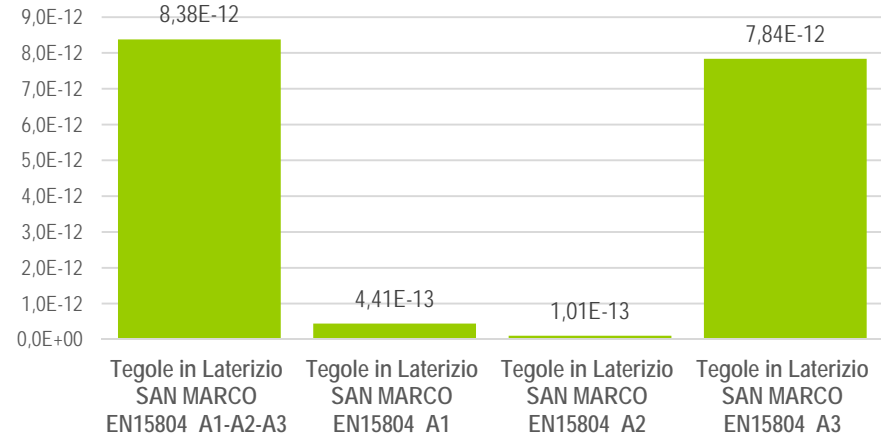


# Roof Tile SAN MARCO A1-A2-A3

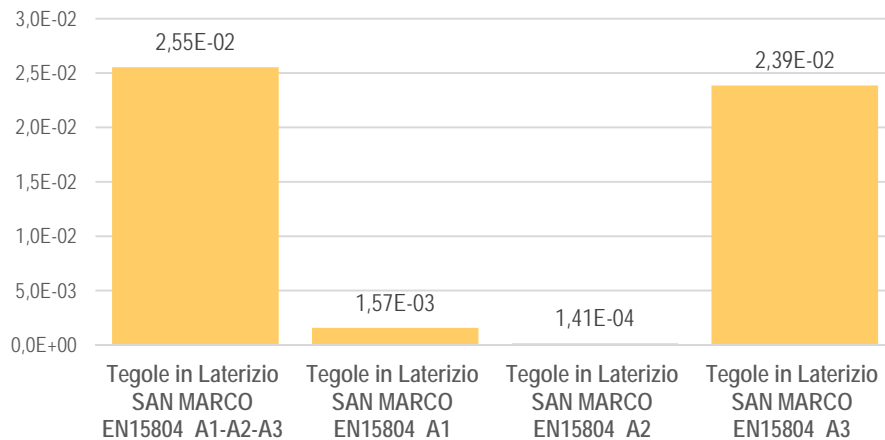
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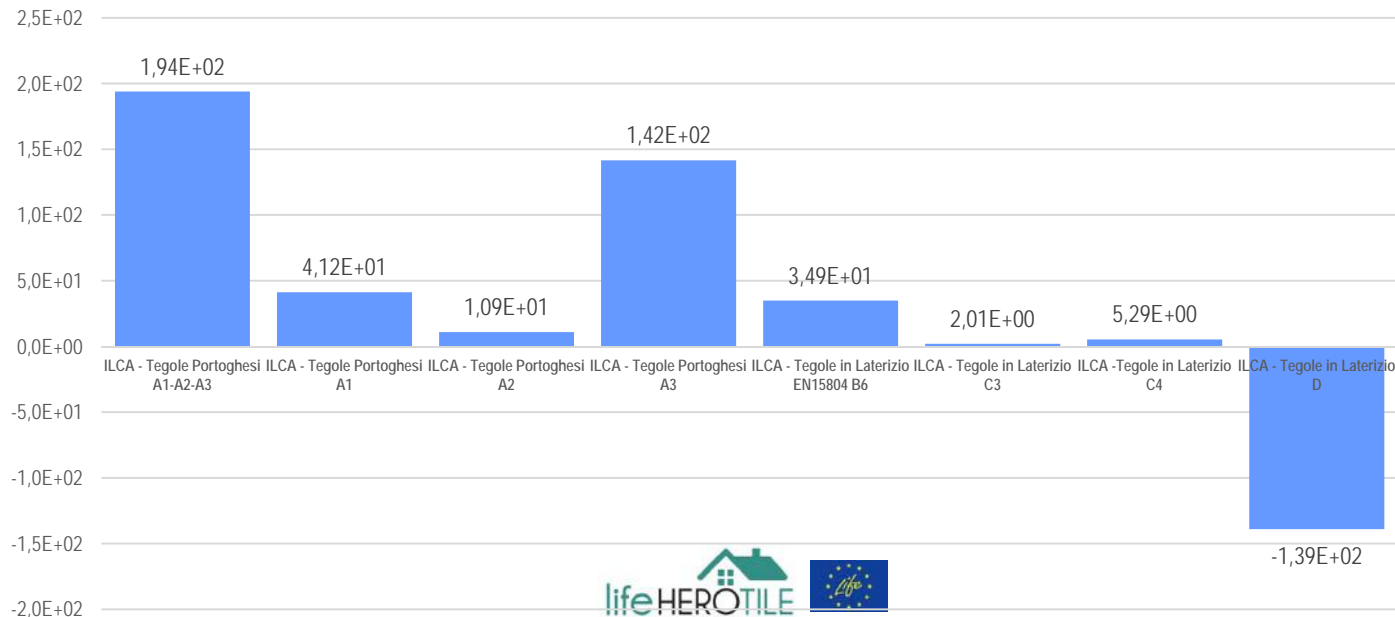
	ILCA - Tegole Portoghesi A1- A2-A3	ILCA - Tegole Portoghesi A1	ILCA - Tegole Portoghesi A2	ILCA - Tegole Portoghesi A3
Use of <b>renewable primary energy</b> excluding renewable primary energy resources used as raw materials (PERE) [MJ, net calorific value]	1,20E+00	-1,07E-07	-6,16E-08	1,20E+00
Use of <b>renewable primary energy resources</b> used as raw materials (PERM) [MJ, net calorific value]	3,26E+02	1,54E+01	9,78E+00	3,00E+02
Total use of <b>renewable primary energy</b> resources (PERT) (primary energy and primary energy resources used as raw materials) [MJ, net calorific value]	3,27E+02	1,54E+01	9,78E+00	3,02E+02
Use of <b>non renewable primary energy</b> excluding non renewable primary energy resources used as raw materials (PENRE) [MJ, net calorific value]	9,26E+03	1,65E+02	1,85E+02	8,91E+03
Use of <b>non renewable primary energy resources</b> used as raw materials (PENRM) [MJ, net calorific value]	2,76E-05	2,24E-07	1,40E-06	2,60E-05
Total use of <b>non renewable primary energy resources</b> (PENRT) (primary energy and primary energy resources used as raw materials) [MJ, net calorific value]	9,26E+03	1,65E+02	1,85E+02	8,91E+03
Use of <b>secondary material</b> (SM) [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of <b>renewable secondary fuels</b> (RSF) [MJ, net calorific value]	1,96E-21	8,17E-29	9,25E-28	1,96E-21
Use of <b>non renewable secondary fuels</b> (NRSF) [MJ, net calorific value]	2,31E-20	1,24E-27	1,40E-26	2,31E-20
Net use of <b>fresh water</b> (FW) [m <sup>3</sup> ]	2,18E-02	1,17E-02	1,79E-02	-9,84E-03

# HEROTILE Full Life Cycle

## Other environmental information describing waste categories

	ILCA - Tegole Portoghesi A1-A2-A3	ILCA - Tegole Portoghesi A1	ILCA - Tegole Portoghesi A2	ILCA - Tegole Portoghesi A3
Componenti per <b>riuso</b> (CRU) [Kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materiali per <b>riciclo</b> (MFR) [Kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materiali per <b>recupero energetico</b> (MER) [Kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
<b>Energia Elettrica Esportata</b> (EEE) [MJ]	4,80E-01	0,00E+00	0,00E+00	4,80E-01
<b>Energia Termica Esportata</b> (EET) [MJ]	8,63E-01	0,00E+00	0,00E+00	8,63E-01

EN15804 - Global warming potential (GWP) [kg CO2 eq.]





# Clay Roof Tiles in Europe

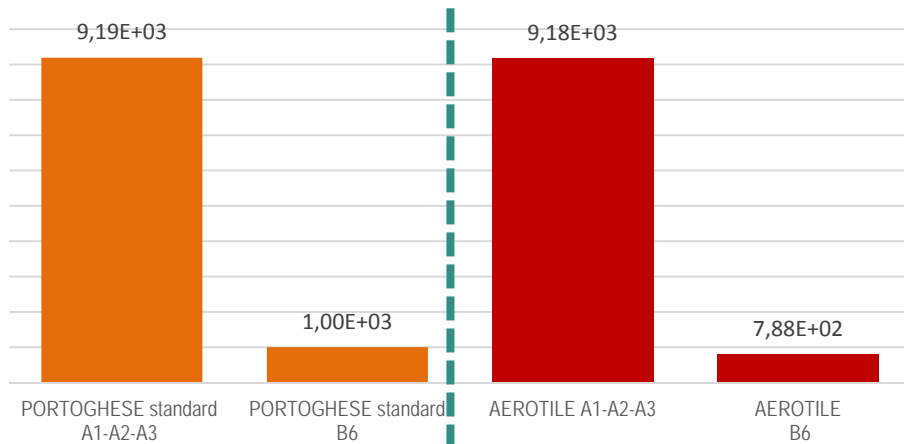
	HEROTILE	DachZiegel EPD NEL-20150326-IBD1	DachZiegel EPD ERL-20140214-IAC1	AT: Clay roofing tile Initiative Ziegel (A1-A3)	BRAAS roofing tiles Monier ts-EPD	Clay roof tile, factory Dorfen CREATON (A1-A3)	Clay roof tile, factory HAngeda - CREATON (A1-A3)	DE: Roof tile (EN15804 A1-A3)	EU-28: Roof tile (A1-A3)
EN15804 - Abiotic depletion potential for fossil resources (ADPF) [MJ]	<b>3,56E+03</b>	5,32E+03	4,70E+03	4,16E+03	4,32E+03	5,78E+03	4,51E+03	4,85E+03	4,87E+03
EN15804 - Abiotic depletion potential for non fossil resources (ADPE) [kg Sb eq.]	<b>5,75E-05</b>	3,34E-05	5,21E-05	2,51E-05	2,87E-04	1,87E-05	1,67E-05	4,96E-05	3,11E-05
EN15804 - Acidification potential (AP) [kg SO2 eq.]	<b>1,88E-01</b>	3,38E-01	4,70E-01	3,34E-01	3,40E-01	3,47E-01	3,23E-01	2,70E-01	3,09E-01
EN15804 - Eutrophication potential (EP) [kg Phosphate eq.]	<b>3,31E-02</b>	5,14E-02	5,00E-02	3,58E-02	5,19E-02	4,99E-02	4,23E-02	4,90E-02	4,58E-02
EN15804 - Global warming potential (GWP) [kg CO2 eq.]	<b>9,96E+01</b>	3,50E+02	2,97E+02	2,55E+02	2,93E+02	3,61E+02	2,82E+02	3,25E+02	3,10E+02
EN15804 - Ozone Depletion Potential (ODP) [kg R11 eq.]	<b>8,38E-12</b>	1,12E-09	5,21E-09	4,14E-09	5,05E-09	2,06E-07	3,84E-07	7,64E-11	1,68E-10
EN15804 - Photochemical Ozone Creation Potential (POCP) [kg Ethene eq.]	<b>2,55E-02</b>	4,17E-02	4,00E-02	4,52E-02	2,52E-02	3,70E-02	3,47E-02	6,61E-02	6,96E-02

-40% kg CO<sub>2</sub>eq.  
emitted during production  
Life Cycle stage

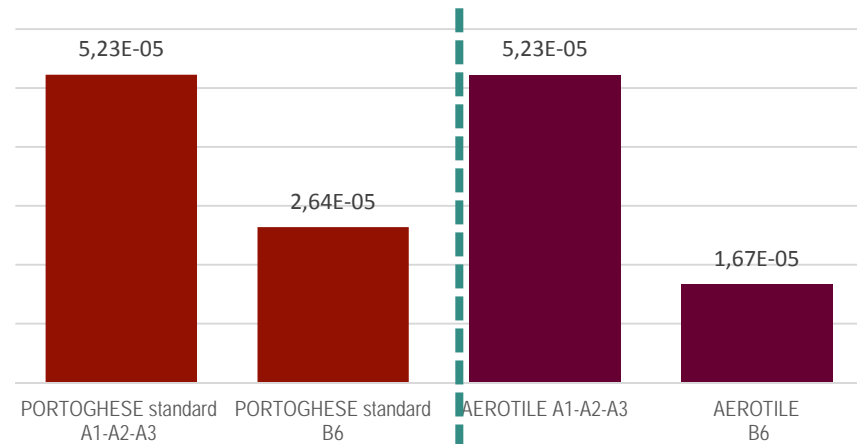


# HEROTILE Use stage B6

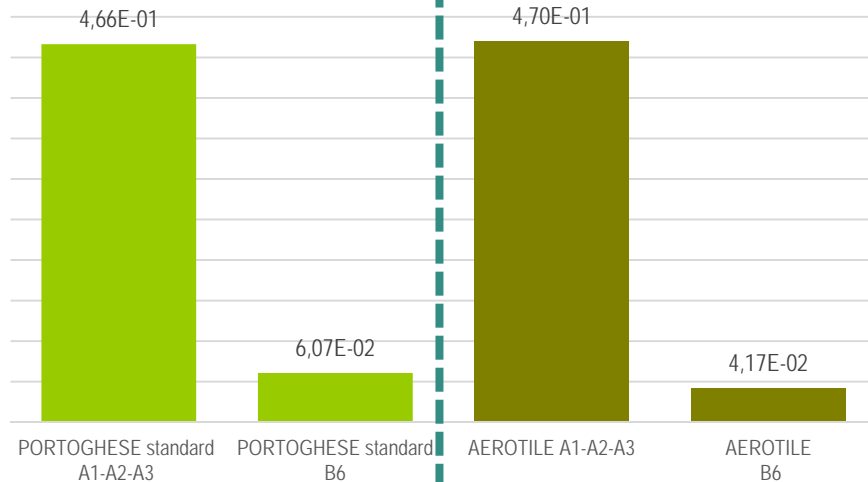
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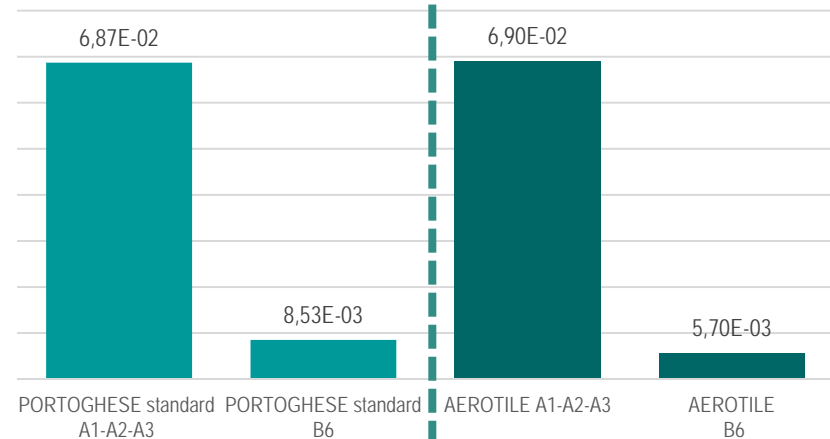
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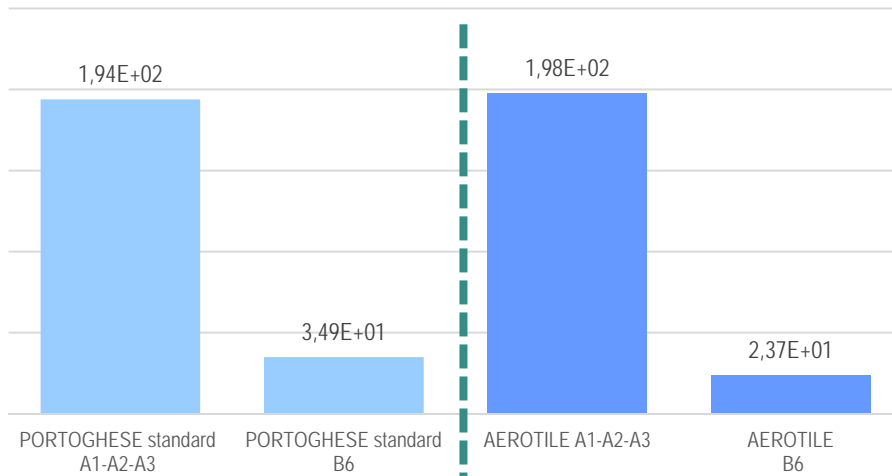


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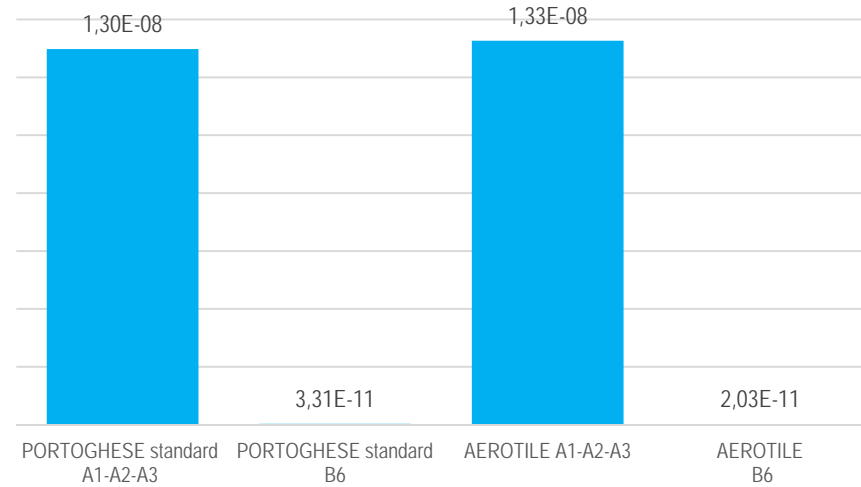


# HEROTILE Use stage B6

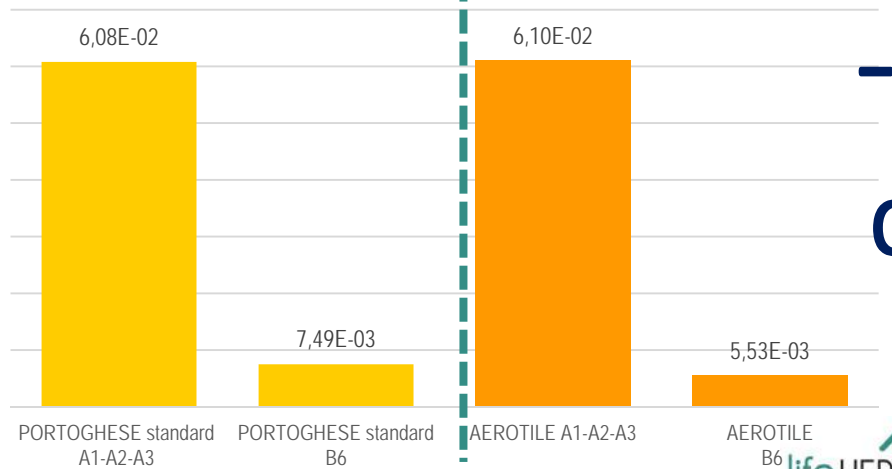
EN15804 - Global warming potential (GWP) [kg CO2 eq.]



EN15804 - Ozone Depletion Potential (ODP) [kg R11 eq.]



EN15804 - Photochemical Ozone Creation Potential (POCP) [kg Ethene eq.]

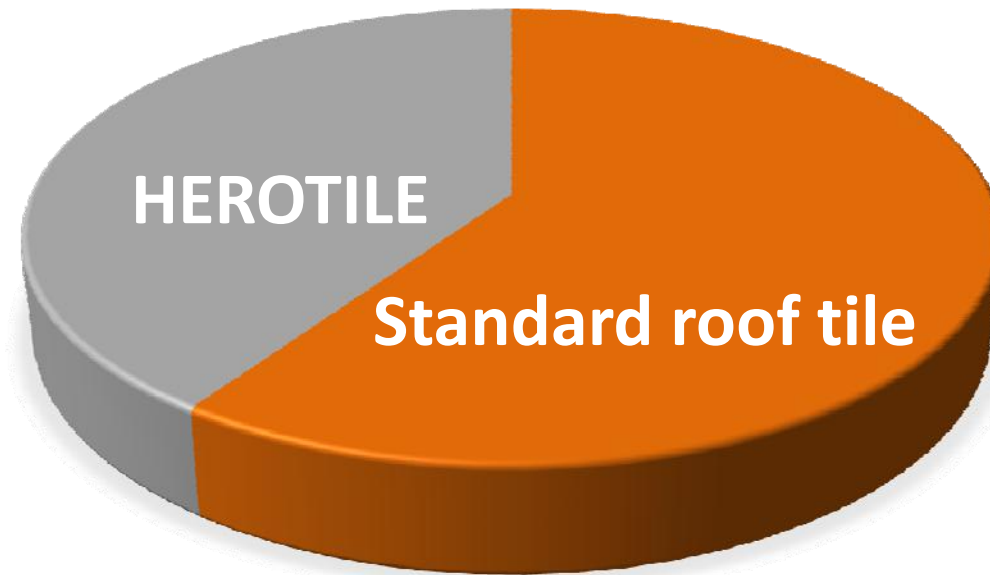


**-26% Env. Impact during 100 years RSL**



# HEROTILE Use stage B6

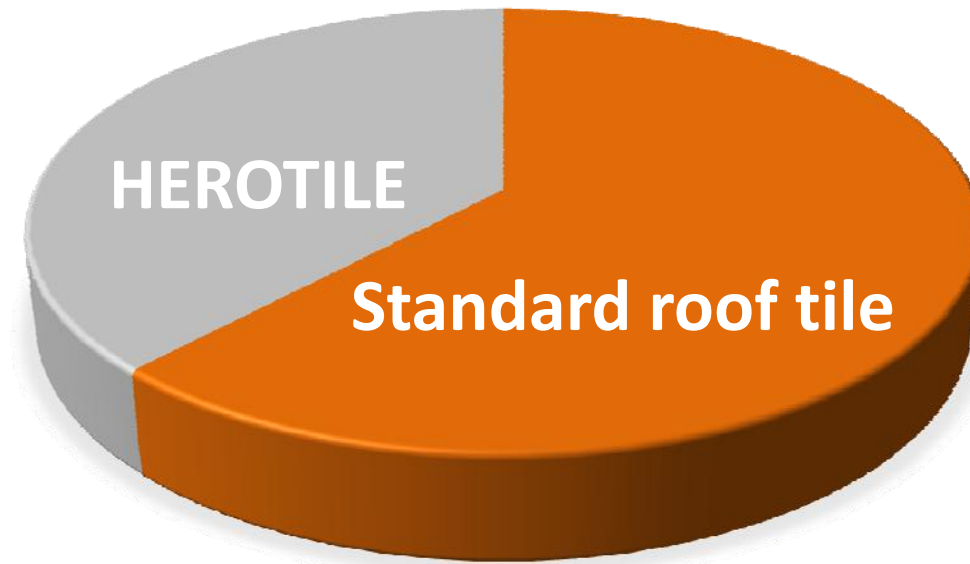
-30% GWP kg CO<sub>2</sub> eq. emissions



**Global warming potential**

# HEROTILE Use stage B6

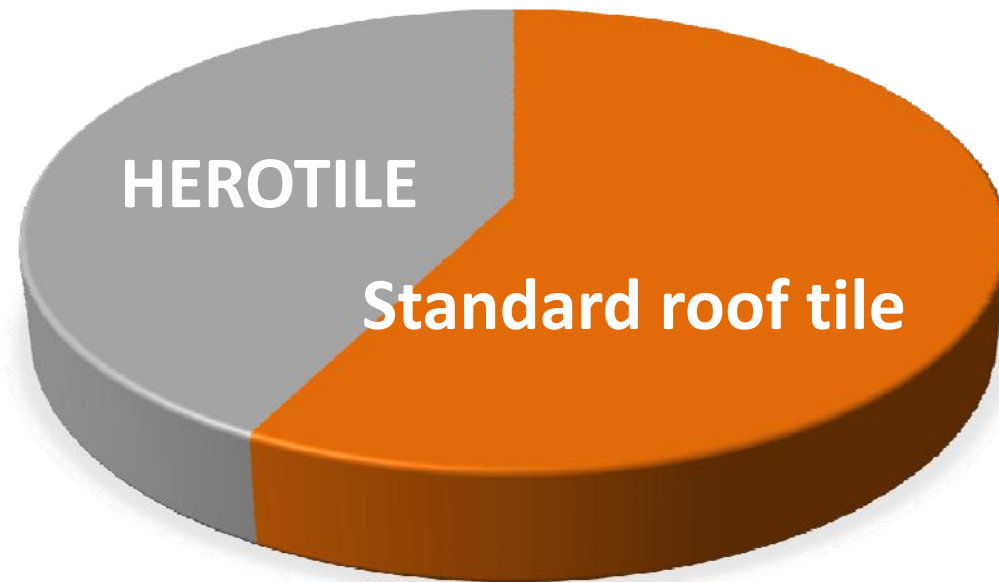
-38% ODP kg R11<sub>eq.</sub> emissions



**Ozone Depletion Potential**

# HEROTILE Use stage B6

-26% POCP kg Ethene<sub>eq.</sub> emissions



## Photochemical Ozone Creation Potential



*"It's not easy being green"*  
*Kermit the Frog, 1972.*

**arch. Caterina Gargari**

Laboratorio TEA

Università degli Studi di Pisa



teaunipi@gmail.com