Boosting the secondary materials market levering on their circular performances.
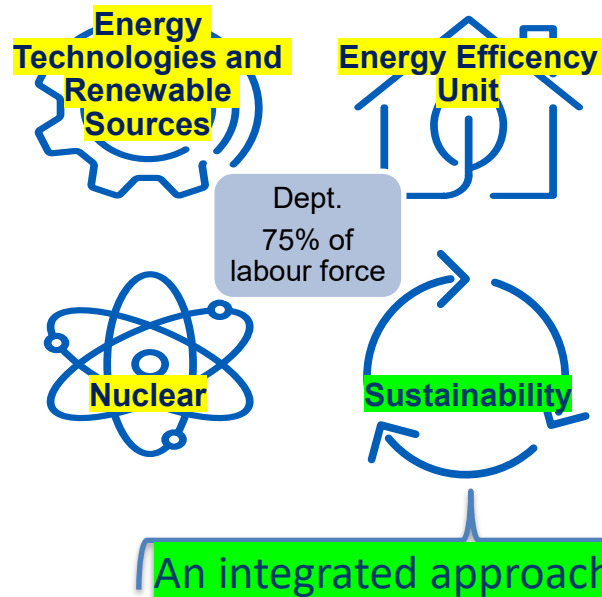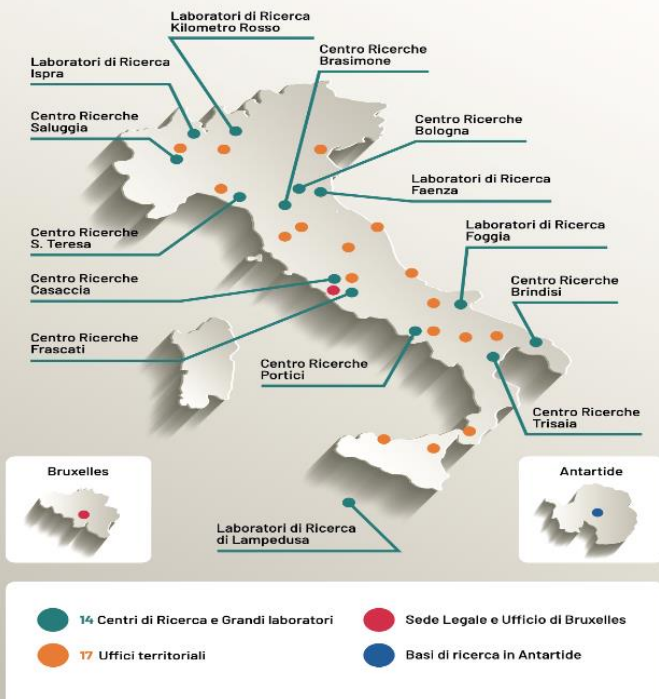
How circular performances of secondary materials can be valorized from an economic point of view.

30 June 2025

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ENEA – National Agency for New Technologies, Energy and Sustainable Economic Development

Energy Technologies and Renewable Sources

Energy Efficency Unit

Dept.
75% of labour force

Nuclear

Sustainability

An integrated approach

60
anni di ricerca
e innovazione

8
direzioni tecniche
e amministrative

14
centri
di ricerca

4
dipartimenti

2250
ricercatori, tecnologi,
tecnici e amministrativi

AREE URBANE
Progettare e vivere città più sostenibili, circolari e inclusive

TERRITORIO E MARE
Pianificare e gestire il capitale naturale, il territorio ed il mare in ottica di economia circolare

SISTEMA INDUSTRIALE
Supportare le imprese nella transizione verso modelli di produzione e consumo più sostenibili e rigenerativi

CATENA DI VALORE
Promuovere e facilitare la chiusura dei cicli nelle filiere produttive e lungo il ciclo di vita di prodotti e materiali

TE3C project - ENEA-UTILITALIA 2021-2023

Main goal: to foster the use of secondary materials.

Its main objective is to develop and propose a scheme to support the valorization of potential energy savings or carbon footprint reduction associated with the replacement of primary materials with secondary ones.

Two different credit schemes are proposed and discussed

Circular Energy Efficiency Certificates (TEEC)

Circular Carbon Credits (3C)

TEEC are defined based on potential energy savings associated with the use of secondary materials compared to primary ones

3C are defined based on the potential reduction of CO_2 eq. emissions associated with the use of secondary materials compared to primary ones
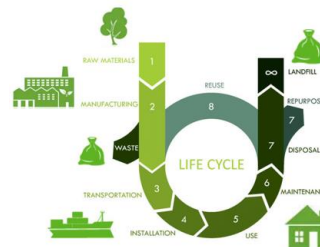
from CRADLE

↓

to GATE

+

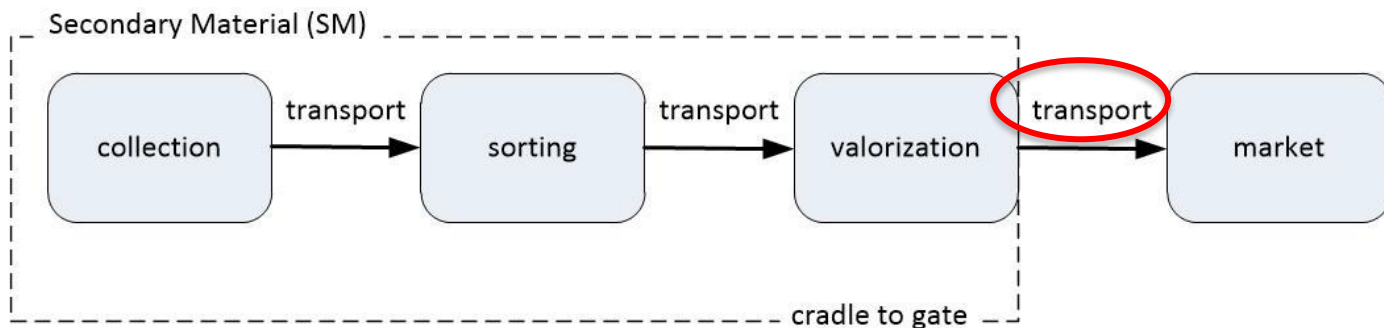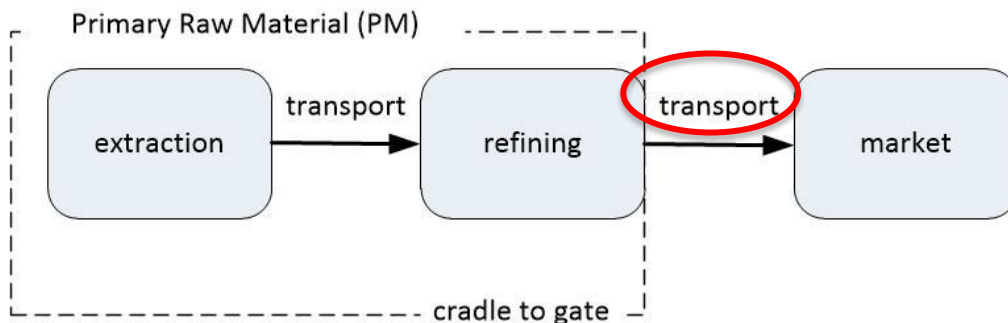transport to the market

Primary (PM) and Secondary materials (SM) are evaluated along their life cycle in terms of:
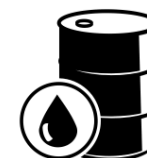
TEEC (Titoli Efficienza Energetica Circolare - TEP)
(en: Circular Energy Efficiency Credits - TOE)

Δ **= Energy intensity PM - Energy intensity SM**

If Δ **> 0** a credit (subsidy?) can be assigned to SM accordingly.

The number of TEECs obtainable by a company is directly correlated to the energy savings due to the use of secondary materials instead of primary ones with the same function.
The energy saving at the base of the TEEC is, therefore, calculated as:

Number of TEECs = Q [ton] * (Energy PM – Energy SM) [toe/ton]

Where Q, expressed in tons, refers to the quantity of SM that substitutes the PM, Energy SM and Energy PM are the energy intensities of secondary and primary materials, respectively.
Consequently, the correspondence between TEEC and toe is one to one (1 toe = 1 TEEC).

The methodology

3Cs (Crediti di Carbonio Circolare – ton CO$_{2eq}$)
(en: Circular Carbon Credits – tons CO$_{2eq}$)

$\triangle$ = Carbon footprint PM – Carbon footprint SM

If $\triangle$ **> 0** a credit (subsidy?) can be assigned to SM accordingly.

With a similar equation it is possible to calculate the number of 3Cs:

Number of 3Cs = Q [ton] *(CO$_2$ eq.PM – CO$_2$ eq. SM) [ton CO$_2$ eq. /ton]

Energy intensity $_{PM}$ = 4,078 toe/t
Energy intensity transport $_{PM}$ = 0,042 toe/t

Primary material

Energy intensity $_{SM}$ = 0,447 tep/t
Energy intensity transport $_{SM}$ = 0,001 tep/t

Secondary material

TEEC = $((IE_{PM} + IE\ trasporto\ _{PM}) - (IE_{SM} + IE\ trasporto\ _{SM}))*$**Q**

1 ton of secondary aluminum (**Q = 1 t**):

TEEC = ((4,078 tep/t + 0,042 tep/t) − (0,447 tep/t +0,001 tep/t))*1t = **4 tep**

BENCHMARK
Ecoinvent Version 3 (market for aluminium, primary, ingot)
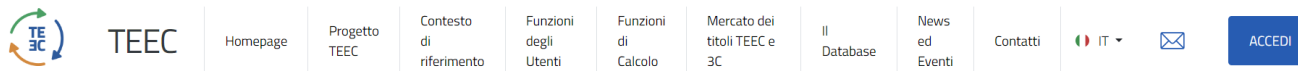val. min 2,34 kg oil eq./kg val. max 4,68 kg oil eq./kg

Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, [online] 21(9), pp.1218–1230.

3C - EXAMPLE CALCULATION (Aluminum)

Carbon footprint $_{PM}$ = 16 t CO_2 eq./t
Carbon footprint transport $_{PM}$ = 0,054 t CO_2 eq./t
    Primary material

Carbon footprint $_{SM}$ = 0,786 t CO_2 eq./t
Carbon footprint transport $_{SM}$ = 0,002 t CO_2 eq./t
    Secondary material

3C = ((IC $_{MP}$ + IC trasporto $_{MP}$) – (IC $_{MS}$ + IC trasporto $_{MS}$))*__Q__

1 ton of secondary aluminum(**Q = 1 t**):

3C = ((16t CO_2 eq./t + 0,054t CO_2 eq./t) – (0,786t CO_2 eq./t +0,002t CO_2 eq./t))*1t =
= **15 t CO_2 eq.**

BENCHMARK
Ecoinvent Version 3 (market for aluminium, primary, ingot)
val. min 10 kg CO_2/kg val. max 21 kg CO_2/kg

Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, [online] 21(9), pp.1218–1230.

The Database and the Tool TE3C

teec.enea.it

The database (DB) for the calculation of TEEC and 3C, in short TE3C, has the aim of mapping and characterizing all those materials that may be of interest for the purposes of replacing primary materials (PM) with secondary materials (SM).

The DB is the basis of the web-based software, to be able to calculate, for users who request it, any TEEC and 3C accrued in the event of the use of an SM instead of the corresponding PM.

The cooperative DB

- Up to now, **Database with 34 materials** sub-divided into 8 macrocategories.

- The data relating to the materials present in the DB are both secondary data (coming from technical-scientific literature) and primary ones coming from Utilitalia associated companies. In both cases data, before being taken into consideration by the calculation algorithm, are validated on reference benchmarks.

- DB can be fed even only with data regarding "segments" of the supply chain since it has been foreseen that in this case the algorithm calculates the missing information by making weighted averages on the available data..

Category	Sub-category
1 Plastica/gomma	1 PET
	2 HDPE
	3 PO (PP/PE)
	4 PVC
	5 PET
	6 PE
	7 gomma generica
	8 LDPE
	9 Polimero generico
2 Inerti	10 calce
	11 sabbia
	12 ghiaia
3 Metalli non ferrosi	13 piombo
	14 platino
	15 cobalto
	16 argento
	17 piombo
	18 rame
	19 magnesio
	20 gallio
	21 alluminio
	22 palladio
	23 manganese
	24 zinco
4 Metalli ferrosi	25 acciaio/ferro
5 Carta/Cartone	26 carta grafica
	27 tissue
	28 carta/cartoncino
6 Vetro	29 granuli di vetro
7 Tessili	30 lana
	31 cotone
	32 tessili generici
	33 nylon
8 Legno	34 Legno

The Database and the Tool TE3C

The TE3C web-based tool allows you to perform some main functions including:

1 → the calculation of TEEC and 3C and the related issuing of a certificate;

2 → the uploading of new data through the cooperative contribution of interested stakeholders.

Different types of stakeholders, such as companies, consortia, universities, research institutions, can access different functions of the site, based on the role that is recognized to them.

The first step is to register on the site, then you need to be enabled as **a TE3C user (that "ask" the tool to calculate their TEEC or 3C according to a defined account of secondary materials)** or as a **user that provides data into TE3C DB**.

Then, you are allowed to access the simulation procedure of TEEC and 3C credits.

# teec.enea.it

The Database and the Tool TE3C

This software hosts a **cooperative database** containing benchmark data for energy and carbon intensities of both primary and secondary materials collected from scientific literature.

The database is also fed with primary data provided by companies operating in the collection, sorting, and recycling sector of waste.

Three kinds of users are foreseen:

1 – feeder user (company providing primary data – both for PM or SM);

2 – TE3C applicant (secondary material user and applicant for credits);

3 – administrator (a qualified user able to check entered data and validate the application procedure).

ADMINISTRATOR

Web Server

database

TE3C SOFTWARE

USER DATA FEEDER

BASIC USER (TE3C applicant)

#EU GREEN WEEK
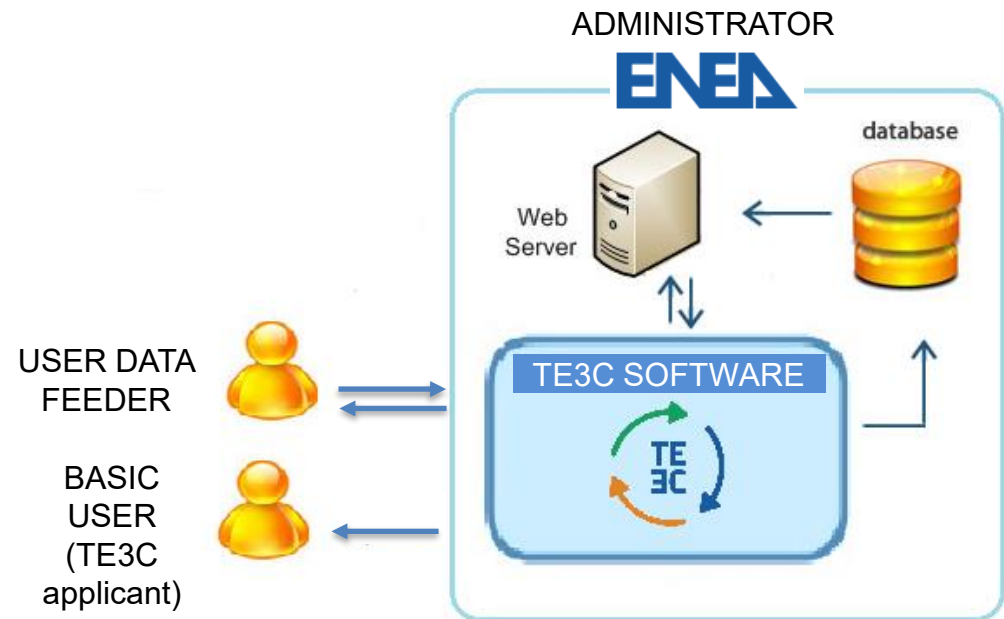
Conclusions

- Through the TE3C tool it is possible to rigorously **evaluate energy savings** and the **reduction of GHG** resulting from the replacement of PMs with corresponding SMs.

- The TE3C tool is **cooperative**; it allows the DB to be fed with primary and/or secondary data (relating to part of the supply chain or to the entire supply chain of the material being studied) by different kinds of stakeholders and their verification by administrators.

- The certificate relating to the TEECs and 3Cs accrued is issued not only based on a **technical verification** of the primary and secondary data used but also based on a **"documentary" verification** of the actual sale/purchase of the secondary material for which the credits are requested.

- Next steps are coming …… (average scenario vs SM scenario, comparison for same function, …)

*Thank you for
your attention!*

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