POLITECNICO MILANO 1863

Assessment on WAste and REsources

materia & energia da rifiuti
materials & energy from refuse

ASSESSMENT OF THE CDW MANAGEMENT SYSTEM IMPLEMENTED IN LOMBARDY REGION (ITALY)

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Assessment on WAste and REsources

OBJECTIVES OF THE RESEARCH PROJECT

- Quantifying construction and demolition waste (CDW) amount and flows within the management system of Lombardy Region
- Investigating types, amount and quality of “secondary products” obtained from CDW recovery plants and their actual use (highlighting the limiting factors for their market)
- Assessing the environmental performance of the current regional management system through the application of the Life Cycle Assessment (LCA) methodology
- Identifying benefits and critical aspects of the CDW management system
- Defining possible improving actions based on the state-of-the-art recovery technology and the LCA results of the current management scenario, to be compared and evaluated from a life cycle perspective

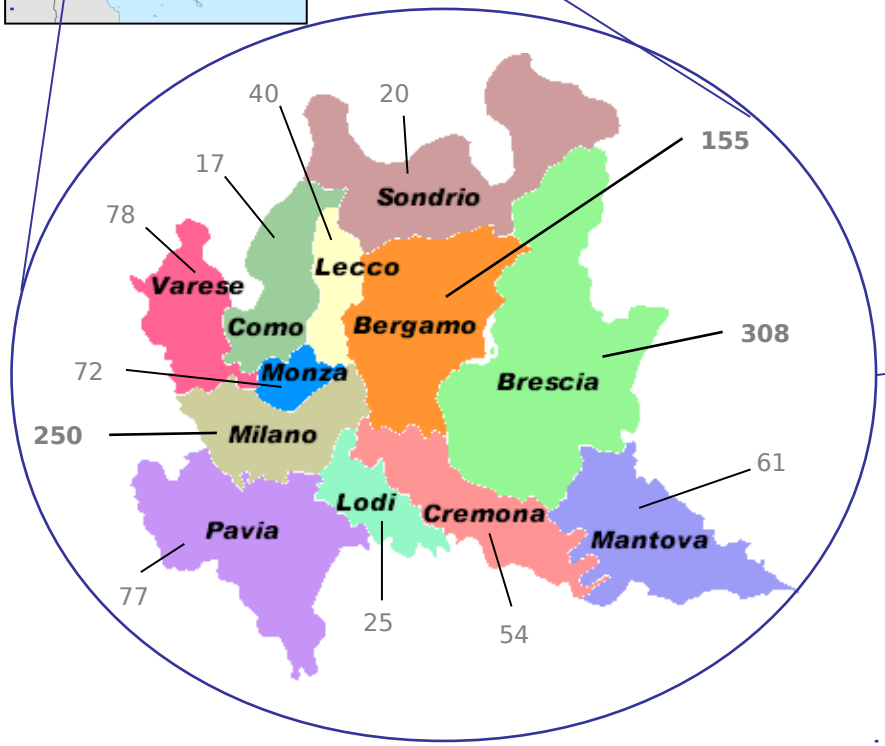
LOMBARDY REGION - ITALY

AREA: 23.844 km²

POPULATION: 10 MILLION (1/6 ITALIAN POPULATION)

GROSS DOMESTIC PRODUCT (GDP): 22% ITALY'S GDP

ADMINISTRATIVE DIVISIONS: 12 PROVINCES, 1530 MUNICIPALITIES



Non hazardous CDW generation in Lombardy (2014): 11.9 Mt

(Italy: 50.2 Mt) (source: ISPRA2017)

CDW MANAGEMENT SYSTEM

1'157 PLANTS IN OPERATION IN 2016 (LANDFILLS: 39; RECYCLING PLANTS + TRANSFER STATIONS: 1'118)

SOURCE: CATASTO GEOREFERENZIATO DEI RIFIUTI REGIONE LOMBARDIA
www.cgrweb.servizirl.it/menu.do?method=ricerca

WASTE UNDER STUDY

NON-HAZARDOUS CDW INCLUDED IN THE STUDY:

EUROPEAN WASTE CODE (EWC) 17 XX XX:

- **17 01 concrete, bricks, tiles and ceramics**
  - CONCRETE (17 01 01)
  - BRICKS (17 01 02)
  - TILES AND CERAMICS (17 01 03)
  - CONCRETE, BRICKS, TILES AND CERAMICS IN MIXTURES, CONTAINING NON HAZARDOUS SUBSTANCES (17 01 07)
- **17 02 wood, glass and plastic** (17 02 01, 17 02 02, 17 02 03)
- **17 03 bituminous mixtures, coal tar and tarred products** (17 03 02)
- **17 04 metals (including their alloys)** (17 04 01, 17 04 02, 17 04 03, 17 04 04, 17 04 05, 17 04 06, 17 04 07, 17 04 11)
- **17 08 gypsum-based construction material** (17 08 02)
- **17 09 other construction and demolition waste**
  - MIXED CONSTRUCTION AND DEMOLITION WASTES (17 09 04)

RESULTS: CDW FLOWS

REFERENCE YEAR: 2014

EXPORT (plants)

EWC 17 01:	**9,189 t**
EWC 17 03 02:	**1,665 t**
EWC 17 08 02:	**4,870 t**
EWC 17 09 04:	**38,149 t**

FOCUS OF THE PRESENT RESEARCH

Imported CDW:
EWC 1701: 47,075 t;
EWC 170302: 174,389 t;
EWC 170802: 4,419 t;
EWC 170904: 382,931 t

CDW GENERATION IN LOMBARDY REGION(2014):

EWC 17 01:	**>= 804,625 t**
EWC 17 03 02:	**>= 1,018,580 t**
EWC 17 08 02:	**>= 31,405 t**
EWC 17 09 04:	**>= 5,851,639 t**

WASTE DELIVERY

WASTE MANAGEMENT SYSTEM

CDW GENERATED AND TREATED IN LOMBARDY

EWC 17 01:	**763,950 t**
EWC 17 03 02:	**971,656 t**
EWC 17 08 02:	**20,988 t**
EWC 17 09 04:	**5,625,978 t**

PRODUCED AND TREATED IN LOMBARDY
EWC 1701, 170302 and 170904: 95%
EWC 170802: 67%

*DIRECTLY EXPORTED WASTE**

EWC 17 01:	**> = 31,487 t**
EWC 17 03 02	**> = 45,259 t**
EWC 17 08 02	**> = 5,547 t**
EWC 17 09 04:	**> = 187,512 t**

EWC = European Waste Code

* >= because it doesn't include the CDW quantity from those producers not obliged to fill in the yearly waste declaration

LCA METHODOLOGY APPLIED TO CDW MANAGEMENT

~~Products (future waste) production, distribution and use~~

Materials consumption
Energy consumption
Emissions to air, water and soil
Residues production

Avoided natural materials

Secondary materials

Collection

Transport to pre-treatment

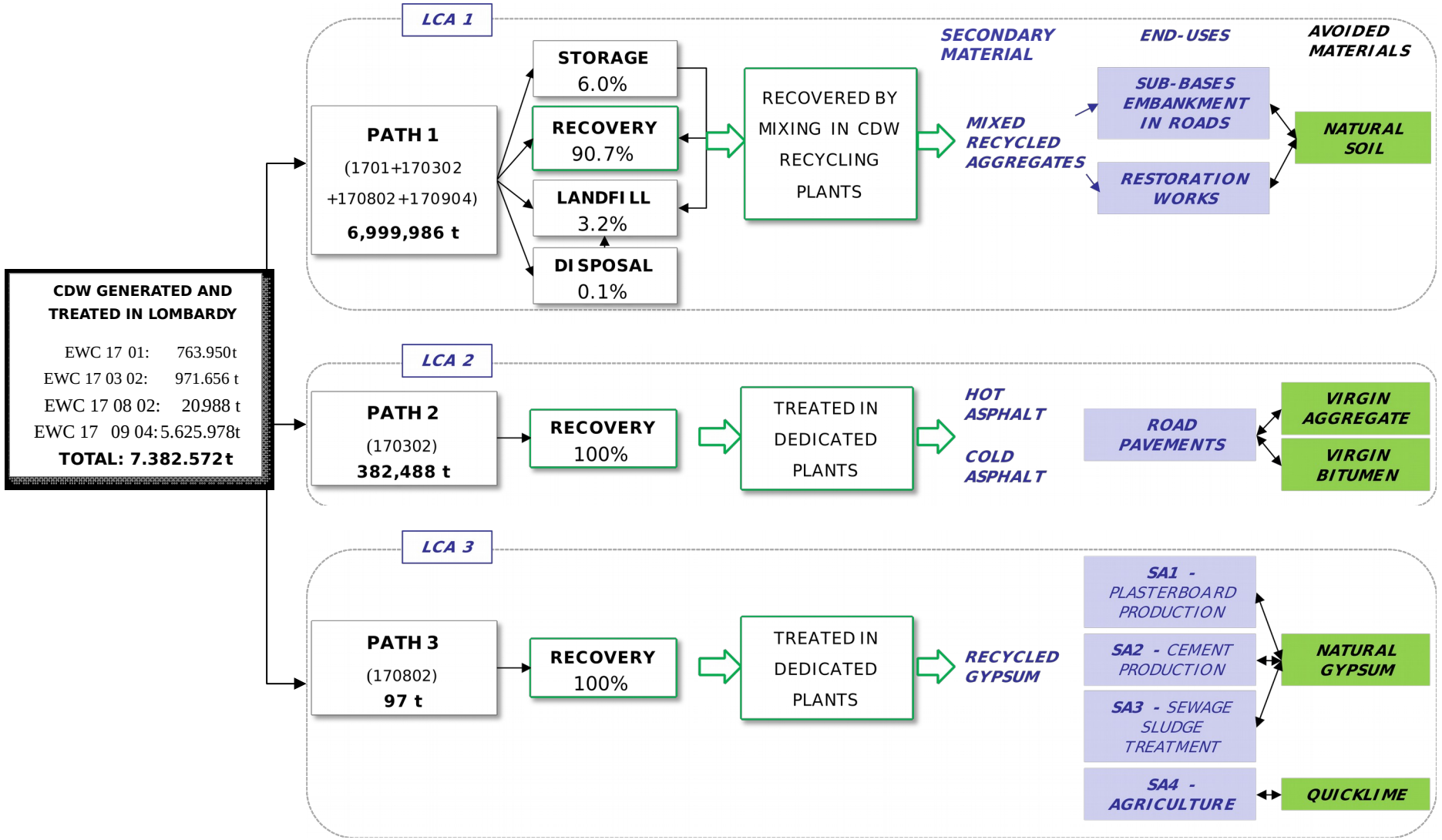
Pre-treatment

Transport to treatment

Treatment

LCA applied to CDW management: comparison between impacts added to the environment (+) and avoided impacts (-) in each scenario

SETTING UP THE LCA



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Life cycle assessment of non-hazardous Construction and Demolition Waste (CDW) management in Lombardy Region (Italy)

Giulia Borghi [a, *], Sara Pantini [a, b], Lucia Rigamonti [a, b]

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Towards resource-efficient management of asphalt waste in Lombardy region (Italy): Identification of effective strategies based on the LCA methodology

S. Pantini [a,b,*], G. Borghi [a], L. Rigamonti [a,b]

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Full length article

A LCA study to investigate resource-efficient strategies for managing post-consumer gypsum waste in Lombardy region (Italy)

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LCA 1: RECYCLING PLANTS

RECEIVED WASTE

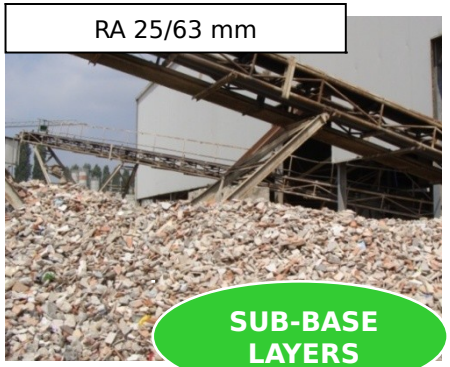
MIXED CDW
(EWC 170904)

STATIONARY PLANTS

MOBILE PLANTS

RECYCLED AGGREGATES (RA)

RA 25/63 mm



SUB-BASE LAYERS

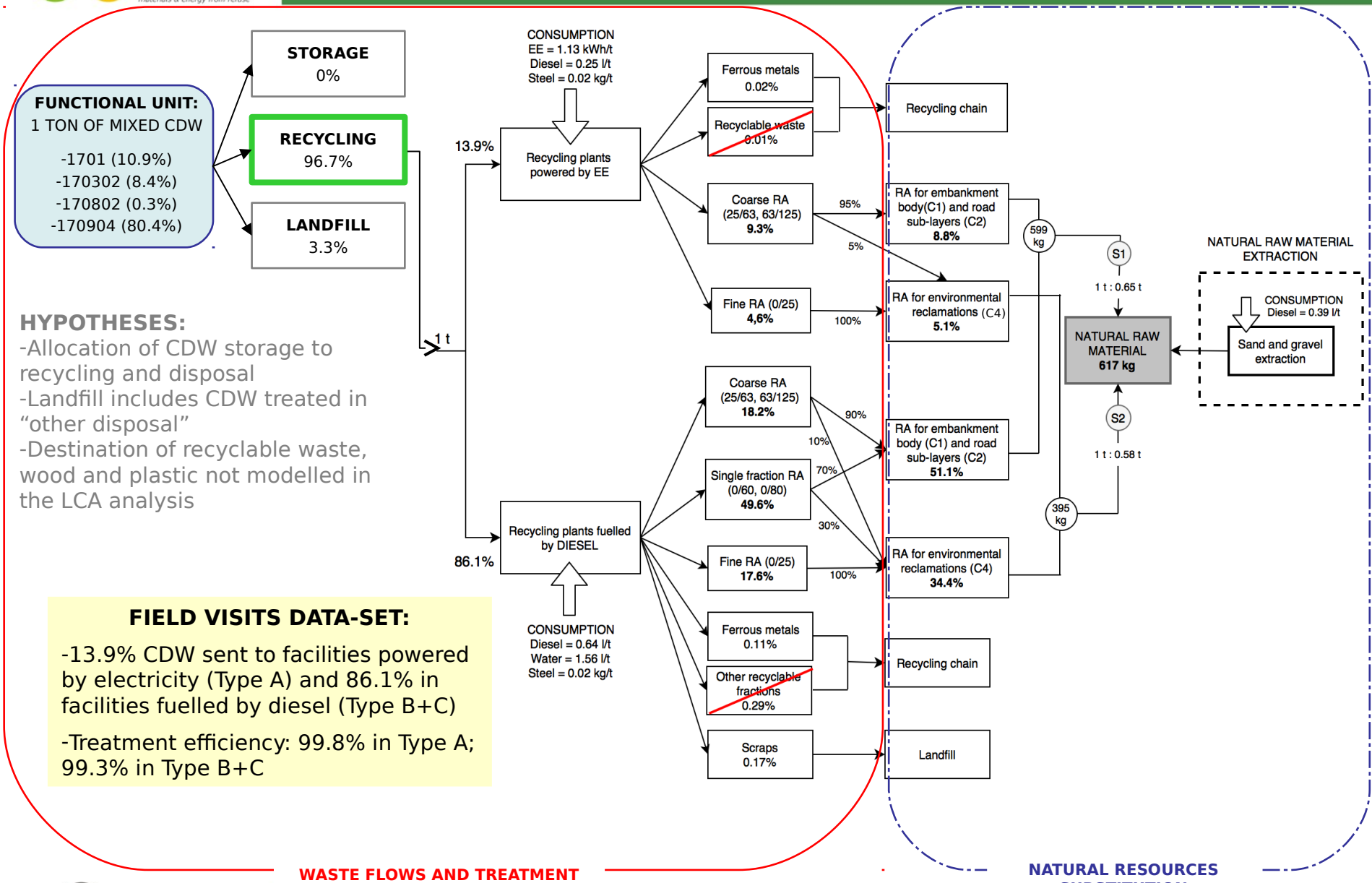
RA 63/125 mm

DRAINAGE LAYERS

RA 0/63 mm

RECLAMATION/ FILLINGS

LCA RECYCLING SYSTEM



HYPOTHESES:

-Allocation of CDW storage to recycling and disposal

-Landfill includes CDW treated in "other disposal"

-Destination of recyclable waste, wood and plastic not modelled in the LCA analysis

FIELD VISITS DATA-SET:

-13.9% CDW sent to facilities powered by electricity (Type A) and 86.1% in facilities fuelled by diesel (Type B+C)

-Treatment efficiency: 99.8% in Type A; 99.3% in Type B+C

The actual CDW management system implemented in Lombardy region

-has better environmental performances than the landfill disposal

-but the induced environmental impacts are higher than the benefits arising from CDW recycling. The biggest environmental burdens come from waste transportation and are not balanced by the small avoided impacts associated with the use of recycled aggregates in the actual applications (i.e. low grade applications)

The system can be improved so that the environmental benefits associated with the use of recycled aggregates compensate the impacts due to the waste management system itself

LCA 1: RECOMMENDATIONS

PROMOTE THE MARKET OF THE RECYCLED AGGREGATES

Regulatory tools aimed at promoting the use of recycled aggregates	Green Public Procurement
Mining sector planning aimed at having a more sustainable use of natural resources	• Higher taxes for the extraction activities • More rational permission system, that considers recycled aggregates availability on the territory
Adapt the technical tools to the European standards	Special tender dossier, price list of construction works

IMPROVE THE QUALITY OF RECYCLED AGGREGATES

Selective demolition on site to improve the CDW quality entering the recycling facilities	• Separation of undesired materials • Market creation for those materials that are now mixed together before the recycling treatment
Improve the plant technologies	• Encourage and promote the authorization of recycling facilities powered by electricity • Improve selection efficiencies; implement more advanced plant technologies

OPTIMISE THE MANAGEMENT SYSTEM

Minimize transport distances and temporary management phases	• Optimal facilities distribution • Updating recycling plants regional lists and maps • Promote the opening of facilities where it is needed
Reduce landfill disposal	• Increase disposal taxes • Ban on disposal for those fraction that can be recycled

LCA 2: ASPHALT WASTE MANAGEMENT

RAP = reclaimed asphalt pavement

S. Pantini et al./Waste Management 80 (2018) 423–434

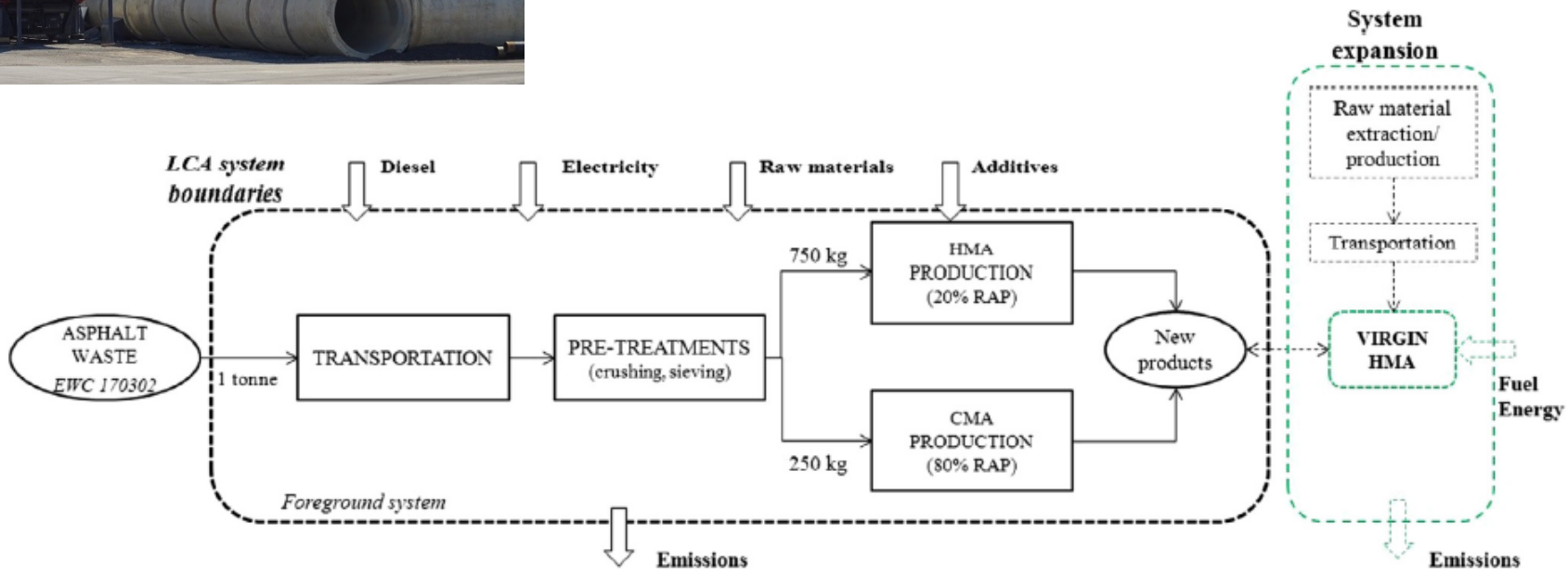
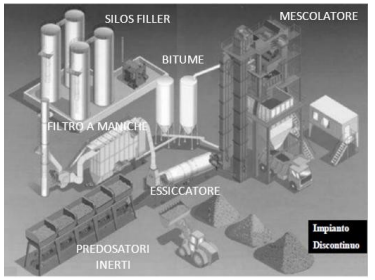


Fig. 1. Diagram flow of recycling 1 tonne of asphalt waste (RAP) in the regional system (75% hot-mix asphalt –HMA and 25% cold-mix asphalt -CMA plants) with the inclusion of the avoided products.

LCA 2: ASPHALT WASTE MANAGEMENT



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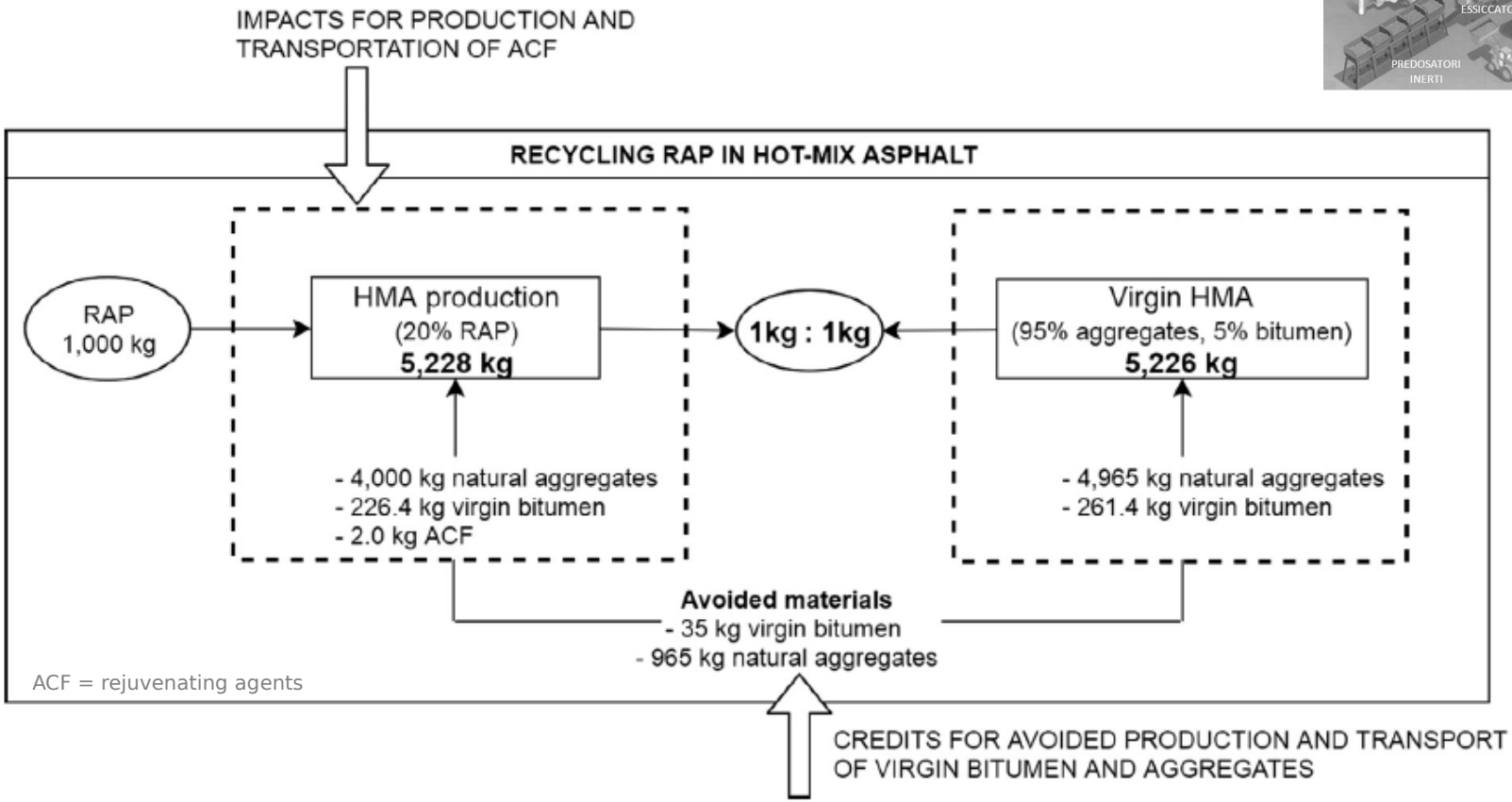

Fig. 2. Diagram flow of recycling 1 tonne of RAP in hot-mix asphalt plants with indication of credits and burdens for the system.

LCA 2: ASPHALT WASTE MANAGEMENT

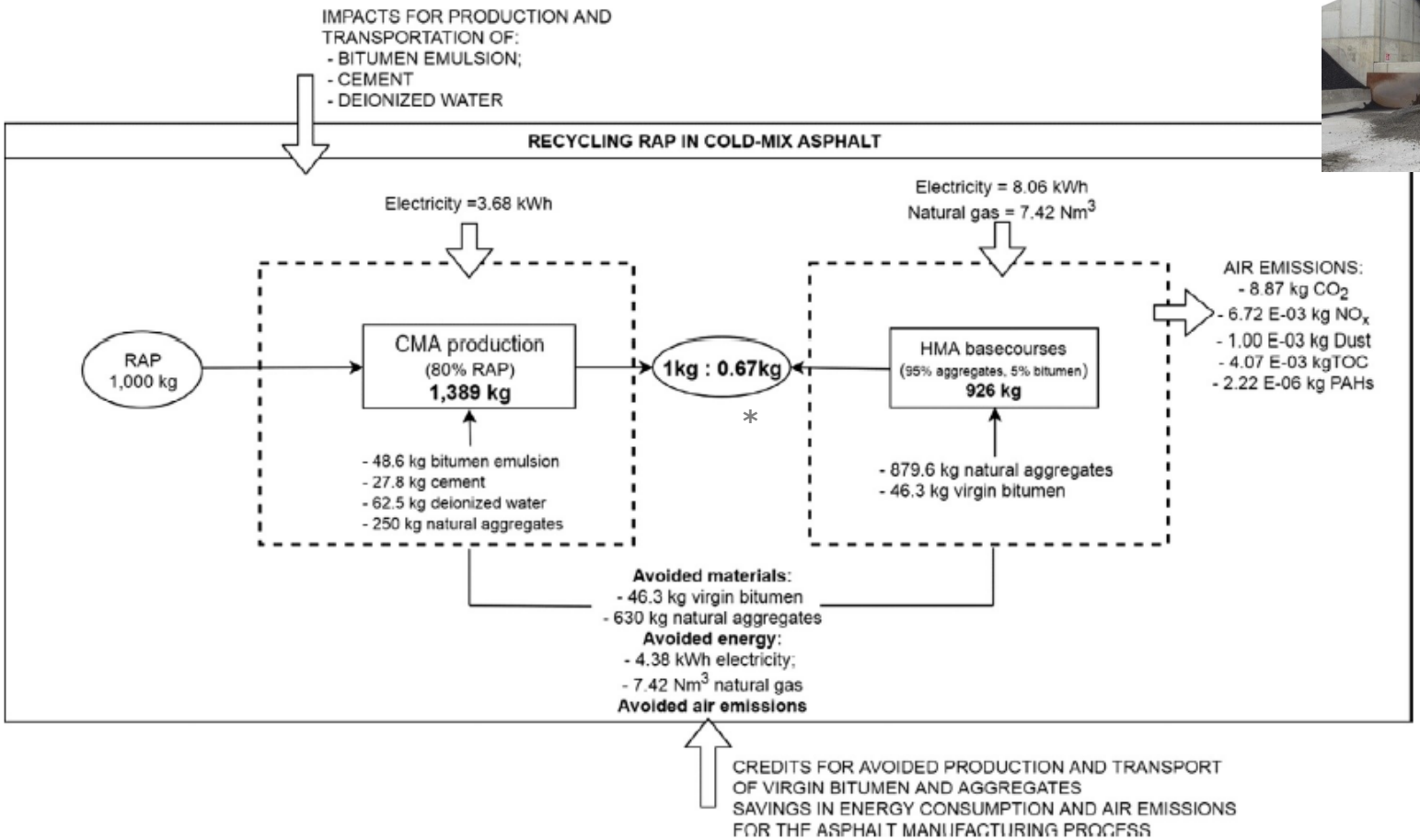

Fig. 3. Diagram flow of recycling 1 tonne of RAP in cold-mix asphalt plants with indication of credits and burdens for the system.

* CMA with RAP is generally used as basecourses in roads with medium/high traffic volume or as base/binder courses in case of low traffic level. **To take into account for the lower field performances, road constructors usually increase by 30–50% the thickness of the layer compared to the typical value required for traditional HMAs**

LCA 2: CONCLUSIONS

- The LCA analysis of the current regional system for recycling asphalt waste in new asphalt mixes is already characterized by good environmental performances

- The largest benefits come from the use of RAP in the manufacturing of hot asphalt mixtures, which appeared as the most widespread recycling technology in the region and which provides better environmental performance compared to cold recycling in plants

- The lower performances associated to cold recycling techniques are mainly due to the use of bitumen emulsion and cement, whose production processes appear highly impacting, and to the inferior quality of CMAs compared to HMAs which implies a replacement coefficient minor than 1 to guarantee the same pavement lifetime

LCA 2: RECOMMENDATIONS

- Updating technical specifications in public road projects to prevent discrimination/excessive restrictions in the use of RAP in asphalt pavements
- Promoting RAP recycling in hot mix asphalt while reducing the use of RAP as unbound material in road construction
- Incentivizing the revamping of HMA plants to favor the adoption of innovative technologies that ensure lower environmental impacts and larger dosage of RAP into the final mixtures
- Optimizing waste transportation through a widespread coverage of the regional territory

LCA 3: GYPSUM WASTE MANAGEMENT

Resources, Conservation & Recycling 147 (2019) 157–168

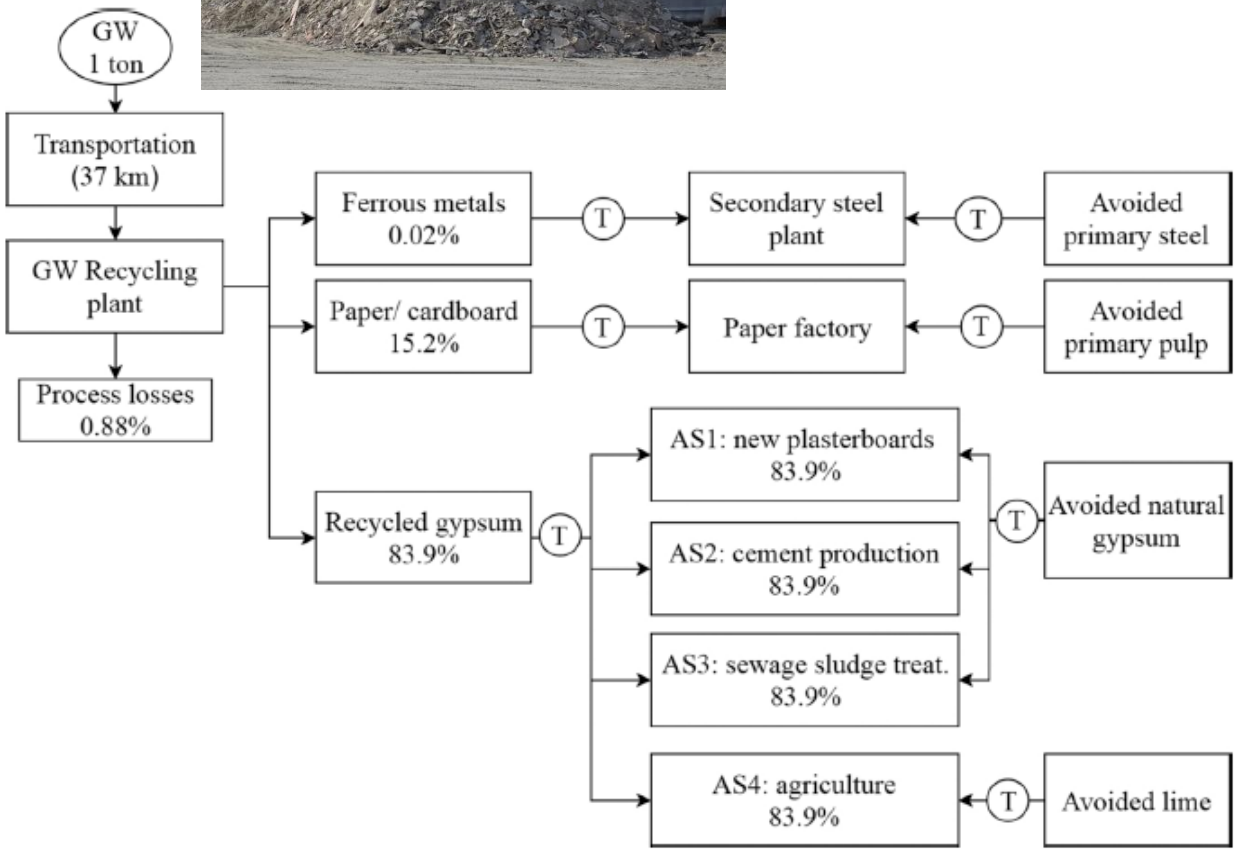

Fig. 1. Gypsum waste (GW) management in the alternative scenarios (AS). T = transportation.

LCA 3: CONCLUSIONS

- There is only one GW recycling plant in the region and GW is mostly (99.5%) recycled in CDW facilities → deficiency of the regional GW management system
- Better environmental performance of dedicated GW recycling, compared to that of mixing GW with CDW
- Recycling GW in dedicated facilities leads to significant savings, mainly ascribed to the recovery of paper
- Comparison among alternative end-uses of the recycled gypsum (excluding the benefits from paper recycling): the plasterboards production is the least viable option due to the nonexistence of manufacturing plants in the regional territory (→ long transport distances); the best environmental and energetic profile is associated to the use of the recycled gypsum in the agricultural sector

LCA 3: RECOMMENDATIONS

WASTE MANAGEMENT	1. Solving the under-capacity of the regional system for managing gypsum waste → **at least, two more plants are needed to cover current GW generation** 2. Reducing transport distances of wastes and secondary materials → **strategic planning of future recycling facilities**
WASTE PROCESSING	1. Avoiding the mixing of gypsum waste with other mineral CDW → **promoting GW recycling in dedicated plants** ↳ ***To enhance technical properties of recycled aggregates from CDW and potentially increase their market demand***
	2. Incentivizing the adoption of adequate technologies able to achieve high-quality recycled gypsum and to **separate cardboard/paper sufficiently pure to be destined to paper factories**
MARKET	**Promoting the use of recycled gypsum** in the different technically feasible applications (cement production, sludge treatment, agriculture)

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THANK YOU FOR YOUR ATTENTION

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