POLITECNICO MILANO 1863

mater
materia & energia da rifiuti
materials & energy from refuse

HERAKLION 2019
7th International Conference on Sustainable Solid Waste Management,
26-29 June 2019, Crete Island

Treatment and Recovery Of Incineration Bottom Ash (IBA) From Municipal Solid Waste

L. Biganzoli, L. Rigamonti, M. Grosso, G. Dolci, S. Cernuschi

Aim of the study

The evaluation of the environmental impacts of the treatment of the incineration bottom ash (IBA), including the metal scraps and the mineral fraction recycling, by applying the Life Cycle Assessment (LCA) methodology.

Are the benefits associated with material recovery able to compensate the burdens due to the treatment itself?

Definition of the system (1)

Wet extracted IBA is treated in dedicated plants which operate in dry conditions. IBA is sieved, grinded and the metals scraps are separated through magnets and eddy current separators.

- **Metals are sent to upgrading and recycling.**
- **The mineral fraction is sent to recycling (eventually after washing with water). Five possible applications were considered:**
  - **CLINKER** (the mineral fraction is used in the production of the raw meal)
  - **CONCRETE**
  - **BITUMINOUS CONGLOMERATE**
  - **ROAD A** (the mineral fraction is used in the construction of a road embankment)
  - **ROAD B** (the mineral fraction is used in the construction of a road sub-base)

Definition of the system (2)

The system was modeled on the basis of primary data gathered from three IBA treatment plants located in northern Italy (ref. years 2013-2016).

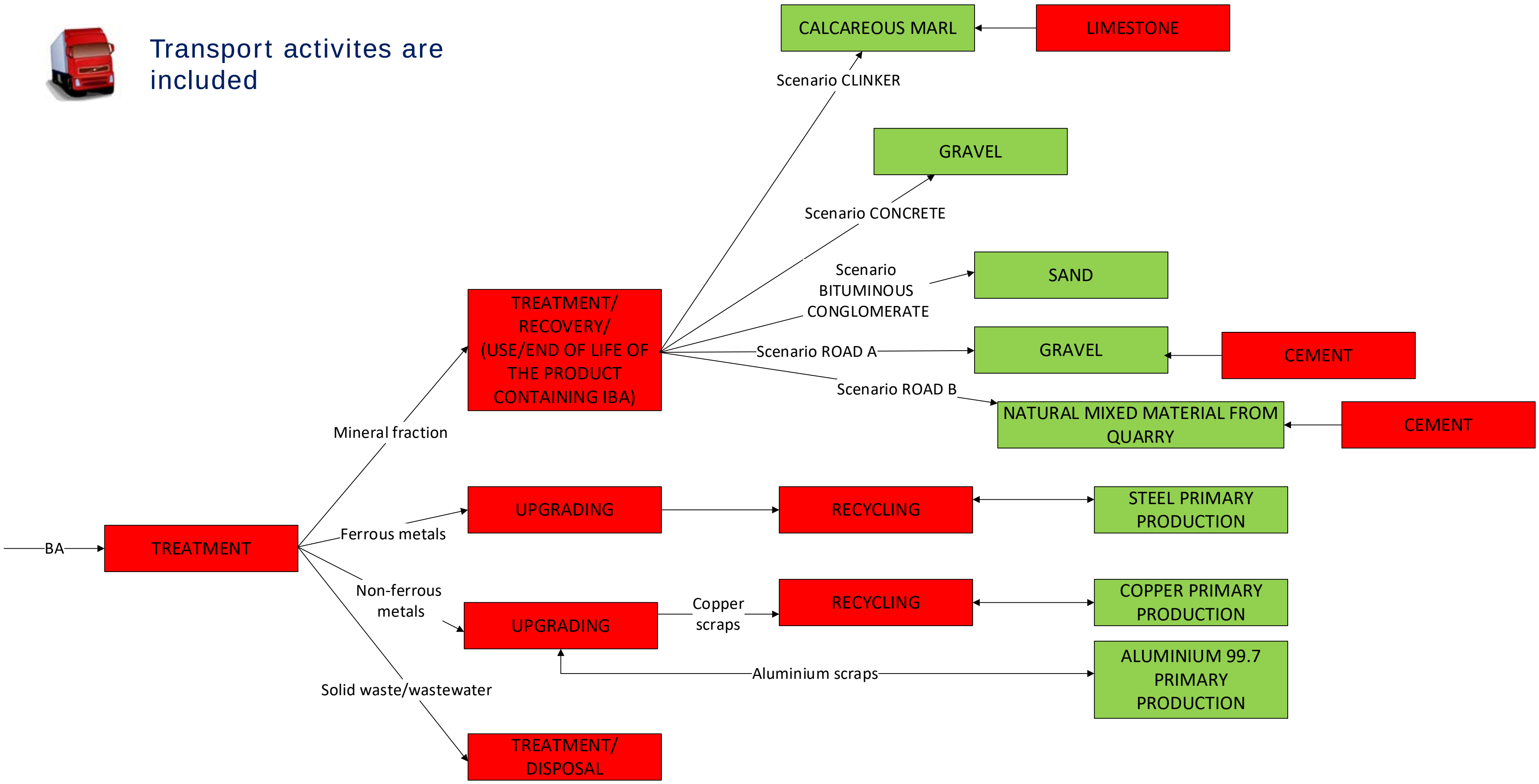
Definition of an «average» IBA treatment plant

(layout, mass balance, energy consumption, use options of the mineral fraction)

FUNCTIONAL UNIT: 1 tonne of IBA treated in an «average» IBA treatment plant located in the North of Italy.

System boundaries:

Transport activites are included



RED → phases that cause additional impacts to the environment

Green → phases that determine avoided impacts to the environment

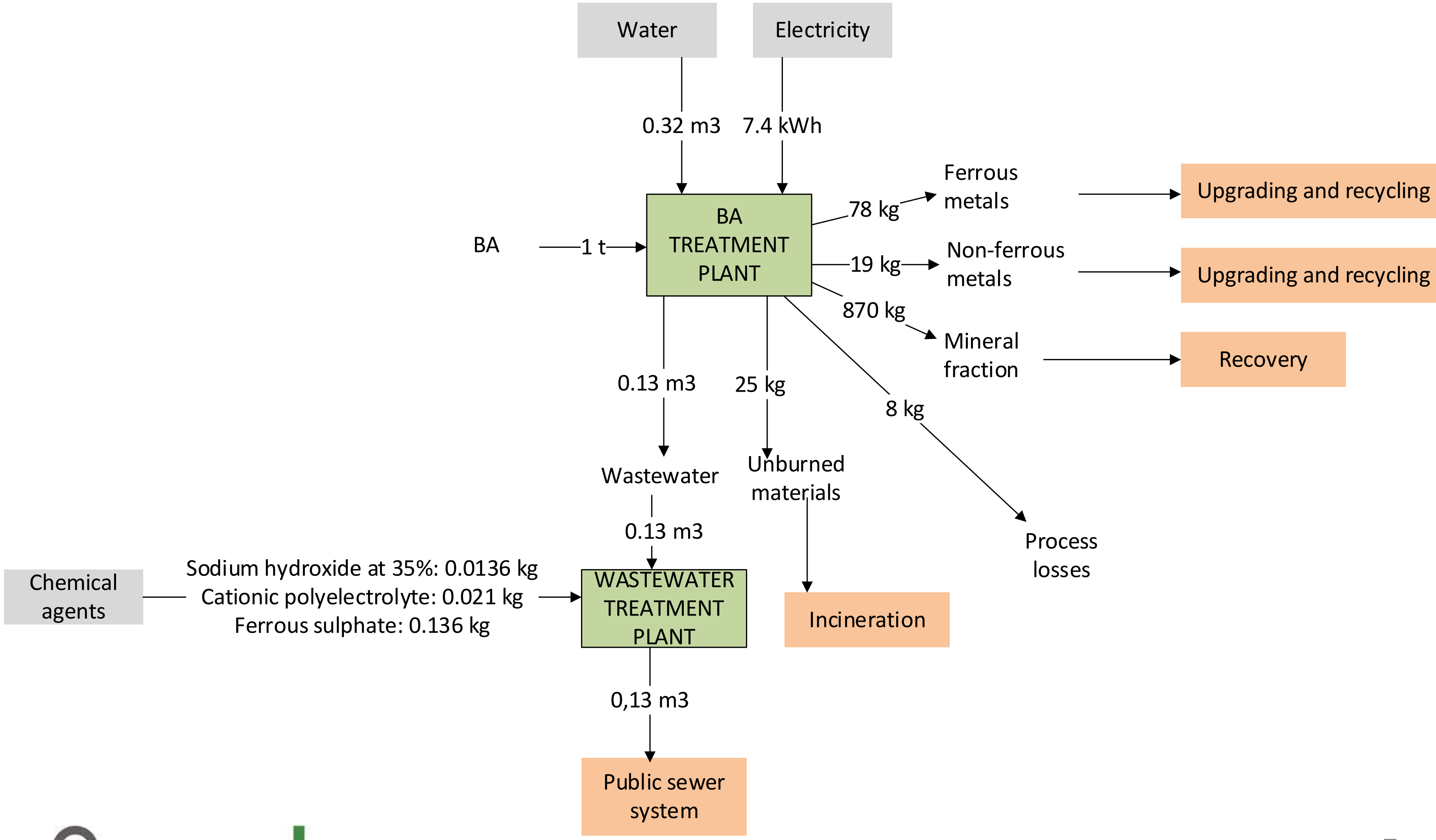
- **Environmental impact categories considered:**
  1. ***Climate change***
  2. ***Ozone depletion***
  3. ***Photochemical ozone formation***
  4. ***Particulate matter***
  5. ***Acidification***

  They were calculated on the basis of the characterization models reported in the Product Environmental Footprint (PEF) guide

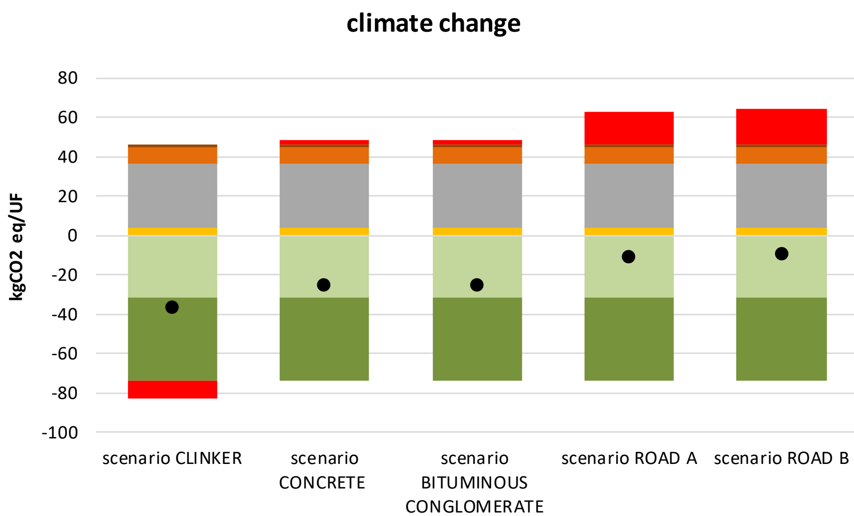
- **Indicator of *mineral resources depletion* tailored built from the *SimaPro inventory***

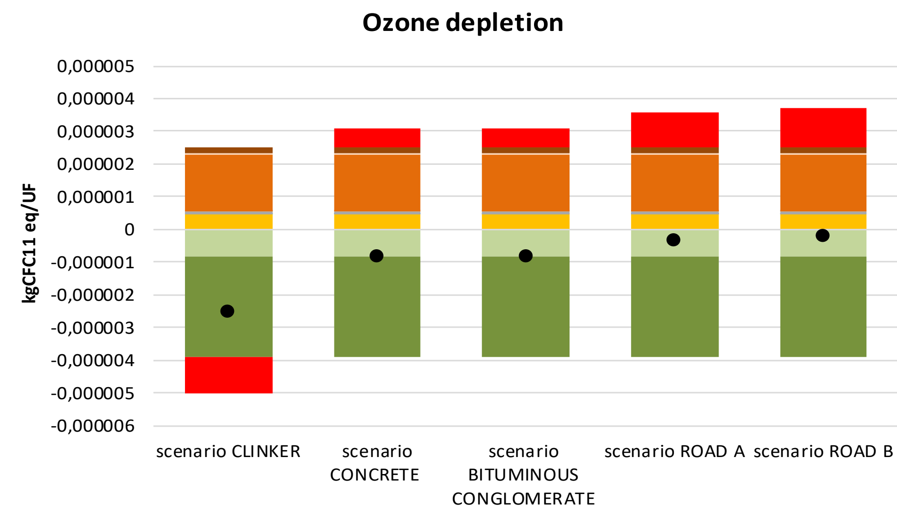
- ***Cumulative Energy Demand (CED)* indicator calculated to evaluate the energy performance of the examined processes (*Hischier et al., 2010*)**

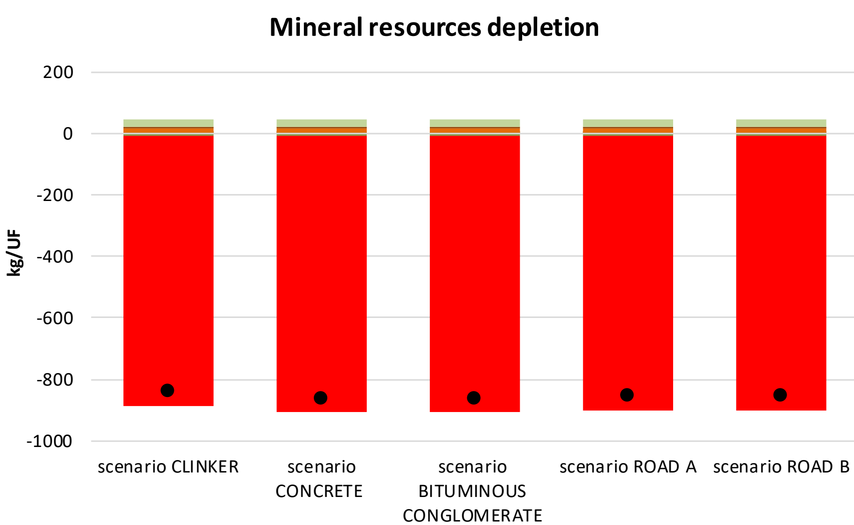
Mass balance and energy consumption of the IBA treatment plant



Environmental impact indicators and *mineral resources depletion* indicator associated with the treatment of 1 tonne of IBA

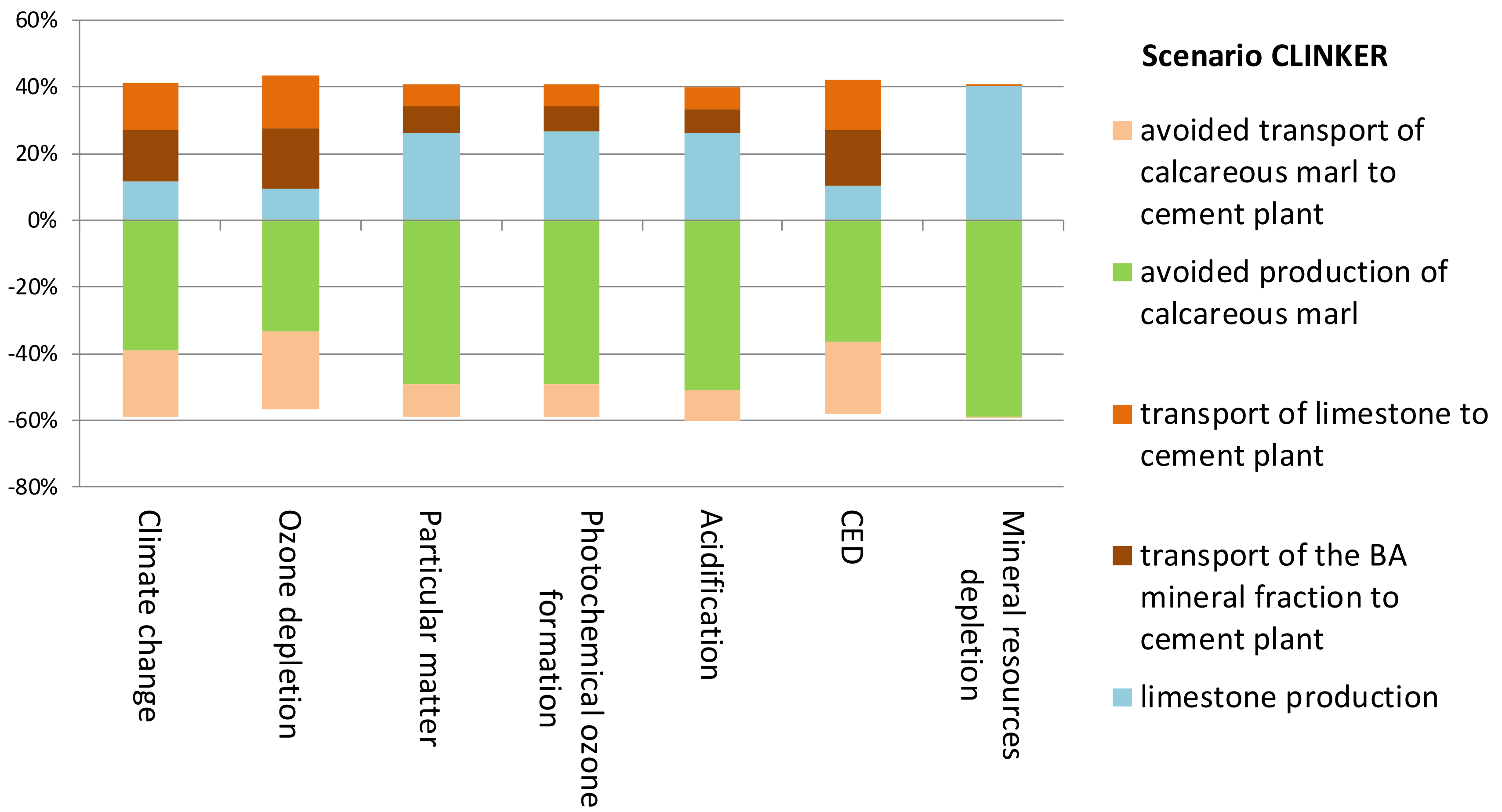




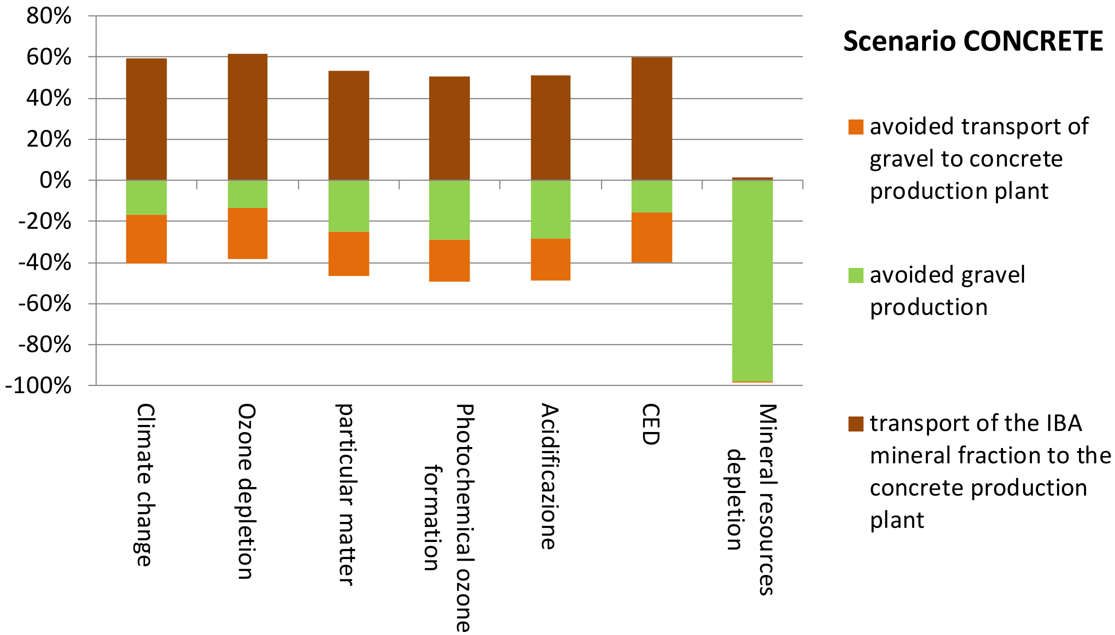


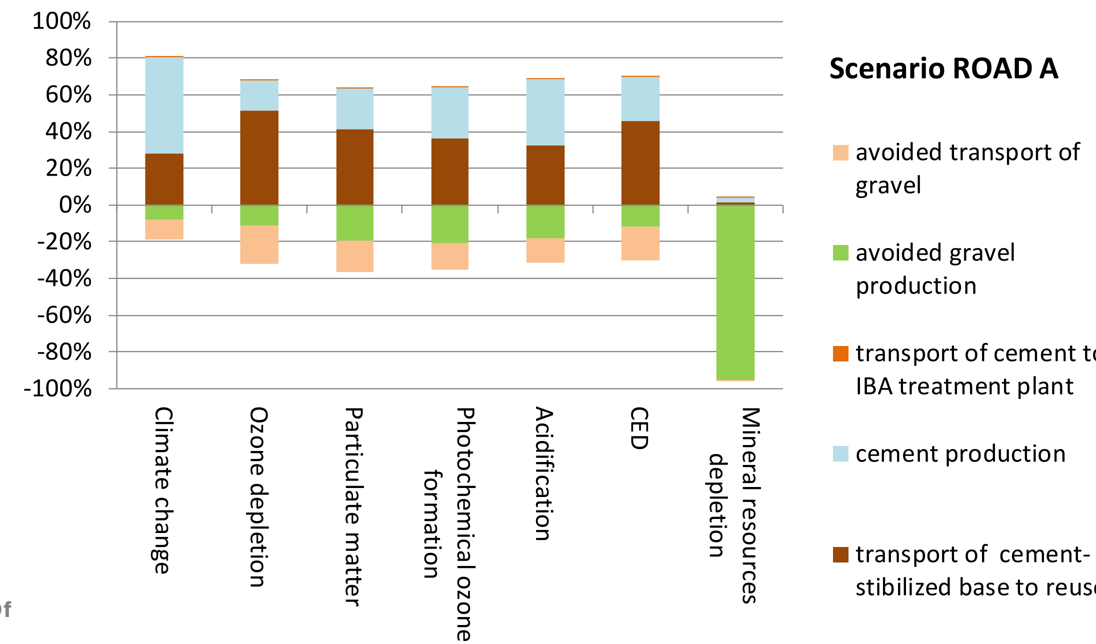
- recovery of the mineral fraction
- upgrading and recovery of non-ferrous metals
- upgrading and recycling of ferrous metals
- transport of the metal scraps to upgrading
- transport of the unburned materials to incineration
- transport of the BA from the incineration facility to the treatment plant
- chemicals transport
- water consumption of the BA treatment plant
- incineration of the unburned materials
- wastewater treatment plant
- electricity consumption of the BA treatment plant

Analysis of the contributions related to the use of 1 kg of mineral fraction recovered from IBA



Analysis of the contributions related to the use of <u>1 kg of mineral fraction recovered from IBA</u>





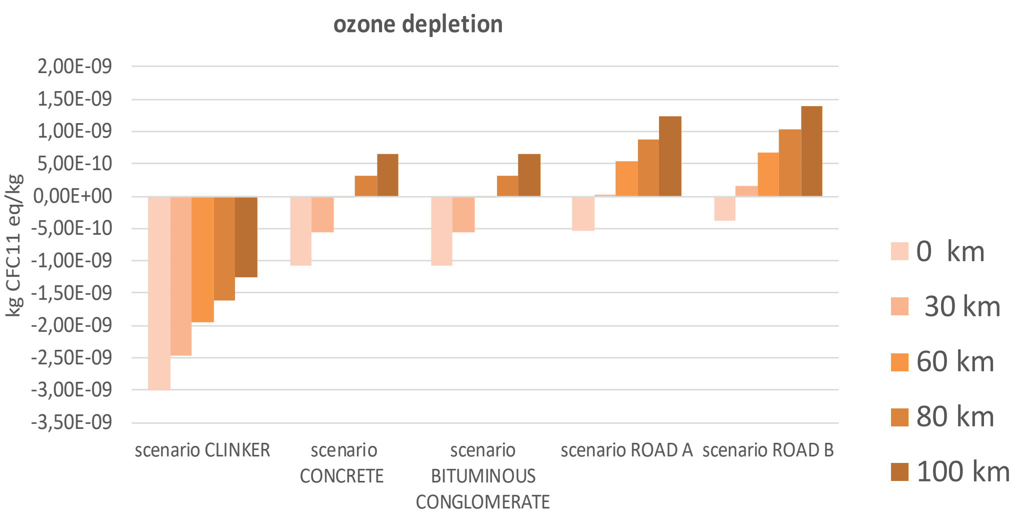
SENSITIVITY ANALYSIS ON TRANSPORT

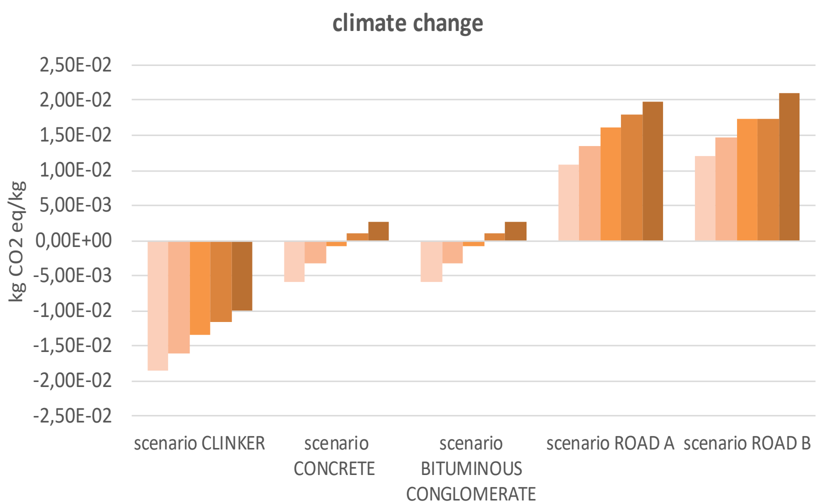
- **Distance between the incineration plant and the IBA treatment plant: from 0 to 350 km (baseline scenario= 100 km)**

Overall the IBA treatment and recovery still remains beneficial for all the considered indicators, expect for the *ozone depletion* impact indicator for distance > 100 km

- **Distance between the IBA treatment plant and the place where the mineral fraction is recycled: from 0 to 100 km (baseline scenario= 100 km).**

Environmental impact indicators calculated for 1 kg of mineral fraction sent for re-use as a function of the distance between the IBA treatment plant and recycling site of the mineral fraction.





- **The IBA treatment and recovery shows overall environmental benefits for all the indicators, regardless of the destiny of the mineral fraction.**

- **The main environmental burdens are associated with the transport of IBA from the incineration plants to the treatment plants, the incineration of the unburned materials and the recycling of the mineral fraction (Except for the CLINKER scenario).**

- **The main environmental benefits are associated with the recovery of metal scrap, both ferrous and non-ferrous.**

- **Recovery of the mineral fraction has a secondary role. The only scenario with environmental benefits is the one where mineral fraction is used in the production of the clinker in substitution of the marl.**

- **The IBA treatment and recovery brings on average a saving of 800 kg of natural mineral resources per tonne of IBA treated.**

- ***Break-even* transport distances are approximately 100 km from the WtE plant to the IBA treatment plant and 0-60 km from IBA treatment plant to the site where the mineral fraction is reused, depending on the considered indicator.**

mater
materia & energia da rifiuti
materials & energy from refuse

POLITECNICO
MILANO 1863

THANK YOU FOR THE ATTENTION!

laura.biganzoli@polimi.it

www.aware.polimi.it
www.mater.polimi.it

Assessment on WAste and REsources