



**WHY A CO<sub>2</sub>e QUANTIFICATION?**

# Motivation



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- In order to slow down the global warming, every industry has to do their contribution to reduce greenhouse gases (CO<sub>2</sub>e).
- A worldwide initiative to reduce the greenhouse gases started with the Kyoto protocol in 2005 [1]. Today, the European Union has pledged to reduce the CO<sub>2</sub>e by
  - 40% from 1990 to 2030
  - 30% from 2005 to 2030
  - 80% from 1990 to 2050

[2]

In order to achieve these reductions and due to unsuccessful voluntary commitment from e.g. the car industry, the European Union is implementing CO<sub>2</sub>e regulations in each sector.

The European Union has shown keen interest to regulate the CO<sub>2</sub>e emissions in agricultural and construction equipment.

- The European legislation demands all large companies from year 2017, a yearly sustainability report in which sustainability aspects including the supply chain are described. The main focus lays in describing precisely objectives and measures to achieve them. [3]

# Approach: machine related to their processes

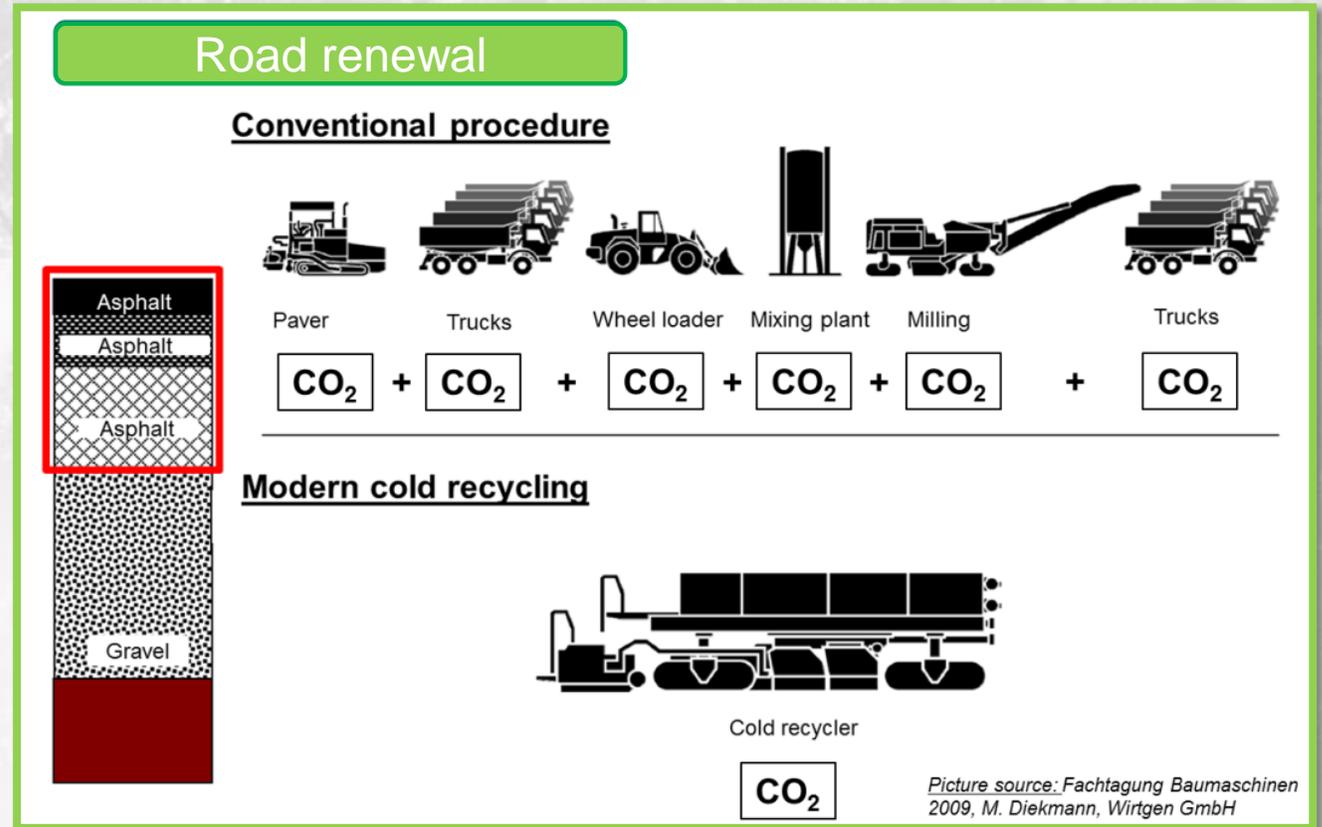
- The mobile machines industries favour a CO<sub>2</sub> reduction through technology development and market driven competition instead of regulations. Such approach would ensure the companies competitiveness in the global market.
- In fact there are a lot of factors influencing the fuel consumption of a mobile machine. Each construction machine has different functions, different technologies and different areas of application. In addition, because a construction results out of a combination of works from different machines, the use of a machine type depends also on what other machines were used and / or will be used. The material used during operation should also be considered. For example the use of recycling material should be favoured over conventional material and should appear in the CO<sub>2</sub>-balance.



Mobile machines are influenced by many factors, for an objective and effective CO<sub>2</sub> quantification, the mobile machine needs to be related to their processes.

# E.g. machine related to their processes

- A modern cold recycler which mills, recycles asphalt and does paving is producing more CO<sub>2</sub> emissions than for e.g. a conventional paver.
- As shown in the figure from the view of the whole road maintenance process of a specific road, the cold recycler replaces several machines.
- From the point of view of the “process”, the cold recycler is emitting less CO<sub>2</sub> emissions.



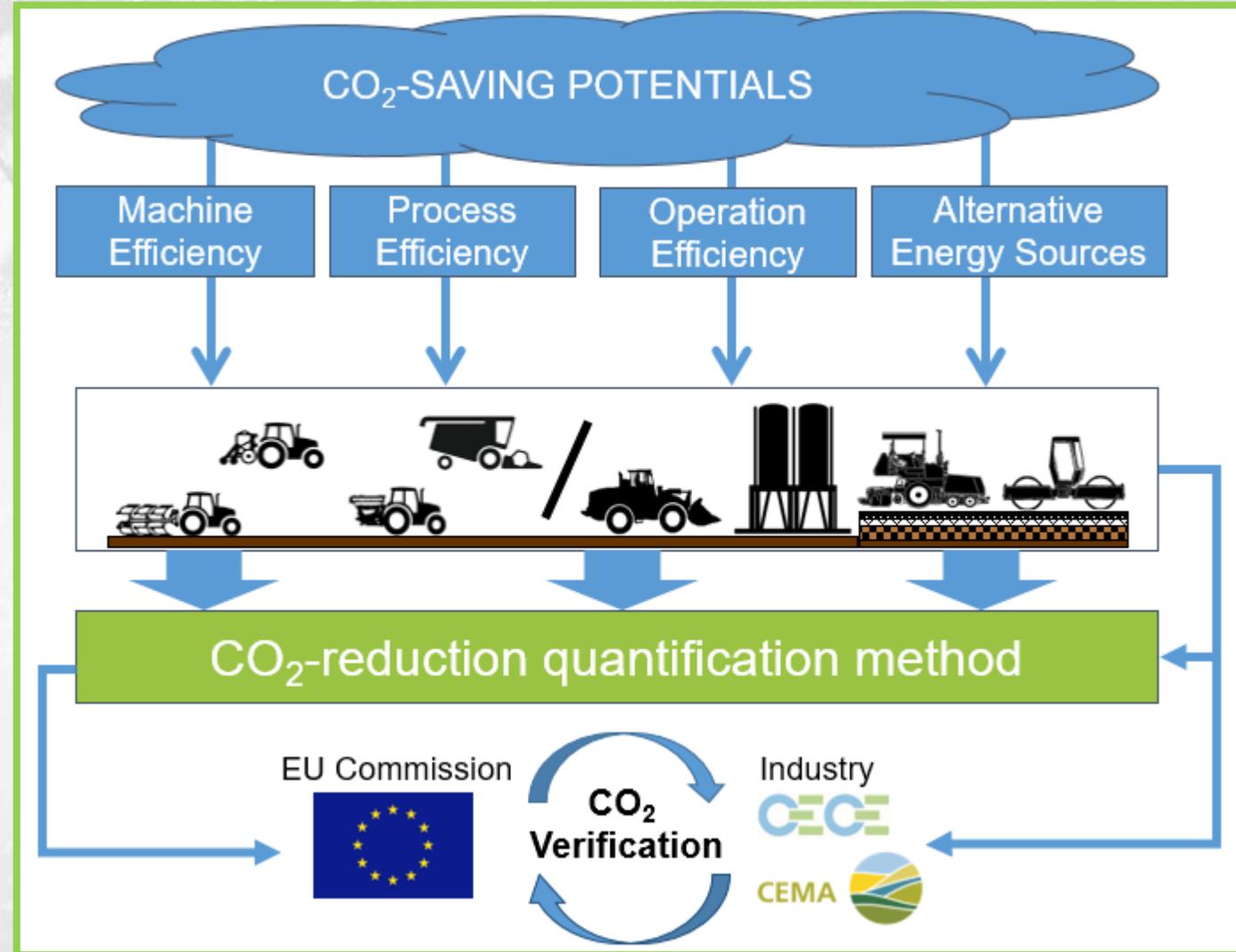
However a cold recycler is not always the best machine, the choice depends on the requirements of the processes, on the quality, on the legislator, on the contracting authority etc. Choosing the wrong method implies for e.g. for the cold recycler either no market share or a market monopole. A market monopole would mean absolute no market for the paver and the milling machine. Such effects from CO<sub>2</sub> evaluation methods are unknown at the moment.

# General approach

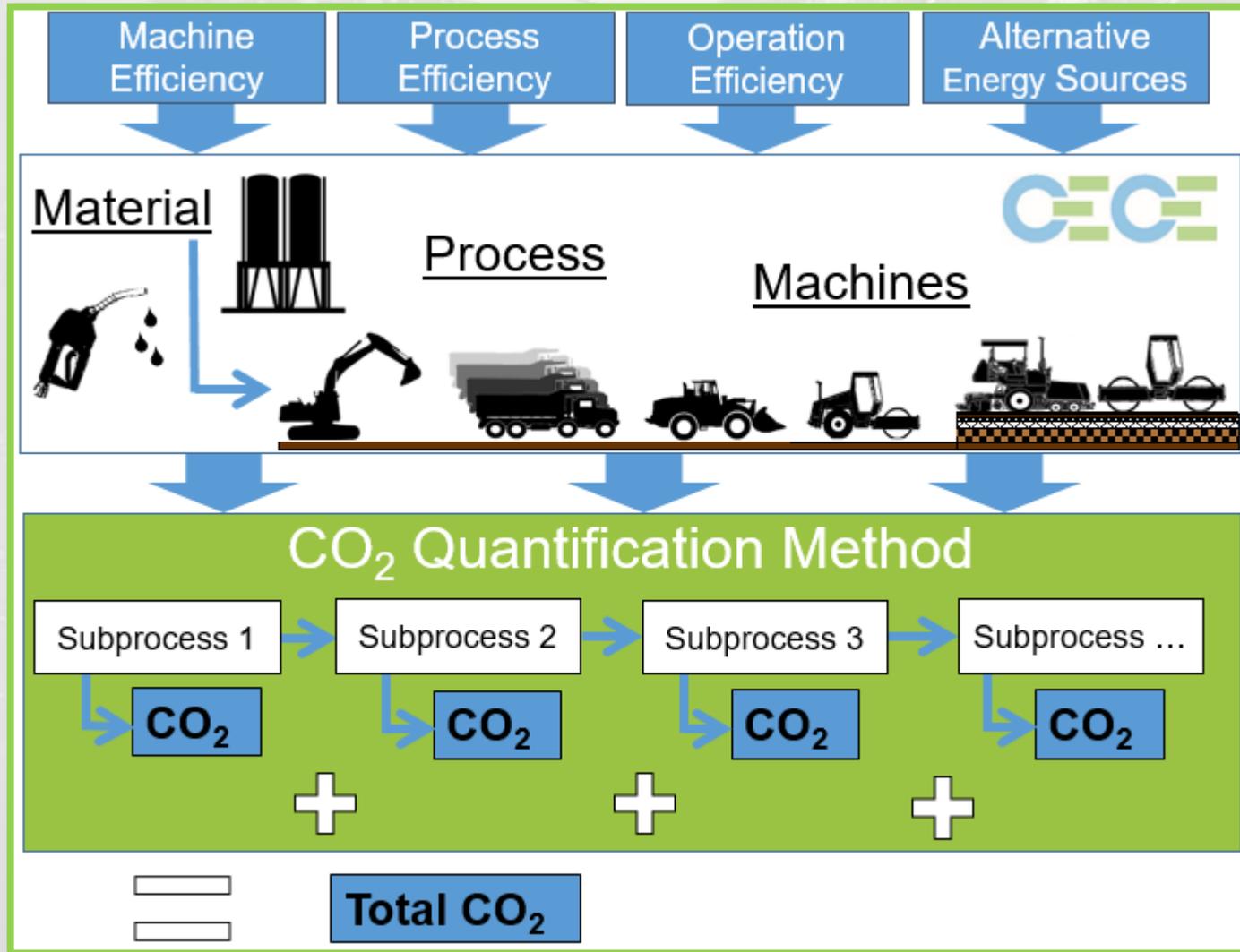
The overall aim is to develop a resilient scientific method to quantify the CO<sub>2</sub>e emissions and its evolution in the timescale: past – present – near future.

- In the top of the figure are listed the four CO<sub>2</sub>e saving potentials for mobile machinery.
- Based on the data obtained through the mobile machinery, it's possible to apply the method to quantify the CO<sub>2</sub>e reduction.
- The results obtained with this method are verified in common accord by the European Union commission and by the Industry.

In order to quantify the CO<sub>2</sub>e reduction, it is necessary to quantify the CO<sub>2</sub>e emissions of the entire construction process in the past, in the present and in the future. The obtained difference represents the CO<sub>2</sub>e reduction.



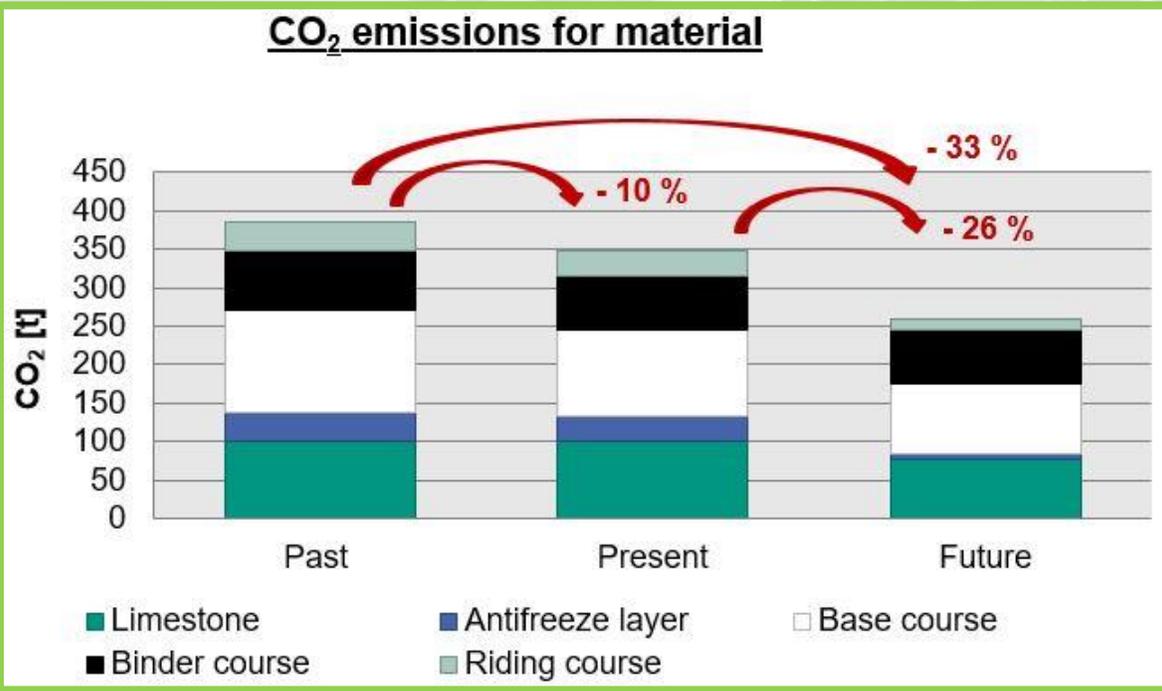
# CO<sub>2</sub>e quantification method



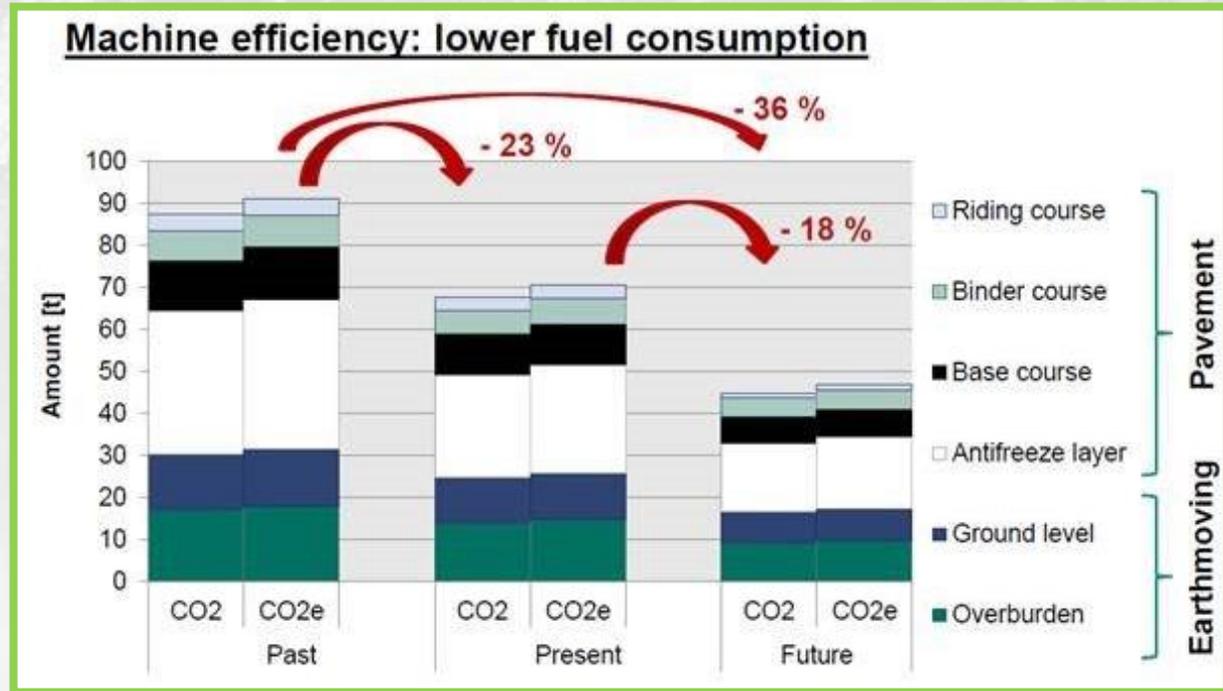
- The four saving potentials have a direct impact on the mobile machinery.
- Because a lot of factors influence the CO<sub>2</sub>e emissions, we are considering not only the machines but also the material and the process.
- In a first step the process is divided into small subprocesses. The CO<sub>2</sub>e emissions of each subprocess are quantified.
- The quantification of the total CO<sub>2</sub>e emissions of the entire process results out of the addition of the CO<sub>2</sub>e quantification of each subprocess.

# Some first approximated results

**CO<sub>2</sub> emissions for material**



**Machine efficiency: lower fuel consumption**



Example: CO<sub>2</sub> quantification for the construction of a new Bk10 road (Bk10 is a road type defined after German norms)

# Current research

**Aim of this project is to further develop the scientifically substantiated method on how the reduction of CO<sub>2</sub> emissions in the construction sector can be quantified and validated. Reference applications of the mobile machine in the building construction, road construction, earthmoving and quarry sectors will be defined and parametrised in order to quantify the CO<sub>2</sub> emissions. The method will then be validated with data from construction sites.**

**In the end, this method will be implemented into a software tool, which will be able to hold data from the past and show the development trend. With this tool, politics and industries will not only be able to quantify the CO<sub>2</sub> emission for a specified process, but also reduce the CO<sub>2</sub> emission by simulating and optimising the construction process.**

# Project partners & Funding committee





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