A Life Cycle Inventory for Lime
‘Life Cycle Thinking’ has become a central pillar in environmental policies and sustainable business decision-making.

Today, the impact of products and services on the environment has become a key element of decision-making processes. Instead of considering only fragments of environmental impacts such as those resulting from production, use or disposal, societies of the future will have to consider a product’s life cycle as a whole. Against this background, ‘Life Cycle Thinking’ has become a central pillar in environmental policies and sustainable business decision-making.

Life Cycle Assessment (LCA) is a tool to review the environmental impact of products throughout their entire life cycle – (from cradle to grave) – from raw material extraction through transport, manufacturing and use all the way to their end of life. In order for the analysis to be meaningful, it is essential to use consistent and reliable data. Therefore, a crucial first step in the LCA process is the production of a Life Cycle Inventory (LCI). The LCI is an extensive set of data on the relevant energy and material inputs and environmental outputs.

It is within this context that the European Lime Association (EuLA) has developed a ‘cradle to gate’ LCI for quicklime and hydrated lime. The EuLA LCI study is the first representative study covering the European lime production, based on an extensive data collection and processing exercise.

The summary report and more details can be found at www.eula.eu/our-topics/lca

The Life Cycle Inventory (LCI) commissioned by EuLA provides valuable and reliable data to downstream users who intend to carry out LCAs for their products. EuLA is committed to a better understanding of the life cycle of lime products.

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* see case studies for illustration
The aim of the EuLA LCI was to quantify the environmental impacts that occur during the manufacturing of quicklime and hydrated lime produced in Europe.

The European Lime Association (EuLA) ensured reliable and consistent data for its LCI on the production of lime:

- **Methodology:** The report and the inventories have been developed according to ISO 14040- and ISO 14044-compliant methodologies.

- **Independence:** EuLA commissioned the conduct of the LCI study to an independent third party. Plants located in Europe provided data related to their material inputs and environmental outputs, including the use of natural resources, the consumption of water and energy as well as the emissions. These data were used to calculate European averages.

- **System boundaries:** The study covered the production of quicklime and hydrated lime ‘from cradle to gate’, i.e. beginning with the extraction of raw materials from the ground (the ‘cradle’), to the finished products, ready for shipping at the gate of the production plant. The data were collected for the three main process steps consisting of mining, calcination and hydration (see graphic below).

- **Reference flow:** One tonne of lime and one tonne of hydrated lime have been used as reference units to which all derived figures were compared. The date is representative of the production conditions prevailing in the EU(27).

- **Data:** The data were rigorously cross-checked for accuracy and consistency.

- **Cut-off criteria:** The results of the LCI covered 99% of all environmental impacts of the lime production process.

- **Representativeness:** The EuLA LCI study is based on data covering more than 70% of all lime production in Europe. It is the most representative LCI available on lime.

- **Critical review:** The study has been shown to meet the requirements of an independent external review.

The EuLA LCI study is the most representative study available on lime production in Europe.
LIME – AN ESSENTIAL RAW MATERIAL

Lime is a product derived from limestone in an industrial process. Naturally occurring limestone, which is composed almost exclusively of calcium carbonate [CaCO₃], transforms into quicklime [calcium oxide (CaO)] by applying heat.

When slaked with water, quicklime transforms into hydrated lime, which is a dry powder composed of calcium hydroxide [Ca(OH)₂].

Hydrated lime can be used in a suspension called milk of lime.

Due to its particular chemical characteristics, lime is extensively used in several industries and is therefore important to many aspects of people’s every-day lives:

- Lime is widely used in environmental protection (purification of water, waste water treatment, flue gas cleaning, hygienisation).
- Lime is extensively used in the iron and steel industry and in numerous other downstream manufacturing industries (chemical, glass, paper, plastics, paints, cosmetics, rubber and many other applications).
- Lime is an important element in construction materials and in civil engineering (bricks, mortars, roads, asphalt, railways).
- Lime finds applications in farming, agriculture and forestry (fertilizing, hygienisation, neutralization).
Lime in the life cycle of products

Case Studies 01

How lime enters in the life cycle of construction materials, steel and water

02

03
LIME IN SUSTAINABLE HOUSING

Lime is a key ingredient in the production of Autoclaved Aerated Concrete (AAC), a lightweight, precast building material that is not only strong but also provides fire and mold resistance.

AAC’s greatest advantage are its excellent thermal insulation properties combined with its low weight, leading to an improved environmental impact in all phases of its life cycle offering an innovative solution for sustainable housing.

Production of AAC bricks – highly resource efficient

Quicklime is mixed with cement, sand, water and aluminium powder to form a slurry. This slurry rises and sets to form honeycomb structured blocks that have excellent thermal and sound insulation properties.

The production of AAC requires relatively small amounts of raw materials per m³ of product, and up to a fifth as much as some other building materials.

Solution for sustainable housing

The production of AAC is not only highly resource efficient, it requires less energy than most other construction materials and its light weight saves energy in transportation. Houses made from AAC are fire and mold resistant, creating a safe and healthy environment for the inhabitants.

Thermal efficiency

AAC’s excellent thermal efficiency makes a major contribution to environmental protection by sharply reducing the need for heating and cooling in buildings including usages in passive housing, while at the same time making the use of additional insulation materials unnecessary.
NO STEEL WITHOUT LIME!

There is probably no material that has defined the industrial age such as steel. Since the industrial revolution, we are surrounded by structures that contain this extremely versatile material, whether in our houses or in our cars.

It remains a relatively unknown fact that the production of steel would be impossible without the help of lime, which is used in almost every step from producing raw iron to the process of reusing scrap for new steel.

**Usage of steel**
Steel is an essential material in the automotive industry, for the production of consumer goods, such as washing machines, and of course in building and construction.

**Recycling scrap as raw material to produce new steel**
The electric arc furnace, a more modern technique of producing steel, allows for using up to 100% scrap when producing new steel, which saves both energy and raw materials. Lime is added as a fluxing agent to produce a basic slag with low viscosity to absorb impurities.

**From iron ore to pig iron**
The first step in the steel production process is the fabrication of pig iron or hot metal through smelting iron ore in a blast furnace. Lime is an essential ingredient and acts as a fluxing agent to facilitate the formation of low viscosity slag and absorption of impurities such as silicon, aluminium, sulphur.

**Steelmaking**
In the next step, the liquid pig iron and/or scrap is refined into the converter to liquid crude steel. For this process, again lime is an essential fluxing agent to form a ‘good’ slag and to remove further undesired elements.

**Steel slag**
The different slags (containing lime) of an integrated steel plant (from iron ore to steel) are further used to produce cement, to construct roads and to fertilize crops.
LIME PROTECTS OUR WATER!

What most people do not know, is that lime plays an important role in supplying us with freshwater.

Thanks to its neutralizing effect, lime is crucial to adjust the pH value of water, whether to make it drinkable or to mitigate the negative effects of industrial water on the environment.

Factories
Lime neutralizes industrial waste water
Lime enables many industries (mining, steel, oil and chemicals, agroindustries, etc) to improve the quality of their water management processes.

Sewage Treatment Works
Thanks to its high pH value, lime neutralizes the acidity in industrial and domestic sewage sludge, killing bacteria, viruses and pathogens and thereby eliminating hygiene and environmental risks.

Houses

Water Treatment Works
Lime is widely used for softening or re-mineralizing drinking water that would otherwise cause scaling or corrode the pipes. This can result in the presence of toxic metals in our drinking water, such as chromium, copper, lead and zinc, that have been shown to cause both acute and chronic health problems. To avoid the corrosion of pipes the carbonic acid is neutralised by lime products.

Sludge
Lime sanitized sludge can be used as fertilizer in agriculture to improve soil quality.

Evaporation

Ground and Surface Water
Pure underground, mountain water and surface water are our main sources of drinking water. To comply with European standards, drinking water undergoes specific physical and chemical treatment.

Cloud storage

Rain

River

Lake