



**SECURE**



**SAVE**



**SUSTAIN**



**STYLE**

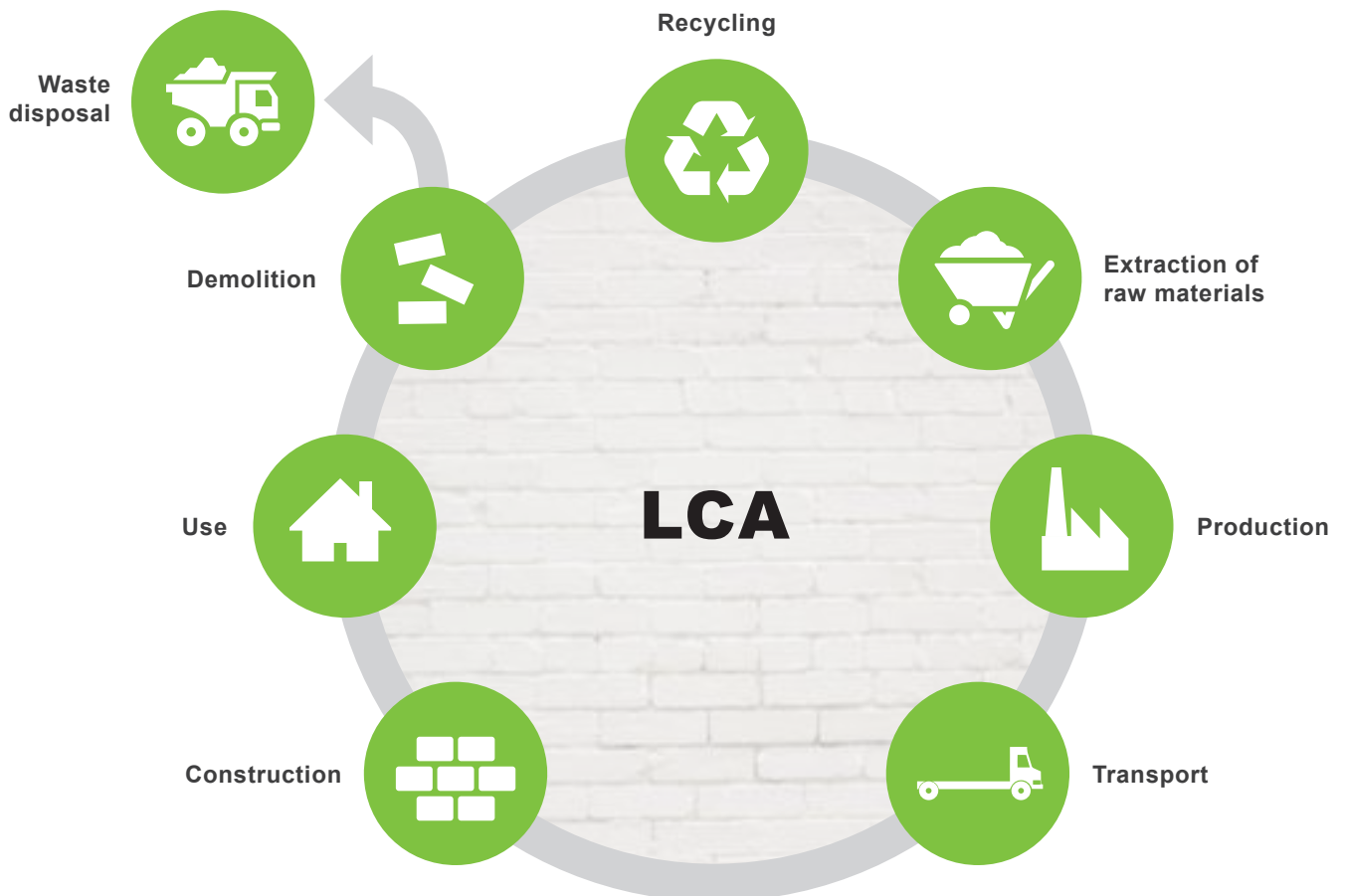
# **THE LIFE CYCLE OF A CLAY BRICK**

**WHY IT MATTERS**

# THE CLAY BRICK ASSOCIATION (CBA) IS COMMITTED TO A SUSTAINABLE FUTURE

The building sector has been linked to high CO<sub>2</sub> emissions and global climate change, a concern that affects us all. A first step towards improving the sustainability of building materials is to understand the extent and source of the environmental and socio-economic impacts. In light of this, the CBA commissioned two detailed scientific

assessments to understand the environmental impact of clay brick production and use in South Africa. The independent studies were conducted by The University of Pretoria. The CBA also commissioned a social LCA which was conducted by G1 Consulting & Associates and Equispectives Research & Consulting Services.



## WHAT IS AN LCA?

Understanding a product's effect on the environment over its entire life span is a considerable undertaking. Leading academics and researchers are grappling with this, and the robust methodology of LCA has developed in response to this challenge.

An LCA is an internationally and scientifically recognised approach that measures the environmental impact of a product by analysing all the inputs (e.g. raw materials and energy) and outputs (e.g. emissions and waste) that occur as a result of that

product being manufactured, transported, assembled, used, maintained, and eventually disposed of. An LCA quantifies the resources consumed and emissions produced over the product's entire life cycle and then assesses the impact of this on specific environmental aspects such as human health, climate change and damage to ecosystems.

A social LCA uses a similar framework to an environmental LCA but assesses how a product affects workers, the community and the consumer in terms of socio-economic factors, such as human rights, working conditions, and health and safety.

# THE CLAY BRICK LCA

The study commissioned by the CBA was conducted in accordance with the ISO 14040 and 14044 standards, with an external review by Quantis International, to assure the highest quality standards. The LCA is underpinned by specific production data from 86 out of the 102 clay brick production sites in South Africa. The data collected covers approximately 95% of the bricks produced in South Africa, and details the resource flows into each of the production steps of clay brick manufacturing. Data from the informal sector was not considered, as this is estimated to represent only 3% of the market.

Various brick manufacturing technologies were analysed in the manufacture phase of the life cycle (cradle to gate) covering how the bricks are fired in different types of kilns.

Specific data for each manufacturing technology was collected over one year with respect to quantities of materials and fuels consumed, and the energy required in manufacturing.

The use phase of a clay brick is the operation of a typical South African lived-in house, and includes the electricity required for heating and cooling the house over its life span. This phase was assumed to last 50 years.

A rigorous thermal performance study was commissioned to inform this important stage of the brick life cycle. The thermal performance study looked at the heating and cooling requirements of typical buildings in South Africa over the six climatic zones of the country. The study compared six wall construction methods, including three clay brick wall types.

After the resources consumed and emissions produced over the clay brick wall's life cycle were quantified, the impact of these were assessed on specific environmental aspects such as human health, climate change, resources and damages to ecosystems.



**95%** of bricks produced in South Africa

**86** out of the **102** clay brick production sites

The LCA looked at the environmental impact of a clay brick over the **4 stages** of its life cycle:



**Mining and brick production**



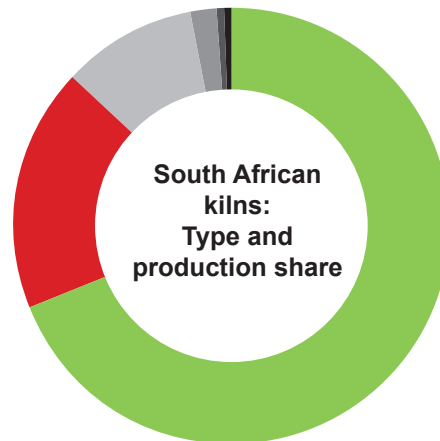
**Transport and construction**



**Operation of a lived-in house**



**Demolition and disposal**



- **CLAMP KILN**
- **TUNNEL KILN**
- **TVA KILN**
- **VSB KILN**
- **HOFFMAN KILN**
- **ZIGZAG KILN**

# THE SOCIAL LCA



- Human rights**
- Working conditions**
- Governance**
- Health and safety**
- Socio-economic repercussions**

The social LCA included all stakeholders in brick manufacturing – workers, local community, larger society and consumers. A future study is planned to look at the brick life cycle stages beyond manufacturing. The study looked at the clay brick industry's socio-economic impact

in South Africa in the categories of human rights, working conditions, governance, health and safety, and socio-economic development. The study follows the United Nations Environment Programme Guidelines for the Social Life Cycle Assessment of Products.

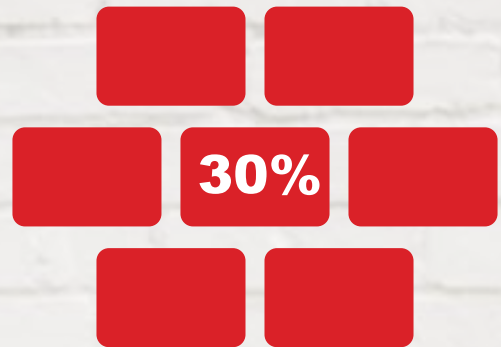


# WHAT THE STUDIES FOUND

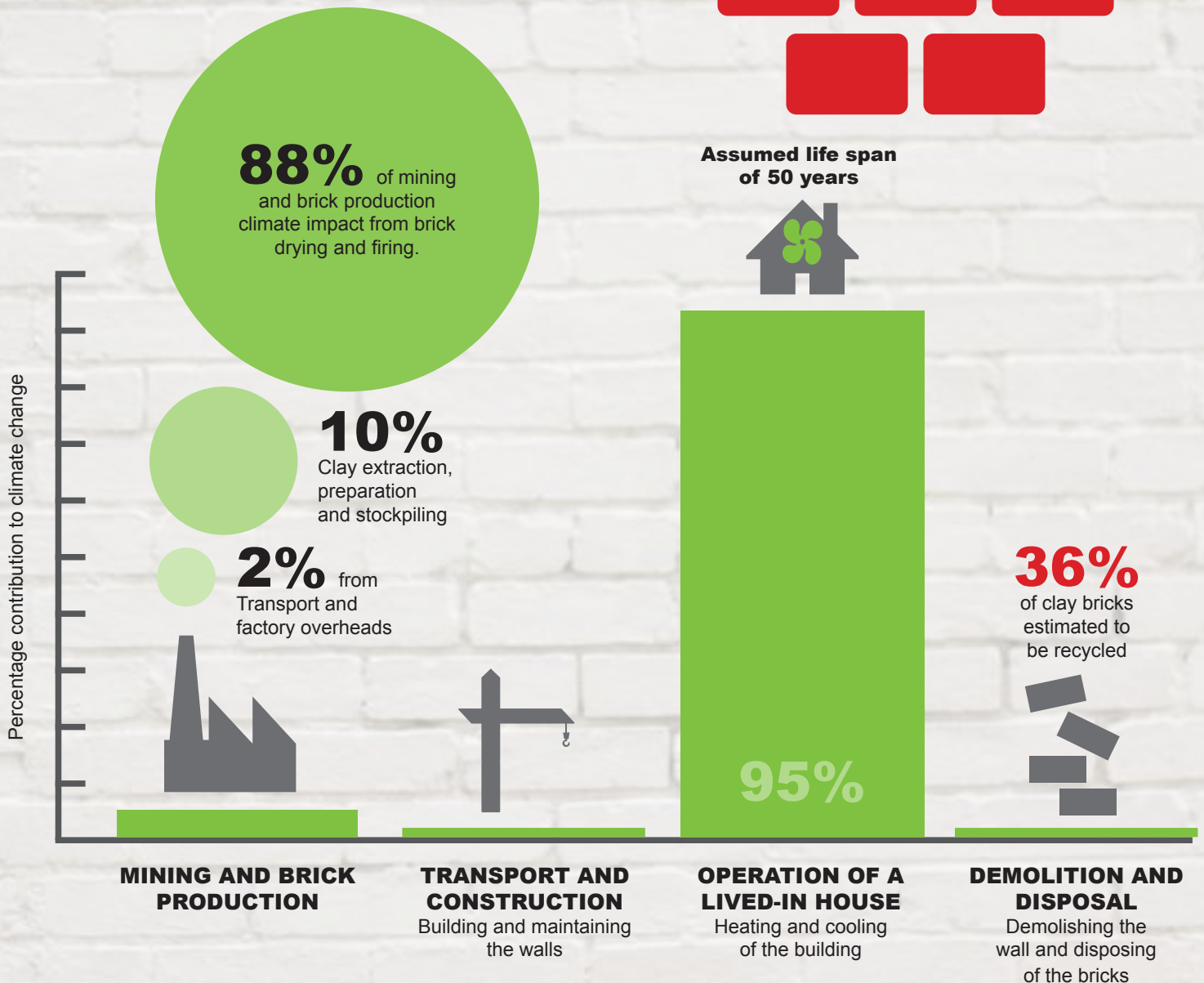
Contribution to **climate change\*** of a 220mm double brick wall over its life cycle:



Building with an **insulated cavity wall** rather than a solid wall reduces the use phase climate impact by



Assumed life span of 50 years



\*Very similar relative trends were observed for human health and ecosystem impacts as they are also predominantly caused by coal use.



## ENVIRONMENTAL IMPACTS DRIVEN BY DEPENDENCE ON FOSSIL FUELS

The most significant environmental impacts from the production and use of a brick are contribution to global climate change, consumption of non-renewable resources and emissions of substances that cause respiratory diseases. All three of these impacts are a consequence of the use of fossil fuels, primarily coal, either directly in the kilns during the production phase or indirectly as electricity during the use phase of the brick.



## A BRICK'S BIGGEST IMPACT IS IN ITS USE

By far the greatest share of climate and health impacts occur in the use phase of the brick. The electricity used for heating and cooling houses in South Africa has a very high impact as it is predominantly produced from burning coal.



## THE HIGHEST MANUFACTURING IMPACTS OCCUR IN BRICK FIRING

In terms of brick production, the highest environmental impacts occur during clay preparation and firing. The high impacts on ecosystem quality and resources are caused by the production of coal. During firing, the main impacts come from the emissions of burning fossil fuels, either from coal mixed in with the clay mixture as internal fuel, or from coal, natural gas or fuel oil used to fire the kiln.



## KILN TECHNOLOGY AFFECTS THE BRICK'S IMPACT ON CLIMATE, ECOSYSTEM QUALITY, HUMAN HEALTH AND RESOURCES

Of the six different kiln types used in South Africa no one technology consistently performs best across all the different environmental impacts assessed, but the Hoffman kiln always performs worse than the other technologies, whilst continuous firing technologies perform best. There are therefore minor improvements to be made on the production side, by moving towards continuous firing technologies and using higher quality, cleaner burning fuels. However the savings that can be achieved in this phase are minimal compared to the savings that can be achieved in the use phase.

## THE IMPORTANCE OF DESIGN AND EDUCATION

The greatest potential for the clay brick sector to reduce its environmental impact is by educating the building sector on the need for the design of energy-efficient buildings and the importance of choosing suitable building materials.

The Thermal Performance Study carried out in conjunction with this LCA found residential buildings constructed with clay brick walls to have the lowest heating and cooling requirements of all commonly employed walling systems in South Africa. In the temperate climate zones of South Africa, potential energy savings of 30% were found for residential buildings built of solid brick walls, whilst savings of 70% were found for insulated cavity brick walls. In terms of climate change impact, this is equivalent to taking between 3 and 7 passenger cars off the road for a month for every year the building is in use. Even higher savings are evident in the hotter regions of South Africa and in non-residential buildings, where electricity use for air conditioning is much higher.



**30% to 70% energy saving using clay brick** relative to other typical building materials

= **3 to 7 passenger cars off the road** for a month for every year the building is in use

## A PREDOMINANTLY POSITIVE SOCIO-ECONOMIC IMPACT

The brick industry provides employment, particularly in rural communities where it is most needed. It is also actively engaged in community development programmes as well as being a significant supporter of SMMEs. It takes 26 man-hours to produce a thousand bricks, which results in four jobs created per million bricks produced. A particular strong-point of the industry is that there is transparency and communication about the industry's environmental performance and a positive impact regarding health and safety and living conditions. Areas for improvement include providing equal opportunities for employment at higher education levels, and equal remuneration across gender and race.

**4 JOBS** for every million bricks



**74% OF SUPPLIES** provided by SMMEs



**R6.50 SPENT ON COMMUNITY DEVELOPMENT** per 1000 bricks produced

This study was undertaken by the Clay Brick Association representing the brickmakers that participated and contributed to the development of the study, published in February 2017.

The lead authors of the environmental and social LCA studies respectively are Prof Piet Vosloo and Greg Rice (University of Pretoria), and Michele Gilbert and San-Marié Aucamp. The studies were funded by the Clay Brick Association and the National Research Foundation

Full reports are available at [www.claybrick.org/LCA](http://www.claybrick.org/LCA)

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