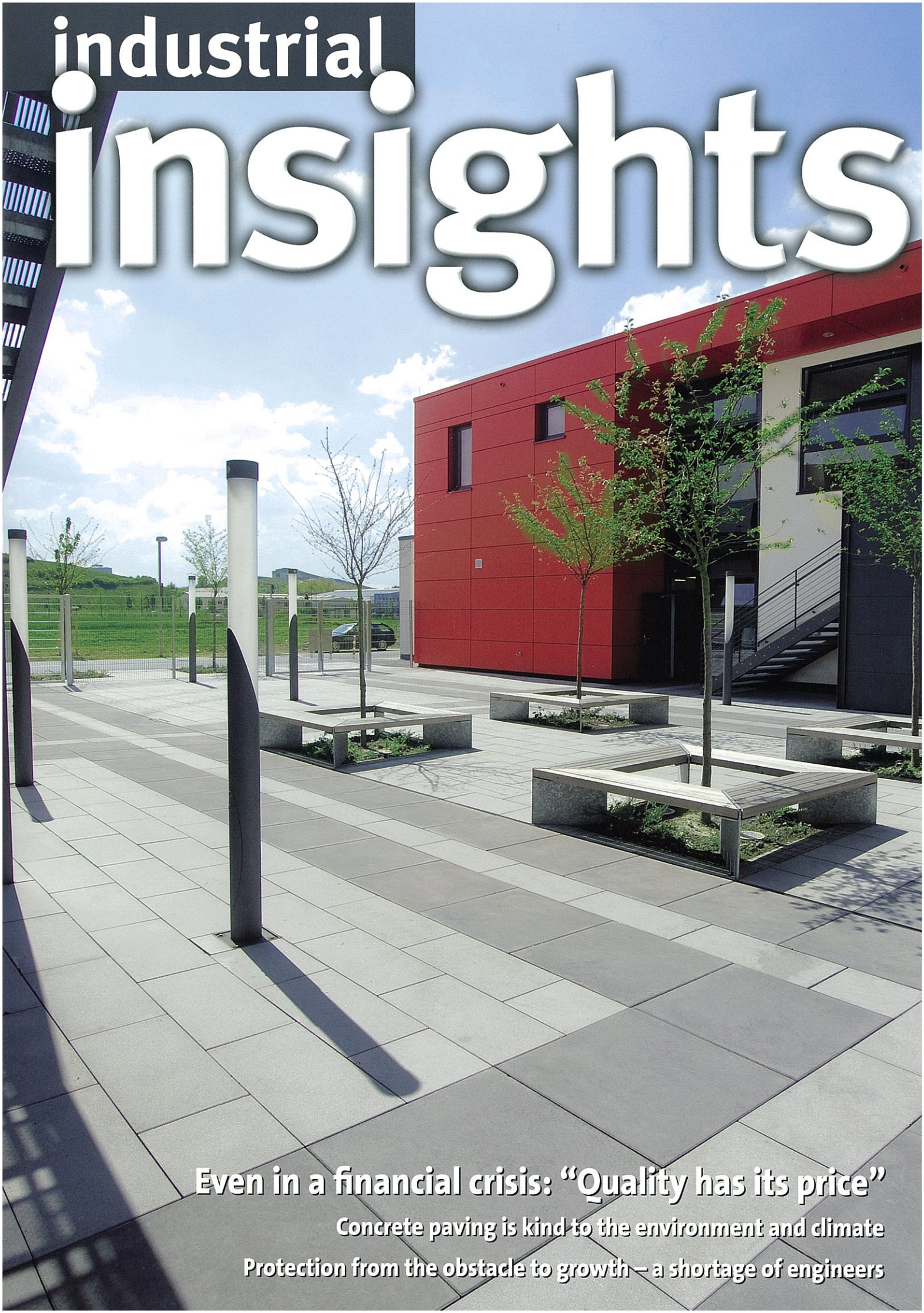
industrial insights



Even in a financial crisis: "Quality has its price"

Concrete paving is kind to the environment and climate

Protection from the obstacle to growth – a shortage of engineers

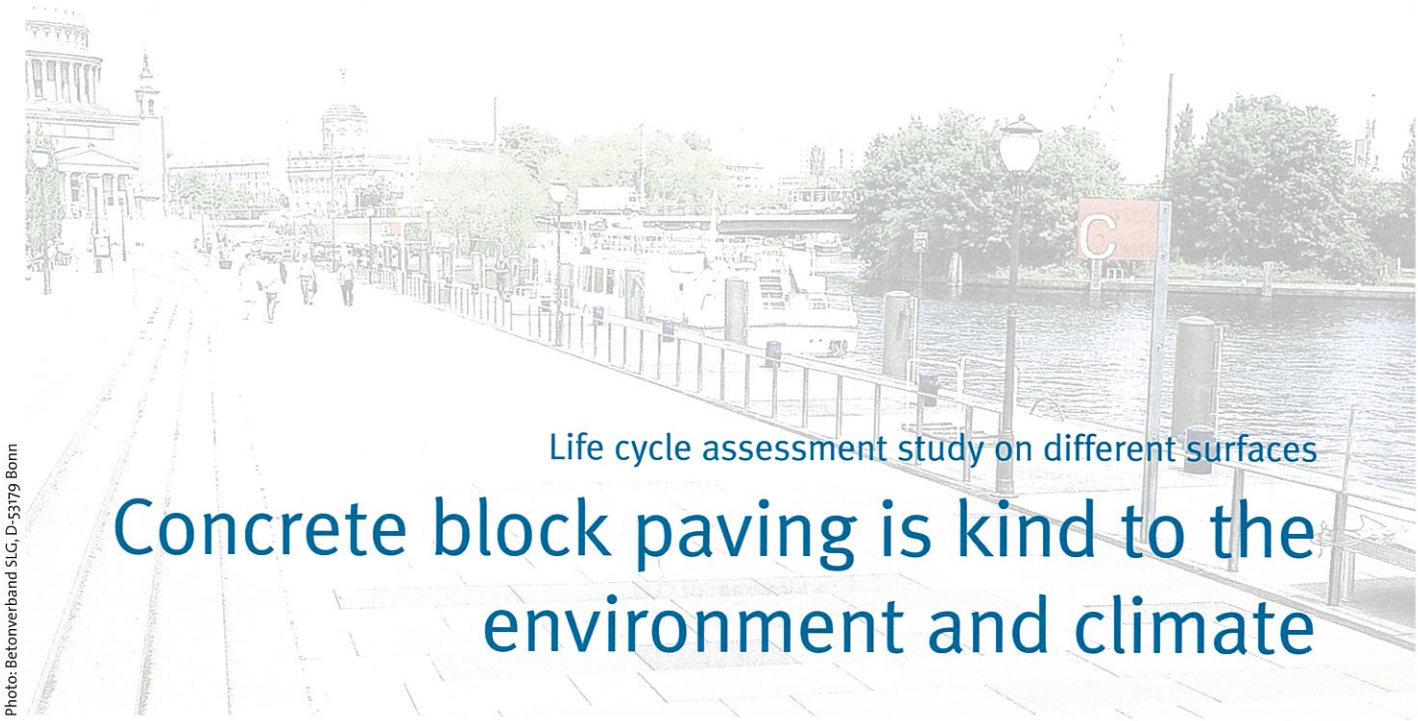


Photo: Betonverband SLG, D-53179 Bonn

Life cycle assessment study on different surfaces

Concrete block paving is kind to the environment and climate

Planners of public thoroughfares are under increasing pressure to make roads, squares, pavements and traffic installations, e.g. bus stops or crossroads, so that they are not only economically but also ecologically sustainable and conserve resources. How does the environmental impact of a pavement structure with concrete block paving compare to natural stone, brick or asphalt paving? This question was evaluated by PE INTERNATIONAL, an internationally respected firm in the field of sustainability research, on behalf of the SLG Precast Concrete Association and BetonMarketing Deutschland GmbH.

Photo: Betonverband SLG, D-53179 Bonn

Dietmar Ulonska

Photo: PE INTERNATIONAL

Johannes Kreißig

Conserving resources, the sustainable economy and climate protection are terms on everyone's lips. "The worst effects of climate change can still be prevented," announced Warren Washington of the National Center for Atmospheric Research (NCAR) in Boulder (USA) and his colleagues recently after a series of supercomputer model calculations. "However, in order to do this, people would have to reduce the emission of greenhouse gases by 70 percent by 2100. "Our climate, the rising sea level as well as our health and the survivability of whole economies increasingly depend on how we conserve resources in an environmentally friendly way.

"Conserving resources, effective climate protection and sustainability are also important in the concrete industry," said Dietmar Ulonska, the Managing Director of the Concrete Association for Roads, Countryside and Gardens, in his conversation with INSIGHTS. This is why his association and BetonMarketing Deutschland GmbH appointed the consultancy and software firm, PE INTERNATIONAL, to produce a comparative life cycle assessment. The consultants at PE INTERNATIONAL are considered to be international leaders in the field of sustainability research. On behalf of the concrete industry, they examined the environmental impact of various pavement structures used in public thoroughfares.

Analysis of environmental impact

What exactly is a life cycle assessment? The International Organization for Standardization (ISO) defines life cycle assessment (LCA) as the following: "Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle." Life cycle assessments examine all environmental effects during production, use and the disposal of a product. And not only that: the environmental impact of upstream and downstream processes too, for example the manufacture of raw materials and consumables is included in a life cycle assessment.

"The method of life cycle assessing facilitates both a systematic comparison of building solutions and the analysis of the manufacture of products," says Johannes Kreißig from PE INTERNATIONAL GmbH in Leinfelden-Echterdingen near Stuttgart.

The aim of the life cycle assessment study by PE INTERNATIONAL was to compare the environmental impact of four typical pavement structures for public thoroughfares with different surfaces. They analysed the effects of a construction with concrete block paving in comparison to paving with

asphalt, brick and natural stones over the complete life cycle. In so doing, 100m² of a development road in building category V (low level of traffic) was chosen as the standard to be used in the assessment. In this way, the four different surfaces could be compared with each other. Examples of other road surfaces frequently assigned to building category V are residential streets, service roads or parking areas with a low amount of heavy traffic.

Concrete block paving is particularly environmentally friendly

The results of the study are clear: it was shown that concrete block paving is a particularly environmentally friendly surface for paving. In the production phase, construction with concrete block paving achieved the best environmental performance in all impact categories examined (with the exception of the ozone depletion potential). Constructions with asphalt, brick and natural stone sometimes use much more primary energy than concrete block paving. Within the scope of a life cycle assessment, primary energy means energy supplied from natural energy sources, such as crude oil, gas, coal, uranium, wind, biomass, sun or water. The global warming potential of the concrete blocks pavement structure also has the lowest values. If building materials have a relatively long transport route, then this has a negative effect on the life cycle assessment. In particular, natural stone imports from overseas have clear disadvantages with regard to the life cycle assessment but this is partially compensated for by good reusability at the end of their life.

Global warming potential:
The (relative) global warming potential or CO_2 equivalent indicates how much a set amount of greenhouse gas contributes to the greenhouse effect. Carbon dioxide is used as a comparative value; the abbreviation is CO_2e (e for equivalent). The value describes the mean warming effect over a set period. As a rule, a period of 100 years is used. Example: the CO_2 equivalent for methane is 25 in a period of 100 years. This means that a kilogram of methane contributes 25 times more to the greenhouse effect than a kilogram of CO_2.

Local procurement of building materials is environmentally friendly

In order to calculate the impact of transport (or imports) on the environmental effects of manufacture, PE INTERNATIONAL examined various scenarios. In so doing, the following transport mix was adopted and included in the life cycle assessment for setts of natural stone:

- 40% regional procurement (Germany), transport distance on average 350 km

Photo: Betonverband SLG, D-53179 Bonn

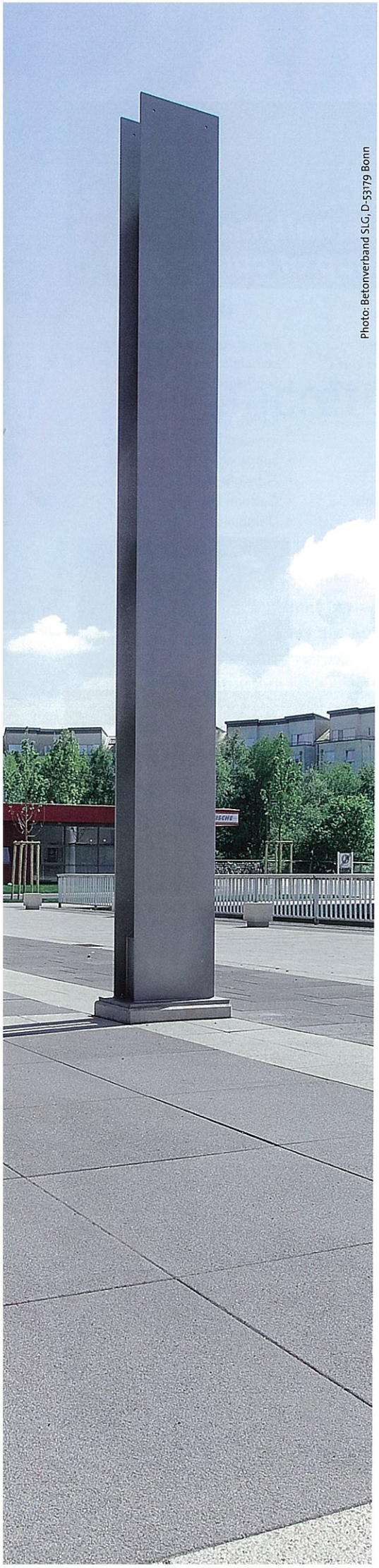


Photo: Betonverband SLG, D-53179 Bonn

- 30% European procurement (e.g. Italy), transport distance on average 1,000 km
- 30% overseas procurement (e.g. China), transport distance approx. 20,000 km

The assessment of primary energy consumption made clear that even in the case of transport within Europe, the same order of magnitude can be consumed by transport as by the manufacture of setts of natural stone. The global warming potential for transport from overseas also produced much higher values than for manufacture alone. Therefore, the authors of the study recommend that building materials are sourced locally. It is not recommended to use setts from overseas as this form of procurement is not sustainable.

Assessment of the study by a group of experts

At the request of the clients, the SLG Precast Concrete Association and Beton Marketing Deutschland GmbH, the life cycle assessment study was completely checked and assessed by an independent group of experts led by Dr.-Ing. Wolfram Trinius. "The study has been conducted in accordance with international standards and can be considered to be scientifically and technically correct," Wolfram Trinius confirmed to INSIGHTS. Dietmar Ulonska from the SLG Precast Concrete Association used a striking example to sum up how great the advantages of concrete block paving construction are in practice with regard to the life cycle assessment: "If concrete is used instead of asphalt to construct a car park of 2,000 square metres, this will save so much primary energy – considered over the full life cycle – that it could cover the annual electricity consumption of 34 average private households in Germany."

Primary energy requirements:
Life cycle assessments determine the primary energy consumption (PEC) of a product or service. Primary energy is energy supplied by natural energy sources, such as crude oil, gas, coal, uranium, wind, biomass, sun or water. Its consumption is indicated in joules or multiples thereof.

Summary of balance sheet results:

	Asphalt pavement	Concrete block paving	Brick paving	Natural stone paving
Primary energy consumption, non-renewable (MJ)	117,903	44,347	87,513	46,839
Primary energy consumption, renewable (MJ)	608	3,343	913	596
Global warming potential GWP (kg CO_2e)	4,040	3,169	5,485	3,025
Ozone depletion potential ODP [kg R11-equivalent]	1.19 E-04	1.24 E-04	1.74 E-04	1.19 E-04
Acidification potential AP [kg SO_2-equivalent]	12.8	9.72	15.6	16.3
Eutrophication potential EP [kg PO_4-equivalent]	1.60	1.38	1.91	1.93
Summer smog potential POCP [kg ethylene equivalent]	5.68	0.98	1.57	1.24

Abbreviations: megajoule (MJ), CO_2 equivalent (CO_2e)

All values apply to a 100 square metre development road in building category V over its entire life cycle.

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