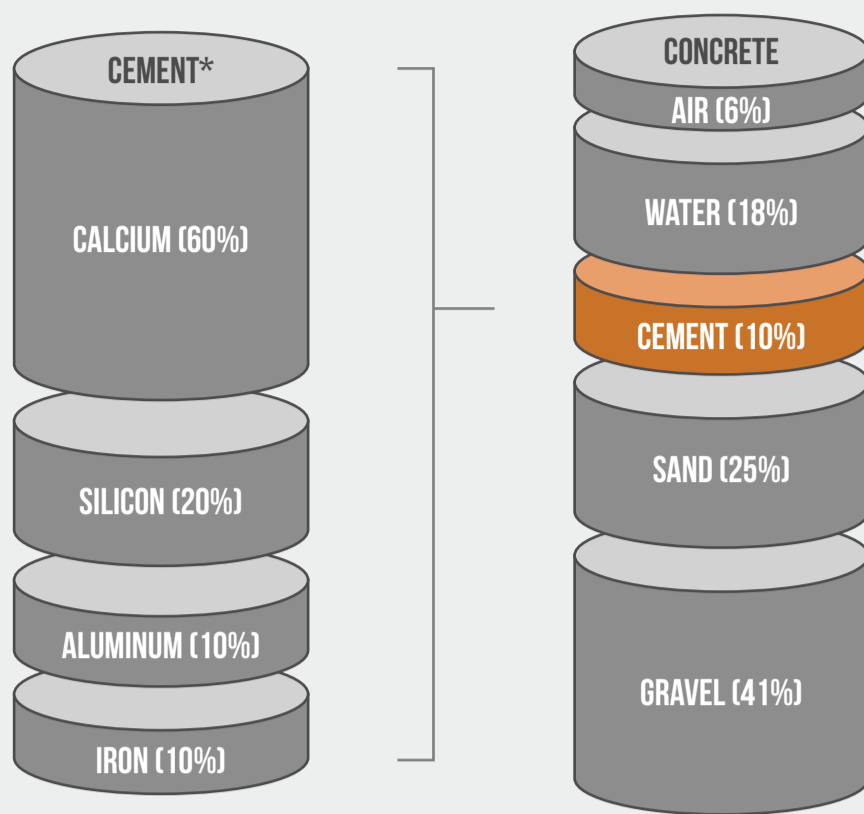


# BUILDING BLOCKS

RESEARCH AND TEXT BY BEN LAUER WITH LAYOUT AND DESIGN BY TODD REUBOLD | SOURCES: U.S. DEPARTMENT OF ENERGY, U.S. GEOLOGICAL SURVEY, U.S. ENERGY INFORMATION ADMINISTRATION | PHOTO: © SHUTTERSTOCK.COM/IBAJARS

Roads, bridges, buildings, runways, homes, dams, canals and more are all built with concrete. The coarse, gray building material has been so ubiquitous throughout history that even the nearly 2,000-year-old Roman Colosseum was constructed with an ancient concoction of concrete. Despite all its benefits of strength and durability, there is a downside. Production of cement, primary ingredient in concrete, is responsible for a whopping 5 percent of human-generated carbon dioxide emissions. The good news: Some industry newcomers are creating cleaner versions of the versatile building material.

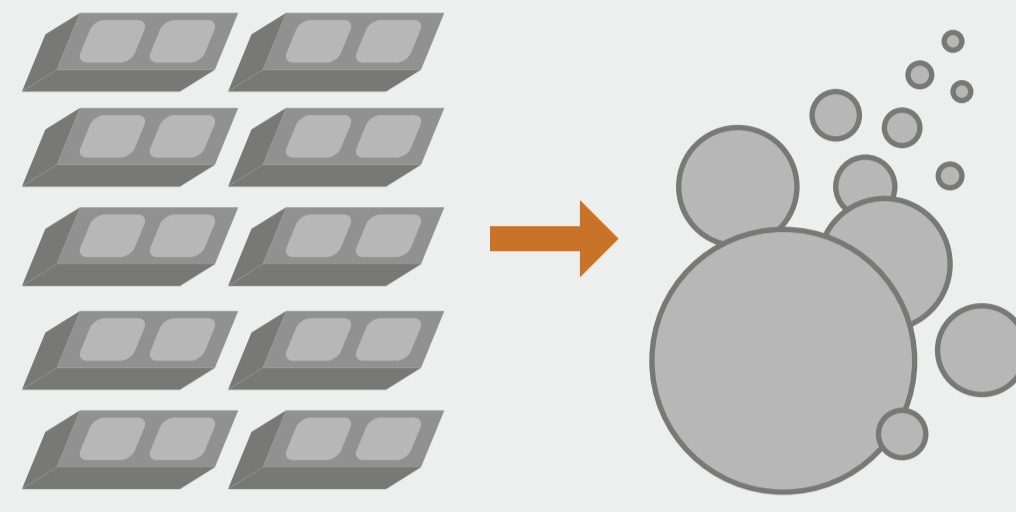
## FROM CEMENT TO READY-MIXED CONCRETE (BY PERCENTAGE WEIGHT)



\*Plus trace amounts of other materials and chemicals

**5** PERCENT OF GLOBAL CO<sub>2</sub> EMISSIONS ATTRIBUTED TO CEMENT PRODUCTION

## CEMENT AND CARBON DIOXIDE EMISSIONS IN THE U.S.



**1,000**  
KG OF CEMENT PRODUCED

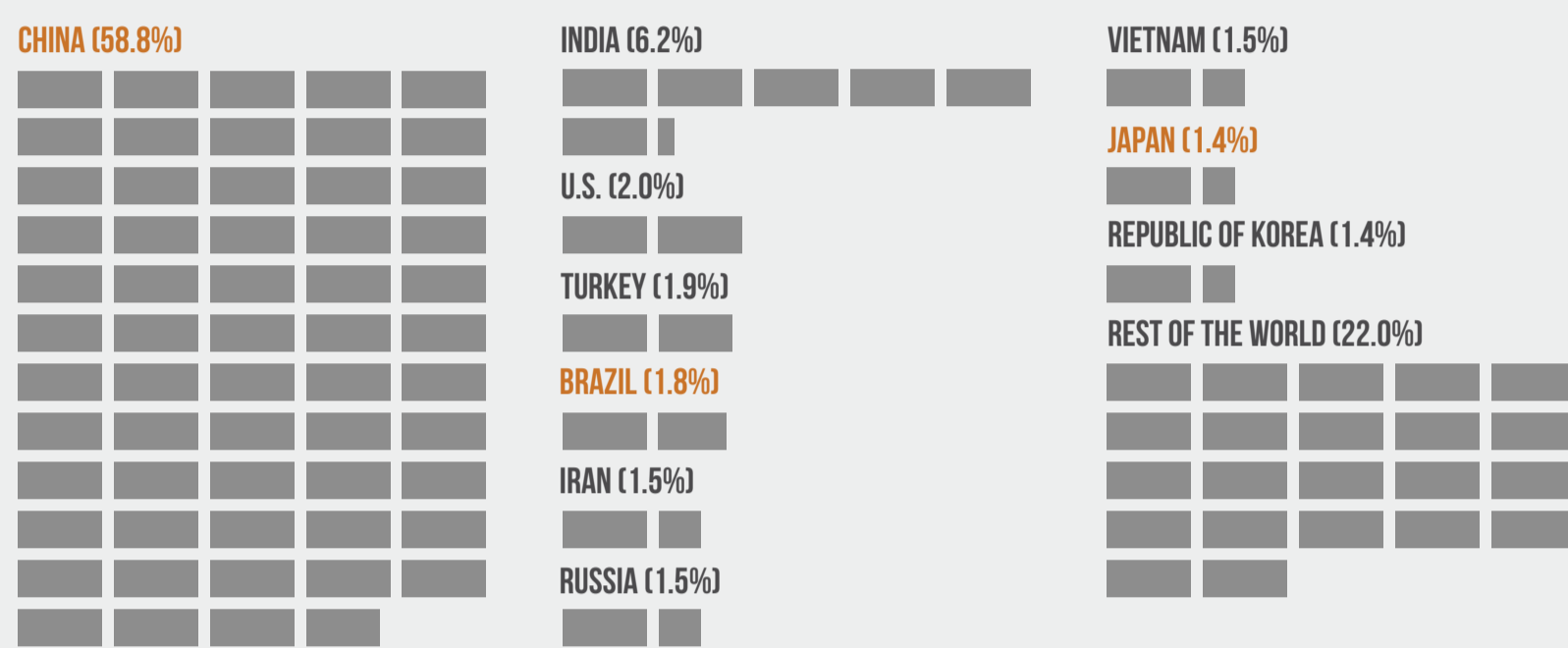
**900-1,100**  
KG OF CARBON DIOXIDE EMITTED

Cement, which typically originates from limestone, is made by heating a mixture of raw materials to over **1,450 C.**

**67,800,000**  
METRIC TONS OF CEMENT PRODUCED IN THE U.S. (2011)

**3.4 TO 4.4B METRIC TONS**  
PROJECTED GLOBAL GROWTH OF CEMENT PRODUCTION BETWEEN 2010 AND 2050—AN INCREASE OF 30%

## PERCENTAGE OF GLOBAL CEMENT PRODUCTION AND CAPACITY BY COUNTRY (2011)



In 2010 **CHINA** (6.4%) and **BRAZIL** (5.9%) experienced the greatest proportional increase in cement production and capacity. **JAPAN** (-8.7%) experienced the biggest decline.

## THE FUTURE OF LOW-CARBON CEMENT

**NOVACEM:** This London-based company reduces the CO<sub>2</sub> burden of cement by using lower temperatures early in the production process, different feedstocks and a CO<sub>2</sub>-absorbing composition. The process reduces CO<sub>2</sub> production to 420 kg/ton or less and removes up to another 100 kg from the atmosphere.

**LOUISIANA TECH:** Louisiana Tech University researchers are exploring the use of substitutes for cement's binding function in concrete production. Geopolymer concrete, composed of the industry by-product of fly ash, uses strong silica and aluminum binders that avoid large CO<sub>2</sub> outputs.

**CALERA CORPORATION:** This California-based start-up hopes to incorporate carbon sequestration into its cement production process. Carbon from power plant emissions will be transformed into solid minerals that can be used to make a range of building materials.



FOOD INDUSTRIES  
(4.1%)

MACHINERY  
PRODUCTION (4.1%)

PULP & PAPER  
(4.5%)

ALUMINUM  
PRODUCTION (4.9%)

IRON & STEEL  
(16.4%)

CHEMICALS &  
PETROCHEMICALS (16.8%)

**CEMENT  
PRODUCTION  
(20.5%)**

OTHER INDUSTRIAL  
MANUFACTURING (28.7%)

PERCENTAGE OF CARBON DIOXIDE  
EMISSIONS WITHIN THE GLOBAL  
MANUFACTURING SECTOR

Cement production accounts for nearly  
21% of the global manufacturing sector's  
carbon dioxide emissions.