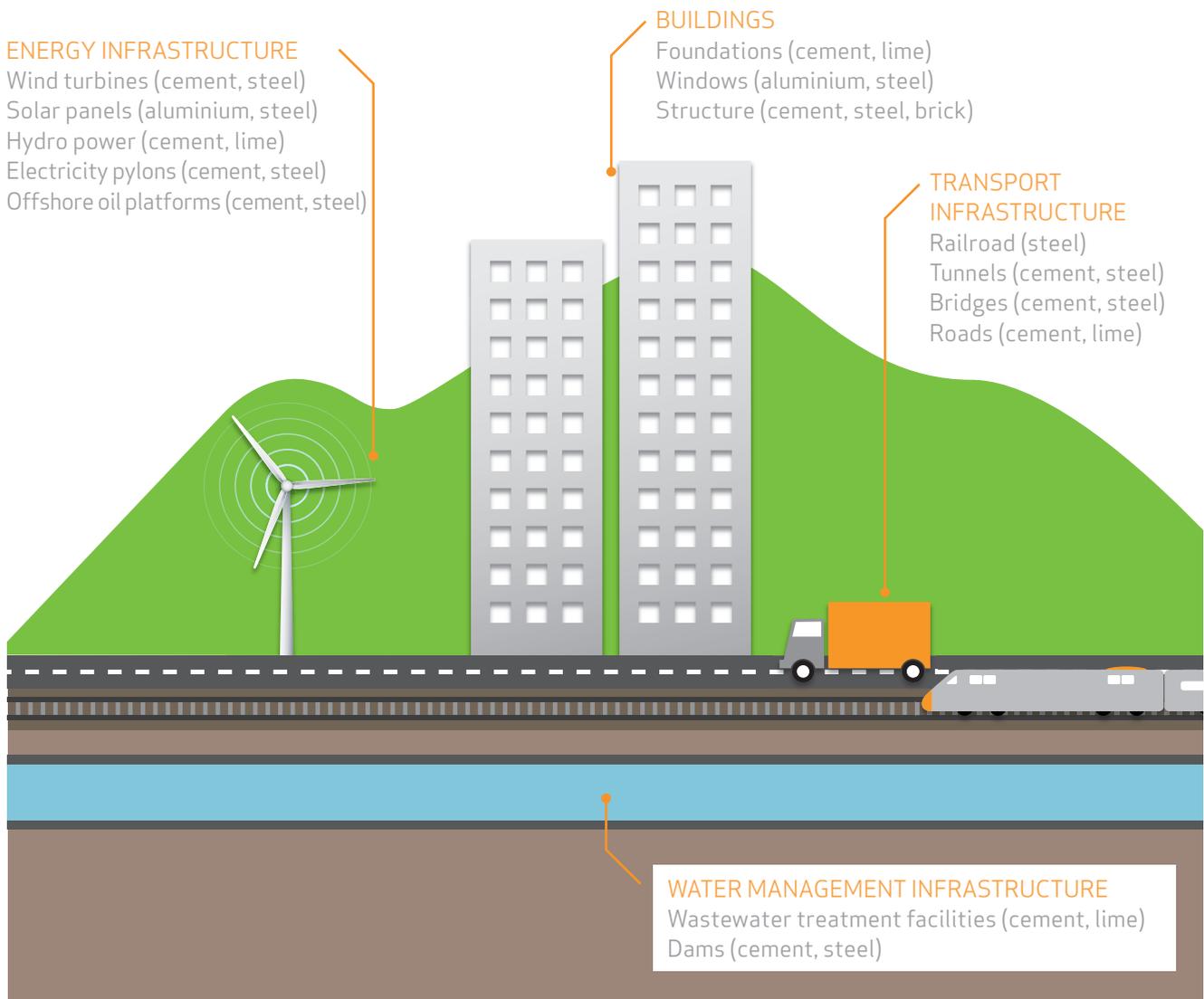


COAL MATTERS

4/Coal and modern infrastructure

How coal is used in modern infrastructure



Economic development involves the increased use of highly energy intensive materials, such as steel, cement, glass and aluminium. These materials are necessary for the construction and development of transport, energy, housing and water management infrastructure. Coal is the most widely used source of energy in energy-intensive industries and is important in the development of modern infrastructure in growing economies. Coal is also an important component of global steel production which is critical in the construction of modern infrastructure such as transport, residential housing and commercial buildings.

Steel

Steel is one of the most efficient modern construction materials. It offers the highest strength-to-weight ratio of any commonly-used material and is exceptionally durable.

It is an essential material used in the construction sector, used to build high-rise buildings, bridges, tunnels and viaducts, as well as in the transport sector, to build railroads, trains, aeroplanes, ships and car bodies. Steel is also key for building energy infrastructure, including electricity pylons, offshore oil platforms, hydroelectric power stations and wind turbines.



Crude steel production by process



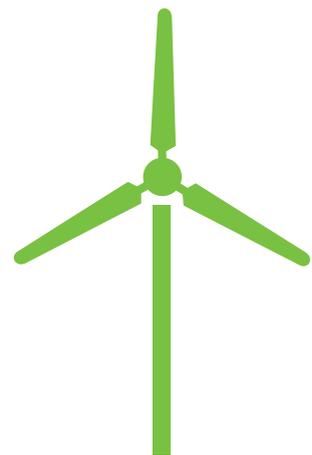
- 70% Integrated route based on coal
- 29% Electric arc furnace route
- 1% Open hearth route

Source: World Steel Association, 2011

There are two main steel production routes; the integrated steelmaking route and the electric arc furnace route. Coal is an essential raw material and energy fuel in both of them. The integrated route, based on the blast furnace and basic oxygen furnace, uses raw materials including iron ore, coal, limestone and recycled steel. On average, this route uses 770kg of coal, 1400kg of iron ore, 150kg of limestone, and 120kg of recycled steel to produce a tonne of crude steel. The electric arc furnace route uses primarily recycled steel and electricity. On average, it takes 880kg of recycled steel, 150kg of coal and 43kg of limestone to produce a tonne of crude steel via this route.

Steel is a key material used to build wind turbines. About 85% of wind turbines globally are installed on steel structures, with steel representing around 80% of all materials used in a single turbine. The important role of coal in steel manufacturing is reflected in the amount of coal present in a wind turbine, over its lifecycle. It is estimated that there are 250 tonnes of coal in an offshore wind turbine and 150 tonnes of coal in an onshore turbine.

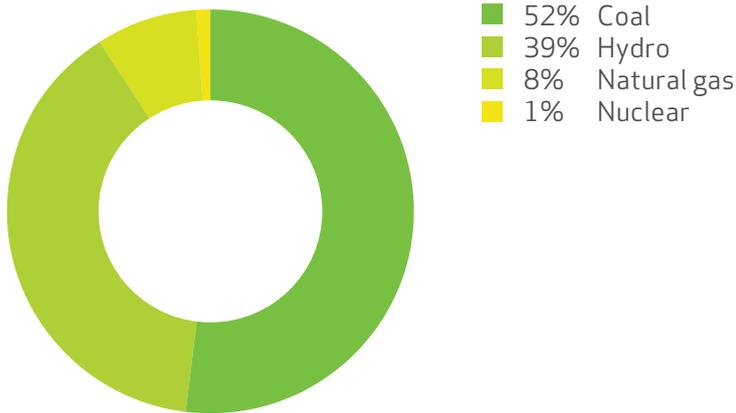
770kg
OF COAL IS USED TO PRODUCE A TONNE OF CRUDE STEEL



250t
250 TONNES OF COKING COAL ARE REQUIRED TO BUILD AN OFFSHORE WIND TURBINE AND 150 TONNES TO BUILD AN ONSHORE TURBINE

Aluminium

Primary aluminium smelting power consumption



Source: International Aluminium Institute 2012

Aluminium is the most widely used non-ferrous metal. It is a lightweight, strong and recyclable material which is resistant to corrosion. Due to these characteristics, aluminium is widely used in the transport sector to reduce the weight of cars, trains and airplanes. It is also used in major power transmission lines as an electricity and heat conductor.

New cars in Europe use, on average, 132kg of aluminium per car. The use of aluminium in new cars is on the rise because of environmental benefits of using light aluminium instead of heavier steel. Weight reduction directly reduces the energy consumption because the energy required to move a vehicle is, except for aerodynamic resistance, directly proportional to its mass.

Aluminium production is an energy intensive process. The common raw material for aluminium production - bauxite - is used to produce aluminium oxide through a chemical process and subsequently aluminium through an electrolytic process. Coal plays an important role as a source of energy fuelling this process as well as in the form of carbon cathodes used during electrolysis. It accounts for over 50% of the power mix used in aluminium production globally.

50%

COAL ACCOUNTS FOR OVER 50% OF THE POWER MIX USED IN ALUMINIUM SMELTING GLOBALLY

132kg

NEW CARS IN EUROPE USE, ON AVERAGE, 132KG OF ALUMINIUM PER CAR

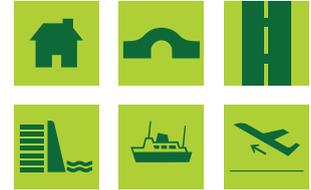


Cement

Cement is the key ingredient in the production of concrete, an essential building material for society's infrastructure around the world, second only to water in total volumes consumed annually.

Cement is essential for building houses, bridges, roads, dams, harbours and airports.

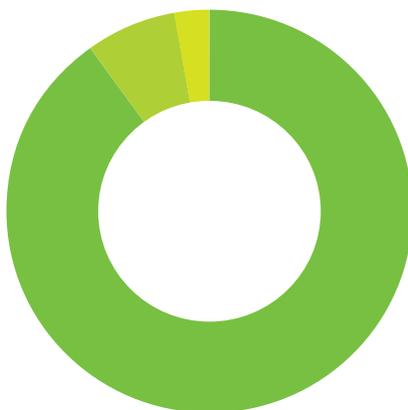
Coal is used as an energy source in cement production to melt raw materials - limestone, silica, iron oxide and alumina. Kilns burn coal in the form of powder and consume around 200g of coal to produce one tonne of cement. Coal combustion products (CCPs), by-products generated from burning coal in coal-fired power plants, also play an important role in concrete production. These by-products include fly ash, which can be used to replace or supplement cement in concrete. Recycling coal combustion products in this way is beneficial to the environment.



200kg

OF COAL TO PRODUCE
ONE TONNE OF CEMENT

Total fuel consumption by cement kilns



- 90% Conventional fuel (mainly coal)
- 7% Alternative fuel (includes a variety of wastes, discarded tyres, oil, plastics, solvents, textiles and waste biomass)
- 3% Biomass

Source: IEA 2009

Close to 90% of the world's cement is produced with the use of coal as the source of primary energy. It takes about 200kg of coal to produce one tonne of cement and about 300-400kg of cement is needed to produce one cubic metre of concrete.

Half of the world's cement is produced in China. China also holds the world record for the largest concrete pour in a single project at the Three Gorges Dam in Hubei Province, the world's largest hydropower station. The amount of concrete used in the construction of this hydropower station is estimated at 28 million m³ of concrete, requiring almost 2 million tonnes of coal.



2,000,000t

THE WORLD'S LARGEST
HYDROPOWER STATION IS
BUILT FROM 28 MILLION
M³ OF CONCRETE,
REQUIRING 2 MILLION
TONNES OF COAL

Lime and bricks

Coal is also often used to fuel lime and brick kilns.

The largest use of lime is in the steel industry, where it is used to remove impurities during the steel manufacturing process. Lime is also essential for the production of non-ferrous metals and for soil stabilisation during the construction of roads, foundations and dams.

In China, where around half of the world's lime is produced, coal accounts for 96% of all fuel used in the lime industry.

Bricks are among the most commonly used building blocks in the construction sector. Coal fly ash can be used as a raw material in brick manufacturing. There are several techniques for manufacturing construction bricks from fly ash. One type of fly ash brick is manufactured by mixing fly ash with an equal amount of clay, then firing in a kiln at about 1000°C. Another type of fly ash brick is made by mixing soil, plaster of paris, fly ash and water, and allowing the mixture to dry. As no heat is required, this technique reduces air pollution. More modern manufacturing processes use a greater proportion of fly ash and a high pressure manufacturing technique, which produces high strength bricks with environmental benefits.

In China, where roughly half of the world's bricks are produced, 42 million tonnes of coal were used to produce bricks in 2005. The IEA estimates that 628kg of coal is needed to produce 10,000 bricks in China. In India, 25 million tonnes of coal are estimated to be used annually to produce bricks.

96%

COAL ACCOUNTS FOR 96% OF ALL FUEL USED IN THE LIME INDUSTRY



628kg

THE IEA ESTIMATES THAT 628KG OF COAL IS NEEDED TO PRODUCE 10,000 BRICKS IN CHINA

The World Coal Association is a non-profit, non-governmental association

Membership is open to coal enterprises and stakeholders from anywhere in the world. The WCA has more than 40 members spread across the globe. Our membership includes many of the world's largest coal producers and includes mining equipment manufacturers, national coal industry associations and coal research bodies. Member companies are represented at Chief Executive level. The WCA is the only international body working on behalf of the coal industry worldwide.

Mission

Our mission is to demonstrate and gain acceptance for the fundamental role coal plays in achieving a sustainable and lower carbon energy future.

Our goals are:

- 1 To demonstrate that coal is an abundant, low cost energy source critical to meeting the energy needs of a low carbon world.
- 2 To demonstrate that coal is essential to building sustainable societies through the use of coal products such as steel and cement.
- 3 To influence international bodies and national governments to support investment in low carbon coal technologies (including improved energy efficiency and carbon capture, use and storage) in support of international climate objectives.
- 4 To ensure that the World Coal Association and its Members are recognised and valued as constructive and responsible participants in international environmental, climate and energy security forums.

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