Urbanization drives resource use and GHG emissions

More people and changing lifestyles lead to increases in living space, infrastructure for supply and disposal, means of transport and communication. This entails a rise in global resource use in business-as-usual scenarios. In the next three decades alone, about as much infrastructure needs to be built as has been created since the beginning of industrialization. This growth will mainly take place in cities, where more people will be living in 2050 than today all over the world. The challenge will be even greater considering the fact that a significant percentage of the built infrastructure since 1990 will deteriorate prematurely due to the massive use of poor-quality building materials and the severe environmental influences and industrial pollutants.\(^1\)

In addition to that, urban infrastructure development over the last decades failed to keep pace with the rapid urbanization process in many developing countries and emerging economies: Around the world, approx. 750 million people have still no access to adequate sanitation, 150 million are lacking access to clean drinking water, and 850 million city residents live in inadequate housing.\(^2\)

Around the globe, the predominant materials for buildings and infrastructure solutions are steel, sand and cement. Between 1959 and 2010, the global steel production went up by a factor of eight while 25 times more cement was produced. The demand for non-metallic industrial and construction minerals\(^3\) even witnessed over the last 30 years a disproportional increase by more than 240%. This boom has not only spurred demand for raw materials but also increased global CO\(_2\) emissions considerably: The cement industry\(^4\) contributes about 5% to global anthropogenic greenhouse gas emissions, steel industry\(^5\) about 6%.

As infrastructure and buildings have a lifespan of many decades, the choices concerning the design, technologies and materials have a strong impact on the ecological footprint not only during construction but operation as well and therefore can lock societies into GHG-intensive emissions pathways that are difficult or very costly to change.

If the expansion of infrastructure and buildings follow the same raw material and energy intensive patterns as today in industrialized countries, this alone could lead to 350 Gt of CO\(_2\) emissions. This corresponds to around a third of the total available CO\(_2\) budget remaining under a two degrees pathway, limiting global warming to less than 2\(^\circ\)C.\(^6\)
building and design methods can help to adapt buildings flexibly to changing demands, reducing demolition waste.

To reduce the use of sand and gravel, secondary raw materials are usable for many civil engineering applications, e.g. carriageways, prefabricated components for tunnel formwork or sleepers as well as buildings itself. However, this still requires targeted measures to increase their acceptance. These range from demolition permits with respective requirements for separation, specifications for the recycling of demolition waste to modifications to construction standards, warranty provisions, requirements in tendering procedures to calculating longer curing times of concretes containing a higher percentage of secondary components. As nearly all countries are facing similar challenges in this context, international exchange of experience is crucial.

### Low-carbon construction material

Cement is an almost indispensable binder. The energy intensity of the different types varies depending largely on the clinker content. To produce clinker, limestone and other clay-like materials are heated in kilns up to more than 1400°C, resulting in between 0.8 and 1 tons of CO₂ generated on average during the production of one ton of cement.⁹ Resource efficiency measures can contribute to reduce the carbon footprint of cement: The use of efficient grinding and milling technologies, for example, can decrease the global electricity intensity of cement by 14% by 2050 compared to 2014¹⁰, while refuse-derived fuels from waste reduce consumption of fossil fuels.

New types of cement can lower the clinker content, using alternative materials such as fly ash from coal fired power plants and blast furnace slag. Low Carbon Cement based on a blend of limestone and calcined clay can even reduce CO₂ emissions by up to 30%.¹¹ Once hydrated and hardened there are at the few approaches to recover cement and render it reactive again.

Another alternative becoming more popular consists in using renewable building materials such as bamboo and timber even for constructing high-rise mass buildings.

### Resource efficient urban planning

The density of cities allows economies of scale in citizen-oriented services such as collective transport, power, water and sanitation services, waste management and district heating, reducing commuting distances, air pollution, energy demand, land take and soil destruction. Resource efficient urban planning integrates urban flows and urban forms, linking spatial development and planning of infrastructure systems. It minimises the use of resources on the
available resource efficiency potentials in construction mate-
and buildings not only in emerging countries, tapping the
In view of the rapidly growing demand for infrastructure
synergies with other sectors

Industrial areas are drivers of economic development. Never-
they frequently concentrate environmental pollution
and ineffective resource use. Sustainable Industrial Areas
(SIA) turn these challenges into opportunities: The spatial
proximity between different companies facilitates not only
pooling of state-of-the-art environmental infrastructure as
zero-emissions plants and sharing of services and social in-
frastructure. Such clusters can also be a breeding ground for
industrial symbiosis in which the residues of one company
become raw material of another. Having to consider the
economic, ecological and social dimension in an integrated
manner, such industrial areas require particular management
structures, enhancing communication and collaboration.

In view of the rapidly growing demand for infrastructure
and buildings not only in emerging countries, tapping the
available resource efficiency potentials in construction mate-
rials will be key for preserving natural materials and reducing
greenhouse gas emissions. This will require not only technical
innovations but also favourable framework conditions.

Managing construction
and demolition waste in India

India is witnessing a construction boom due to rapid ur-
banisation which is leading to high rates of exploitation
of primary resources for construction materials. For in-
stance, almost 100% of cement and bricks, 40-60% of
steel, 85% of paint, and 70% of glass produced in India
goes into the construction sector. India is generating each year the
estimated amount of 530 million tons. Generally, the most
common way of managing the waste is illegal dumping in
open areas or mixing it with municipal solid waste.

Against this background, managing construction and dem-
olition waste more effectively for recycling was chosen as
one of the fields of activity in the project “Fostering Re-
source Efficiency and Sustainable Management of Second-
ary Raw Materials”, implemented under the International
Climate Initiative (IKI) and funded by the German Federal
Ministry for the Environment, Nature Conservation, and
Nuclear Safety (BMU). To support informed decision-mak-
ing, the project elaborated, amongst others, a report on
resource efficiency in the construction sector, and com-
missioned a market study on construction and demol-
ition waste utilisation in Ahmedabad. In 2016, the Indi-
an Ministry of Environment, Forest and Climate Change
(MoEFCC) notified the Construction and Demolition Waste
Management Rules, assigning the different stakeholders
with specific responsibilities concerning collection, seg-
regation, storage, transport, and recycling of construction
demolition waste. The Rules also define criteria for
recycling facilities and materials made from construction
demolition waste and its products and foresee penal-
ties for noncompliance. To support the implementation of
the Construction and Demolition Waste Rules at the local
level, the IKI-project worked out a training manual on
construction and demolition waste management in India
for cities and towns. Another field of activity focused
on low carbon cement as alternative building material,
developed in India as Limestone Calcined Clay Cement.

Recommendations

In view of the rapidly growing demand for infrastructure
and buildings not only in emerging countries, tapping the
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rials will be key for preserving natural materials and reducing
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Legal framework

Building codes and standards as well as tender conditions are
generally framed for the use of primary raw materials. As long
as these do not consider explicitly the use of secondary raw
material or construction material from biomass as alternative or complementary options, warranty risks may arise. From a resource efficiency perspective, the legal framework, including liability and procurement regulations, is key for paving the way to resource efficient and low carbon infrastructure and buildings. In view of the high proportion of publicly financed buildings and infrastructure, public bodies have extensive opportunities to promote resource efficiency under their responsibility.

**Fiscal instruments**

Aggregates are still cheap in many parts of the world where sand and gravel are freely accessible and only the costs for extraction and transport need to be covered. Against this background, options that are more resource efficient, environmentally friendly and contribute to mitigating climate change are not competitive. UN Environment recommends therefore to price and tax the extraction of aggregates in a way that helps alternative options, using for example recycled materials, to become economically viable.

**Green Public Procurement**

Resource efficient and low carbon infrastructure and buildings need forward-looking clients that play an important role for developing the market. Governments and local authorities taking over this role can help to demonstrate the viability and reliability of new technologies and innovative construction materials and designs in practice.

**Sources**

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