

The Insatiable Demand for SAND

Deceptively abundant, the basic raw material for glass and concrete can't keep up with demand

Bruce Edwards



Burj Khalifa building,
Dubai, United Arab
Emirates.

THE commercial construction industry is booming. Office towers are popping up in Manhattan at their fastest pace in decades. “There are 23 buildings under construction with an average of 32 stories, and construction is projected to pick up dramatically. And on the multifamily side, we are seeing a record volume of new construction,” says Maddie Eldridge, market analyst for real estate research firm CoStar Group.

New York is not alone. Singapore has more than a dozen 40-plus-story buildings under construction. Dubai has started on a shopping mall covering 8 million square feet, after building the world’s tallest tower. At 2,716 feet, the Burj Khalifa is covered in 1.8 million square feet of glass and required 110,000 metric tons of concrete.

The United Nations says cities around the world are growing faster than ever, with 54 percent of the world’s population now living in urban areas, and 66 percent expected to do so by 2050. According to the UN *World Urbanization Prospects* report, urbanization combined with overall world population growth could add another 2.5 billion city dwellers by 2050. The report says that there were 10 megacities with 10 million people or more in 1990 and 28 today; it predicts 41 by 2030.

But as the world’s metropolises get bigger and reach higher into the sky to accommodate more people, the earth’s natural resources supply chain is being pushed to the limit. That strain is not from increasing demand for gold, diamonds, or copper, but for sand, the primary material for construction and hence for economic development.

Concrete and glass are made mostly of sand, a certain type of sand found deep below the earth’s surface, underwater, and on beaches. Sand mining to meet increasing demand over the years has become a thriving multibillion-dollar industry, but research by the United Nations Environment Programme (UNEP) shows that rate to be unsustainable.

“Sand and gravel represent the highest volume of raw material used on earth after water. Their use greatly exceeds their natural renewal rates” (UNEP, 2014).

Dammed particles

Each grain of sand originates from rock on a mountaintop. The grains, formed by erosion over thousands of years, make a long journey through springs, streams, and rivers to the ocean, where the tides and waves distribute them across the ocean floor and eventually carry them onto beaches.

The damming of rivers during the past century has dramatically impeded this natural process, and so roughly half of the estimated 40 billion metric tons of sand and gravel extracted every year for the construction industry, glass manufacturing, and other uses—such as land reclamation and oil exploration—will never be replenished.

The seemingly endless supply of sand in the Mojave and Sahara deserts just won’t cut it. Desert sand granules have been rounded by wind over time and no longer bind together, an essential characteristic of sand used in construction.

The greatest consumer of sand and gravel is the cement industry. The United States Geological Survey (USGS) estimates that almost 26 billion metric tons went into making con-

crete in 2012, up dramatically from 11 billion in 1994. USGS data show that world cement production almost tripled from 1.37 billion metric tons in 1994 to 3.7 billion in 2012, which UNEP attributes to rapid economic growth in Asia. “China alone built 90,000 miles of road in 2013, and its demand for cement has risen by 437.5 percent in 20 years,” the report says.

As the construction industry scrambles to find more high-grade sand to meet the rising demand for glass and concrete, sand suppliers are contending with another force of nature, hydraulic fracturing. This unconventional oil drilling process, commonly known as fracking, shoots a mixture of sand and water into tight oil formations, breaking the shale rock and making the oil in the rock easier to extract.

And though the use of sand in fracking isn't new, oil producers have recently found that they can increase the output of oil wells if they use more of it. As a result, use of total U.S.

“Sand and gravel represent the highest volume of raw material used on earth after water.”

industrial sand production by the fracking industry skyrocketed from only 5 percent in 2003 to 72 percent in 2014 (USGS, 2004 and 2015).

Stephen Weidner, vice president at Pilkington Glass, says at the height of the fracking boom, glass manufacturing plants were competing for resources. “This forced us to have to source supply from other suppliers/deposits sometimes at greater distance than before. The cost and particularly the transportation cost of sand subsequently increased,” Weidner says.

So critical is sand to their operations that Houston-based oilfield service company Halliburton last year opened what it calls the sand “war room” to help manage the flow of billions of pounds of sand from mines to well sites across the country. Halliburton's senior director for North American operations, Billy Smith, said that the average well can use about 3,500 metric tons of sand, and some as much as 10,000 (Holeywell, 2014).

Until recently, most sand was extracted from land quarries and riverbeds. But with demand so high and growing, suppliers have started dredging for sand in coastal waters, with a tremendous environmental impact on seabed flora and fauna. “Dredging and extraction of aggregates from the sea bottom destroys organisms, habitats and ecosystems and deeply affects the composition of biodiversity,” the UNEP report says.

The dredging boats make matters worse by rejecting sand particles that are too fine, releasing vast plumes that muddy the waters, disrupting habitats well beyond the actual extraction sites.

Beaches erode faster too, and can disappear altogether, when coastal waters are dredged. But the worst thing that can happen to a beach is for it to be stripped bare, which is precisely what's happening in places where a bag of sand means food on the table.

Mining bans, imposed by some countries and meant to mitigate the environmental impact, have only further decreased

supply of the highly sought-after riverbed and coastal sand, and pushed prices up sharply.

Sand trading is a lucrative business around the world—and not only for the big mining conglomerates. Lack of regulation and weak enforcement of the few rules there are have opened the door to illegal mining. In some developing economies, shovels and pickup trucks take the place of dredging boats and heavy mining machinery. Half the sand used for construction in Morocco comes from illegal coastal sand mining. And in parts of India, where they've seen dramatic price increases for sand since the building boom started about a decade ago, cartels control much of the construction industry's supply. Illegal miners are stealing land for sand, and people are being killed in the process.

“Nowhere is the struggle for sand more ferocious than in India. Battles among and against “sand mafias” there have reportedly killed hundreds of people in recent years—including police officers, government officials, and ordinary people” (Beiser, 2015).

Shifting sands

Some cities use sand to expand their landmass: Singapore holds the world record in that category. The island city-state is 20 percent bigger than it was 40 years ago, thanks to sand imported from Cambodia, Indonesia, Malaysia, and Thailand. Singapore has imported 517 million metric tons of sand in the past 20 years, according to UNEP.

Dubai, on the other hand, exhausted its marine sand resources pouring 385 million metric tons to create an artificial set of islands called the Palm Jumeirah between 2001 and 2006. The city has since been relying on Australia to satisfy its seemingly insatiable demand for sand for other massive construction projects.

As the world's population continues to grow, so will the need for housing, office towers, factories, roads, and shopping malls. And given that most of what we build today is made of glass and concrete, sand is a fundamental resource for our economic development.

But with an exponential increase in the amount of sand mined globally and no international conventions to regulate its extraction, use, or trade, UNEP says, the harm to the environment is unequivocal, and occurring around the world.

In the end, our overdependence on this precious natural resource works against any sustainable development strategy. ■

Bruce Edwards is on the staff of Finance & Development.

References:

- Beiser, Vince, 2015, “The Deadly Global War for Sand,” *Wired*, March 26.
- Holeywell, Ryan, 2014, “New Halliburton Office Manages the Flow of Precious Sand,” *Houston Chronicle*, Nov. 11.
- U.S. Geological Survey (USGS), 2004, *Geological Mineral Commodity Summaries* (Washington, January).
- , 2015, *Geological Mineral Commodity Summaries* (Washington, February).
- United Nations Environment Programme (UNEP), 2014, “Sand, Rarer Than One Thinks.”