# Megacity study shows energy and resource use for largest urban areas

April 28 2015, by Bob Yirka

The downtown Dallas, Texas (USA) skyline from a levee along the Trinity River. Facing southeast. Credit: drumguy8800/Wikipedia

(Phys.org)—A massive study headed by Christopher Kennedy an engineer at the University of Toronto has revealed some of the ways energy and resources are used by the world's megacities, which the authors describe as urban areas that have more than 20 million people in them. In their paper published in *Proceedings of the National Academy of Sciences*, Kennedy and his team of researchers from institutions across the globe, describe differences in resource use and efficiencies and how what they have revealed might be used to help better plan city growth in the future.

Among other things, the team found that as of 2010, 6.7 percent of all human beings lived in a megacity—a number which is growing of course—they also noted that there were 27 such megacities around the world. By enlisting the assistance of environmentalists, city planners and engineers, geographers, technologists and experts in other areas, from cities, countries, municipalities, etc. from around the world, the team was able to collect a mass of data that described various aspects of the megacities, and then used that data to contrast and/or compare them.

Among their findings was that megacities produce approximately 15 percent of the world's GDP, 13 percent of the world's trash and consume 10 percent of the gasoline that is produced. These numbers suggest that megacities, on average, are not quite as efficient as some have espoused, considering the still relatively small slice of people that live in them. The data also shows the reason for some of the inefficiency, people commuting to work was but one example. Not surprisingly, the researchers found vast differences between megacities in developed countries versus those in less developed places, particularly those in third world countries. Some of the numbers actually showed some third world megacities as being more efficient, but a closer look revealed that it was most often the result of fewer people having access to resources, such as electricity.

The team also found that electrical energy use in megacities was strongly correlated with building floor space—other correlations were revealed as well, such as heating and other fuel use, energy used to move ground vehicles, water and waste, economic activity and of course population growth—many are growing at a very rapid pace; fortunately, for the people living in most of them, GDP was growing even faster.

**More information:** Energy and material flows of megacities, Christopher A. Kennedy, *PNAS*, DOI: 10.1073/pnas.1504315112

**Abstract**
Understanding the drivers of energy and material flows of cities is important for addressing global environmental challenges. Accessing, sharing, and managing energy and material resources is particularly critical for megacities, which face enormous social stresses because of their sheer size and complexity. Here we quantify the energy and material flows through the world's 27 megacities with populations greater than 10 million people as of 2010. Collectively the resource flows through megacities are largely consistent with scaling laws established in the emerging science of cities. Correlations are established for electricity consumption, heating and industrial fuel use, ground transportation energy use, water consumption, waste generation, and steel production in terms of heating-degree-days, urban form, economic activity, and population growth. The results help identify megacities exhibiting high and low levels of consumption and those making efficient use of resources. The correlation between per capita electricity use and urbanized area per capita is shown to be a consequence of gross building floor area per capita, which is found to increase for lower-density cities. Many of the megacities are growing rapidly in population but are growing even faster in terms of gross domestic product (GDP) and energy use. In the decade from 2001–2011, electricity use and ground transportation fuel use in megacities grew at approximately half the rate of GDP growth.

Press release