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Prosperity Insights

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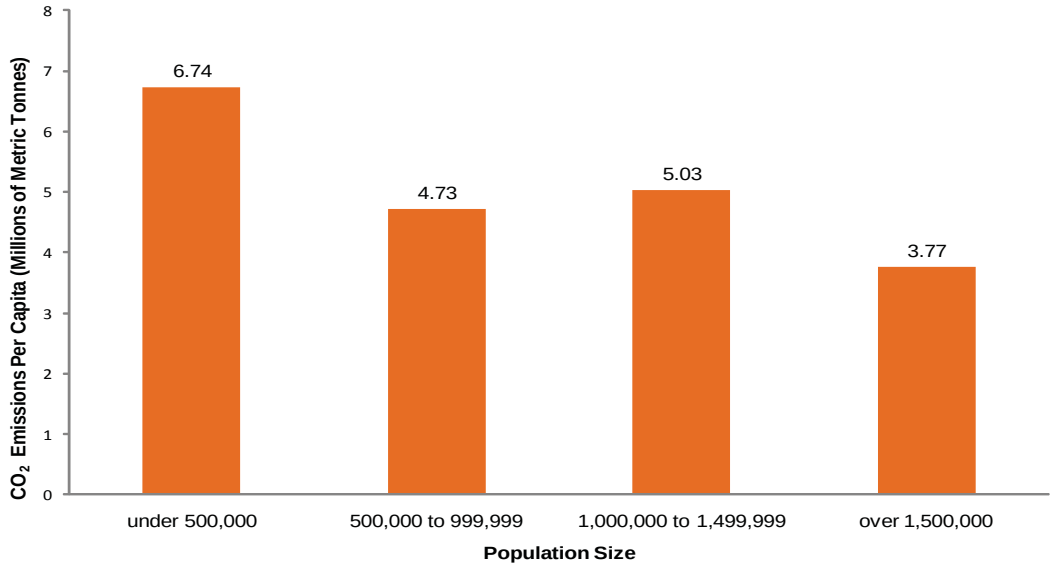
# Cities and $CO_2$ - Bigger *is* Better

There is growing consensus that the world's nations must act in a concerted way to address global climate change. Can action be taken without seriously undermining the ongoing economic recovery? It is commonly argued that environmental protection must necessarily come at the expense of economic growth, and vice versa. But new research from one of our affiliates, Jose Lobo and his colleagues, indicates that this need not be the case. Their findings suggest that our largest cities are not only centres of innovation but also energy efficiency as well, and will be a key part of our economically and ecologically sustainable future.

The US alone comprises 366 metropolitan regions with population in excess of 100,000. Typically when we discuss the functioning of these regions, particularly the largest urban centres, we focus on their deficiencies: sprawl, traffic congestion, pollution. Too often we overlook the ways that larger urban systems actually function better. For example, we already know that increased urbanization and innovation are closely intertwined. As first noted by Alfred Marshall and later elaborated by Jane Jacobs and others, large urban centres are unique in achieving the critical mass of creative workers, flows of knowledge, and sophisticated markets that compel innovation and growth.

In past research, Lobo and his colleagues have analyzed detailed data on cities across the globe and found that rates of patenting, wages and other economic measures do indeed increase with the size of cities.[i] Their recent work examines newly available environmental data and reveals the same scaling effect between metropolitan size and emissions, only this time there is an inverse relationship. Simply put, larger urban regions use energy more efficiently.

## Exhibit 1: Average Per Capita $CO_2$ Emissions by Population Size



CO2 emissions are a widely used proxy for energy consumption, and include total emissions from commercial, industrial, residential and transportation energy usage occurring within metropolitan boundaries. When we observe the relationship between total average CO2 emissions per capita and population size, we discover a negative relationship (Exhibit 1). We clearly see a general drop in CO2 emissions per capita as the population of metropolitan regions grow. While we cannot provide a reason for the slight increase in emissions per capita as cities grow from one million to over one million five hundred thousand, the general trend still holds.

In their original work, Lobo and his colleagues find that total CO2 emissions and population size increase in tandem, but not at the same rate. With each increase of 1% in population, growth in carbon emissions is 0.92%. In other words, as population increases, CO2 emissions per capita drop. The same relationship is even more significant when the researchers used a measure of economic output, Gross Metropolitan Product, a 1% increase corresponds with only a 0.79% increase in carbon emissions.

What these results demonstrate is that as urban regions grow increasingly larger, the rate of growth in their emissions actually declines. For example, on an average annual basis, notoriously smoggy Los Angeles, a metropolitan region of almost 13 million people, produces 1.7 tonnes of CO2 per person. By comparison, agriculture-led Yuba City, CA produced 3.7 tonnes for each of its 150,000 residents.

In some ways, urban systems are similar to biological systems in that many of their characteristics are driven by size. Borrowing from biology, we refer to cities' ability to process inputs efficiently – for example, energy – as their "urban metabolism." And just like biological organisms, the energy metabolism of metropolitan areas slows down as they increase in size: larger regions burn less energy per capita than smaller regions.

What accounts for the more efficient energy use of larger cities? While this research doesn't provide us with a clear answer, we can make some educated guesses. For one, larger cities often make more intensive use of existing infrastructure than smaller regions. Larger cities tend to have less road space per person and fewer gas stations than smaller regions. Larger cities also tend to make greater use of public transit than do smaller centres. Shorter electrical transmission cables in larger cities also results in less loss of electricity and in turn less CO2 produced. Larger cities also tend to be more densely populated, with more compact housing and office space which creates greater efficiencies. Recent research by another MPI affiliate, Chris Kennedy, indicates that policy-makers would be well served to examine the planning codes and other policies adopted by higher efficiency regions such as Toronto.[ii]

As we begin to act seriously on the challenge of global climate change, a great deal of attention is focused on encouraging the development of new green technologies and shifting to more environmentally-friendly consumption patterns. This data shows that we must also pay attention to how certain patterns of urban development can contribute to the fight against climate change. Cities, it seems, are a critical part of our sustainable future.

[i]Refer to Bettencourt, L. M. A. et al. (2007) Growth, innovation, scaling, and the pace of life in cities, Proceedings of the National Academy of Sciences, 104 (17), 7301-7306. Available from http://www.pnas.org_cgi_doi_10.1073_pnas.0610172104

[ii]Refer to Kennedy, C. et al. (2009), Greenhouse Gas Emissions from Global Cities, Environmental Science & Technology, 43 (19), pp. 7297-7302. Available from http://pubs.acs.org/doi/full/10.1021/es900213p?cookieSet=1

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