

Sustainability and Systems Thinking for our Future Cities

Essex County Transportation Master Plan

Possibilities and Potential

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Sustainability is...

...the process of using energy and resources at a rate that does not compromise the natural environment, or the ability of future generations to meet their own needs.

What about Unsustainability?

MEASURING SUSTAINABILITY

SUSTAINABLE DEVELOPMENT GOALS



SDG 11



“Make cities and human settlements inclusive, safe, resilient and sustainable”

Urban metabolism is the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste.

Source: Kennedy et al., 2007



Sustainable Infrastructure in Cities

nature
climate change

LETTERS

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Low-carbon infrastructure strategies for cities

C. A. Kennedy^{1*}, N. Ibrahim¹ and D. Hoornweg²

Reducing greenhouse gas emissions to avert potentially disastrous global climate change requires substantial redevelopment of infrastructure systems¹⁻⁴. Cities are recognized as key actors for leading such climate change mitigation efforts⁵⁻¹⁰. We have studied the greenhouse gas inventories and underlying characteristics of 22 global cities. These cities differ in terms of their climates, income, levels of industrial activity, urban form and existing carbon intensity of electricity supply. Here we show how these differences in city characteristics lead to wide variations in the type of strategies that can be used for reducing emissions. Cities experiencing greater than ~1,500 heating degree days (below an 18 °C base), for example, will review building construction and retrofitting for cold climates. Electrification of infrastructure technologies is effective for cities where the carbon intensity of the grid is lower than ~600 tCO₂e GWh⁻¹; whereas transportation strategies will differ between low urban density (<~6,000 persons km⁻²) and high urban density (>~6,000 persons km⁻²) cities. As nation states negotiate targets and develop policies for reducing greenhouse gas emissions, attention to the specific characteristics of their cities will broaden and improve their suite of options. Beyond carbon pricing, markets and taxation, governments may develop policies and target spending towards low-carbon urban infrastructure.

Over the past five years we have undertaken a sustained effort to conduct greenhouse gas (GHG) inventories for city regions (hereafter cities) using a consistent methodology¹¹. This has included study of ten global cities¹², incorporating Chinese¹³ and low- to middle-income cities¹⁴, analysis of Paris-Isle de France and the Chicago region for the Organization for Economic Cooperation and Development^{15,16}, and further city inventories based on urban metabolism studies¹⁷. The method used is generally similar to that employed or reported by others¹⁸⁻²⁰ being an

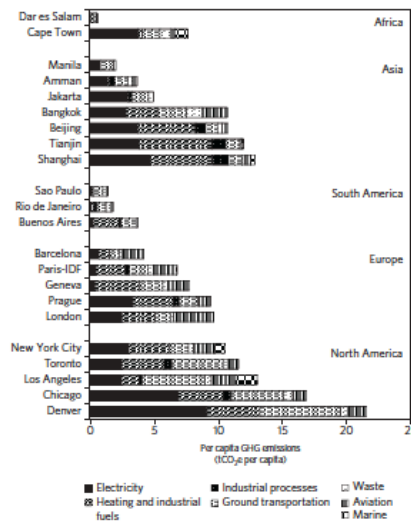
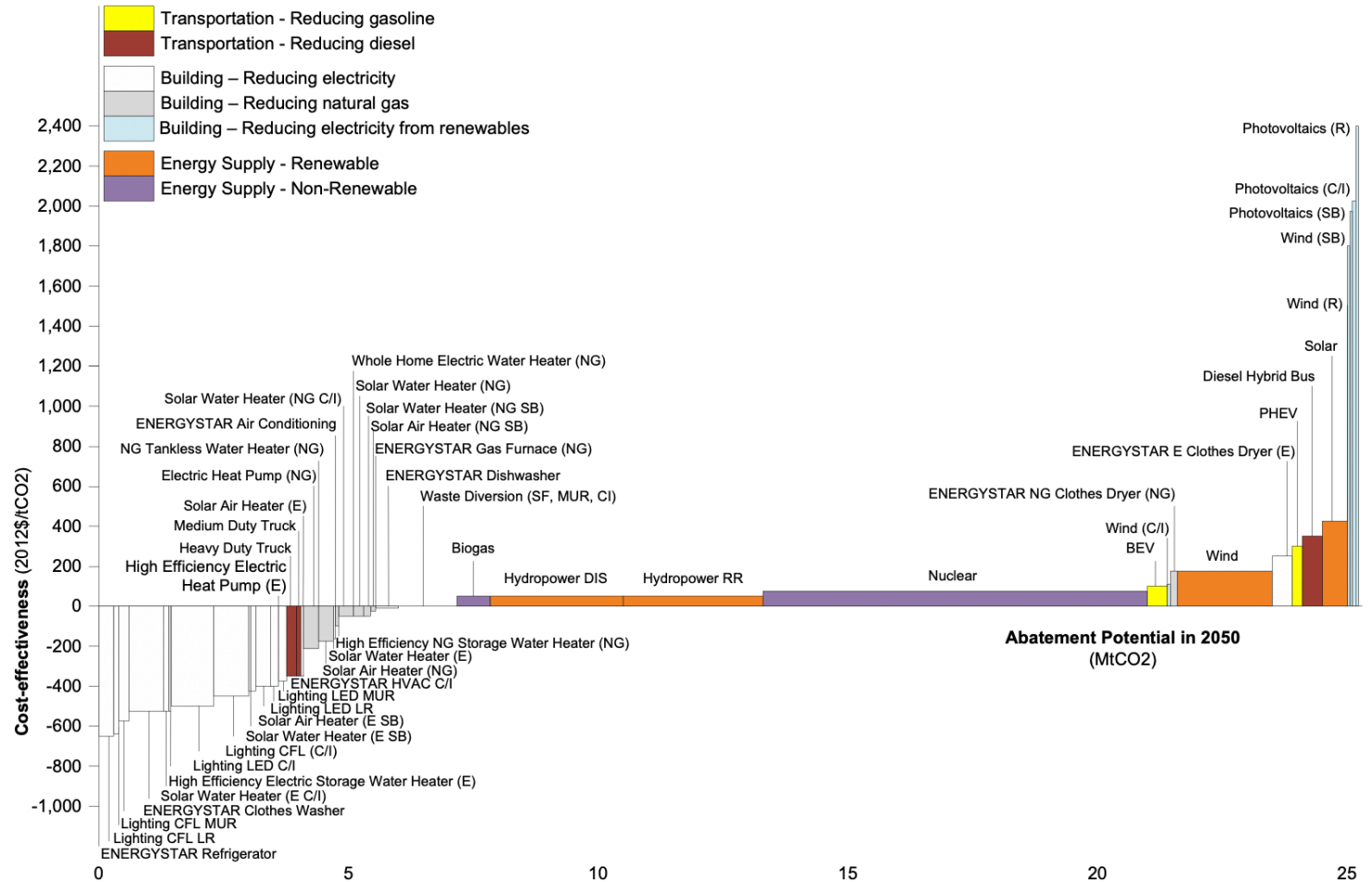


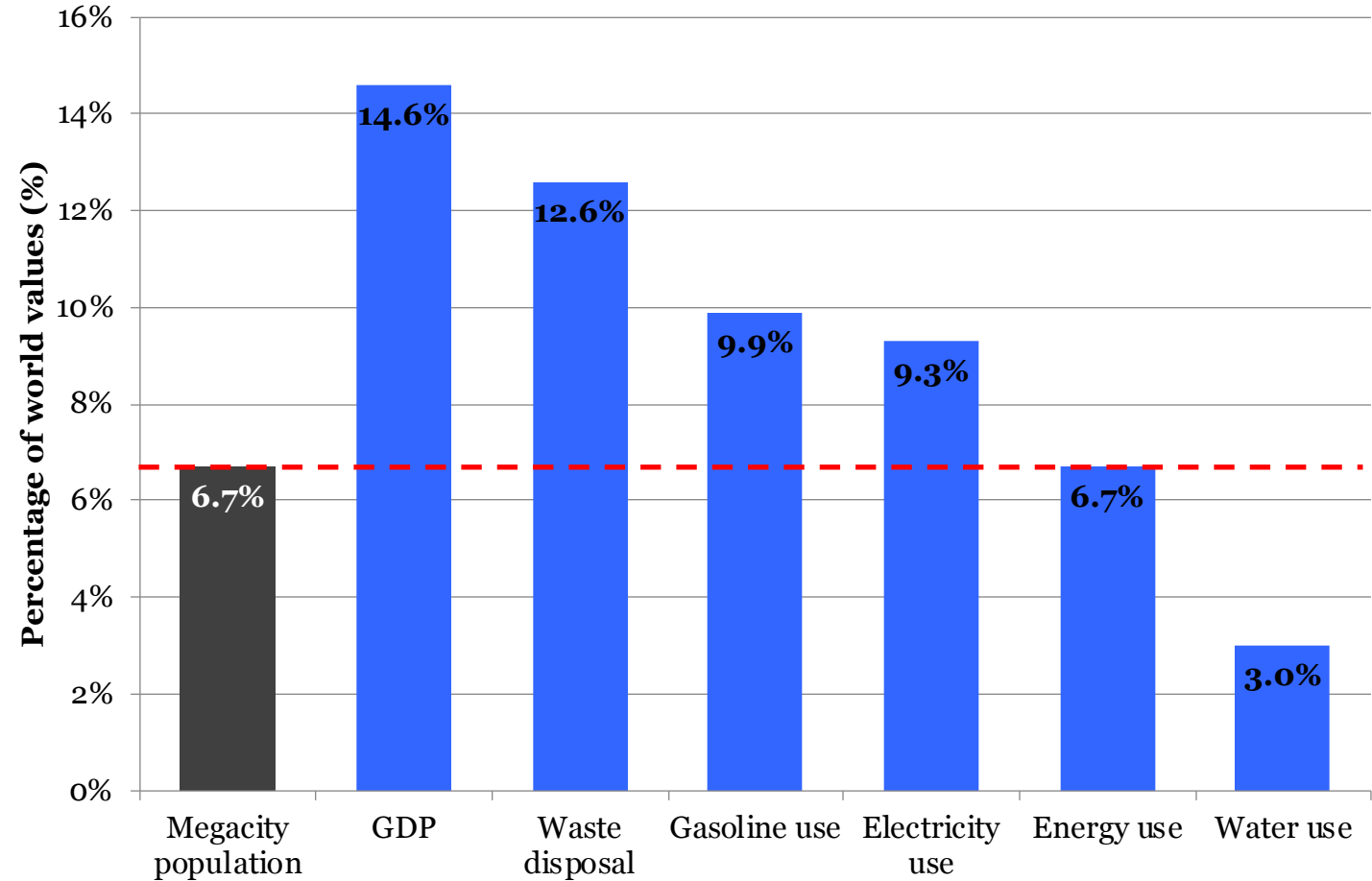
Figure 1 | Per capita GHG emissions for cities, by continent.



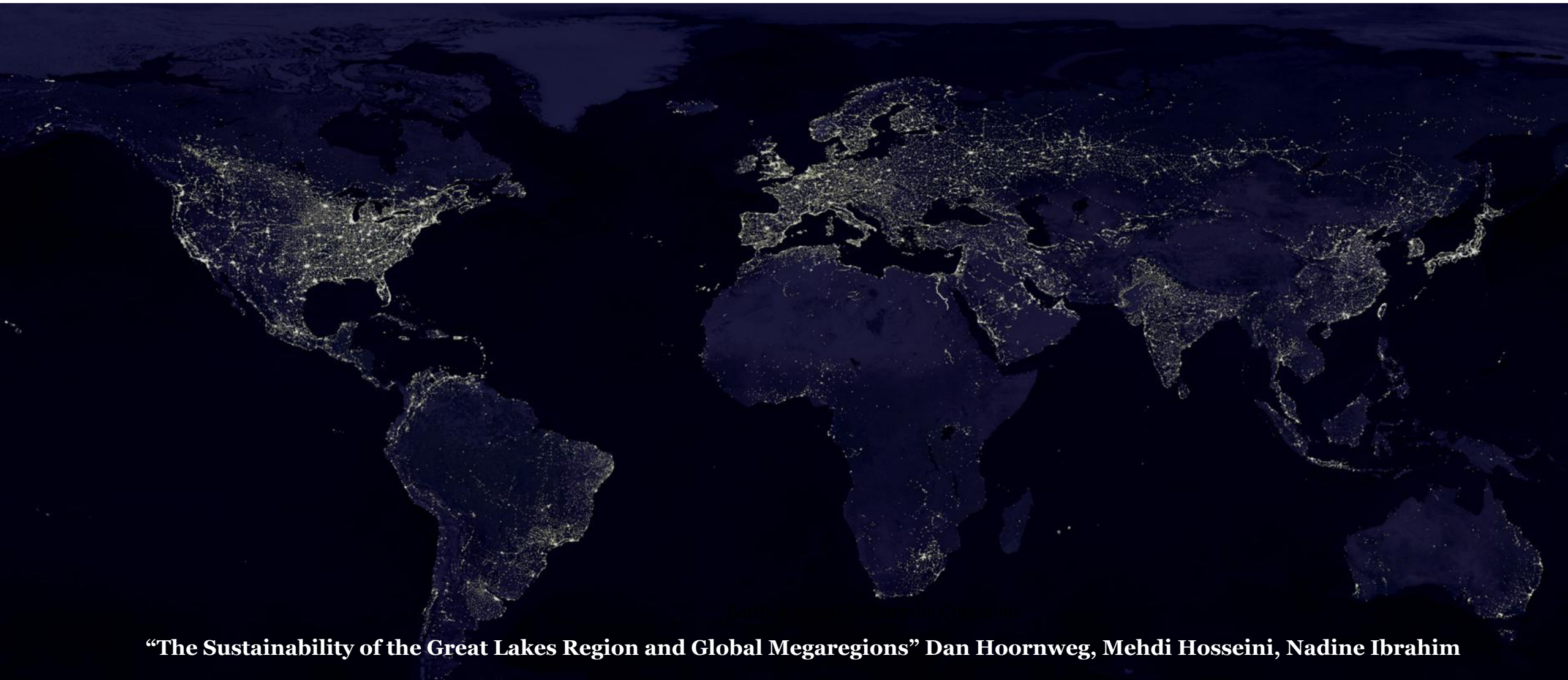
Energy and Material Flows in Megacities

Energy and material flows for the world's 27 megacities

Source: Kennedy, C., Stewart, I., Facchini, A., Mele, R., Chen, B., Cerosimo, I., Uda, M., Kansal, A., Chiu, A., Kim, K., Dubeux, C., La Rovere, E. L., Cunha, B., Pincetl, S., Keirstead, J., Barles, S., Pusaka, S., Gunawan, J., Adegbile, M., Nazariha, M., Hoque, S., Marcotullio, P., Gonzalez, F., Genena, T., Ibrahim, N., Farooqui, R., Cervantes, G., Sahin, A., 2015. "Energy and Material Flows of Megacities." *Proceedings of the National Academy of Sciences (PNAS)*, 112 (19): 5985-5990.



Sustainability Assessment of Megaregions

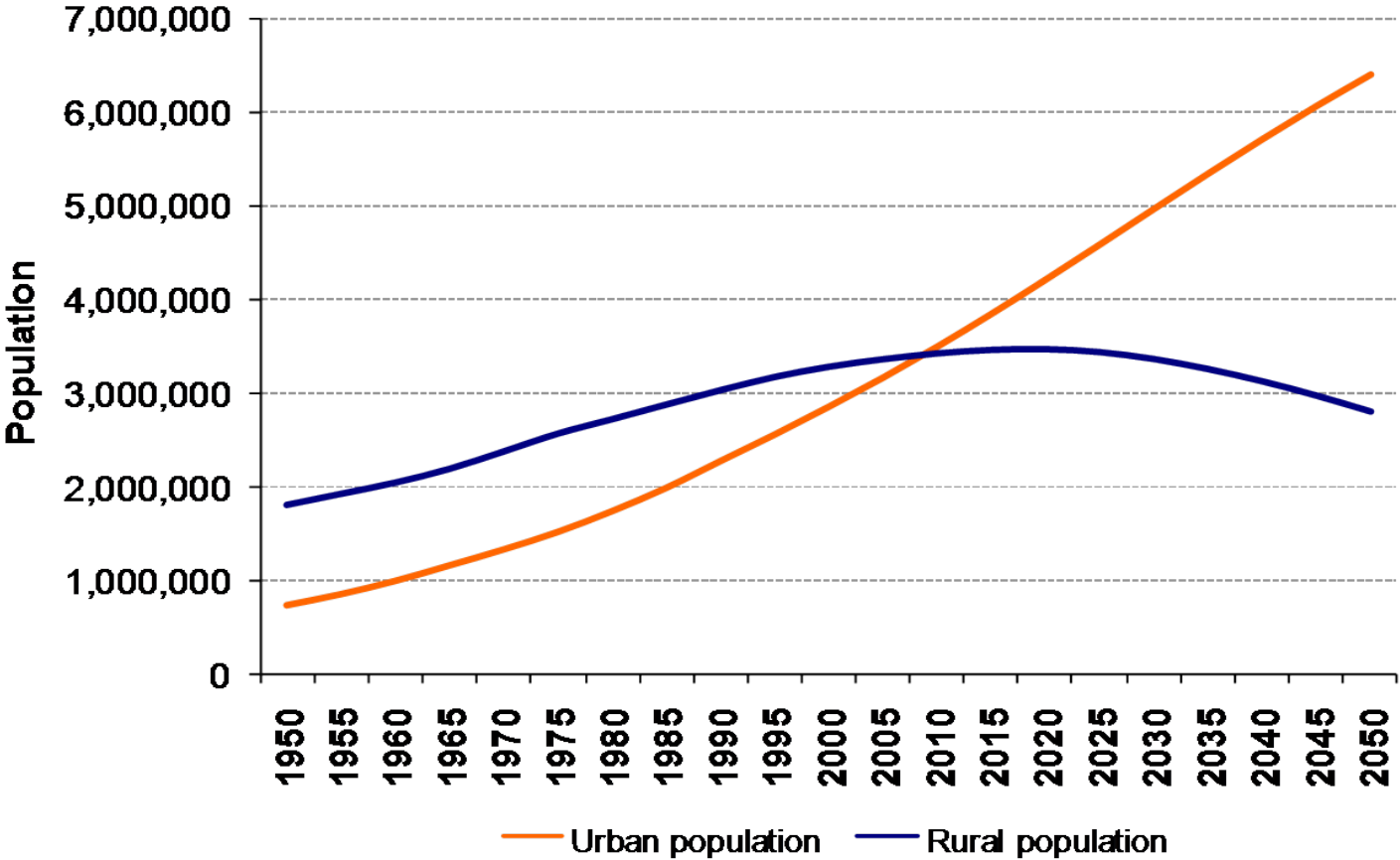


“The Sustainability of the Great Lakes Region and Global Megaregions” Dan Hoornweg, Mehdi Hosseini, Nadine Ibrahim

Funded by Council of the Great Lakes Region

Cities are home to more than 50% of the world's population

2 billion new urban residents by 2030, 3+ billion by 2050



Source: UN World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2007 Revision

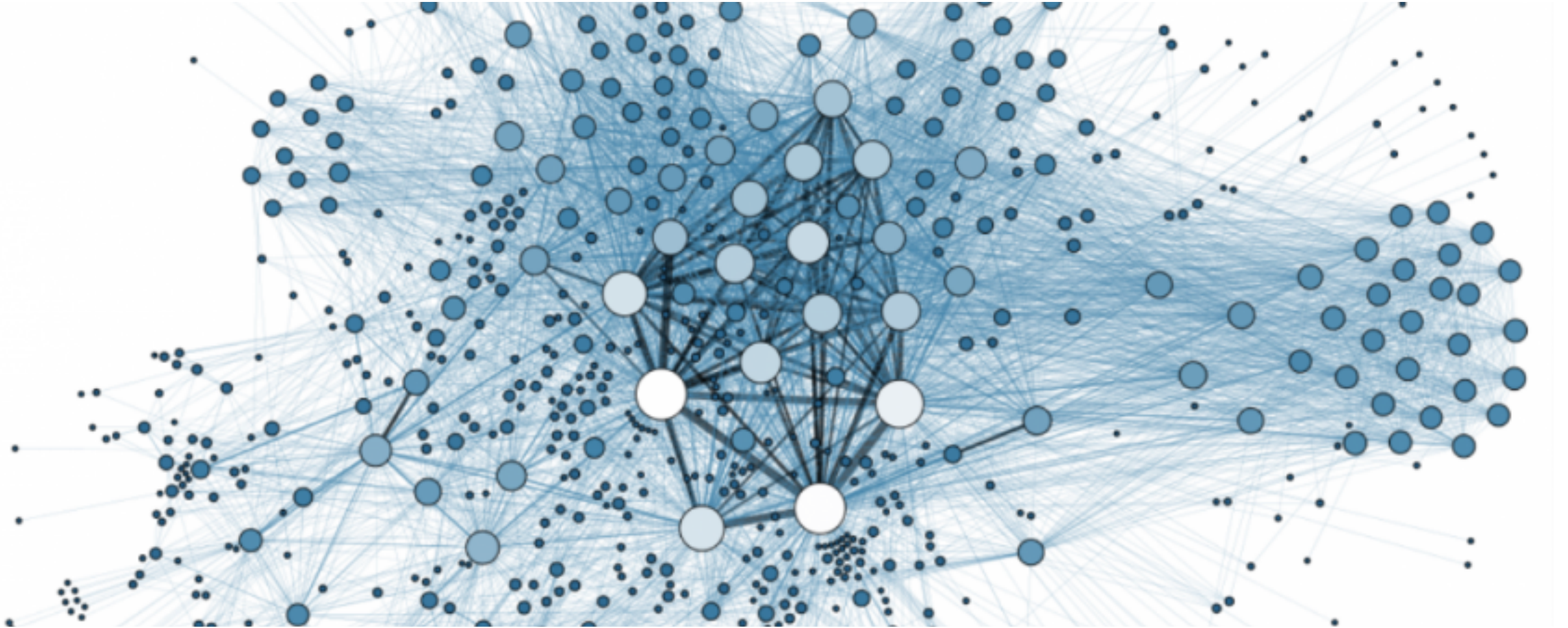
GLOBAL TRENDS

- **Urbanization** (links to poverty, inequity, globalization)
- **Demographics** (ageing societies, shifting wealth)
- **Information (digital) economy**
- **Degradation of biosystems** (loss of biodiversity)
- **Climate change** (adaptation and mitigation)

COMPARABLE MUNICIPALITIES IN ONTARIO

Municipality	Transportation Master Plan Focus
Town of Innisfil	Reducing congestion and enhancing road network connectivity, Providing scalable and reliable transit options, Promoting active and healthy lifestyles, Exploring innovative solutions and planning for autonomous and connected vehicles, Planning for growth while respecting the Town's rural roots
City of Peterborough	Hybrid Strategy that focuses on implementing active transportation, transit, and road network improvements with an emphasis on connectivity and a balanced mode share split. Strategies that are focused on building stronger sidewalk network connections and supporting transit priorities.
Lakeshore	Mobility and Innovation Division. Focuses on the planning and delivery of services that help individuals and products move freely, efficiently, and sustainably throughout Lakeshore and region.
Grey County	2023-2024 Climate initiatives Experimental Acres 2024 program supports farmers in Grey County with the implementation of sustainable agricultural best practices.
Oxford County	Cycling Master Plan (CMP) in 2020
Cobourg	Fixed route pilot program with 35 stops
Wellington County	RIDE WELL is an on-demand, publicly-funded, rural transit pilot project, offering door-to-door transportation in Wellington County and Guelph. This is a ridesharing service, meaning bookings made at similar times, in similar locations, will be paired into one vehicle.
Pembroke	The City of Pembroke is currently preparing documentation to request proposals for the operation of a three-year pilot project where a private contractor will provide an on-demand transit service within the City of Pembroke (Oct 2024)
District of Muskoka	The District Demand-Responsive Transit (DRT) is a transit service linking those in rural areas to urban centres and allowing them to connect to other services.

SYSTEMS THINKING



URBAN INFRASTRUCTURE COMPONENTS

	Water	Energy	Green	Transportation	Buildings
Water	X				
Energy		X			
Green			X		
Transportation				X	
Buildings					X



Transportation and Water

- Sewer and water lines along streets
- Active transportation paths along water bodies
- Transportation infrastructure decreases permeable surfaces which increases stormwater runoff
- Transportation routes may disrupt natural movement of water bodies
- Stormwater network to prevent flooding of the road network



Transportation and Green

- Urban green can offset carbon emissions
- Importance of green space within walking/active transportation distance
- Trees can incentivize active transportation
- Tree spacing impacts the spacing of streets/sidewalks
- Trees can reduce stormwater runoff to reduce runoff on roads



Transportation and Buildings

- Increasing building density and transportation intensity provides high density buildings and public transit
- Building design with high density affects transit decisions
- Bicycle stands and parking locations near buildings
- Building types and land use affects road types/size
- Size and shape of buildings are affected by road use



Transportation and Energy

- Effective public transportation can reduce passenger vehicle usage, reducing energy use
- Clean electricity grid makes electric vehicles viable
- Charging stations and their frequency on the roads
- Electricity intensity affects transportation mix
- Electric public transit increases electricity consumption

3 TAKEAWAYS



The decisions we make today will far outlive us



Transportation infrastructure is the heart of the community



The future we want may not be the future we get

Thank You



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