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International
Energy Agency

1. Energy use and potential in urban systems

IEA #energyefficientworld

Training Overview

1. Energy use and potential in urban systems

Scenario: Your mayor/governor is under pressure to reduce energy consumption

Question: How do you help the mayor/governor understand the drivers of energy consumption in the city?

Training Overview

1. Why is urban energy use important?

- Urbanisation and energy use
- Impacts of energy use in urban areas

10 mins

2. What's the potential for energy efficiency in cities?

- Technologies and solutions that allow higher efficiency

5 mins

3. Activity: mapping of urban authority influence

30 mins

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Training Overview

- This session gives a broad overview of why energy use in urban systems is relevant (concentration of energy-consuming economic activities, and the increasing urbanisation)
- The **impacts of these activities** are laid out as well (energy use, emissions, urban heat island). We do this to call attention to the scale of the impacts and the need to act.
- Then we elaborate the drivers responsible for these changes. We do this to **highlight the aspects** that can be controlled / regulated by policy.
- The aim of the activity towards the end is to:
  - Get a sense of the level of authority and influence of participants over the energy-consumption
  - To allow the participants to understand their sphere of influence and which stakeholders to contact in areas where influence is insufficienct
- The **following sessions** will then cover the specifics of how each subsystem of the city/municipality consumes energy, analysing the drivers, and the recommendations to control them.

1. Why is urban energy use important?

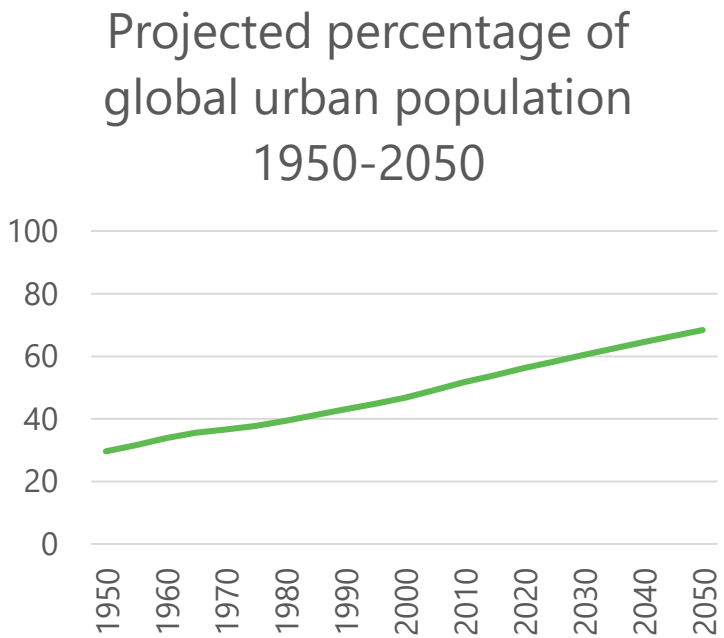
Why is urban energy use important?

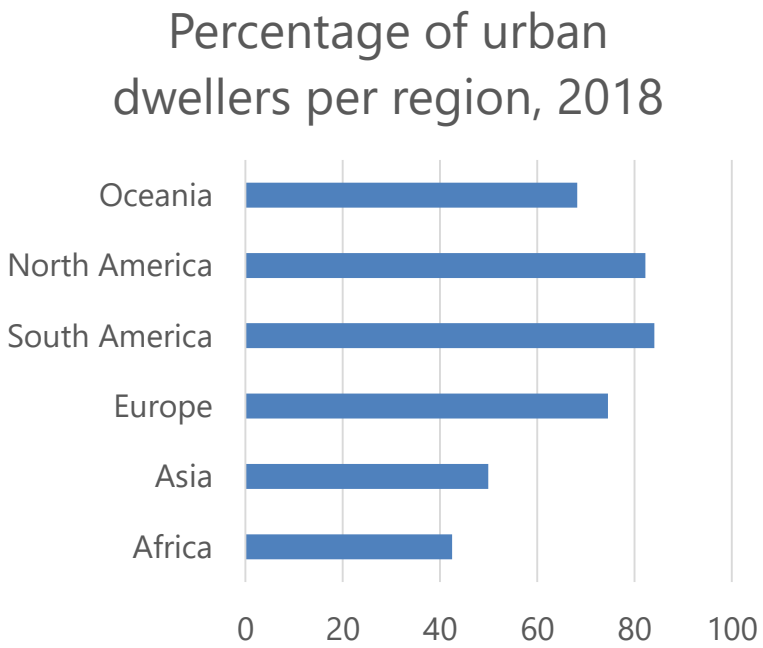
Urban areas account for the greatest shares of both **global population** and world **economic activity**, two **key drivers of energy use**.

As such, the world's urban areas have substantial influence over **global energy demand and energy-related emissions**

Why is urban energy use important?

Urban areas are growing, especially in emerging economies





Source UN Population Division, The Atlas

Why is urban energy use important?

Role of urban authorities: A few of the main responsibilities of cities/municipalities are…

Planning

- Land use
- Urban planning
- Building regulations
- Transport planning
- Municipal infrastructure

Basic Necessities

- Air quality
- Water supply
- Solid waste disposal
- Sanitation
- Public health
- Education

Other Services

- Street lighting
- Social housing
- Traffic and parking
- Public safety

Why is urban energy use important?

… and they involve energy-consuming sectors below in one way or another

Buildings

Public administration buildings, retail and residential buildings, schools, hospitals, museums, social housing

Transport

Public transport, street design, traffic signals and signage

Utilities

Lighting, water, sewerage, local energy and communication networks

Waste

Landfilling, waste management

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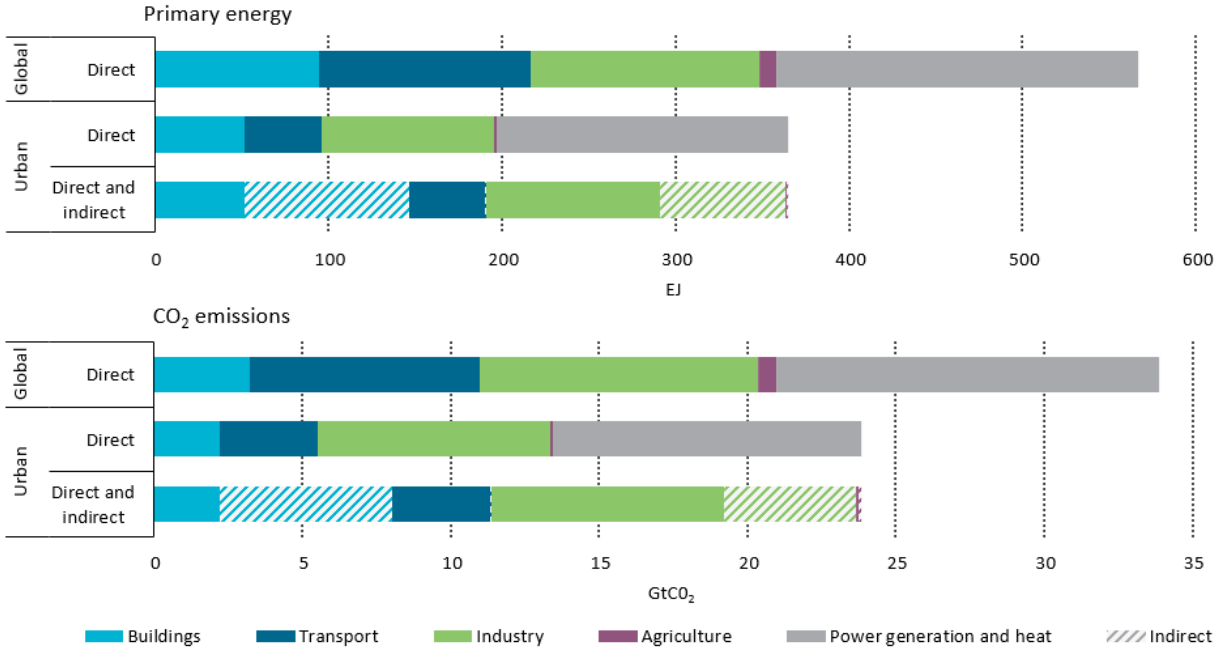
Why is urban energy use important?

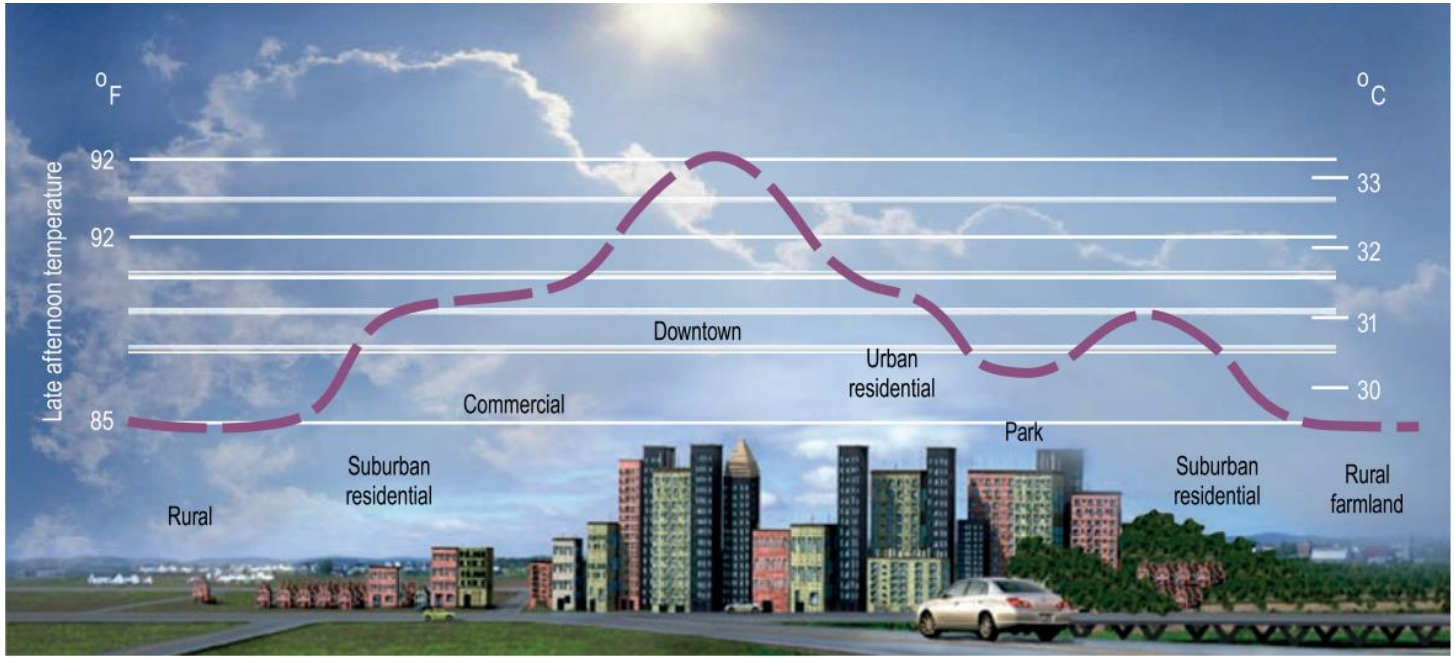
What happens in urban areas: Majority of global energy use and greenhouse emissions comes from cities



Source Energy Technology Perspectives 2016

Why is urban energy use important? Impacts

What happens in urban areas: Urban structures produce heat island effect, which exacerbates need for cooling

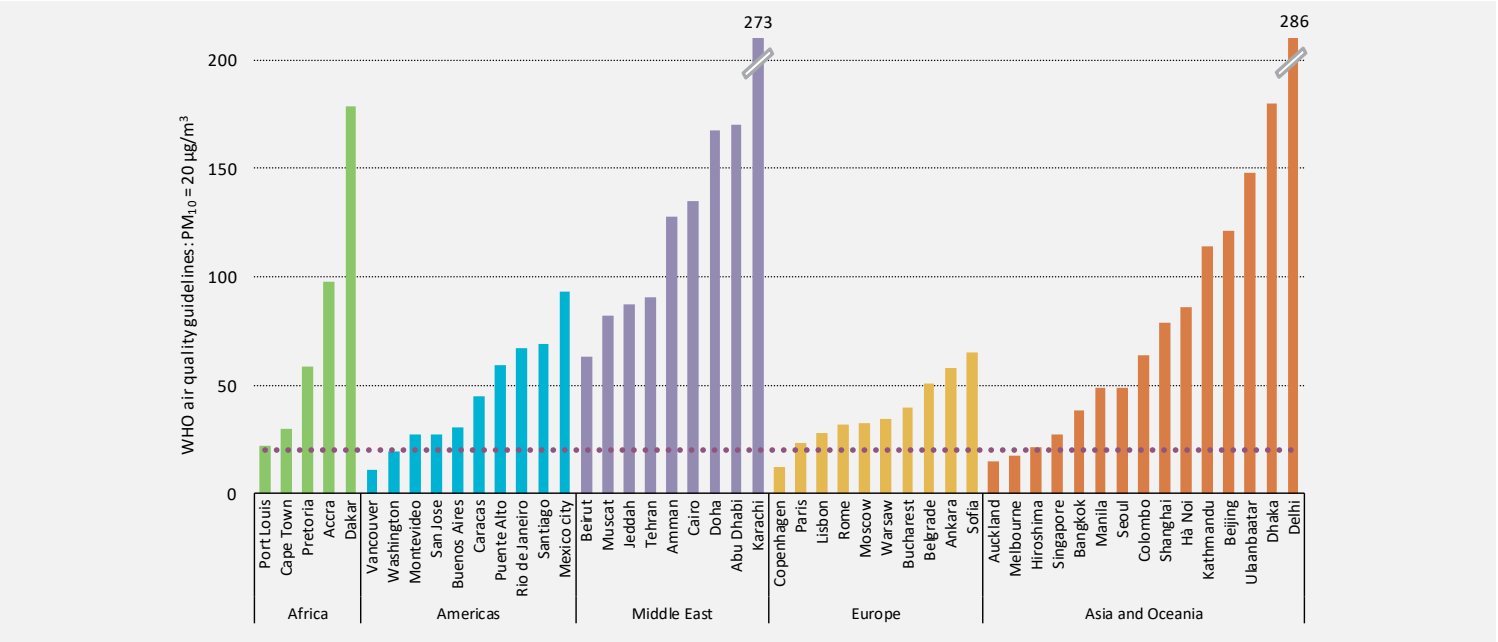


Source: LBNL (2013), Heat Island Group, http://heatisland.lbl.gov/

Why is urban energy use important? Impacts

Where to start? | Tools | What are the steps?

What happens in urban areas: Local air quality is also worse in urban areas, exceeding WHO guidelines of 20 µg/m3, due to externalities of energy use



Source Energy Technology Perspectives 2016

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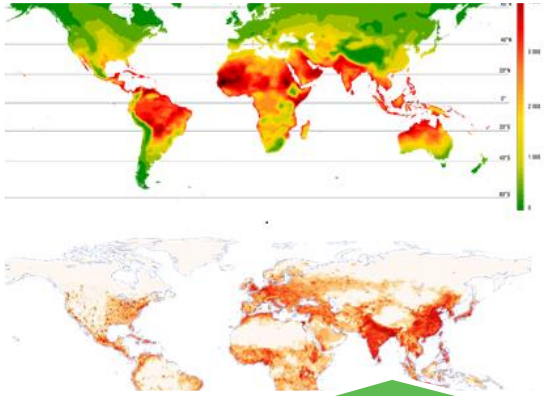
Why is urban energy use important?

What drives energy use in urban areas?

Why is urban energy use important? Drivers of Energy use



Geophysical

Structural

Socio-economic

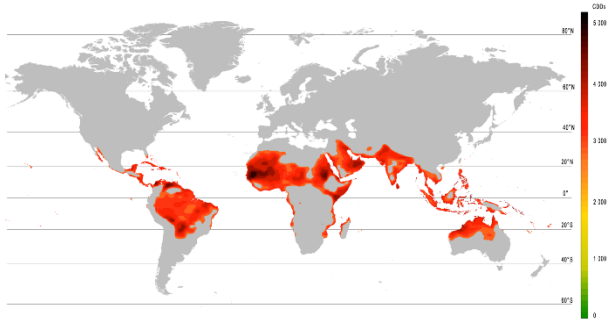
Sources: https://www.popsci.com/city-shape-grid-heat-island-temperature#page-4; https://en.wikipedia.org/wiki/Urban_heat_island#/media/File:20080708_Chicago_Central_Green_Roof.JPG

Why is urban energy use important? Drivers of Energy use

Where to start? | Tools | What are the steps?

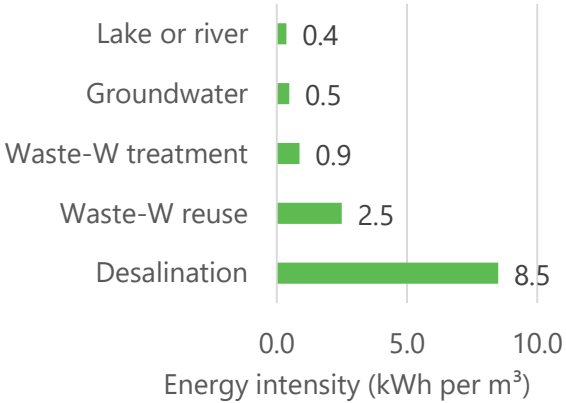
Geophysical

- **The hotter/more humid the climate, the higher the demand for cooling like air-conditioning**



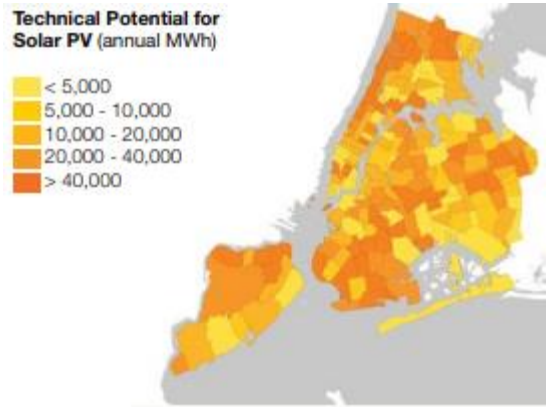
Source https://www.iea.org/futureofcooling/

- **More water-strained, more energy-intensive and costly to deliver water**



EPRI Water and Sustainability Volume 4
https://www.epri.com/#/pages/product/1006787/

- **Topography strongly influences solar irradiation and wind flows even before the built form**



City University of New York
https://nysolarmap.com

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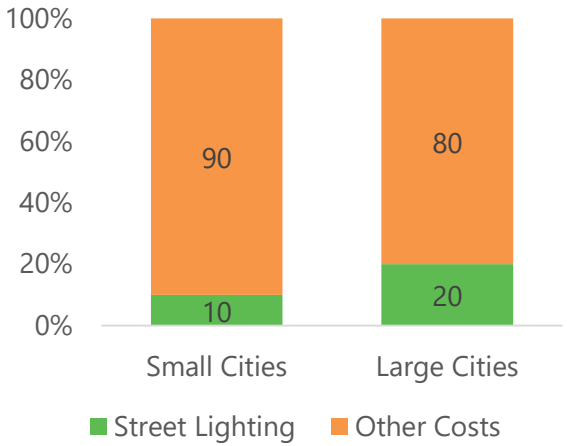
Why is urban energy use important? Drivers of Energy use

Where to start? | Tools | What are the steps?

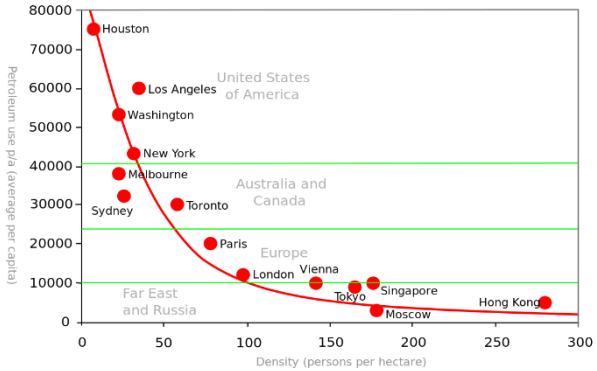
Structural

- **Bigger cities need more lighting, hence consume more energy**

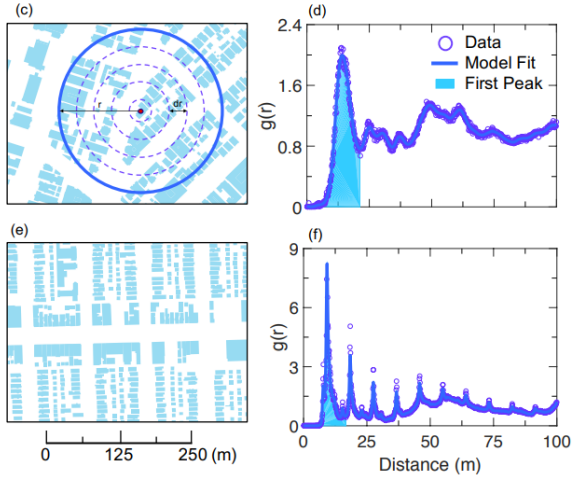


Source http://blogs.worldbank.org/energy/led-street-lighting-unburdening-our-cities

- **More sprawled cities use more energy than dense ones (transport use, water pumping costs)**



- **The more grid-like, the more it traps heat**

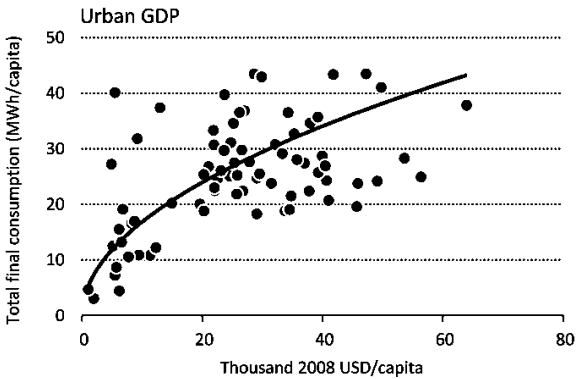


Source http://cshub.mit.edu/sites/default/files/documents/CityTextureUHI_Feb2018.pdf

Why is urban energy use important? Drivers of Energy use

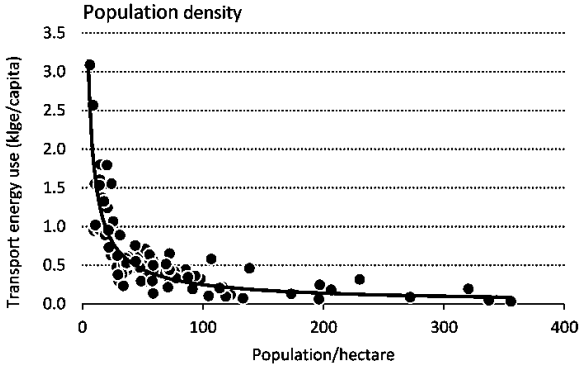
Socio-economic

- **Higher income urban population tends to consume more energy per capita**



Source IEA ETP 2016

- **More dense population consumes less energy per capita**



Source IEA ETP 2016

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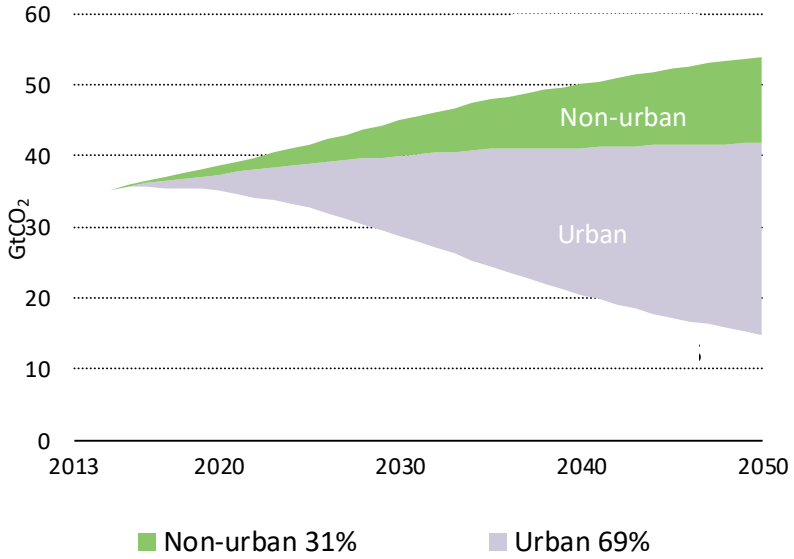
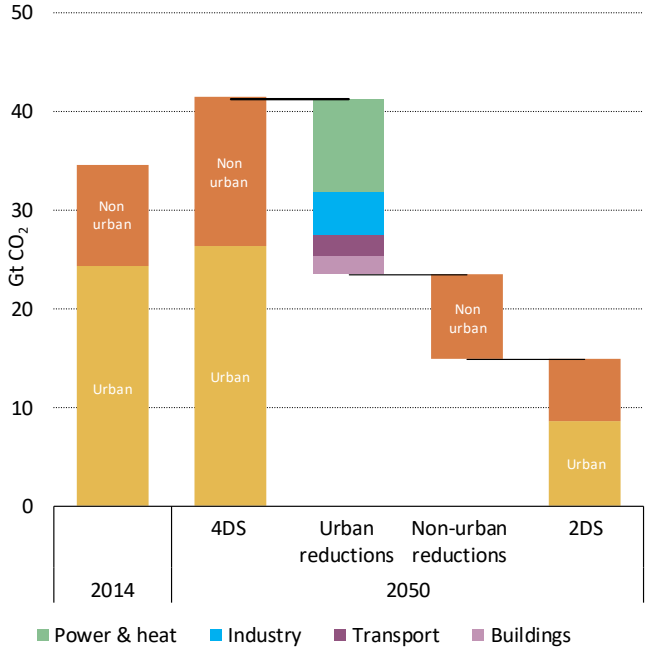
Why is urban energy use important? Opportunity

Where to start? | Tools | What are the steps?

Fortunately, the majority of opportunities to reduce energy use and emissions are also in urban areas





Source: Energy Technology Perspectives 2016

2. What is the potential for energy efficiency in urban systems?

What is the potential for energy efficiency in urban systems?

- **URBAN PLANNING and TRANSPORT:** Potential for **obtaining lower emissions and energy use** based on planning design, influencing transport

Carbon footprints (residential emissions) in different neighbourhoods in Toronto, Canada

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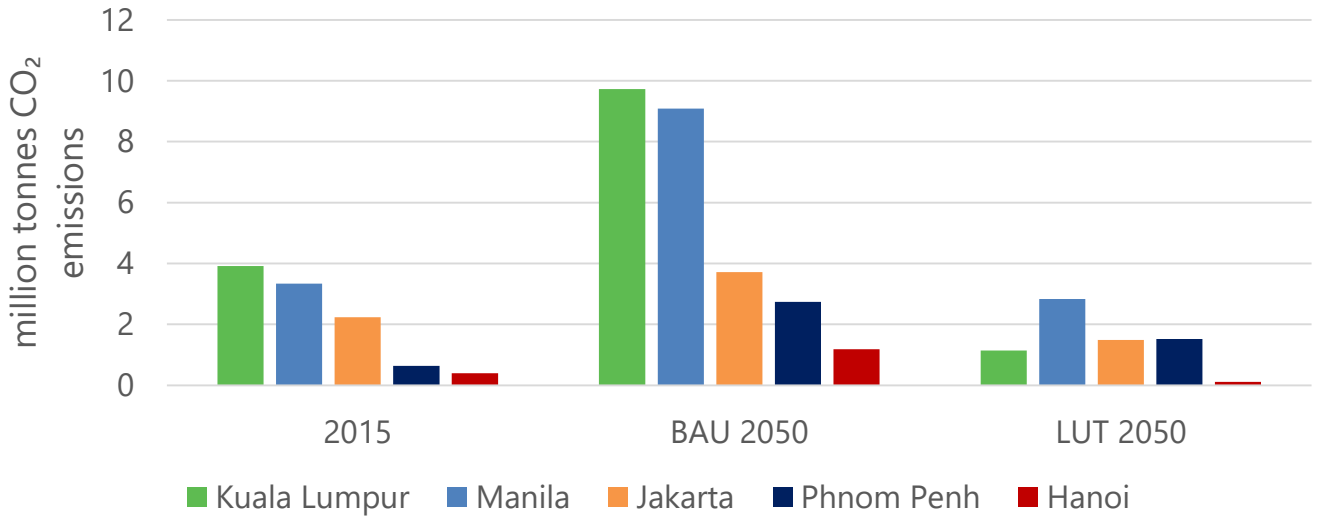
What is the potential for energy efficiency in urban systems?

Total CO_2 emissions in Southeast Asian cities in Business-as-Usual (BAU) and Improved Land Use and Transport (LUT) scenarios



Improving land use and transport could reduce 50% of global CO_2 emissions.
In Southeast Asia, reduction could be between 58% to 93%

Source: http://www.oecd.org/about/publishing/itf-transport-outlook-2017-9789282108000-en.htm; http://dx.doi.org/10.1787/888933442845

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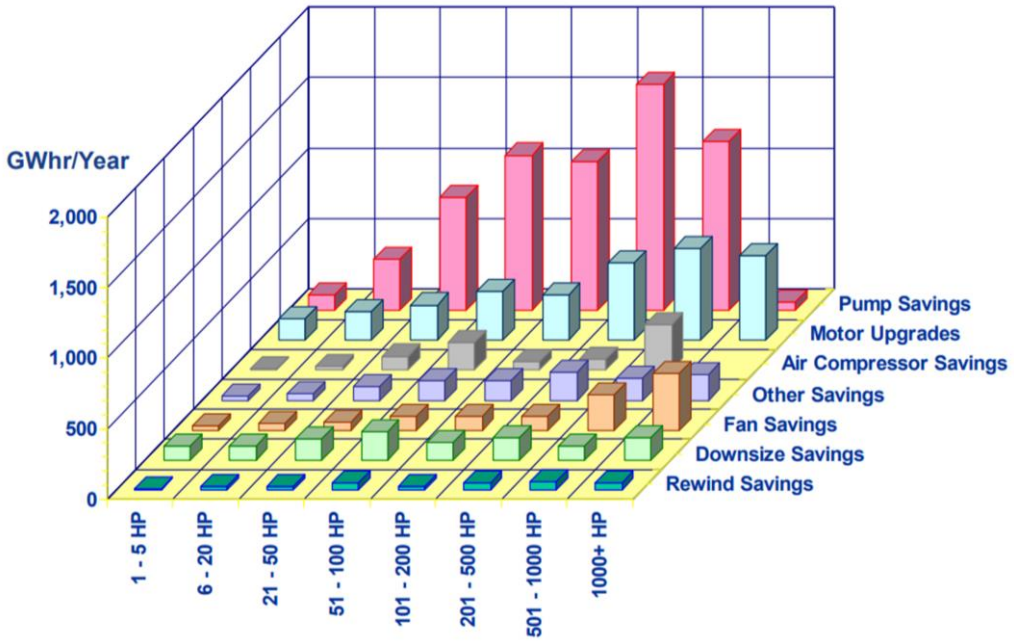
What is the potential for energy efficiency in urban systems?

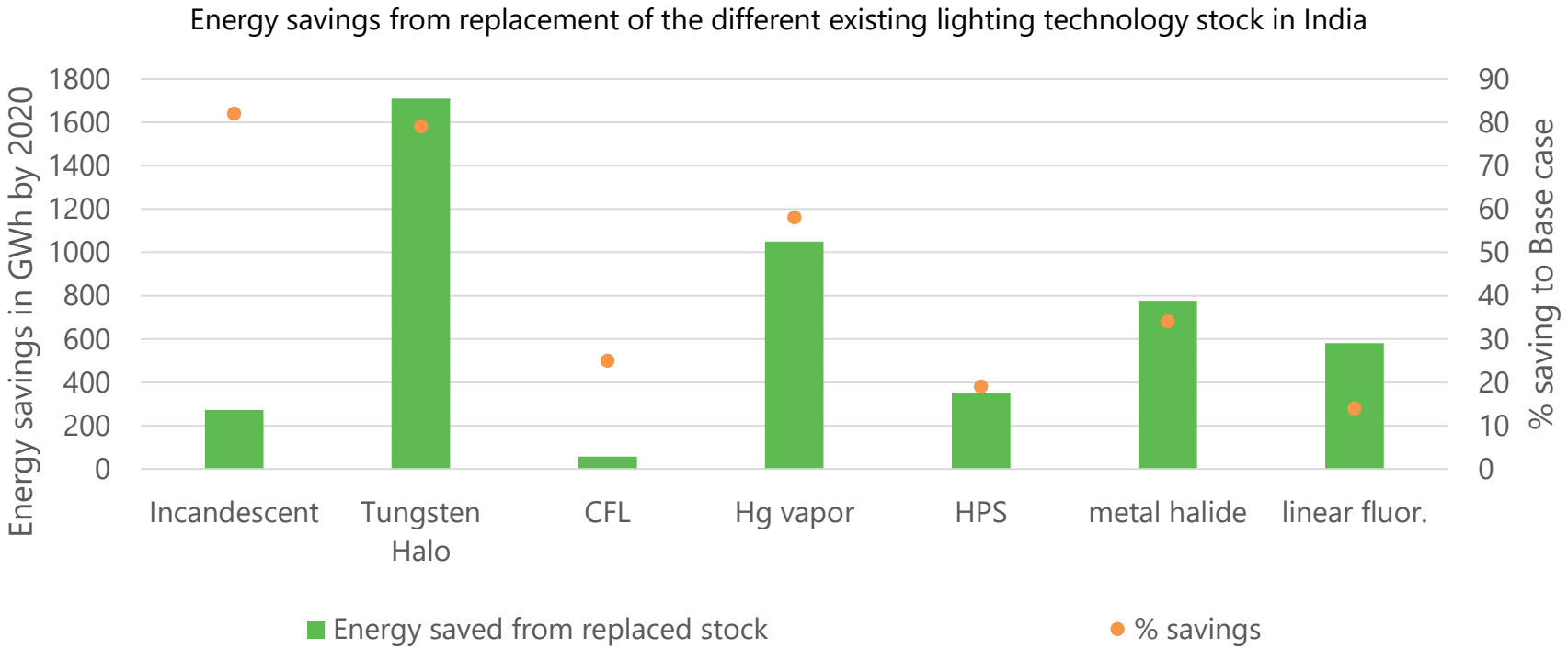
Electricity savings from higher efficiency motors in different sizes and motor-driven applications



Savings based on the sizes of the motors and hours of operation could go up to 1500 GWhr/yr

Source https://betterbuildingssolutioncenter.energy.gov/

What is the potential for energy efficiency in urban systems?

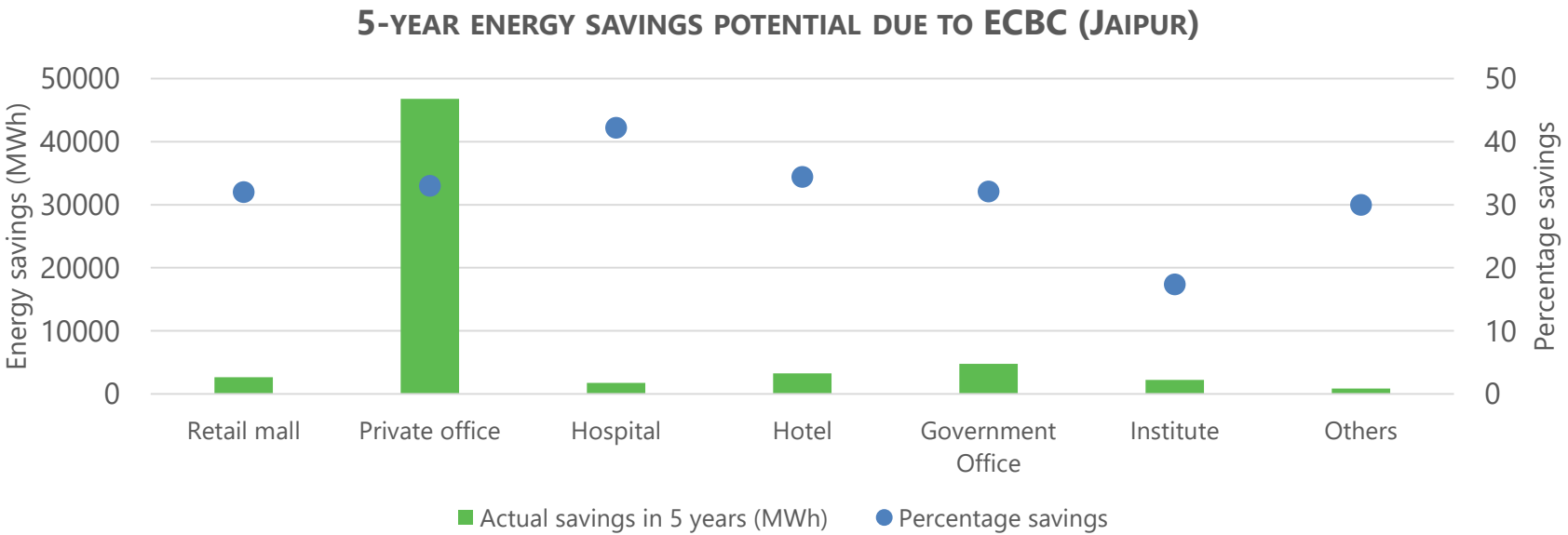


Average energy savings from replacing existing stock of public lighting technologies in India could reach as high as 1600 GW, and 82% in terms of percentage savings

Source https://ies.lbl.gov/sites/all/files/lbnl6576e.pdf

What is the potential for energy efficiency in urban systems?

Energy savings achievable upon implementation of the Energy Conservation Building Code in the city of Jaipur

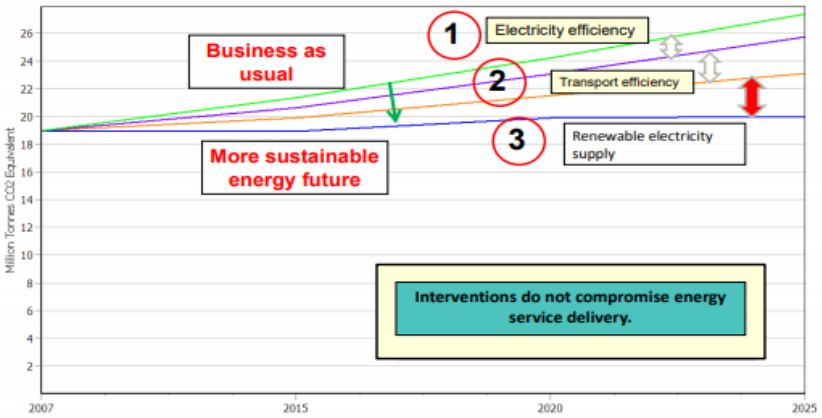


Municipalities in India implementing building codes can expect to gain high savings from private buildings, as well as high percentage savings from their own municipal buildings

Source https://doi.org/10.1016/j.enbuild.2012.11.015 ; https://www.wri.org/blog/2017/11/indias-move-make-buildings-efficient

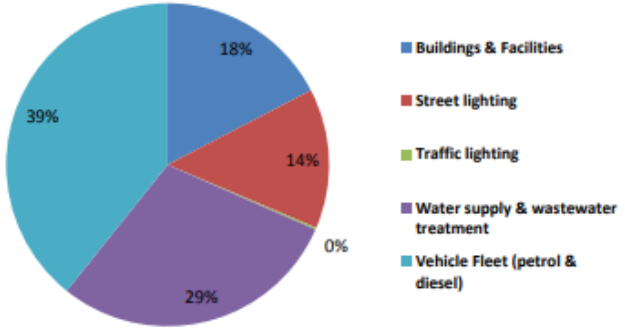
What is the potential for energy efficiency in urban systems?

City carbon future modelling (Cape Town) showing the impact of different policies on carbon emissions



Source: Sustainable Energy Africa (2013) Energy and urbanisation in South Africa http://www.cityenergy.org.za/uploads/resource_262.pdf

Potential energy savings per Sector (GJ/a) in 9 cities of the South African Cities Network (SACN)



Source: South African Cities Network (2014) http://sacitiesnetwork.co.za/wp-content/uploads/2014/07/Modelling-Energy-Efficiency-Potential-in-SACN-Cities-full-report.pdf

There are significant EE opportunities at the urban level in South Africa with significant and multiple benefits

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3. Activity: Mapping of urban authority influence

Activity: Mapping of urban authority influence

Break into groups of 6

Scenario: Your municipal commissioner is under pressure to reduce energy consumption

Question: How do you help the commissioner understand the drivers of energy consumption in the municipality?

What level of influence do you have on the

energy consuming aspects of your municipality?

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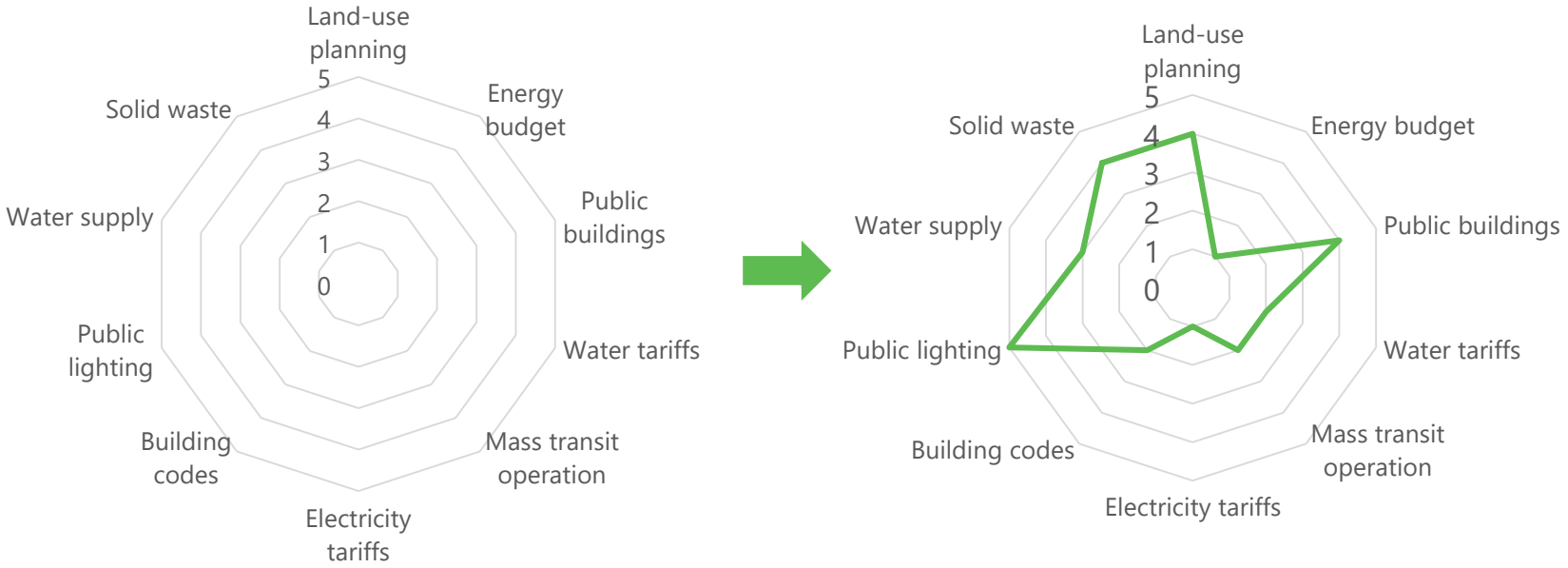
Activity: Mapping of urban authority influence

What level of influence do you have on the energy consuming aspects of your municipality?



1 = no influence

3 = some level of influence (consulted, involved as stakeholder)

5 = complete authority and direction

Source Adapted from ESMAP 2012 Energizing Green Cities in Southeast Asia

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