



1. Energy use and potential in urban systems

John Dulac

Paris, 21 May 2019



IEA #energyefficientworld

1. Energy use and potential in urban systems

Trainer(s): John Dulac

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?

1. Activity: mapping of urban authority influence

30 mins

2. Why is urban energy use important?

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

15 mins

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

- Technologies and solutions that allow higher efficiency

15 mins

1. Activity: Mapping of urban authority influence

1. Activity: Mapping of urban authority influence



Break into groups of 6

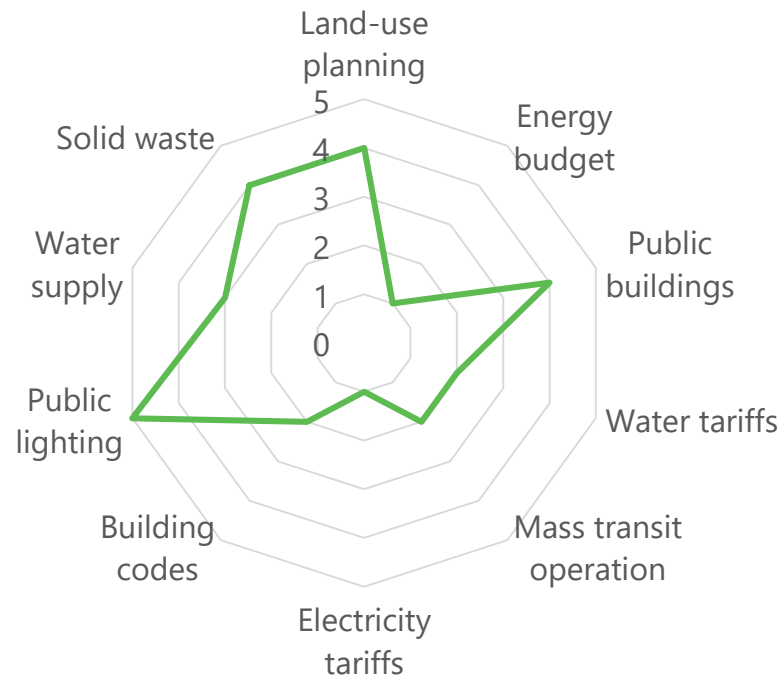
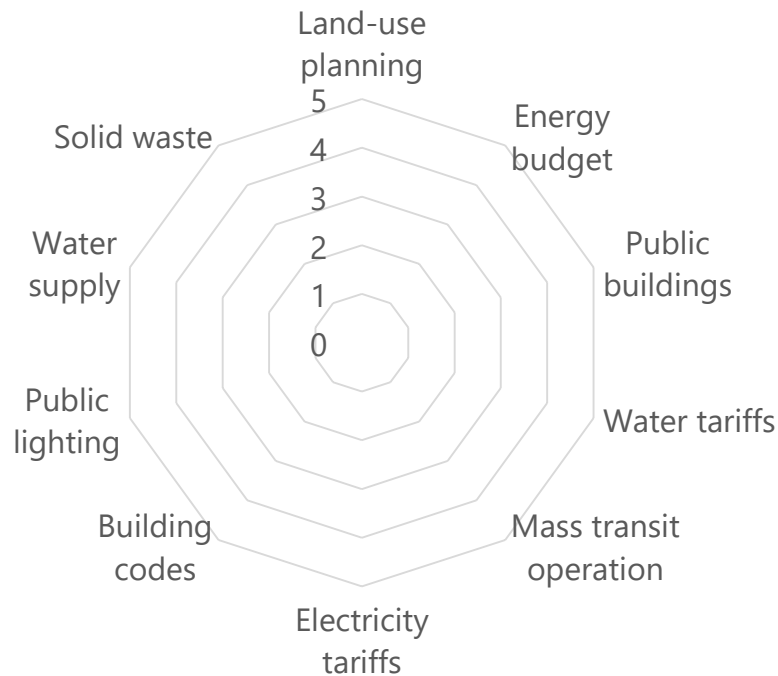
Scenario: Your municipal commissioner is under pressure to reduce energy consumption

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?**

1. 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**

2. Why is urban energy use important?

2. Why is urban energy use important?

Where to start?

Tools

What are the steps?

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**

2. Why is urban energy use important?

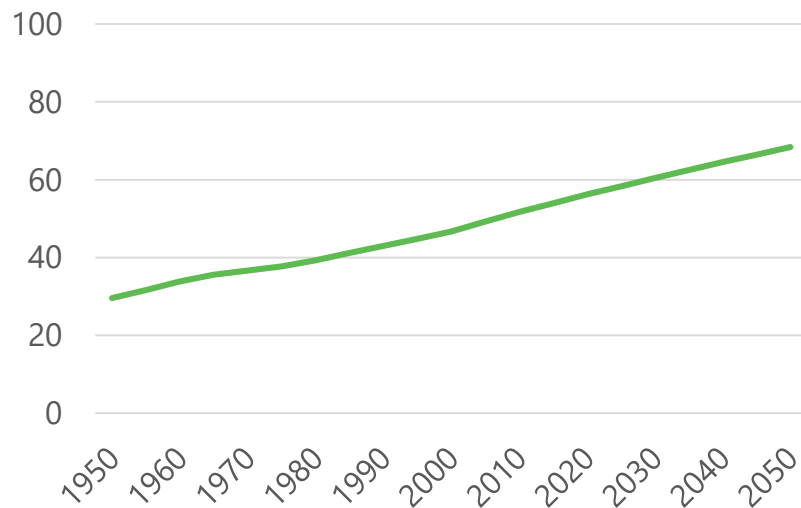
Where to start?

Tools

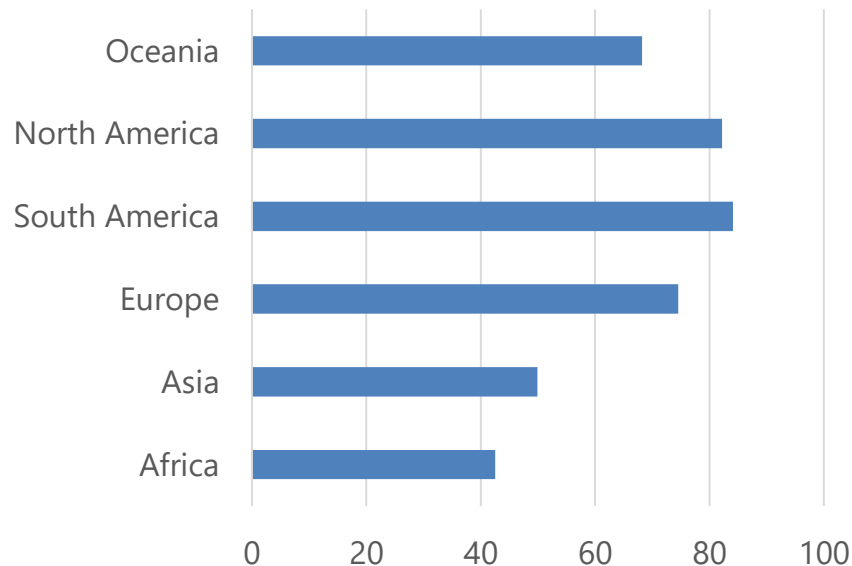
What are the steps?

Urban areas are growing, especially in emerging economies

Projected percentage of
global urban population
1950-2050



Percentage of urban dwellers
per region, 2018



2. Why is urban energy use important?

Where to start?

Tools

What are the steps?

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

Planning

- Urban planning
- Building regulations
- Infrastructure

Basic Necessities

- Water supply
- Public health
- Sanitation

Other Services

- Street lighting
- Social housing
- Parking, public transport

2. Why is urban energy use important?

Where to start?

Tools

What are the steps?

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



Buildings

Public
administration
buildings, schools,
hospitals, libraries,
museums, social
housing



Transport

Public transport,
street design,
traffic signals and
signage



Utilities

Lighting, water
local energy
networks



Waste

Landfilling, waste
management

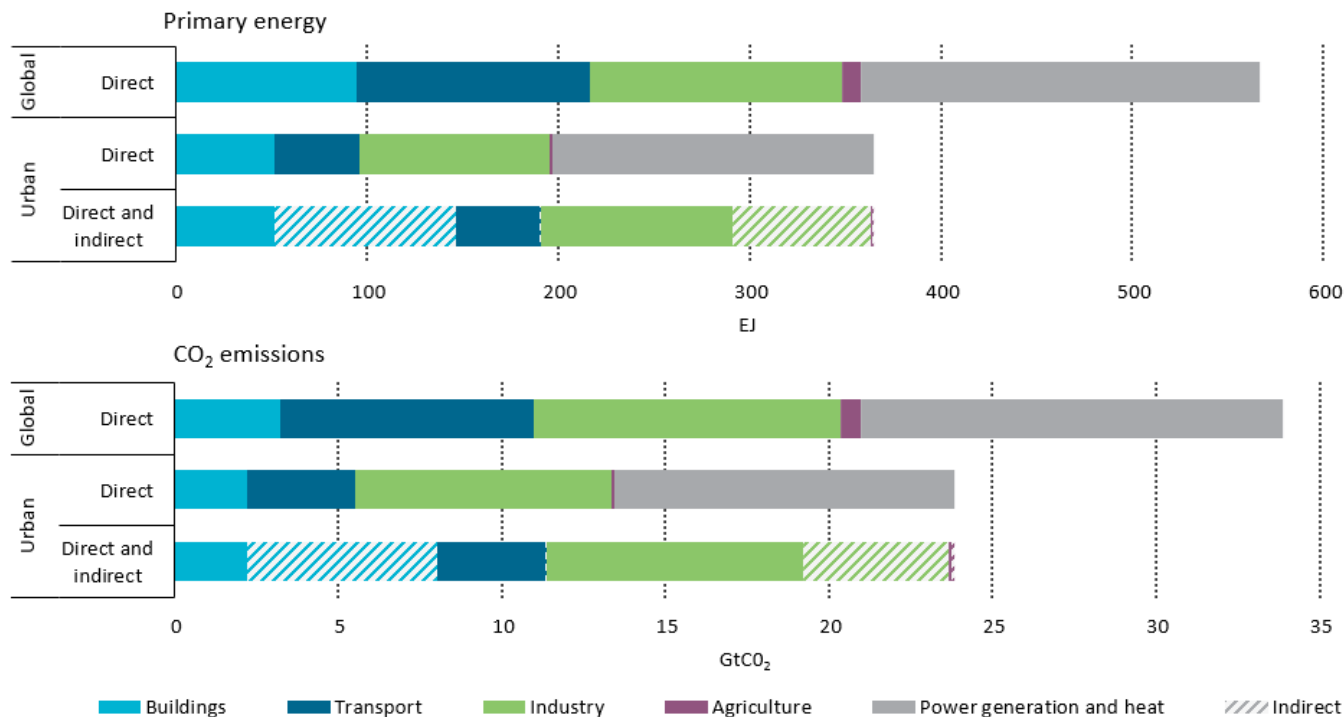
2. Why is urban energy use important?

Where to start?

Tools

What are the steps?

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



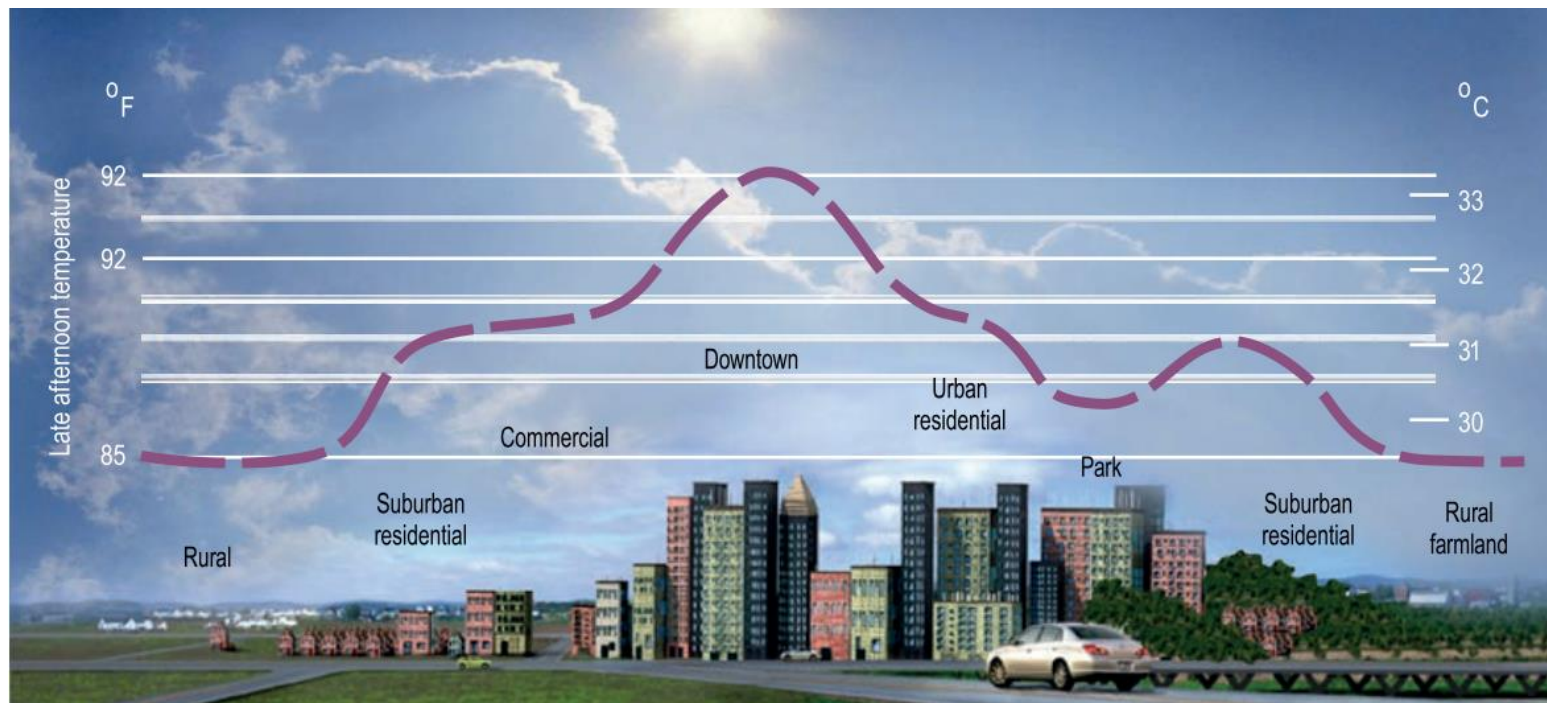
2. Why is urban energy use important? Impacts

Where to start?

Tools

What are the steps?

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



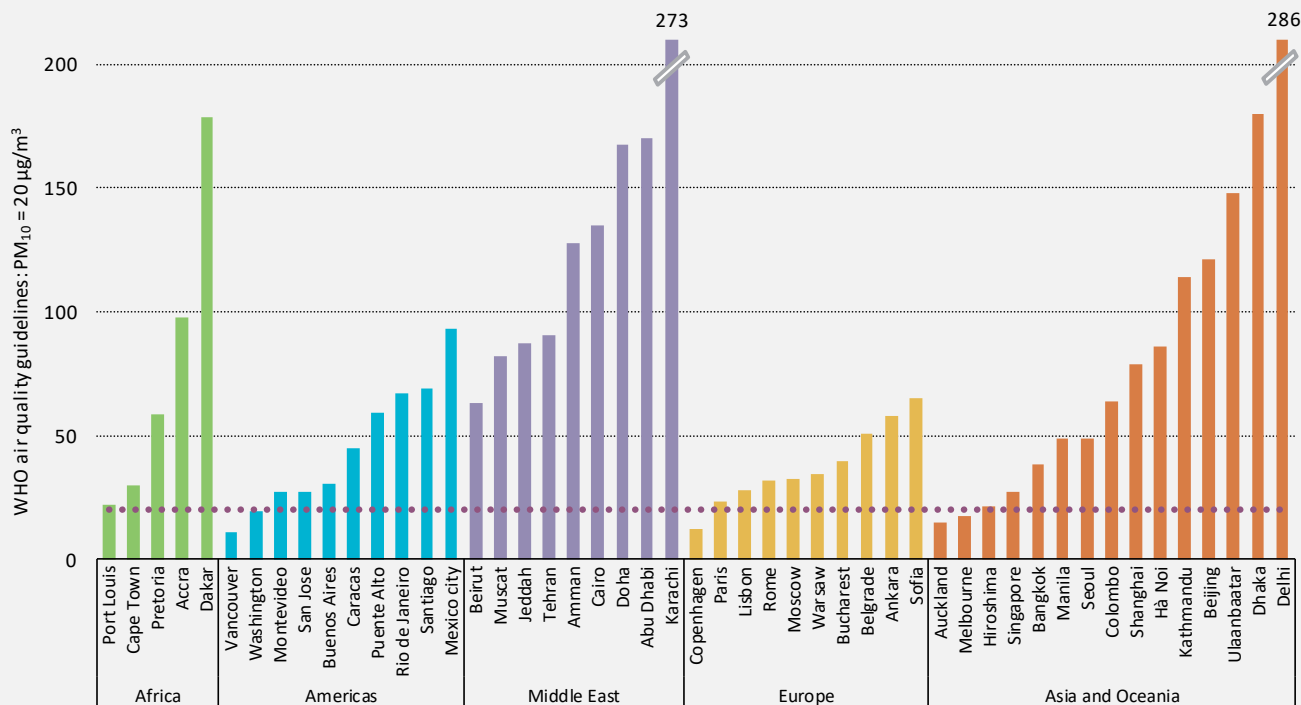
2. Why is urban energy use important? Impacts

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 $20 \mu\text{g}/\text{m}^3$, due to externalities of energy use



2. Why is urban energy use important?

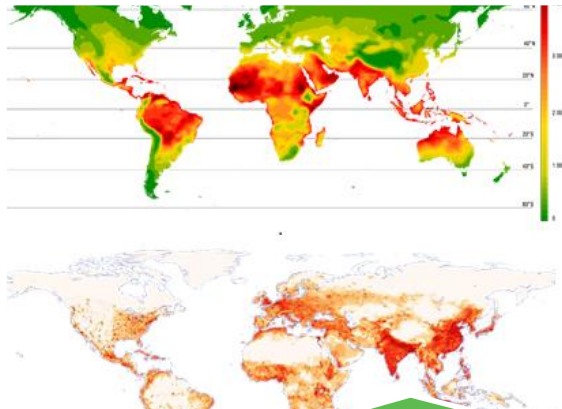
What drives energy use in urban areas?

2. Why is urban energy use important? Drivers of Energy use

Where to start?

Tools

What are the steps?



Geophysical



Structural



Socio-economic

2. Why is urban energy use important? Drivers of Energy use

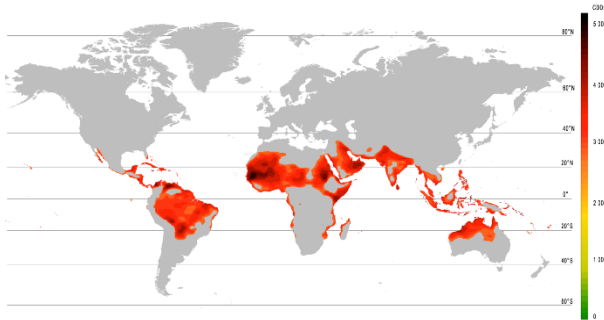
Where to start?

Tools

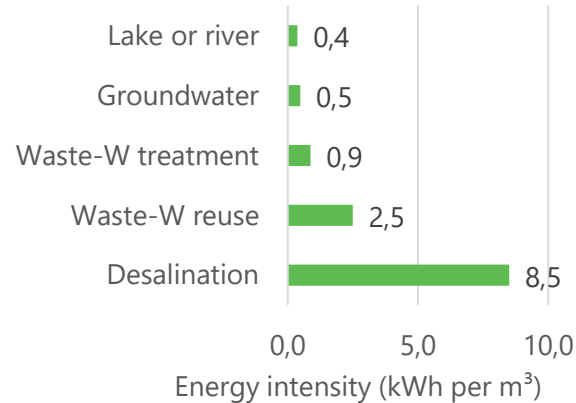
What are the steps?

Geophysical

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



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



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

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

2. Why is urban energy use important? Drivers of Energy use

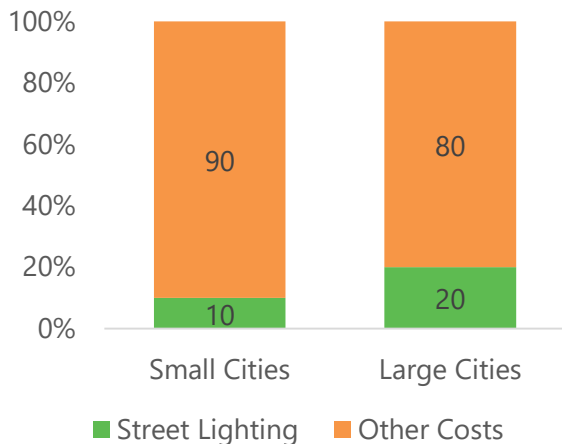
Where to start?

Tools

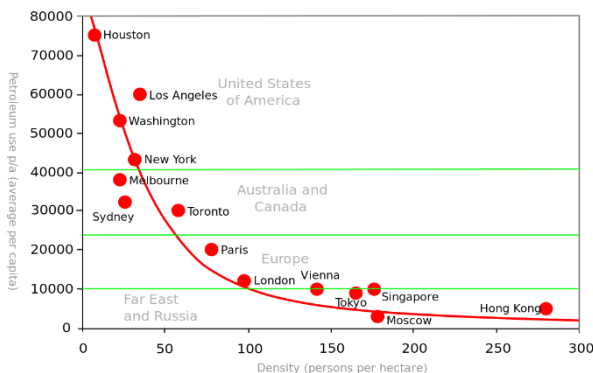
What are the steps?

Structural

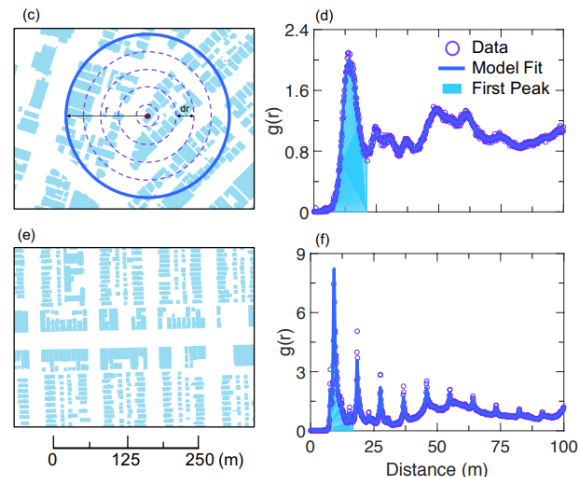
- Bigger cities need more lighting, hence consume more energy



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

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

2. Why is urban energy use important? Drivers of Energy use

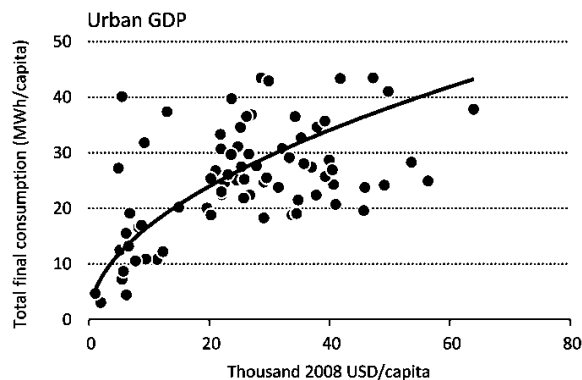
Where to start?

Tools

What are the steps?

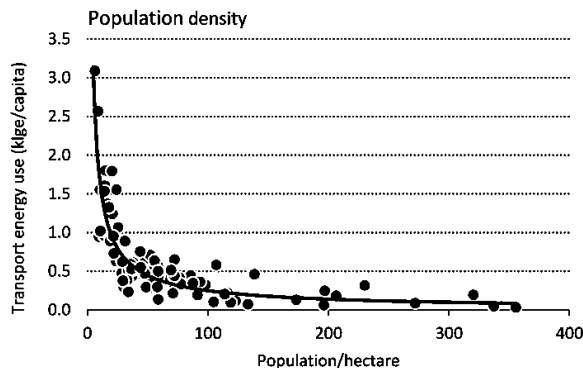
Socio-economic

- **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

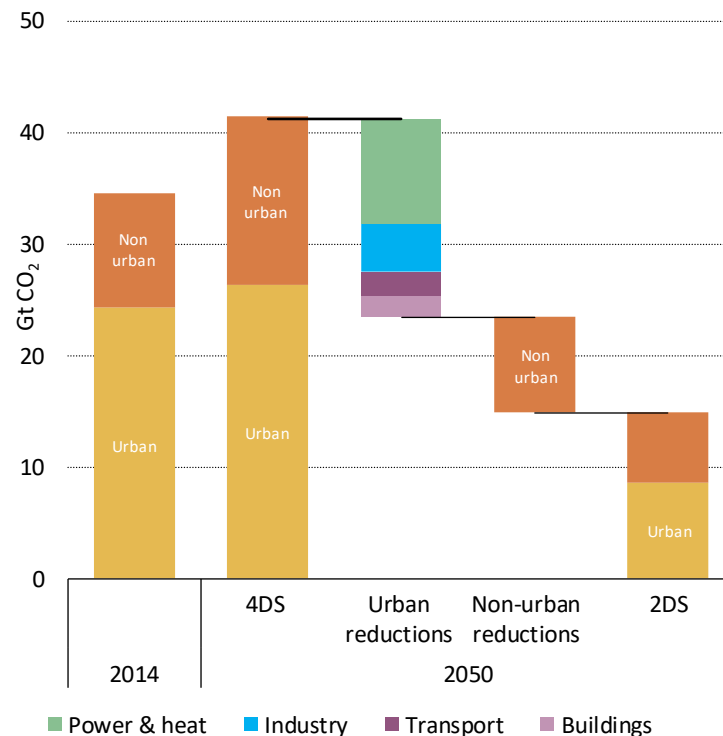
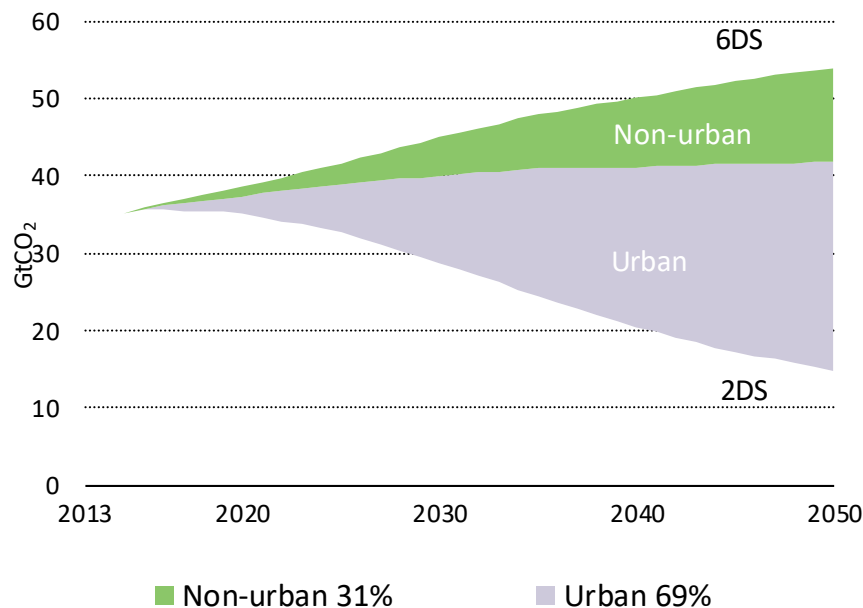
2. Why is urban energy use important? Opportunity

Where to start?

Tools

What are the steps?

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



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

2. What is the potential? Concept of energy efficiency potential



Where to start?

Tools

What are the steps?

- **Technical potential:** analysing the total energy efficiency potential without any economic or market constraints (e.g. analysing the energy savings potential if all buildings used best-available technology)
- **Economic potential:** analysing the energy efficiency potential assuming economic constraints for cost effectiveness (e.g. analysing the energy savings potential if buildings used the most-efficient, cost-effective technology)
- **Market potential:** analysing the energy efficiency potential assuming market constraints in implementing energy efficiency (e.g. analysing the energy savings potential using an adoption curve to estimate typical market implementation given the available policies and technologies)

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

Where to start?

Tools

What are the steps?

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

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



East York - 1.31 tCO₂e/cap (residential only)

High-density apartment complexes within walking distance to a shopping center and public transit:
1,31 tCO₂e/capita



Etobicoke - 6.62 tCO₂e/cap (residential only)

High-density single family homes close to the city center and accessible by public transit:
6,62 tCO₂e/capita



Whitby 13.02 tCO₂e/cap (residential only)

Suburbs with large, low-density single family homes that are distant from commercial activity and public transit:
13,02 tCO₂e/capita

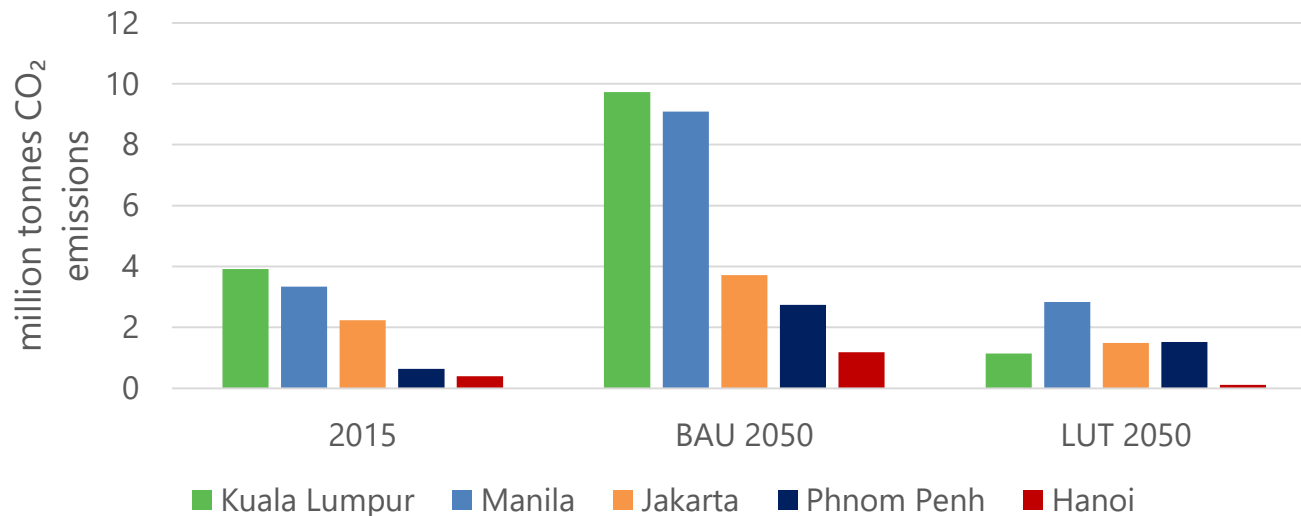
2. What is the potential for energy efficiency in urban systems?

Where to start?

Tools

What are the steps?

Total CO₂ 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 CO₂ emissions.
In Southeast Asia, reduction could be between 58% to 93%**

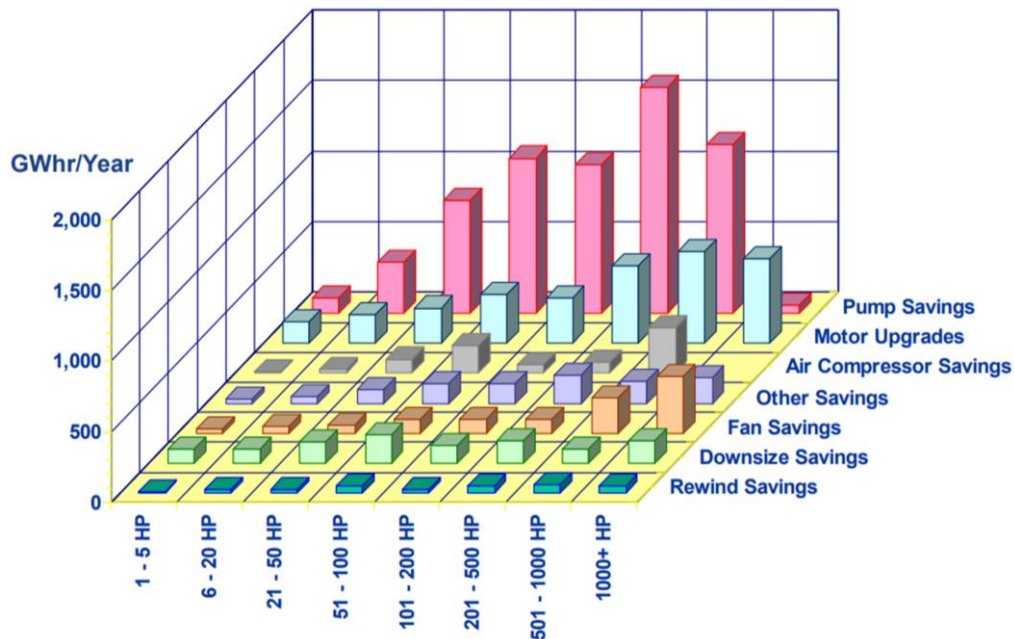
2. What is the potential for energy efficiency in urban systems?

Where to start?

Tools

What are the steps?

- **WATER:** potential to save energy from motor replacement based on size and application



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

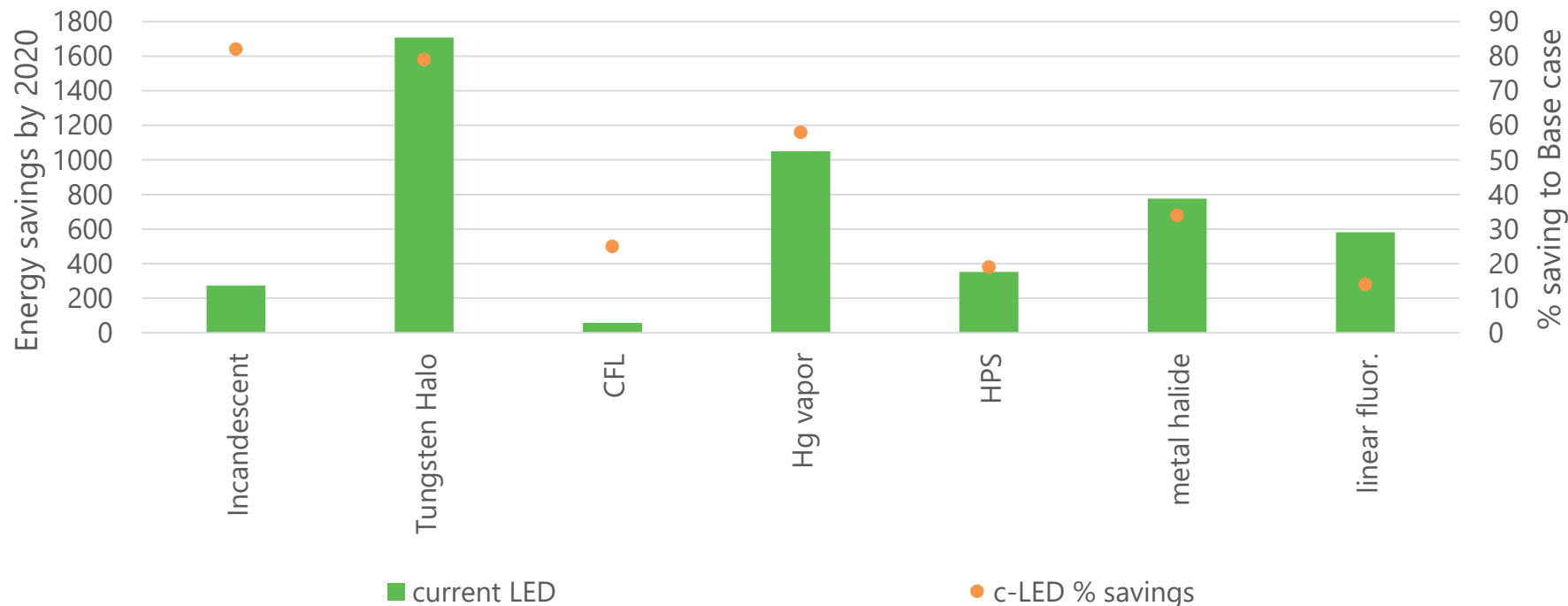
2. What is the potential for energy efficiency in urban systems?

Where to start?

Tools

What are the steps?

- **LIGHTING:** Potential to save on street lighting by 2020 using the current generation LED lamps in replacing the existing lamp technologies (India)



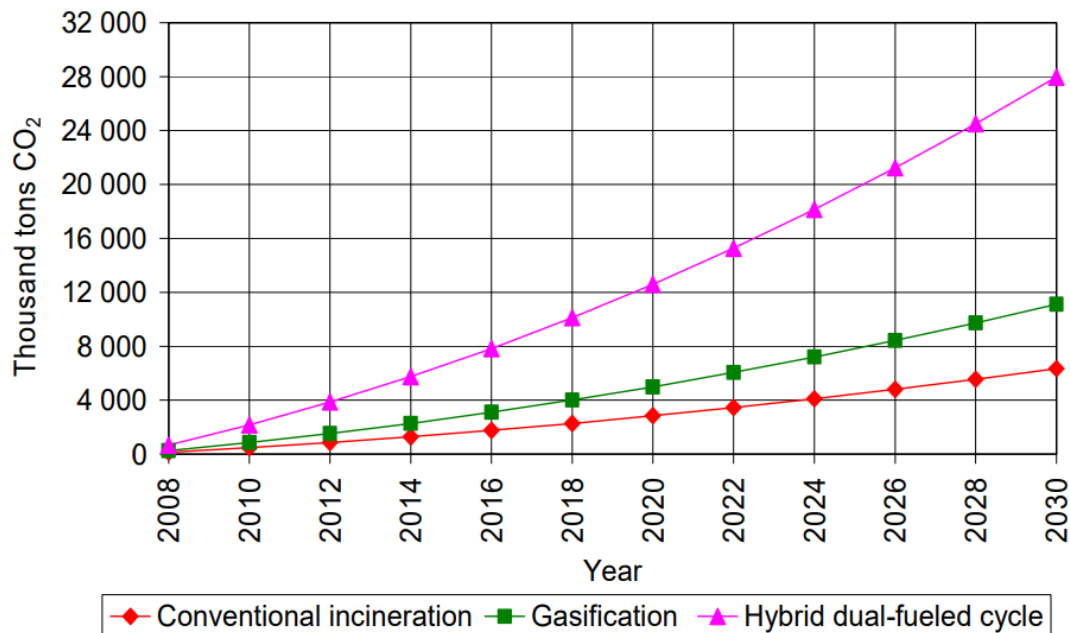
2. What is the potential for energy efficiency in urban systems?

Where to start?

Tools

What are the steps?

- **WASTE:** Efficient waste management leading to waste-to energy technologies like incineration and gasification can recover between **4 to 10TWhr (Bangkok)**



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

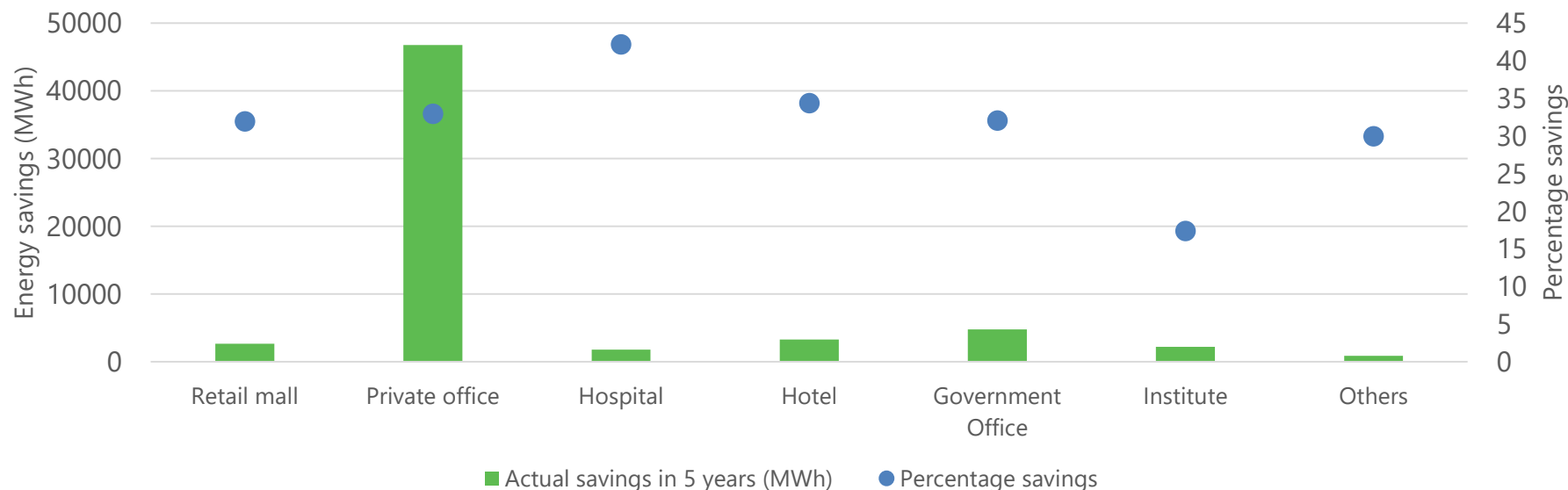
Where to start?

Tools

What are the steps?

- **OTHERS** - Potential of high energy savings by simply enforcing the national building codes

5-YEAR ENERGY SAVINGS POTENTIAL DUE TO ECBC (JAIPUR)





www.iea.org



IEA #energyefficientworld