Energy efficiency of settlement structures

Dr. Maciej Zathey & Robert Skrzypczynski, WUST / IRT

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Our background

Organizational unit of the **self-government of the Lower Silesia** voivodship responsible for **strategic & spatial planing in the region**
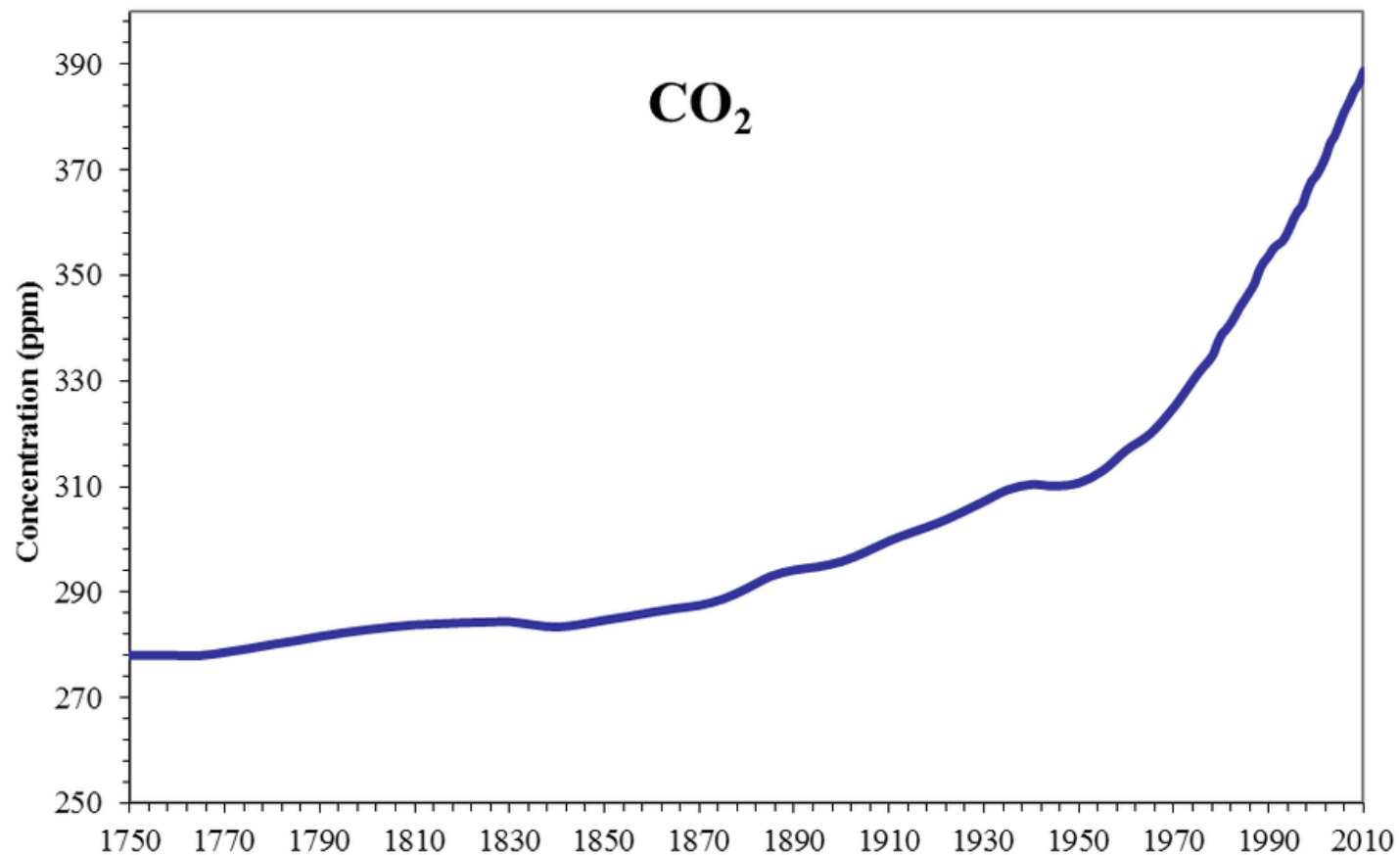
Faculty of Architecture

Chair of Urban Planning and Settlement Processes

Global problem

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Global problem

carbon dioxide

Energy: 74%

World greenhouse-gas emissions

Agricultural by-products: 12.5%

Land use, biomass burning: 10%

Waste: 3.4%

methane

nitrous oxide

Figure 1.9. Breakdown of world greenhouse-gas emissions (2000) by cause and by gas. "Energy" includes power stations, industrial processes, transport, fossil fuel processing, and energy-use in buildings. "Land use, biomass burning" means changes in land use, deforestation, and the burning of un-renewed biomass such as peat. "Waste" includes waste disposal and treatment. The sizes indicate the 100-year global warming potential of each source. Source: Emission Database for Global Atmospheric Research.

(source: https://www.withouthotair.com/c1/figure8.png)

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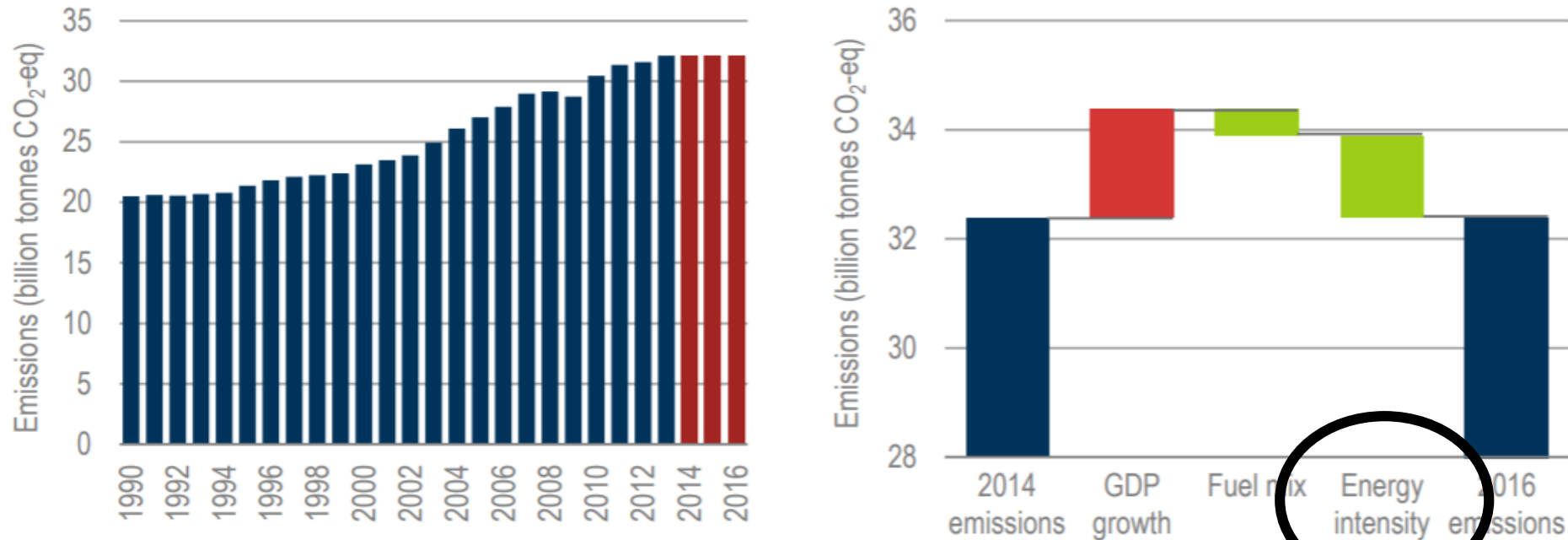Visegrad Fund

Global problem

Figure 1.6 Global energy-related GHGs since 1990 (left) and an analysis of the factors that influence GHGs, 2014-16 (right)
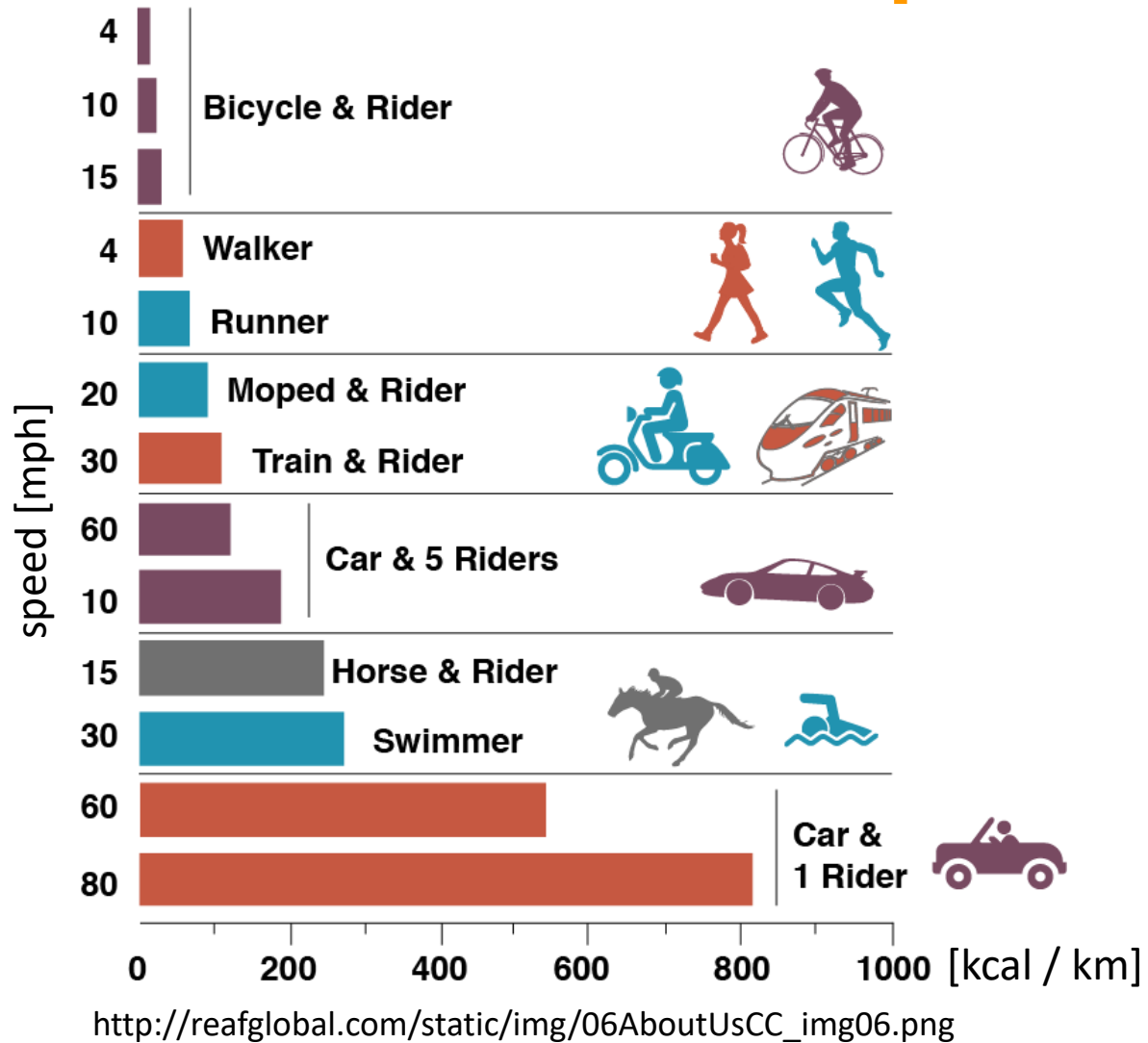

Note: Energy intensity is calculated as TPES per thousand USD of GDP in 2016 prices and PPP.

Sources: Adapted from IEA (2017a), *World Energy Statistics and Balances 2017* (database), www.iea.org/statistics; IEA (2017b), *CO₂ Emissions from Fuel Combustion* (database), www.iea.org/statistics.

(source: International Energy Agency, 2018, *Energy Efficiency 2017*. Available at: https://webstore.iea.org/download/direct/160)

Local problems – mobility

http://reafglobal.com/static/img/06AboutUsCC_img06.png

(source: http://patrz.pl/static/uploaded/images/37/
37139/0575ed60ca0afa8f11b33ee14dabec67_1920.jpg)

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Local problems – air quality

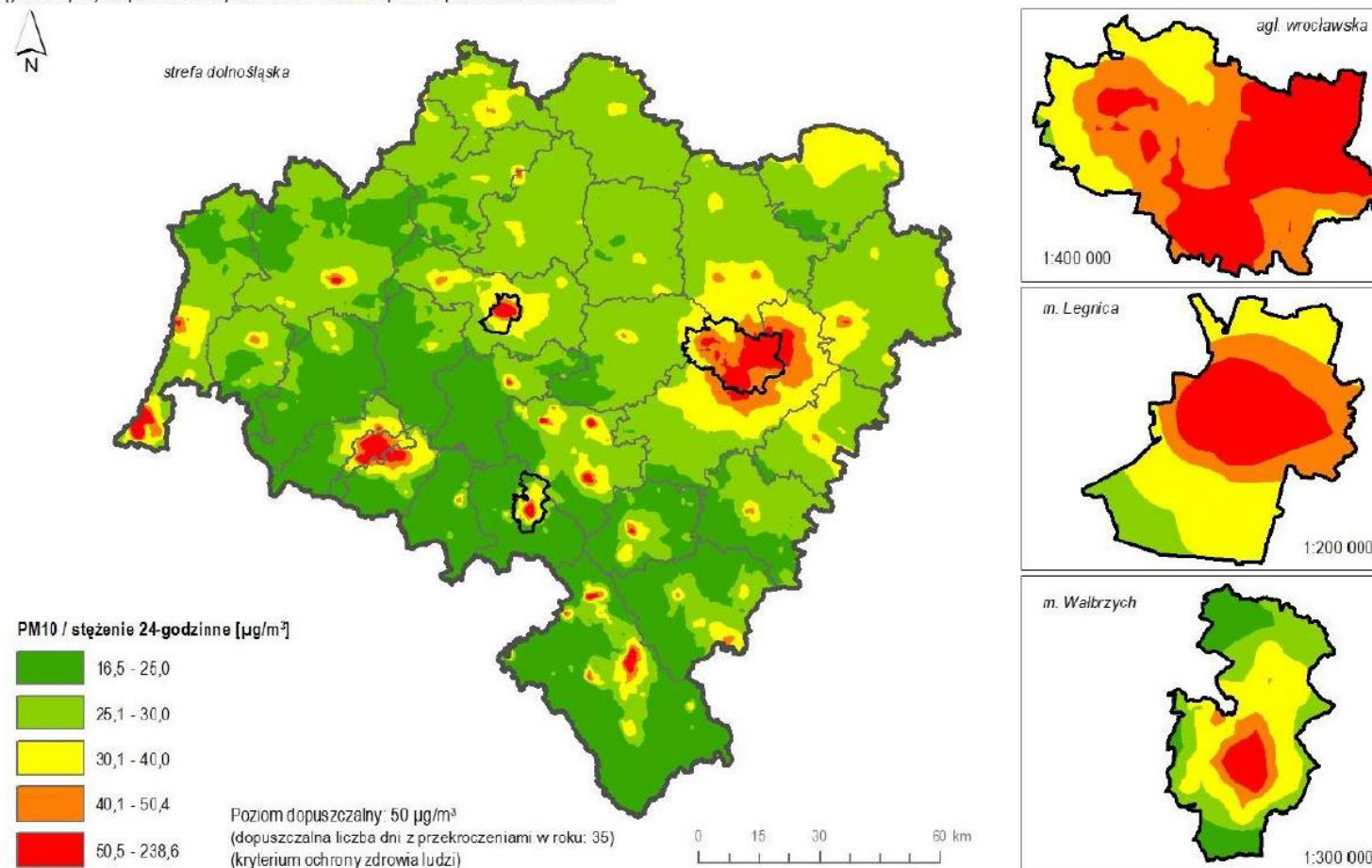Map 4.1   Concentrations of PM₁₀, 2015 — daily limit value
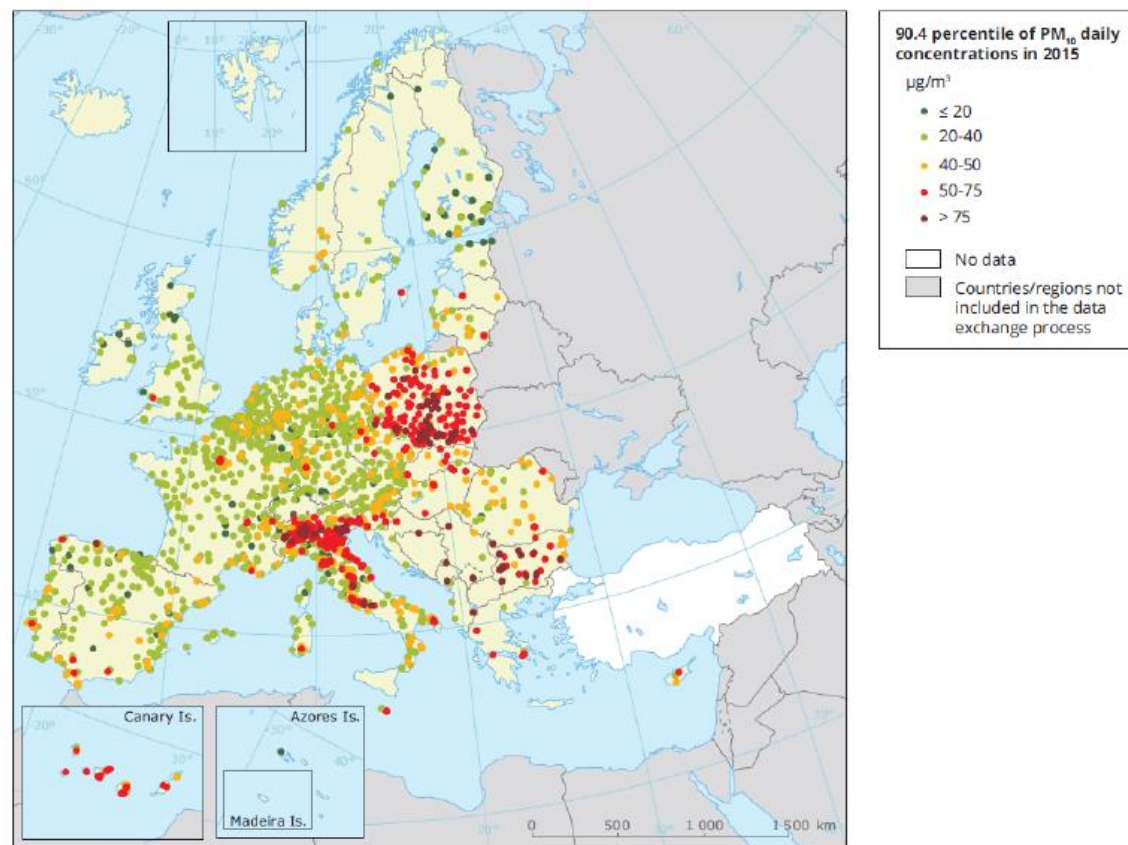
Map 7.1   Concentrations of BaP, 2015
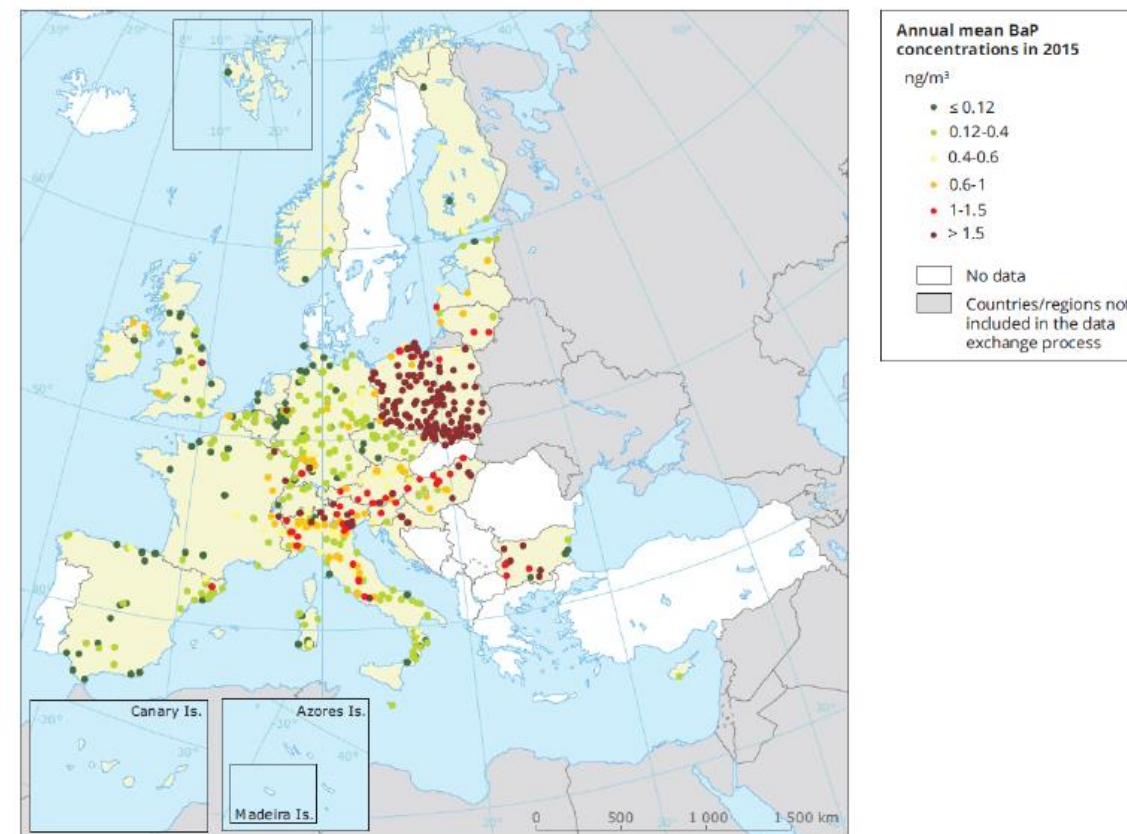
Air quality in Europe — 2017 report

Local problems – air quality

Rozkład stężeń 24-godzinnych pyłu zawieszonego PM10 na terenie woj. dolnośląskiego (36. maksymalne stężenie 24-godzinne / percentyl 90,4 z rocznej serii stężeń 24-godzinnych) na podstawie wyników modelowania jakości powietrza za 2016 rok

PM10 / stężenie 24-godzinne [μg/m³]
- 16,5 - 25,0
- 25,1 - 30,0
- 30,1 - 40,0
- 40,1 - 50,4
- 50,5 - 238,6

Poziom dopuszczalny: 50 μg/m³
(dopuszczalna liczba dni z przekroczeniami w roku: 35)
(kryterium ochrony zdrowia ludzi)

Źródło: Wojewódzki inspektorat Ochrony Środowiska - http://www.wroclaw.pios.gov.pl

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Local problems – air quality

According to the Central Statistical Office, in 2008 **40% of households in Poland spent more than 10% of their income to provide heating** (considered as **'energy poverty'**).

Accoding to the CSO's report on the energy use in Polish households (2012):

- **48,7% of households used solid fuels for heating**

- two main fuels used in the households were: **bituminous coal and wood**

Źródło: Polski Alarm Smogowy

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Energy efficiency

Energy efficiency can be defined as

$$\varepsilon = S / E$$

where:

S – useful work,

E – energy input required for a unit output of useful work.

Energy efficiency in the context of settlement structures

- **Energy use in buildings & public spaces**

- **Infrastructure efficiency**
  - efficiency and appropriate scale of distribution systems

- **Land-use**
  - Density of urban tissue
  - Mixed use
  - Transit-oriented development (TOD)

- **Mobility (transport infrastructure)**
  - Prioritization of walking, cycling, public transport, carsharing, etc.

- **Energy-related habits**
  - Promoting sustainable lifestyles
  - Energy-saving incentives
  - *Rebound effect*

Energy use in buildings & public spaces

http://www.cobaltcarbonfree.co.uk/wp-content/uploads/2017/01/Heat-Loss-and-Thermal-Imaging-Nottingham-Nottinghamshire-Cobalt-Carbon-Free-1024x683.jpg?x52525

(source: https://www.u2j.org/marvellous-led-street-lights-europe)

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Efficiency & scale of energy infrastructure networks
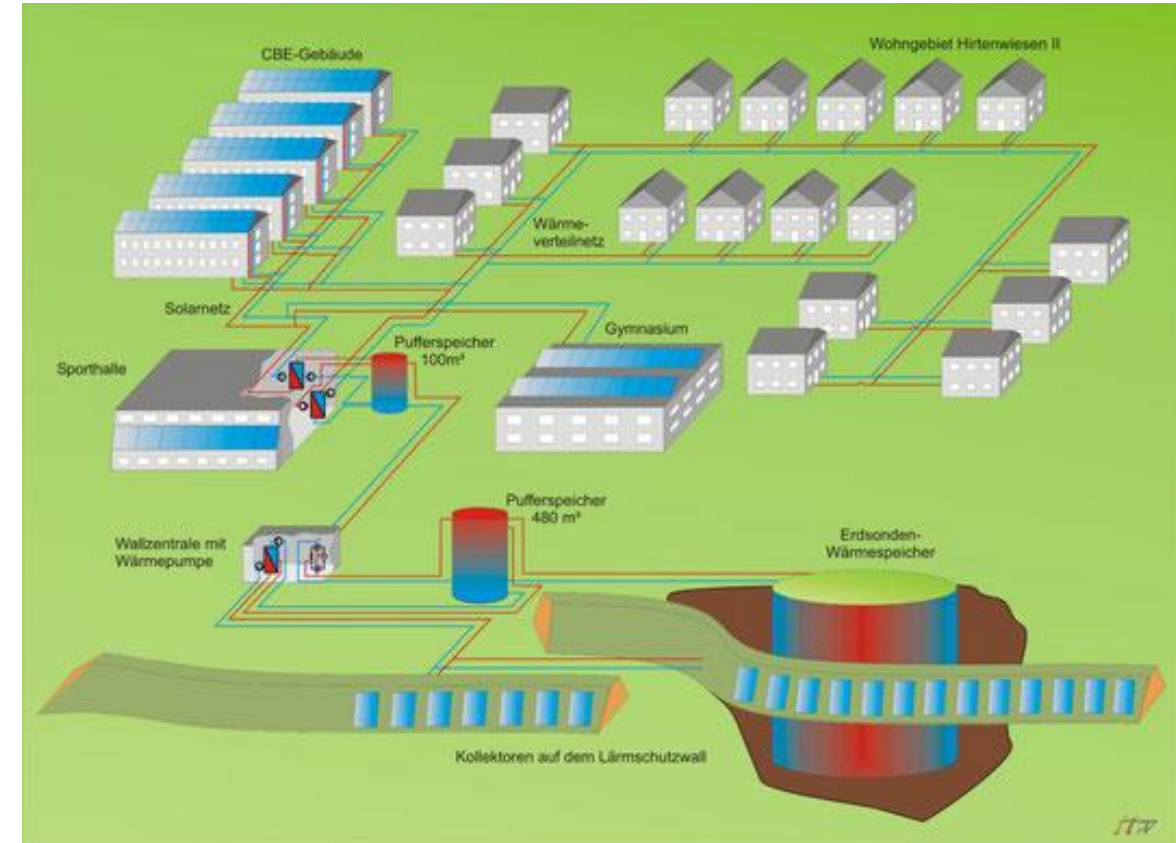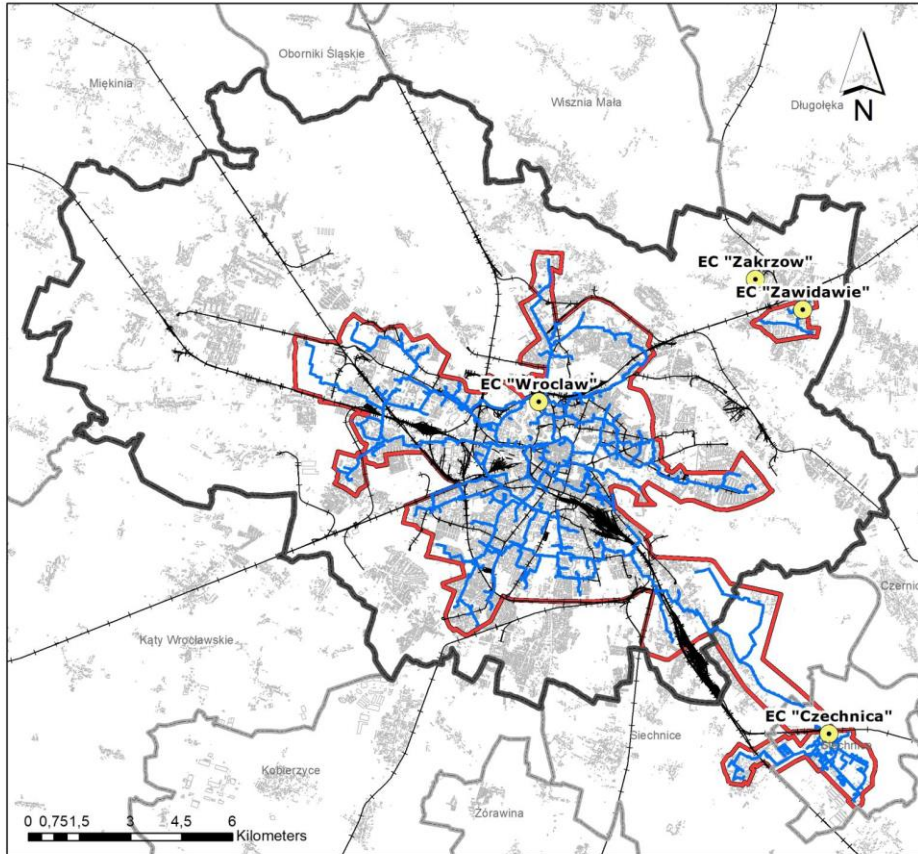
System Crailsheim © www.itw.uni-stuttgart.de

Land-use

City density versus CHG Emissions per capita
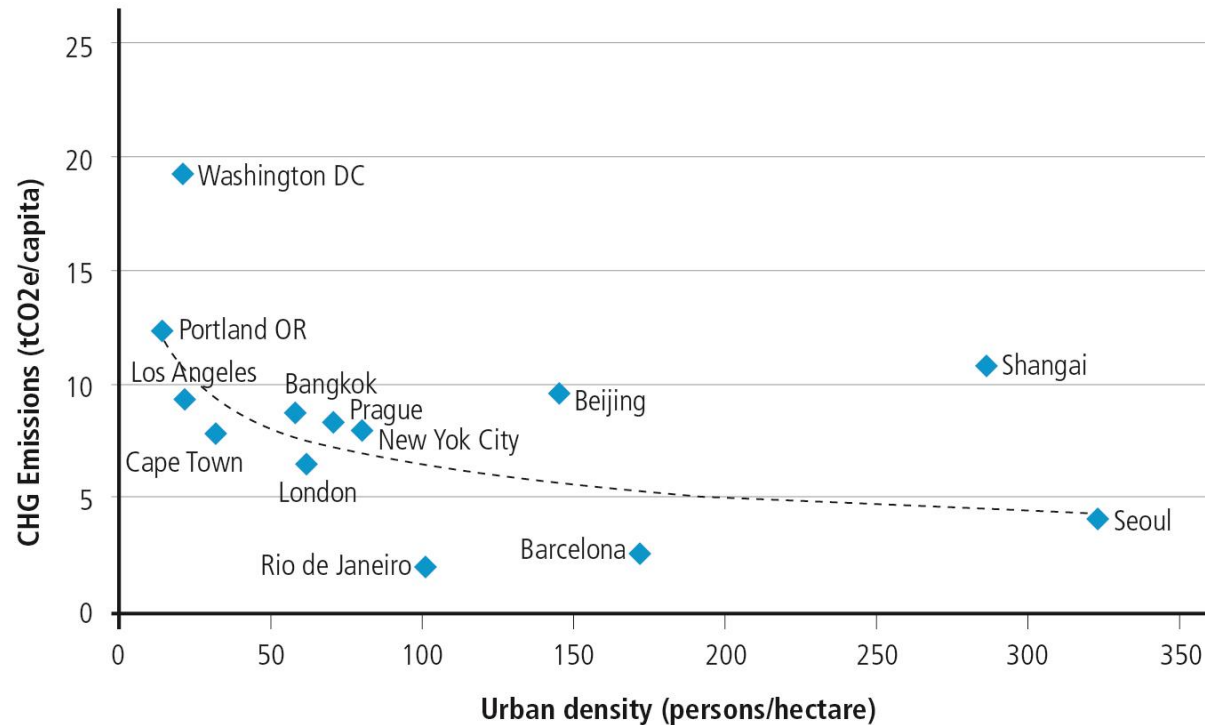
Source: World Bank (Cities and Climate Change: An Urban Agenda)

Access to services

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Transport infrastructure

Car-Oriented Street
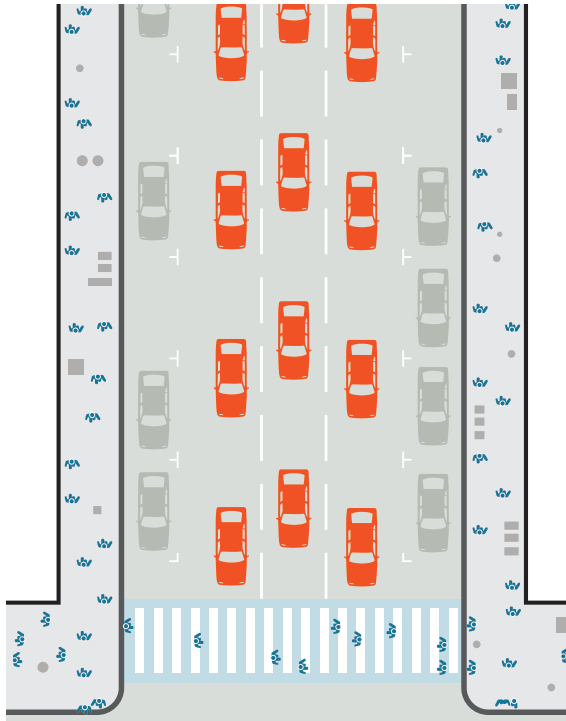
Multimodal Street

Total capacity: 12,300 people/h
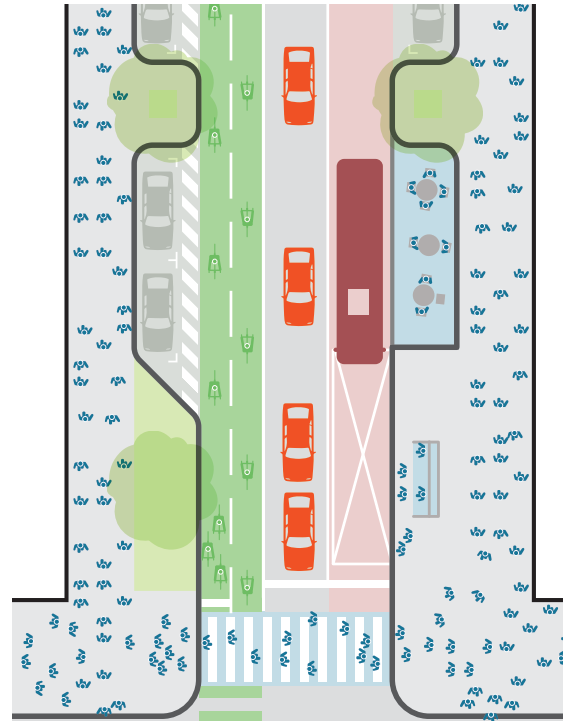
Total capacity: 30,100 people/h[29]

Walking / Running

Cycling

Utility Bicycles

Public Transport

Taxi / Transport

Car Sharing

Own Car

Flying
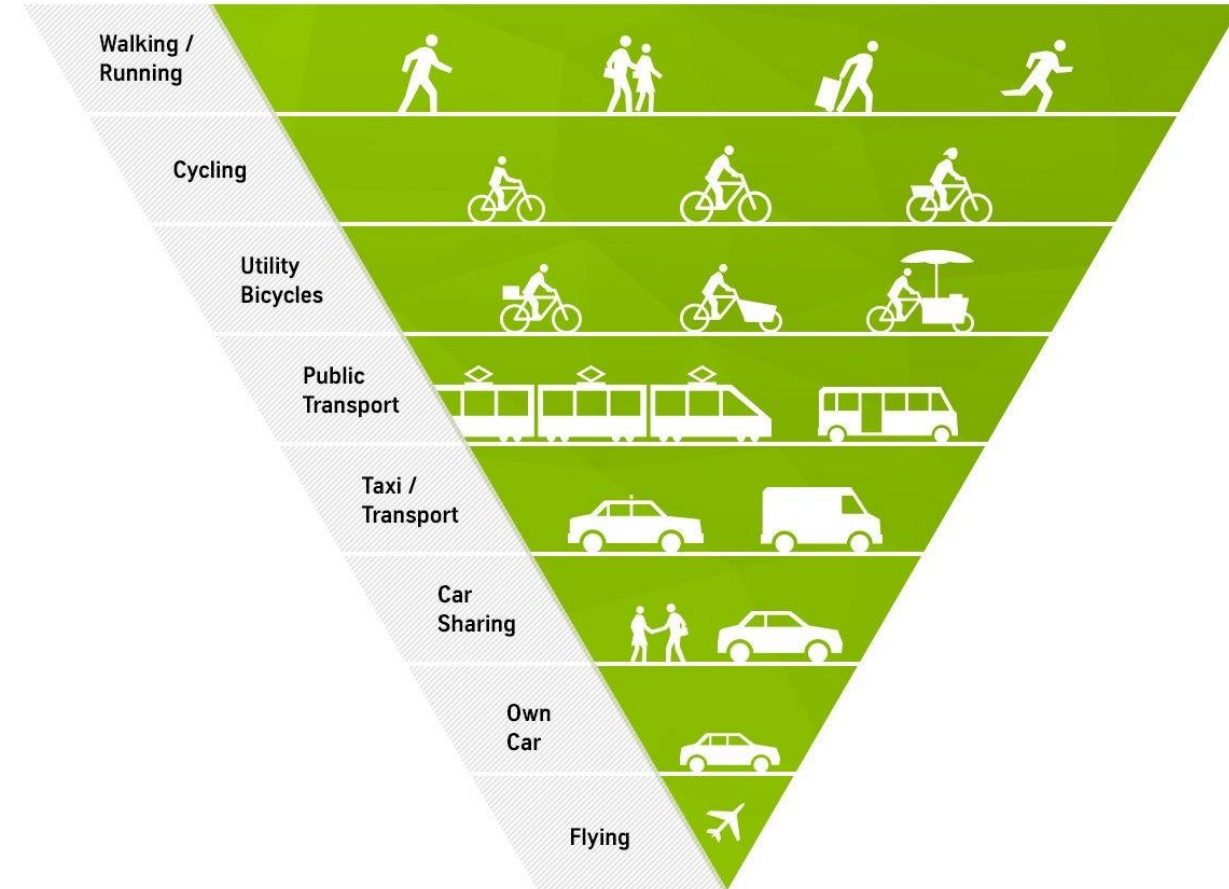
© Bicycle Innovation Lab, Copenhagen, DK

(source: https://globaldesigningcities.org/publication/global-street-design-guide)

Energy-related habits

http://kalkulator.tauron.pl/h5/

(source: https://4.bp.blogspot.com/-YC4enmkBYw4/Vjm2bVHcm3I/AAAAAAAAUP0/_izgm1-8Rmc/s1600/road%2Bsafety%2B2015.jpg)
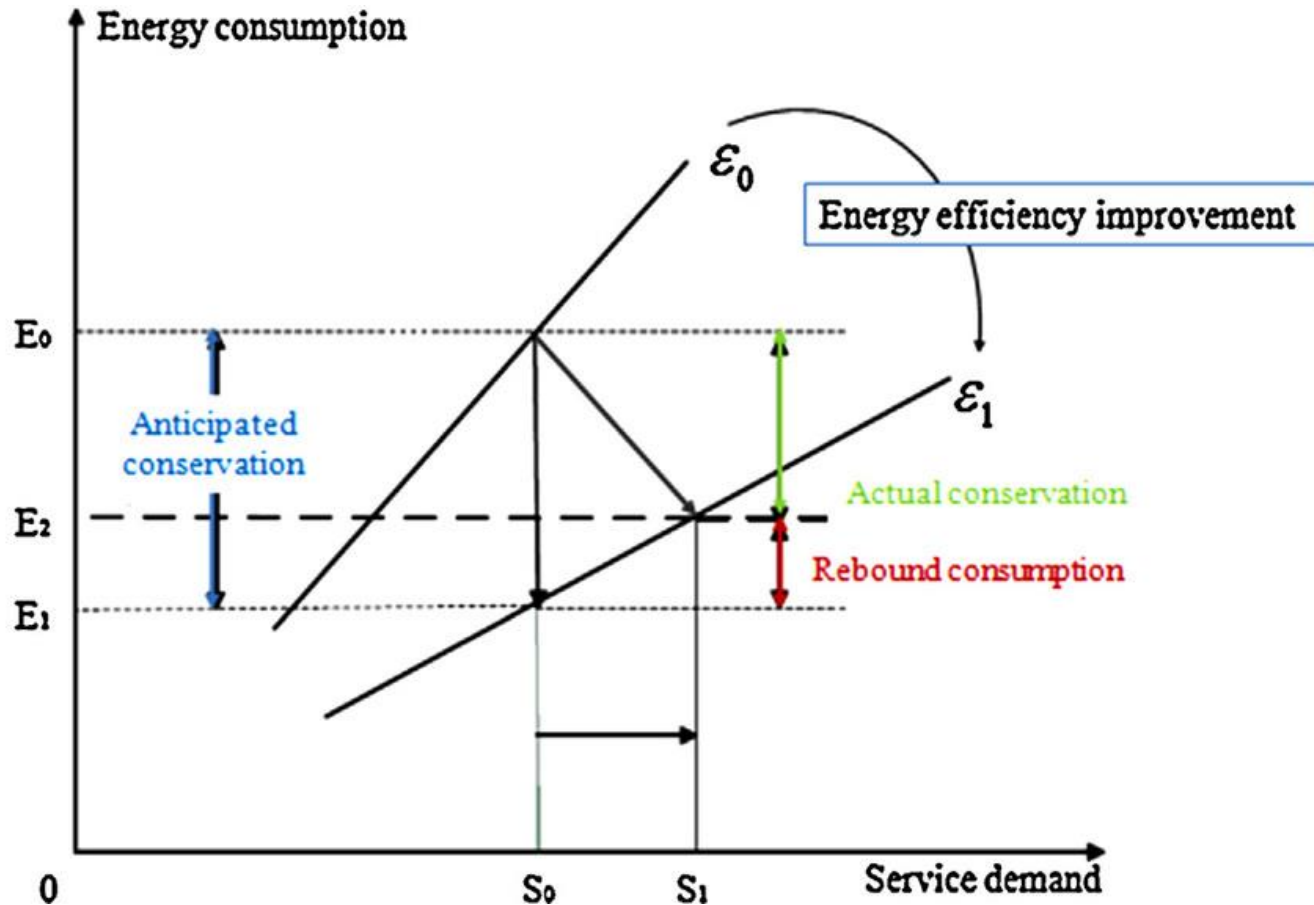
Energy-related habits – awareness

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Rebound effect

Types of rebound effects:

- **Direct rebound effects**

- **Indirect effects**

- **Economy wide effects**

(Sorrell & Dimitropoulos, 2008)

Questions for the workshop

- **Is it feasible (and necessary?) to modify the land-uses within the area?**
  - What new functions could reduce the need to travel out of the neighbourhood?

- **Is it possible to increase the density without compromising life quality?**

- **How to improve the energy efficiency of buildings?**
  - public/private properties – financing sources

- **How to rearrange the energy production & distribution systems to improve their efficiency?**

- **How to lower the energy consumption of transportation?**
  - *prioritizing public transport, carsharing, cycling, walking?*

- **How to encourage citizens to change their habits in order to become more energy-efficient?**

Thank you and please share your remarks!

Dr. Maciej Zathey   Robert Skrzypczyński

maciej.zathey@irt.wroc.pl   robert.skrzypczynski@irt.wroc.pl

maciej.zathey@pwr.edu.pl   robert.skrzypczynski@pwr.edu.pl