# Suburban dream vs. climate-friendly transport?

## Transport and environmental implications of urban sprawl in Poland [LUTEm]


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mobil.TUM 2024
THE FUTURE OF MOBILITY AND URBAN SPACE

Munich, April 10th 2024

# Introduction

- **Dynamic urban development** in Poland since 2004 (EU accession)

- Unfortunately, this coincided with relaxation of urban planning laws:
  - ca. 1/3 of country area covered by **legally binding** local plans
  - provisions in spatial masterplans for 3 - 5x population growth

➔ Resultant (sub)urban sprawl contributes to **major challenges:**

**socio-economic costs**

~ **20 bn EUR** per annum

(Śleszyński, 2021)

**traffic congestion**

3 of top 10 most congested mid-size citites

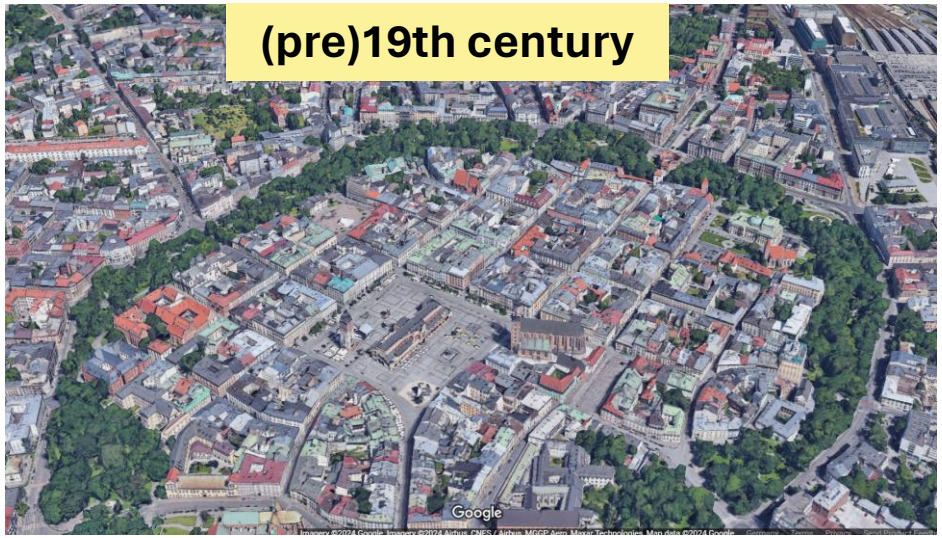
(TomTom, 2023)

**air pollution**

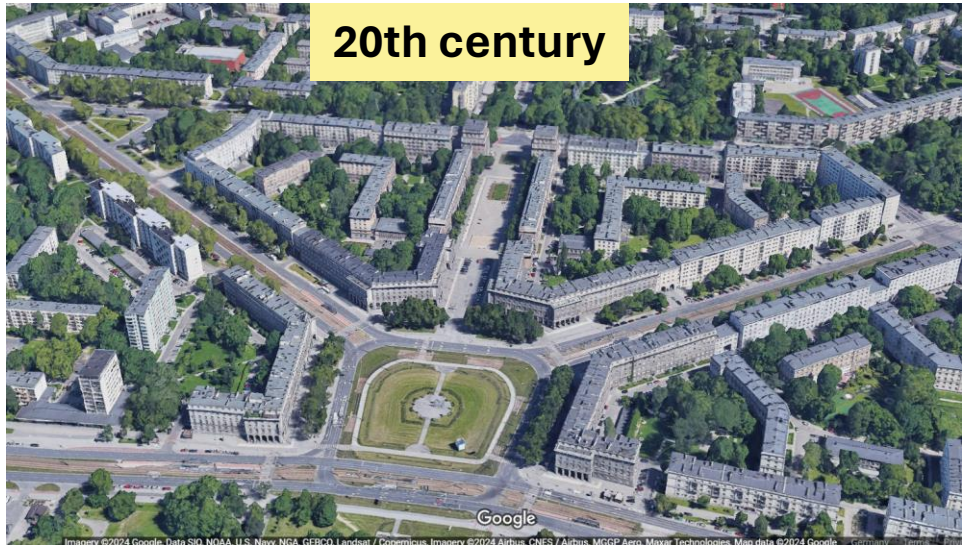
2-3x WHO guidelines (PM2.5, annually)

(IQAir, 2023)

# Problem background








- Rising public awareness, yet strategic planning lags behind

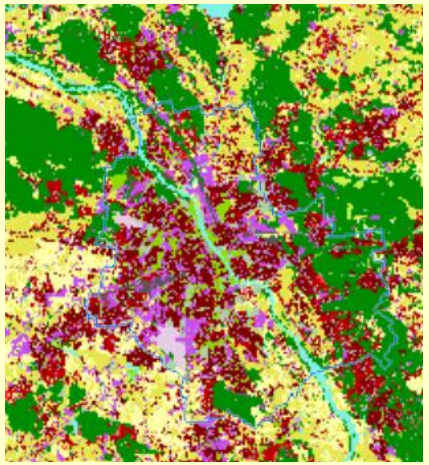
  ➔ *Is it really something new / unknown…?*

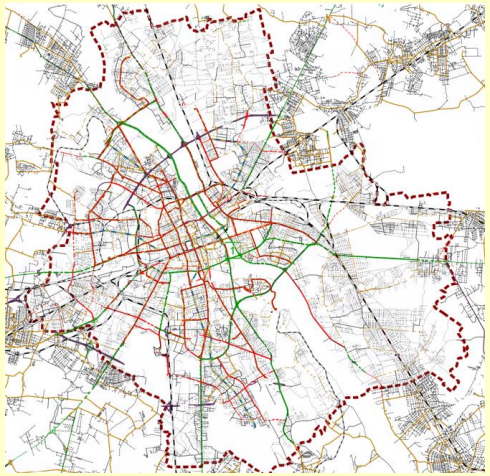
➔ Need for proper analytical toolset and underpinning

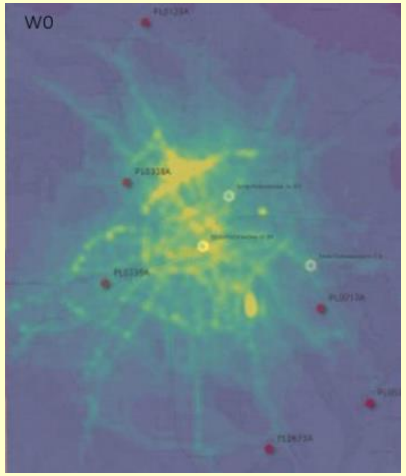
# Objectives and methodology

**LUTEm** research objective ➔ understand relationships between:

[urban sprawl development] vs. [transport performance] vs. [air pollution emissions]








**[1.] Land-Use data**

➔ travel activities

- built environment data
- GIS analyses

**[2.] Transport model**

➔ traffic flows

- 4-step travel demand
- PTV VISUM model

**[3.] Emission model**

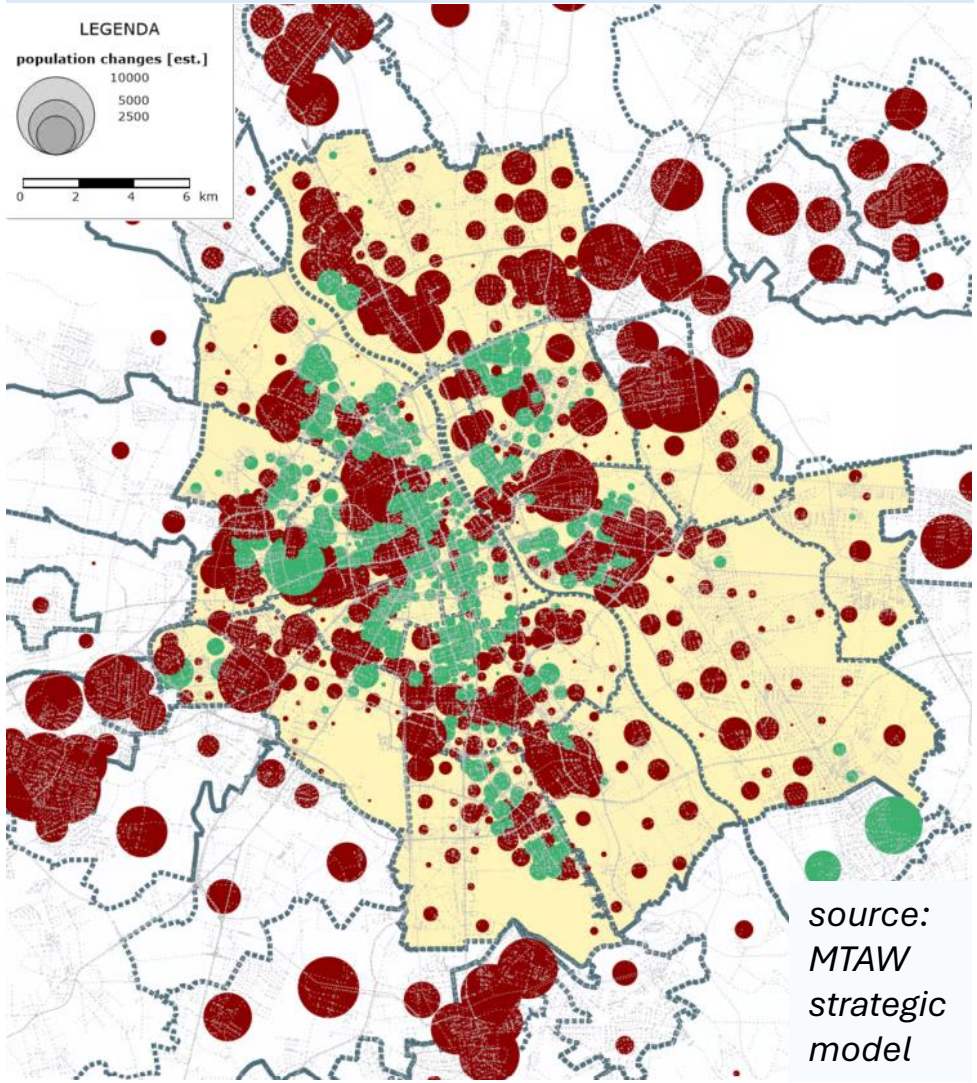
➔ traffic emissions

- HBEFA-based emissions
- NERVE – customised model

- **implications of current policies / trends?**
  - case studies of Polish cities (Warsaw, Rzeszow)
- **what interventions and policy proposals?**
  - ➔ mitigate sprawling externalities
  - ➔ achieve efficiency and sustainability

# Case study - Warsaw

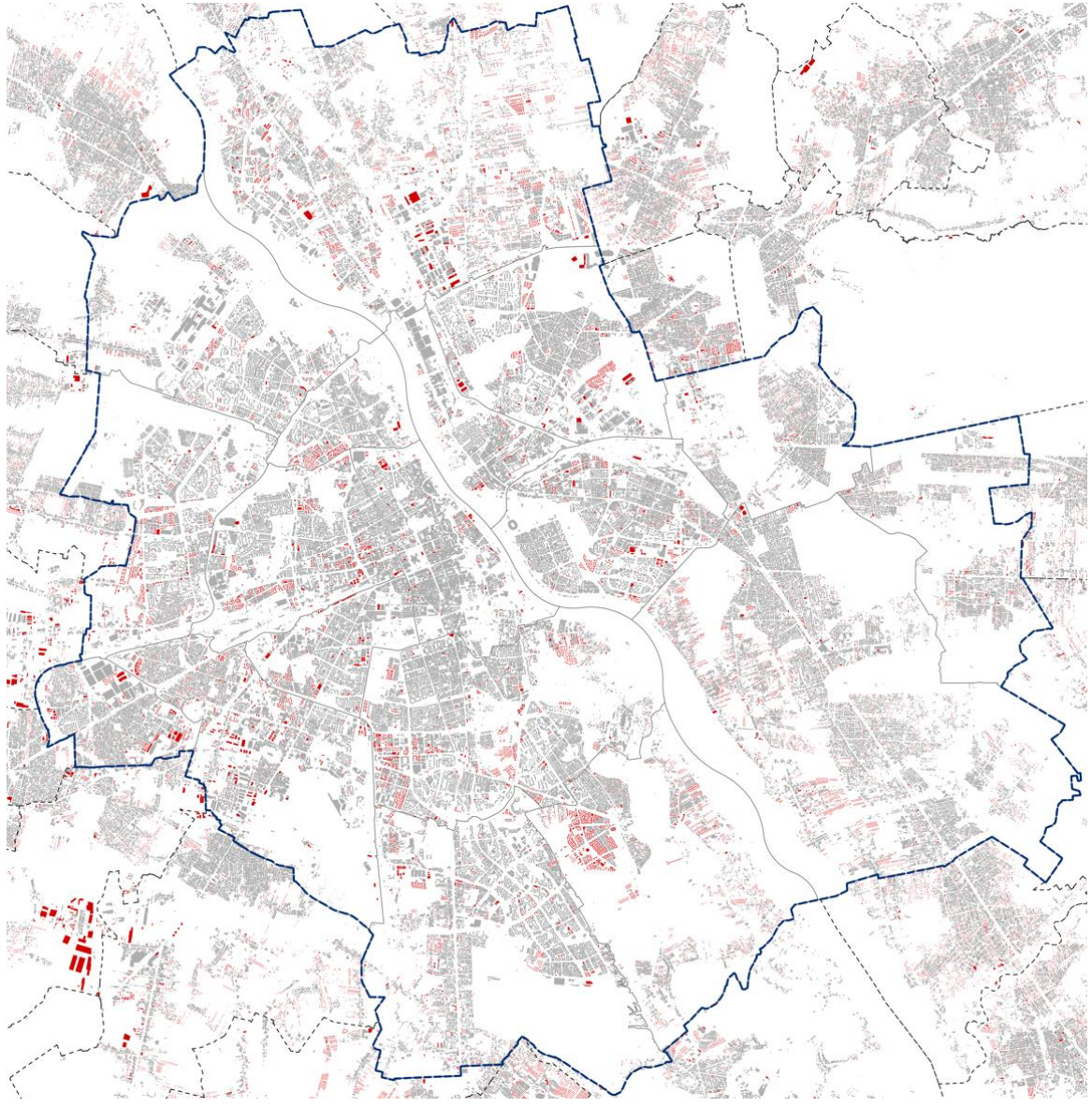
**residential area growth: 2023 vs. 2006**




*source: MTAW strategic model*

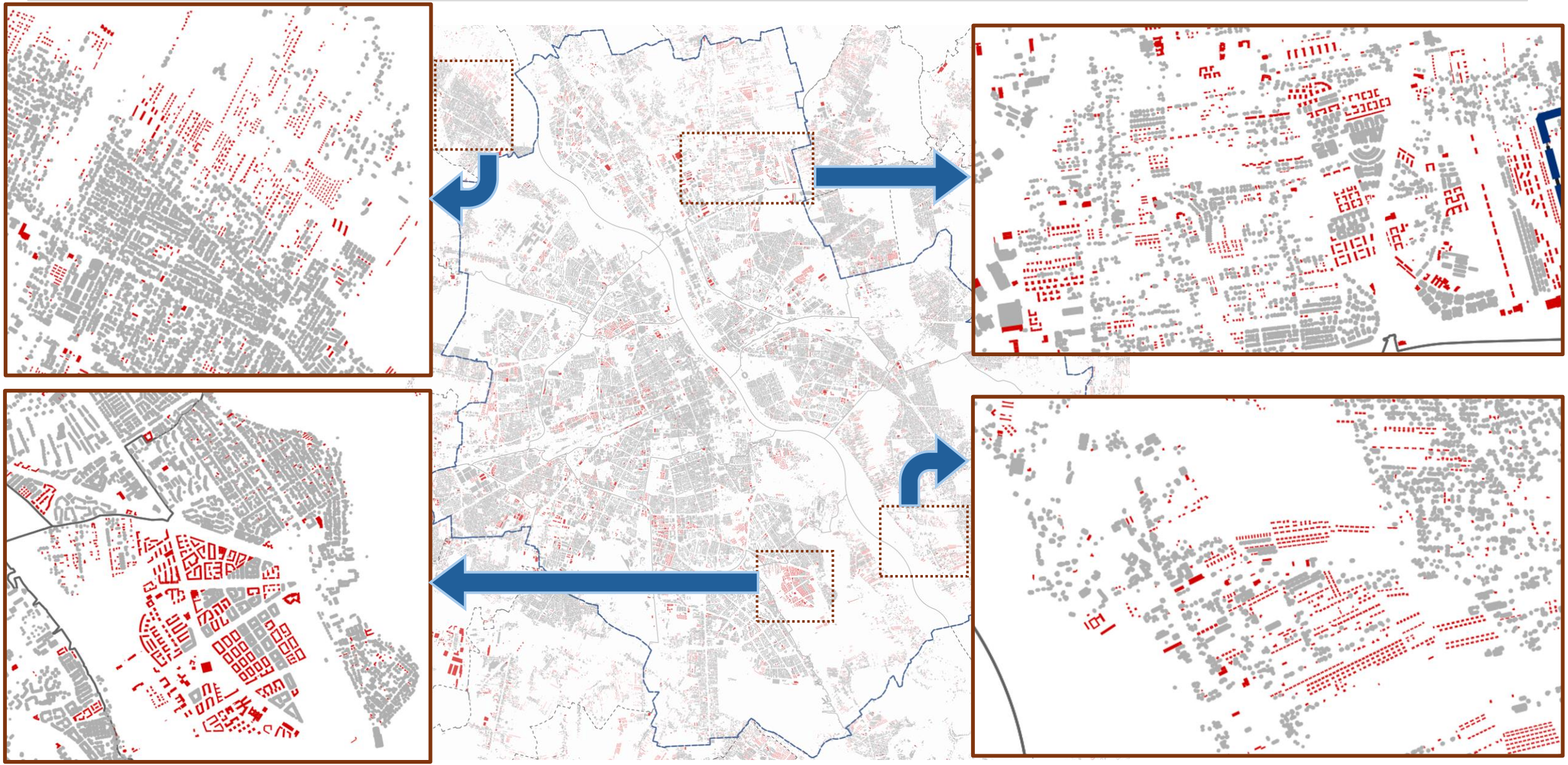
- capital city of Poland
- population (2006 vs. 2023):
  - Warsaw: 1.7m ➔ **1.9m**
  - outer area: 640k ➔ **810k**
- built-up (floor) area: (2006 vs. 2023):
  - Warsaw: **+ 27%**
  - outer area: **+ 82%**
- analysis scope:
  - impacts of land-use changes **2023 vs. 2006?**
  - **what if** current trends are *amplified / reversed?*

# Land-use changes, 2023 vs. 2006



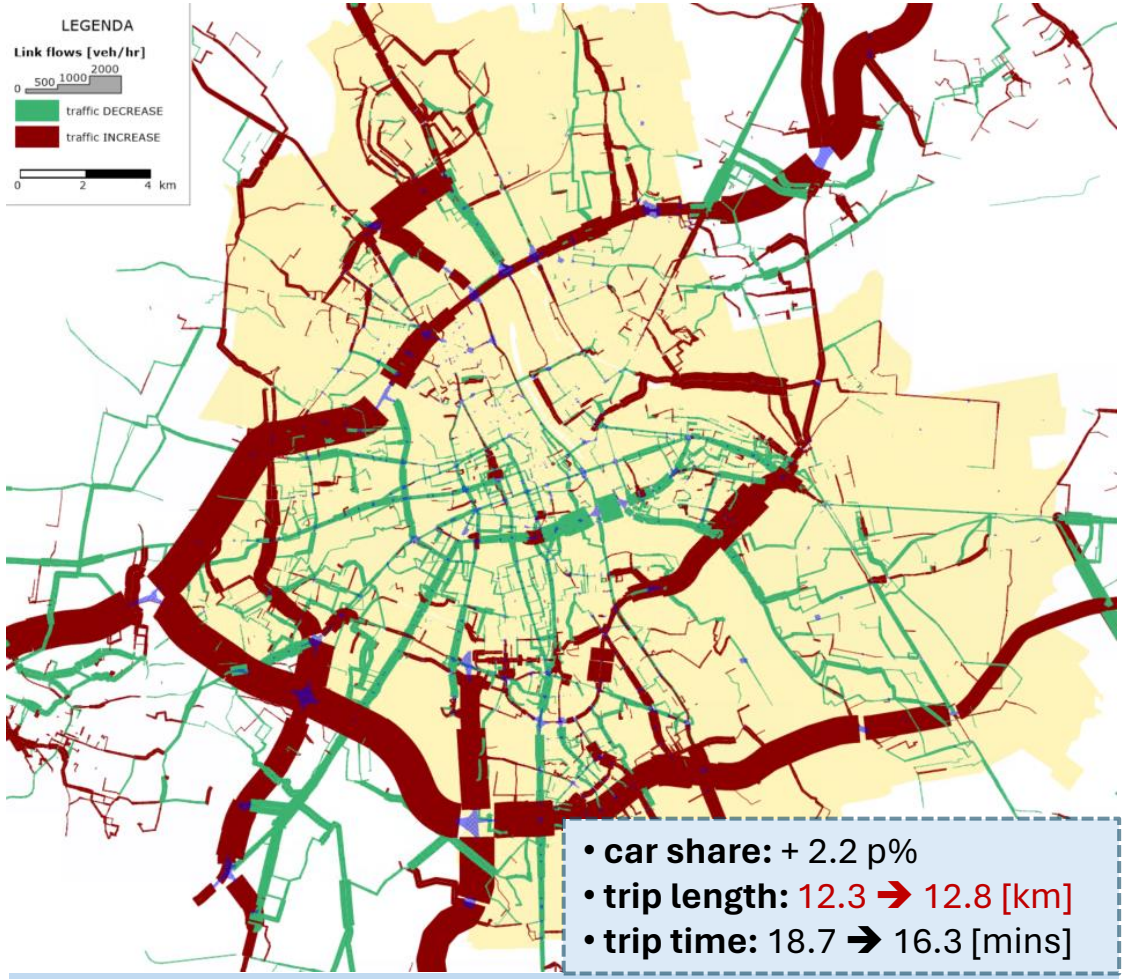
| | |
|---|---|
| | 2006 to 2023 |
| | pre-2006 |

# Land-use changes, 2023 vs. 2006



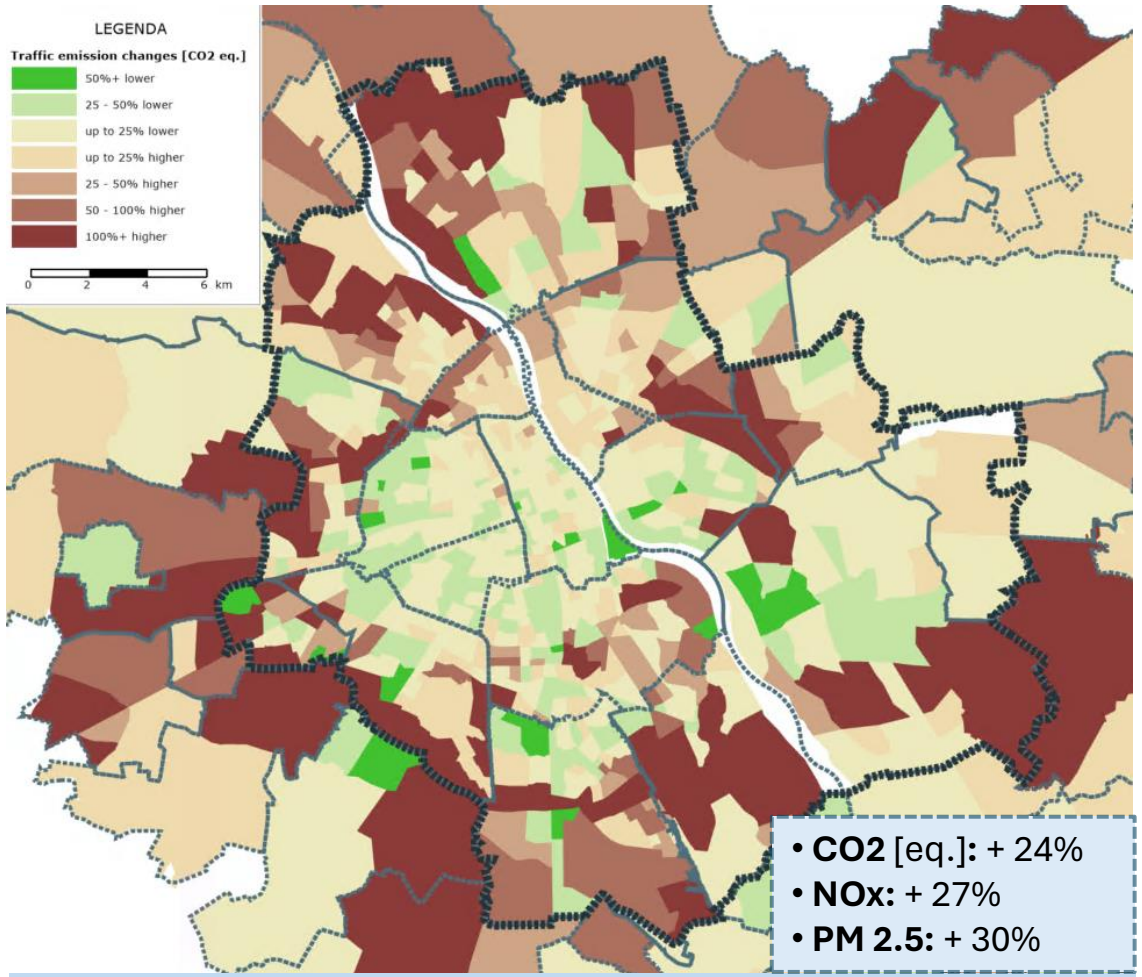
# Land-use impacts, 2023 vs. 2006

simulation results, AM peak – land-use (and road network) changes




- **car share:** + 2.2 p%
- **trip length:** 12.3 → 12.8 [km]
- **trip time:** 18.7 → 16.3 [mins]

**Δ traffic flows**




- **CO2** [eq.]: + 24%
- **NOx:** + 27%
- **PM 2.5:** + 30%

**Δ traffic emissions**

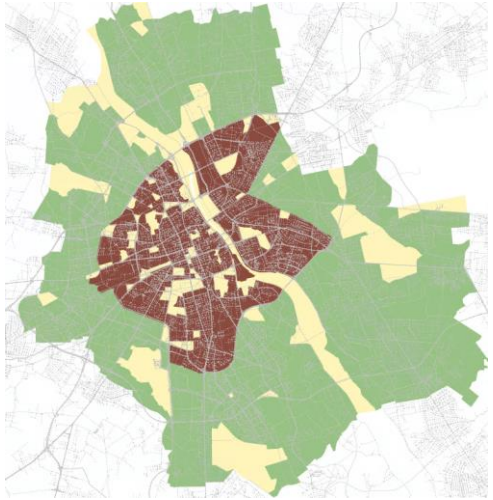
# Warsaw – *what-if*... scenarios

**[W0]** base

20% city **population shifts**

**[S0]**
suburban sprawl

**[C0]**
compact city



20% city **workplace shifts**

*[OR]*

20% public transport **(PT) improvements**

**[S1]**
sprawl
+ central district

**[C1]**
compact
+ central district

**[S2]**
sprawl
+ local subcentres

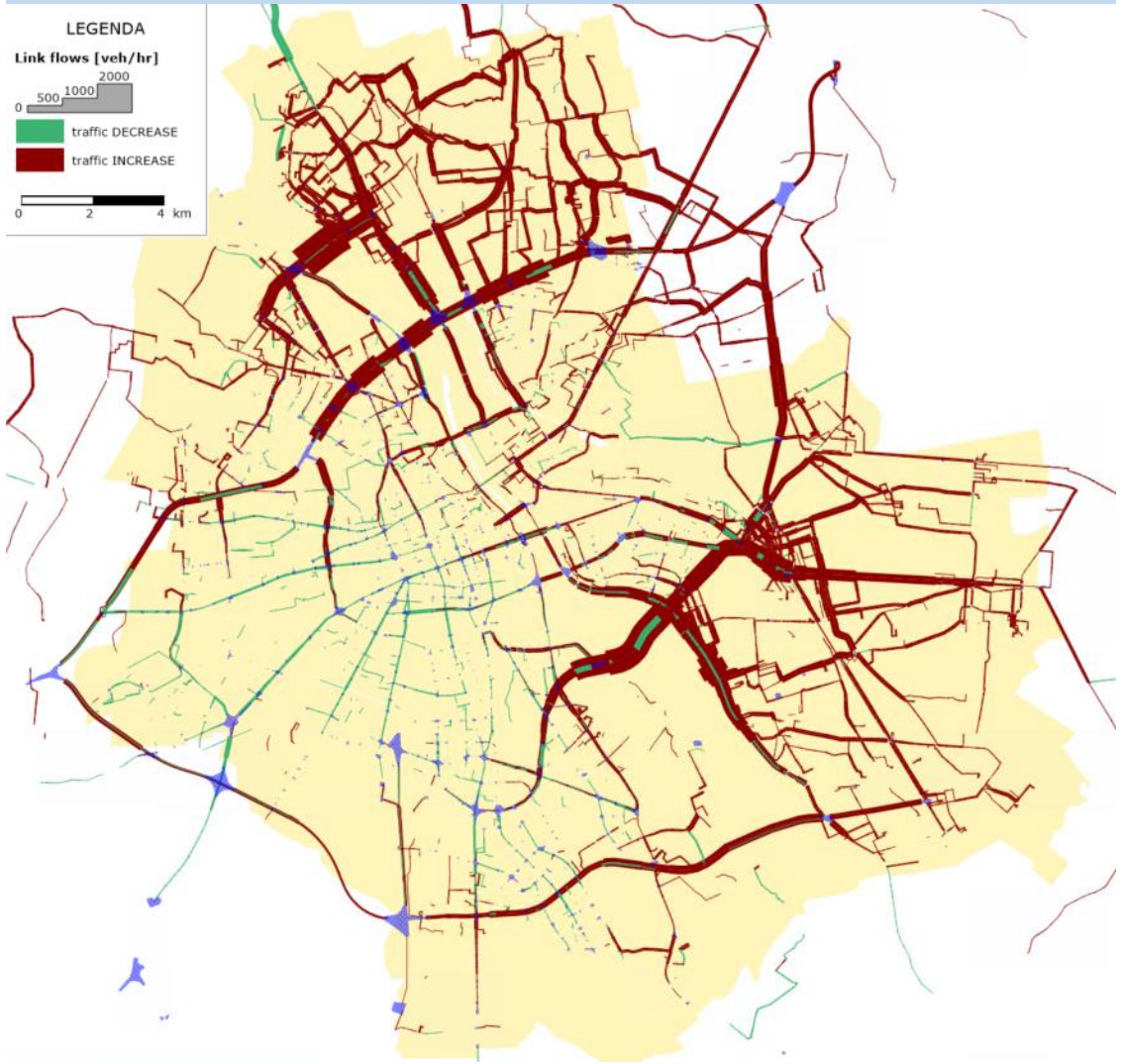
**[C2]**
compact
+ local subcentres

**[S3]**
sprawl + fast PT

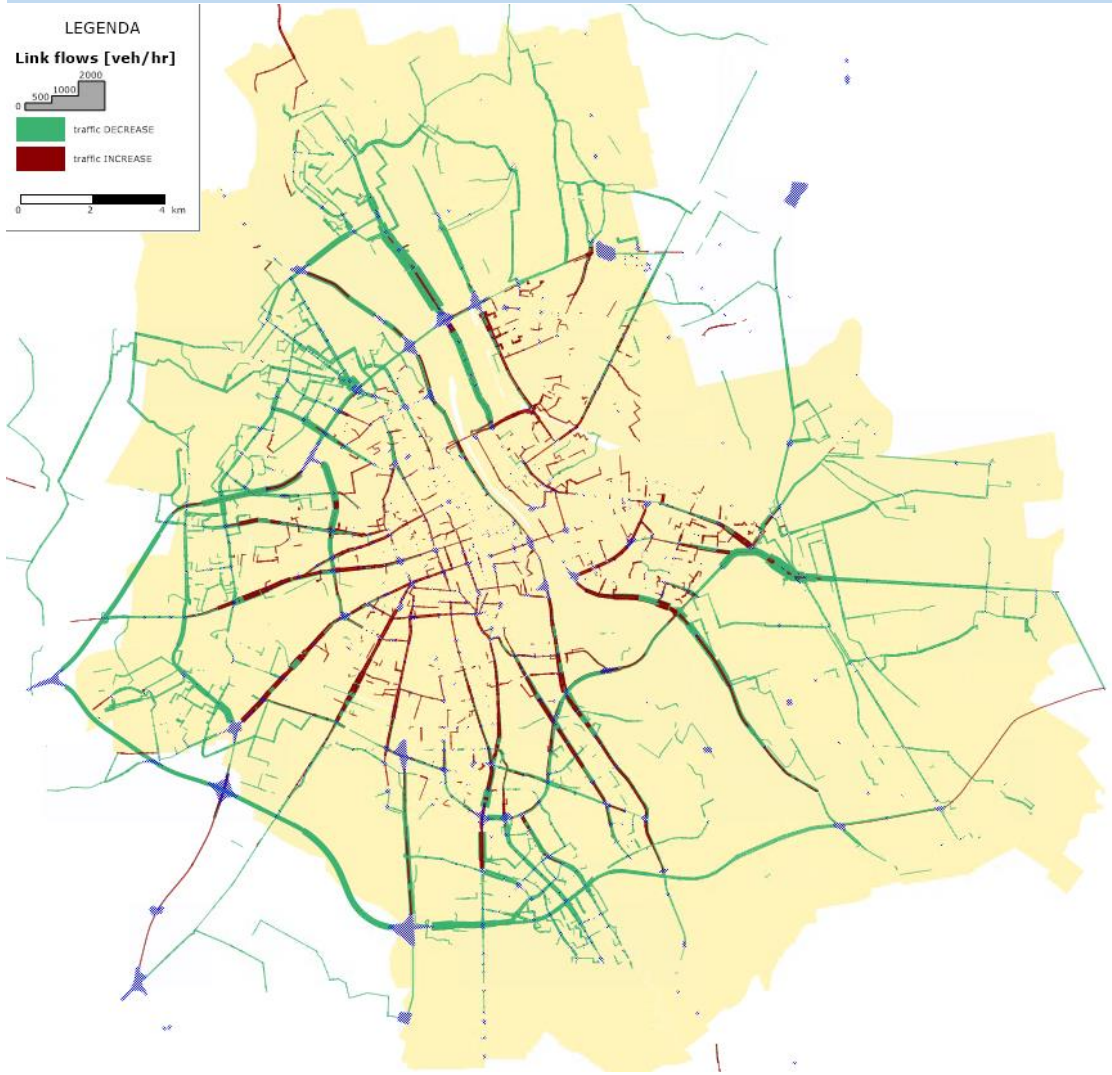
**[C3]**
compact + fast PT

# Results – land use and traffic flows

Δ traffic flows – **[W2] suburban sprawl**

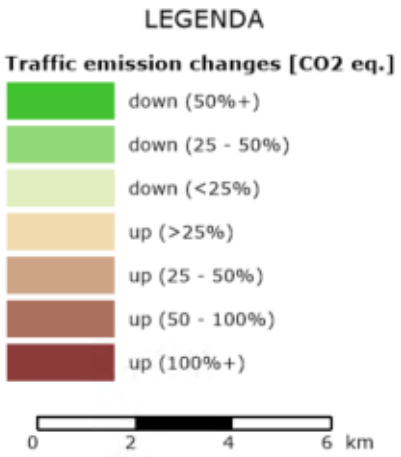


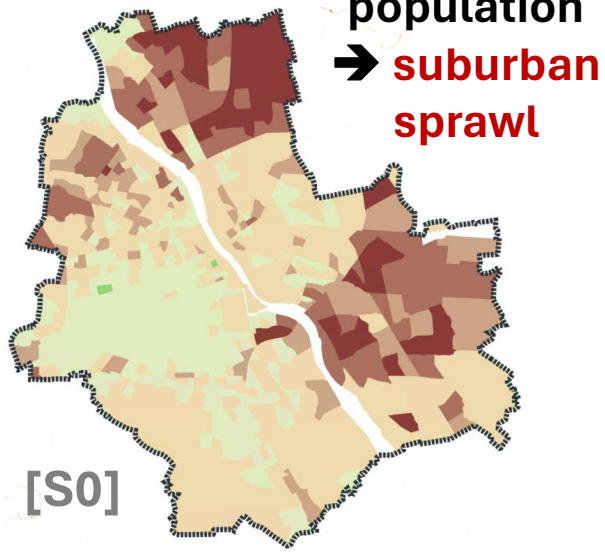

Δ traffic flows – **[W3] compact city**

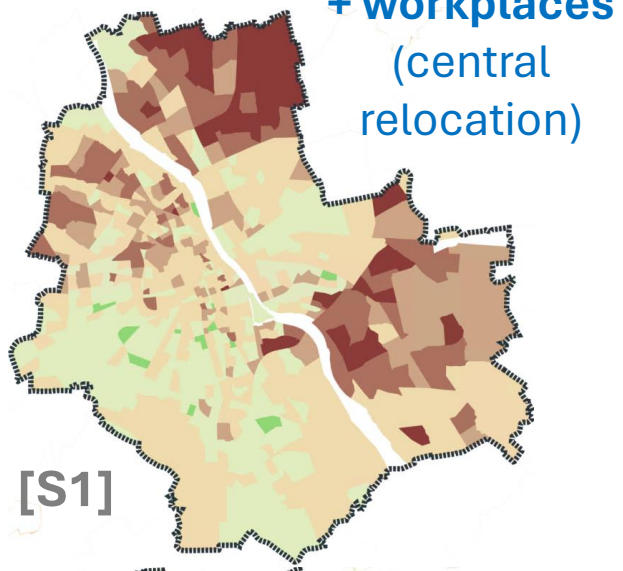


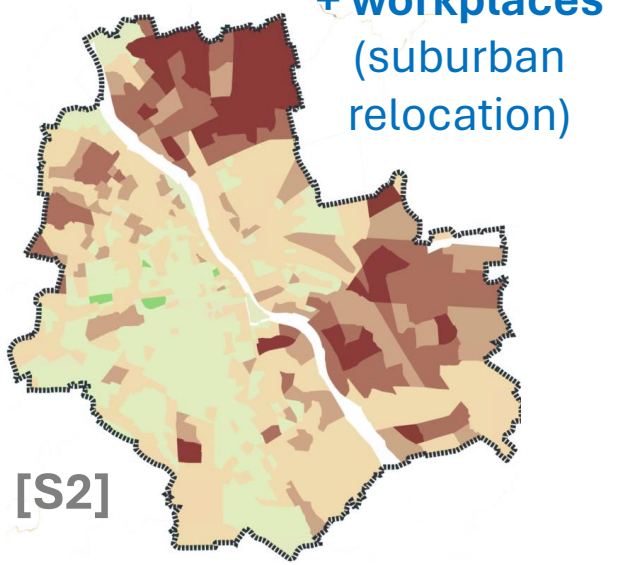
# Results – land use vs. traffic emissions (1)

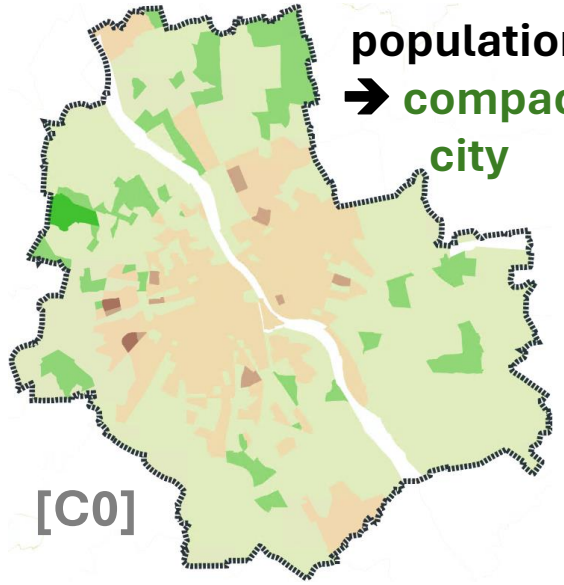
road traffic emissions **(spatial changes)**

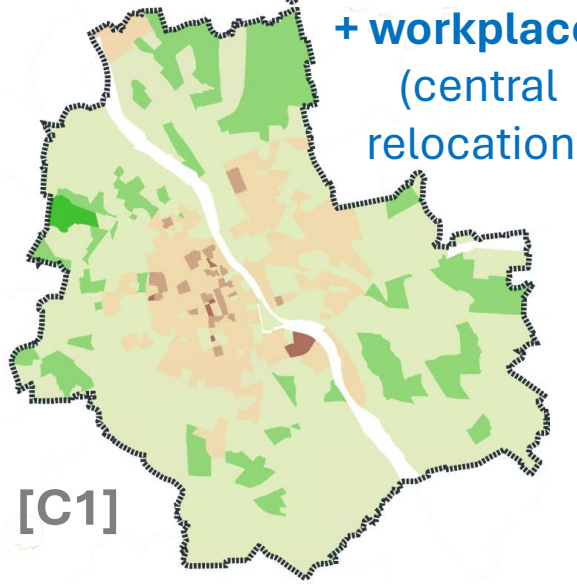


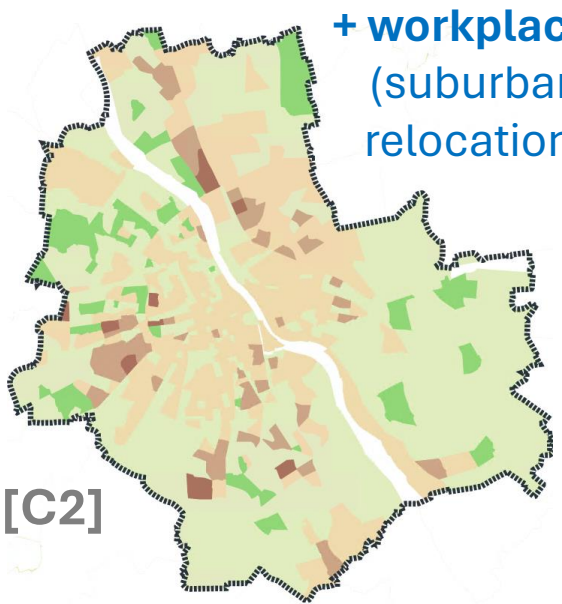



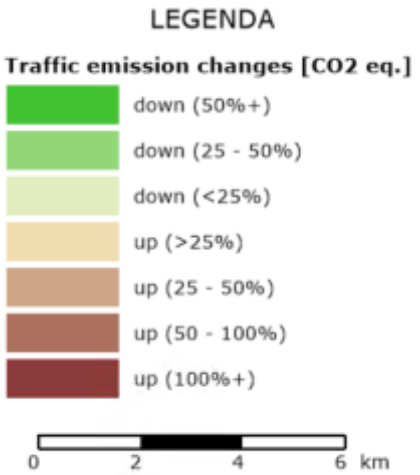



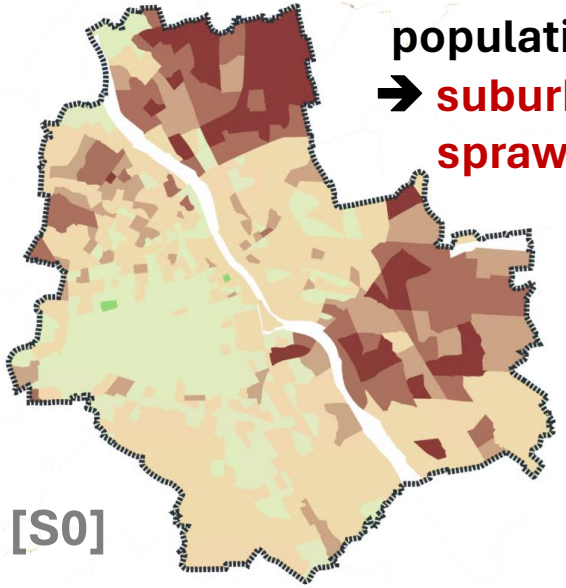



# Results – land use vs. traffic emissions (2)

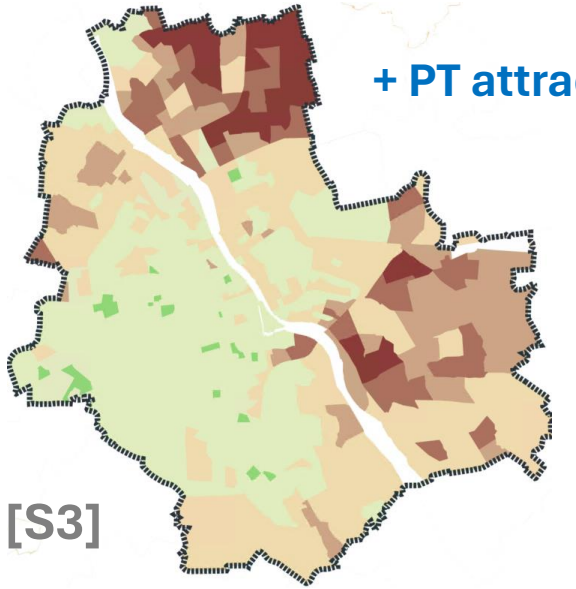
road traffic emissions **(spatial changes)**



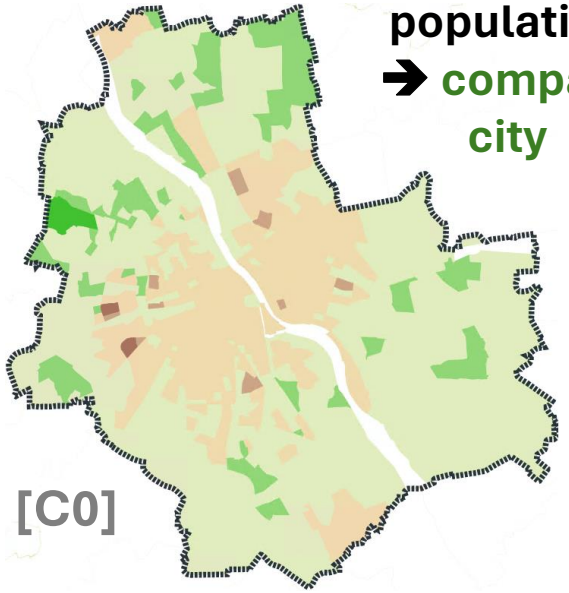
population ➔ suburban sprawl

[S0]



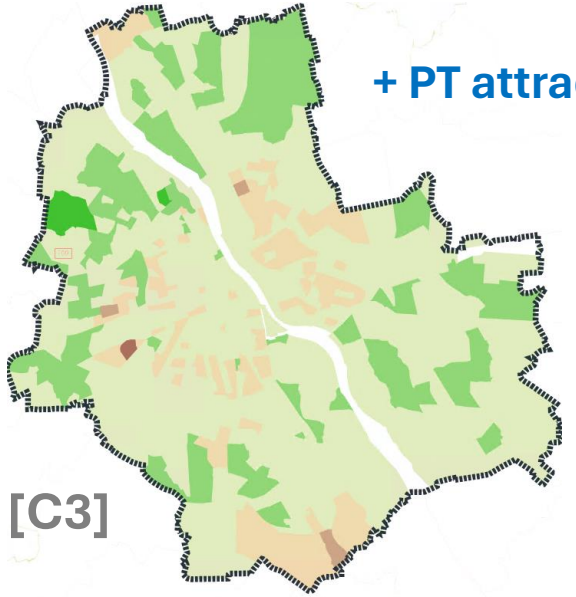
+ PT attractiveness

[S3]



population ➔ compact city

[C0]



+ PT attractiveness

[C3]

# Results – network parameters

*what-if* scenarios – projected (city-wide) effects:

| Warsaw, AM peak hour | modal share | network loads | | emissions | trip parameters | | |
|---|---|---|---|---|---|---|---|
| | [%] car trips | [veh-km] | [veh-hrs] | CO2 eq. [tonnes] | speed [km/h] | distance [km] | time [mins] |
| **[W0]** baseline | 47.5% | 2095.7k | 61.1k | 828.4 | 47.6 | 12.8 | 16.3 |
| ***suburban sprawl*** **scenarios:** | *changes vs. [W0]:* | | | | *absolute values:* | | |
| **[S0]** | + 0.2 %p | + 6% | **+ 37%** | + 12% | 37.0 | 13.4 | 22.0 |
| **[S1]** + workplaces (CBD) | - 0.9 %p | + 6% | **+ 44%** | + 11% | 35.0 | 13.4 | 23.4 |
| **[S2]** + workplaces (suburbs) | + 0.6 %p | + 7% | **+ 33%** | + 11% | 38.1 | 13.3 | 21.3 |
| **[S3]** + faster PT | **- 2.4 %p** | + 2% | + 16% | + 4% | 41.7 | 13.3 | 19.4 |
| ***compact city*** **scenarios:** | *changes vs. [W0]:* | | | | *absolute values:* | | |
| **[C0]** | - 0.4 %p | - 3% | - 6% | - 4% | 48.9 | 12.6 | 15.6 |
| **[C1]** + workplaces (CBD) | - 1.1 %p | - 4% | - 4% | - 5% | 47.7 | 12.6 | 16.0 |
| **[C2]** + workplaces (suburbs) | + 0.2 %p | - 1% | - 4% | - 2% | 48.7 | 12.7 | 15.7 |
| **[C3]** + faster PT | **- 2.8 %p** | - 7% | **- 13%** | - 9% | 50.8 | 12.7 | 15.1 |

# Conclusions

- **land-use changes since 2006 ➔** major contribution to traffic loads & emissions
  - mitigated by road expansion (but with rising car dependence)
- **further urban sprawl ➔** unsustainable, traffic externalities rising non-linearly
  - cannot compensate for population outflux with workplace shifts nor PT attractiveness
- **compact city ➔** potential of *LUTEm synergies*
  - land-use proximity & shorter, efficient trips & minimised traffic externalities
  - complement with (targeted) **network measures** (traffic emission impacts!)

# Summary and outlook

- **integrated land-use, transport and environmental assessment**
  - ➔ key to resolve interdisciplinary dilemmas, e.g.:
    - can land-use changes be *undone* by network interventions?
    - does compact city always imply lower traffic emissions?

- future aspects extending the LUTEm analyses:
  - travel demand effects (e.g. induced traffic)
  - *push* vs. *pull* measures ➔ e.g. *how far can the road narrowing go?*
  - long-term feedback ➔ might network costs induce reurbanisation…?

- **need to influence policy changes ☺**
  - *regain the management* of urban planning over the next 20 years

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# Thank you very much!

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The ***LUTEm*** project is financed within the framework of the EEA Financial Mechanism 2014 – 2021 and Norwegian Financial Mechanism 2014-2021, granted by the Polish Ministry of Development Funds and Regional Policy.

Iceland Liechtenstein Norway grants

Norway grants

Ministerstwo Funduszy i Polityki Regionalnej

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