

# **6.2 Course Summary**

**Urban Energy Infrastructure Policy and Climate Impacts**

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# Course Summary

Urban Emissions Sources

Broad Strategies for Urban Climate Change Mitigation

Climate Action Plans – overview and scoring rubric

Supplementary Topics

# Course Summary

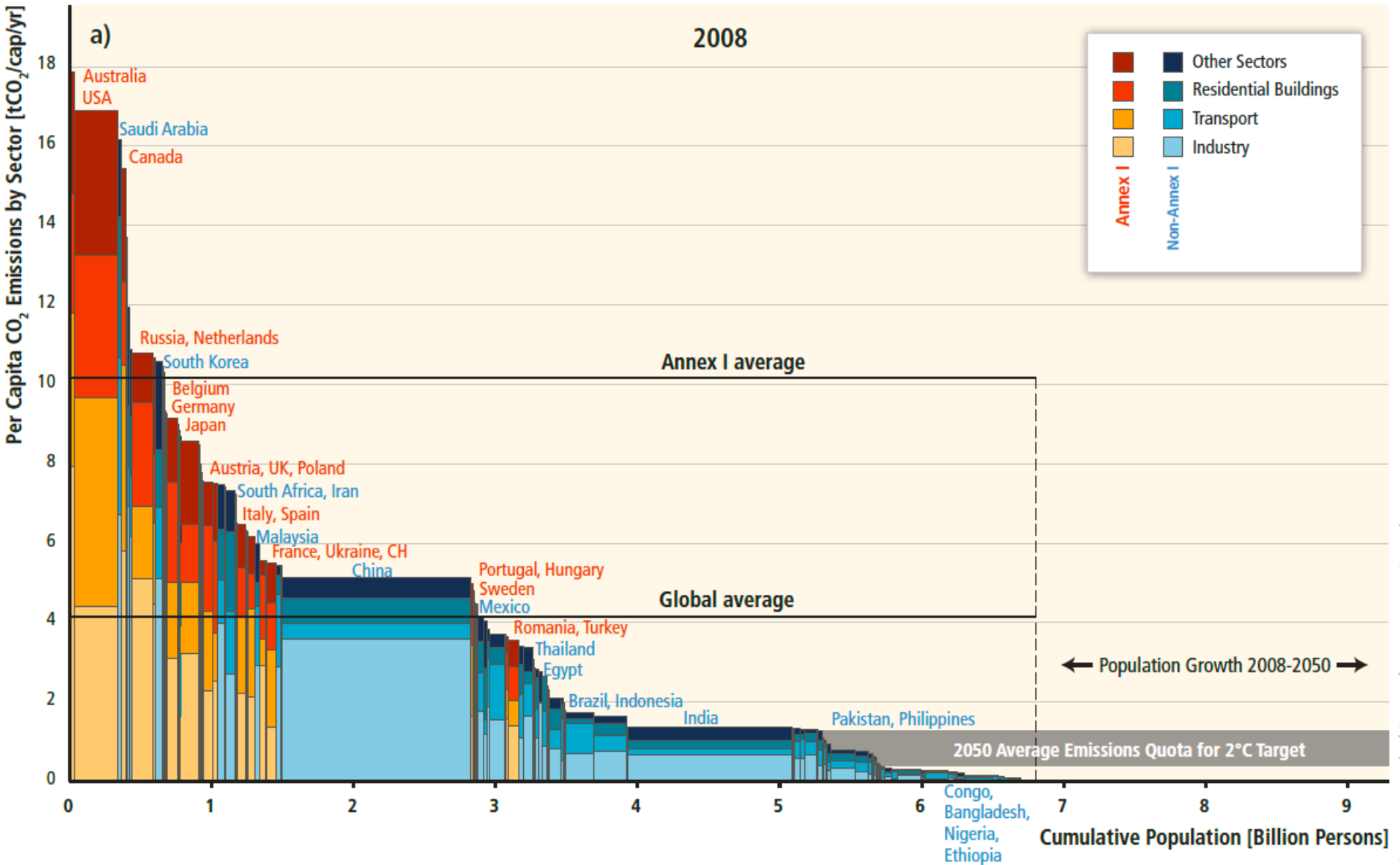
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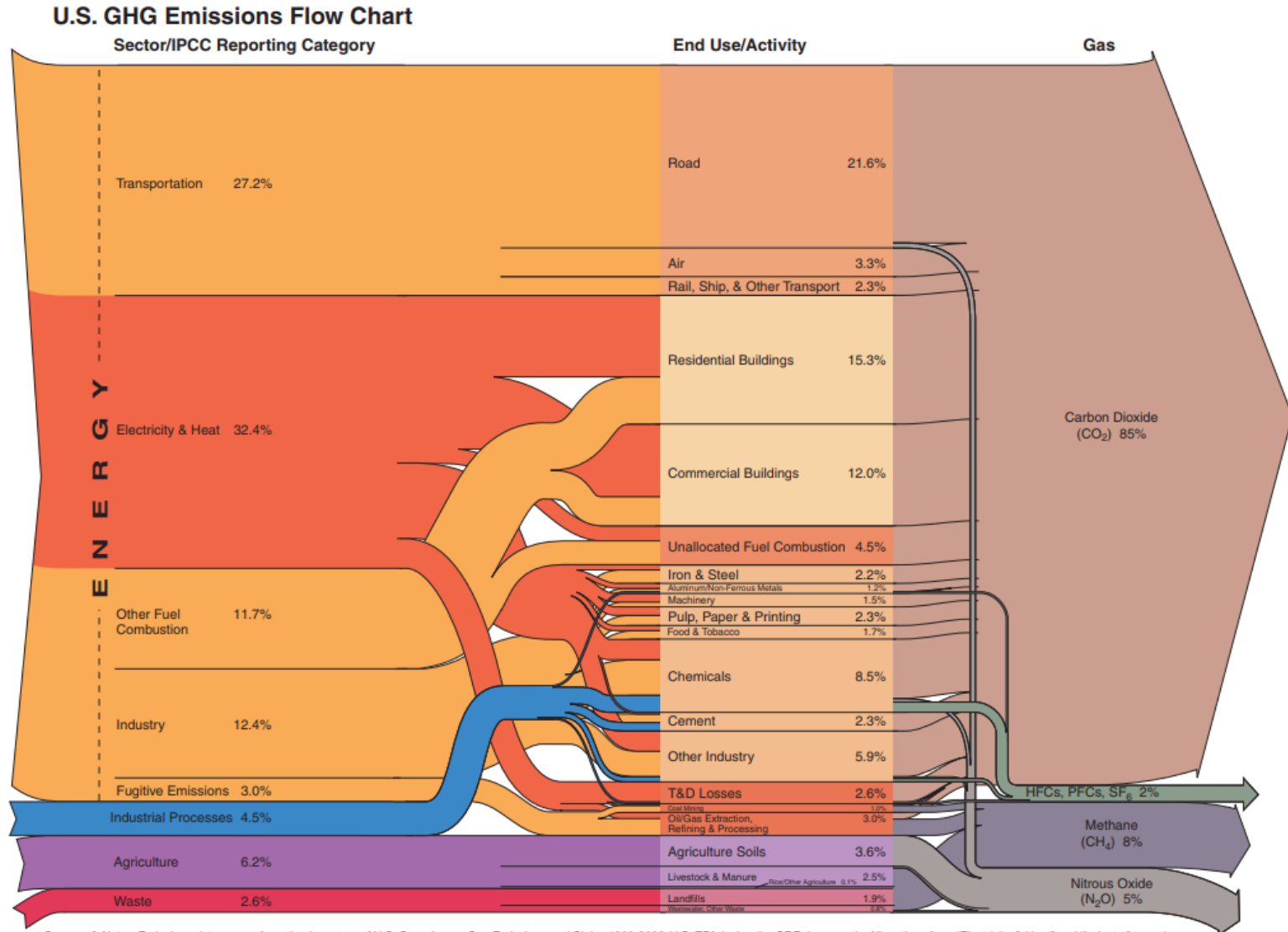
Climate Action Plans – overview and scoring rubric

Supplementary Topics

# Urban emissions vary significantly for countries around the world

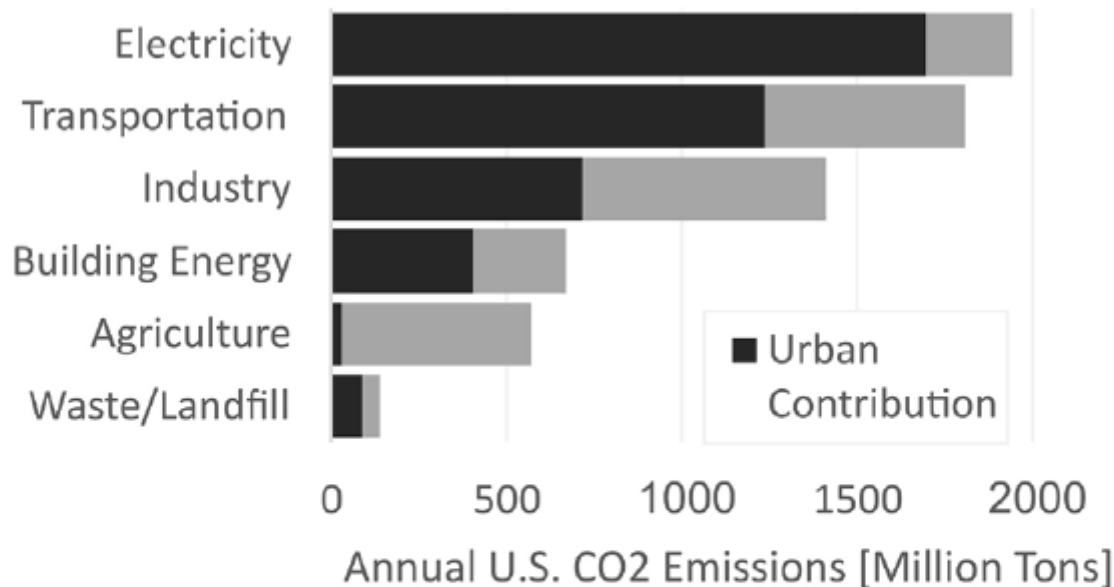


# U.S. GHGs originate from a variety of sources, mainly from energy. Many end uses are urban.



Sources & Notes: Emissions data comes from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2003*, U.S. EPA (using the CRF document). Allocations from "Electricity & Heat" and "Industry" to end uses are WRI estimates based on energy use data from the International Energy Agency (IEA, 2005). All data is for 2003. All calculations are based on CO<sub>2</sub> equivalents, using 100-year global warming potentials from the IPCC (1996), based on total U.S. emissions of 6,978 MtCO<sub>2</sub> equivalent. Emissions from fuels in international bunkers are included under Transportation. Emissions from solvents are included under Industrial Processes. Emissions and sinks from land use change and forestry (LUCF), which account for a sink of 821.6 MtCO<sub>2</sub> equivalent, and flows less than 0.1 percent of total emissions are not shown. For detailed descriptions of sector and

## Energy consumption generates a majority of GHGs in the U.S. Many end uses are urban.



**Fig. 1.** Based on data from [Marcotullio et al. \(2013\)](#) and [U.S. Environmental Protection Agency. \(2018\)](#), urban areas account for 70% of U.S. greenhouse gas emissions. Note that the “electricity” category includes energy consumed by buildings and the “building energy” category focuses mainly on point-source emissions from fuel combustion for heating, cooking, and water heating.

## Urban Emissions Sources Summary

Cities account for ~70% of global GHG emissions

Urban emissions vary significantly around the world

Indirect factors related to emissions

City has limited political influence:

Climate, Economy, Power Sector

City has moderate influence:

Building Quality, Transportation, Urban Form

# Urban Emissions Sources Summary

Direct sources of urban emissions:

Buildings – thermal services, lighting, construction

Transportation – cars, transit

Electricity – power plants, local generation, buildings

Waste – landfill and wastewater treatment



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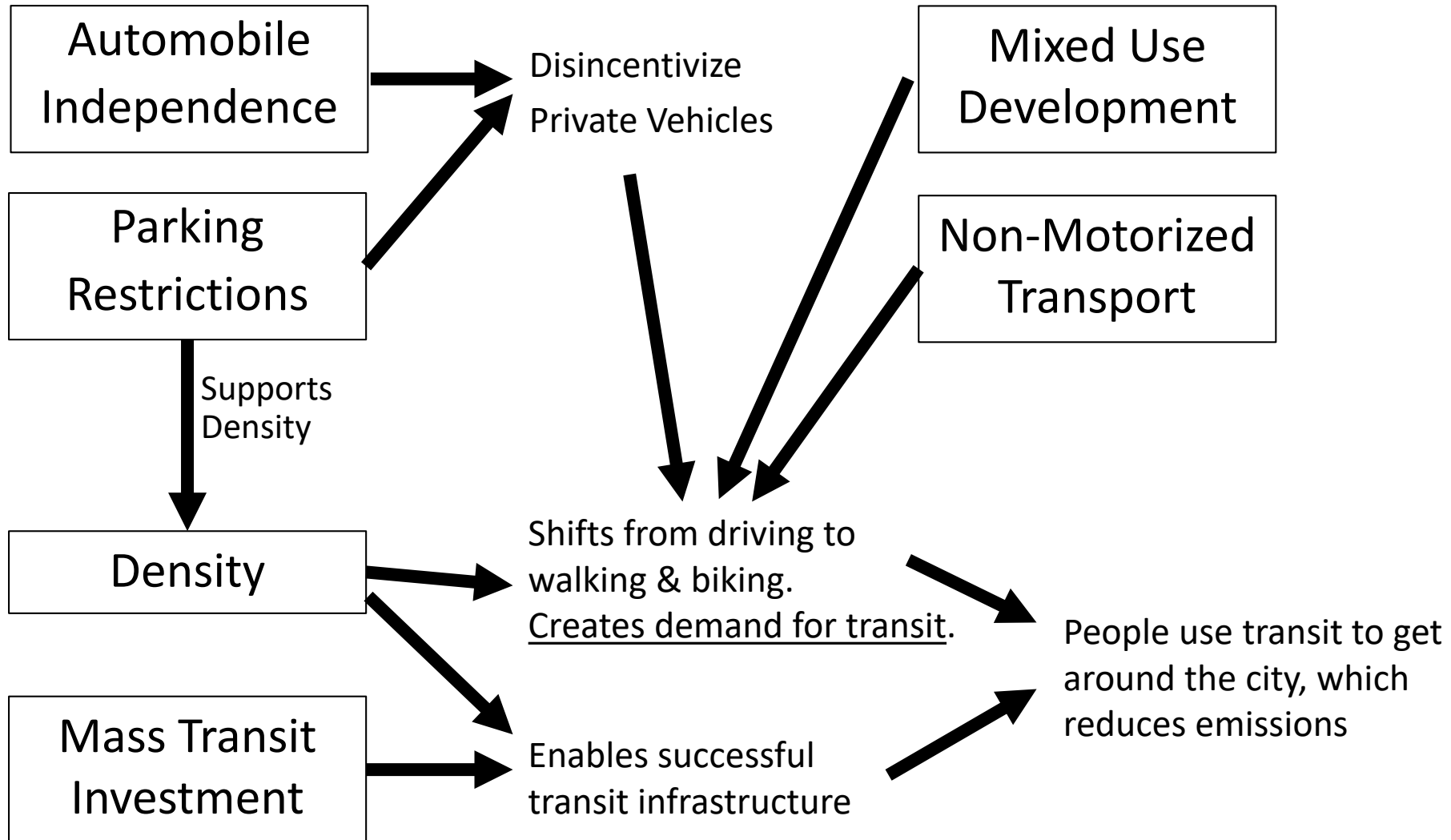
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Supplementary Topics

# One avenue for reducing urban GHG emissions is to shift car drivers to walking, cycling, or transit

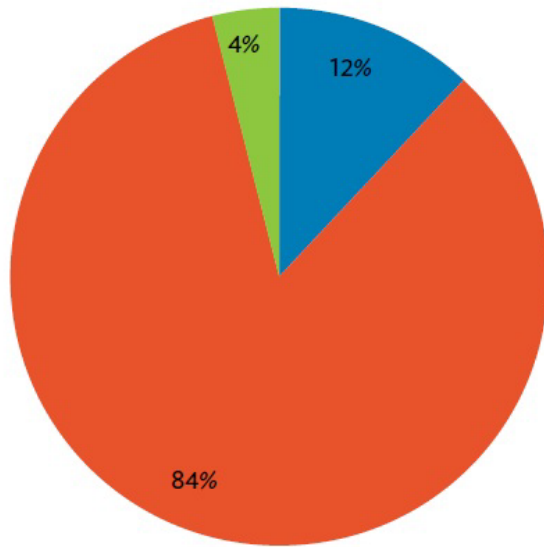


# Combined policies achieve a broader goal of shifting transportation modes



# One avenue for reducing urban GHG emissions is to reduce energy and emissions in buildings

## Life Cycle Energy

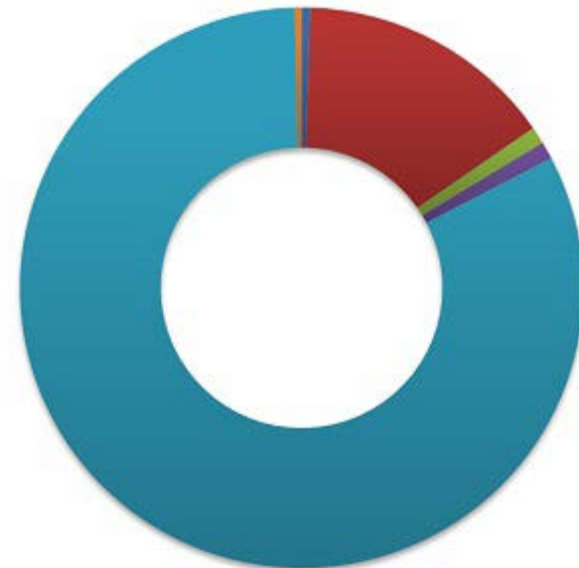


■ Manufacturing, transport, and construction

■ Use (heating, ventilation, hot water, electricity)

■ Maintenance and renovation

## Life Cycle Emissions



■ Design 0.5%

■ Assembly on Site 1%

■ Materials or Product Manufacture 15%

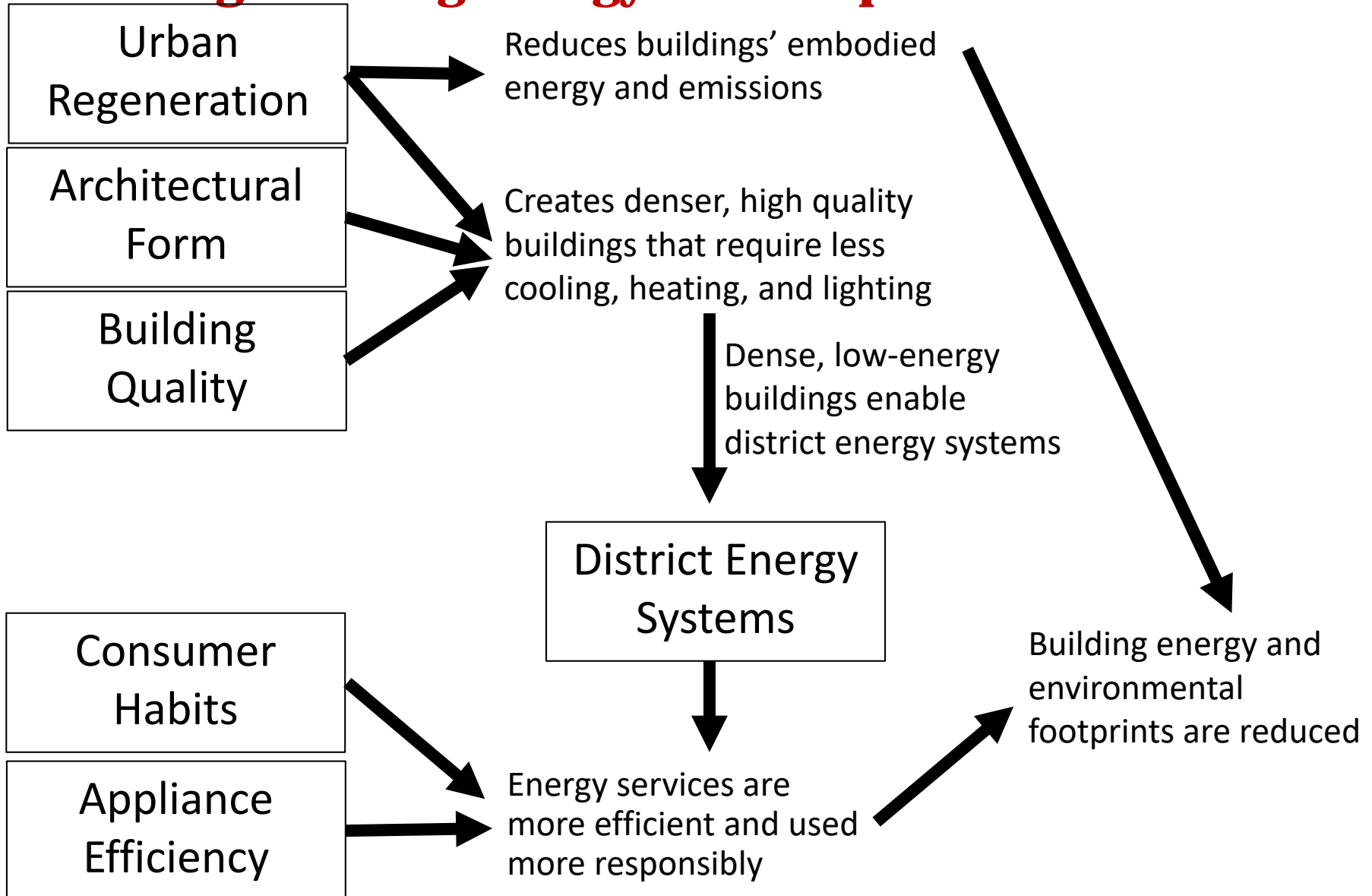
■ In Use 83%

■ Distribution 1%

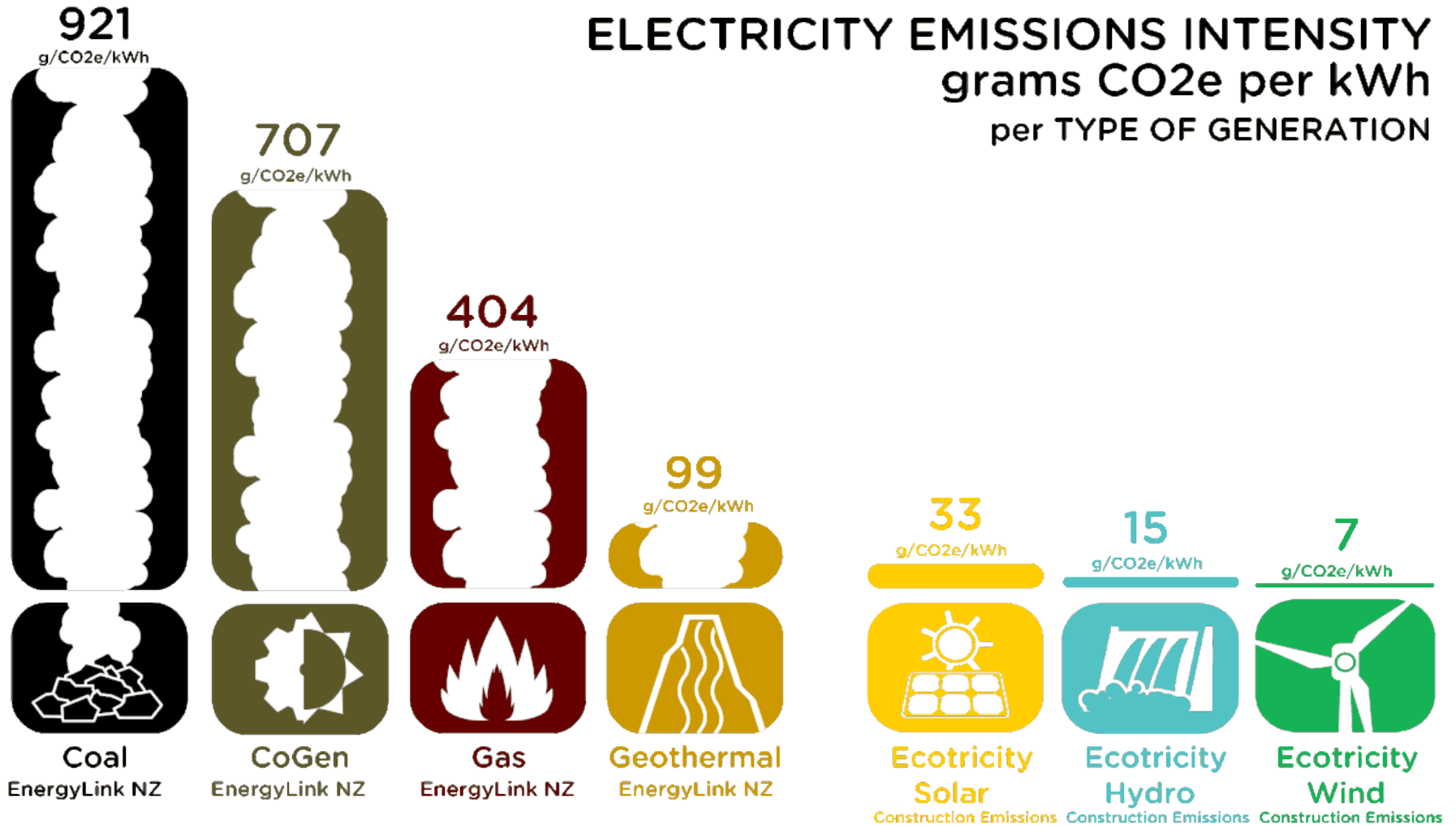
■ Refurbish/Demolition 0.4%

Source: Adalberth (1997).

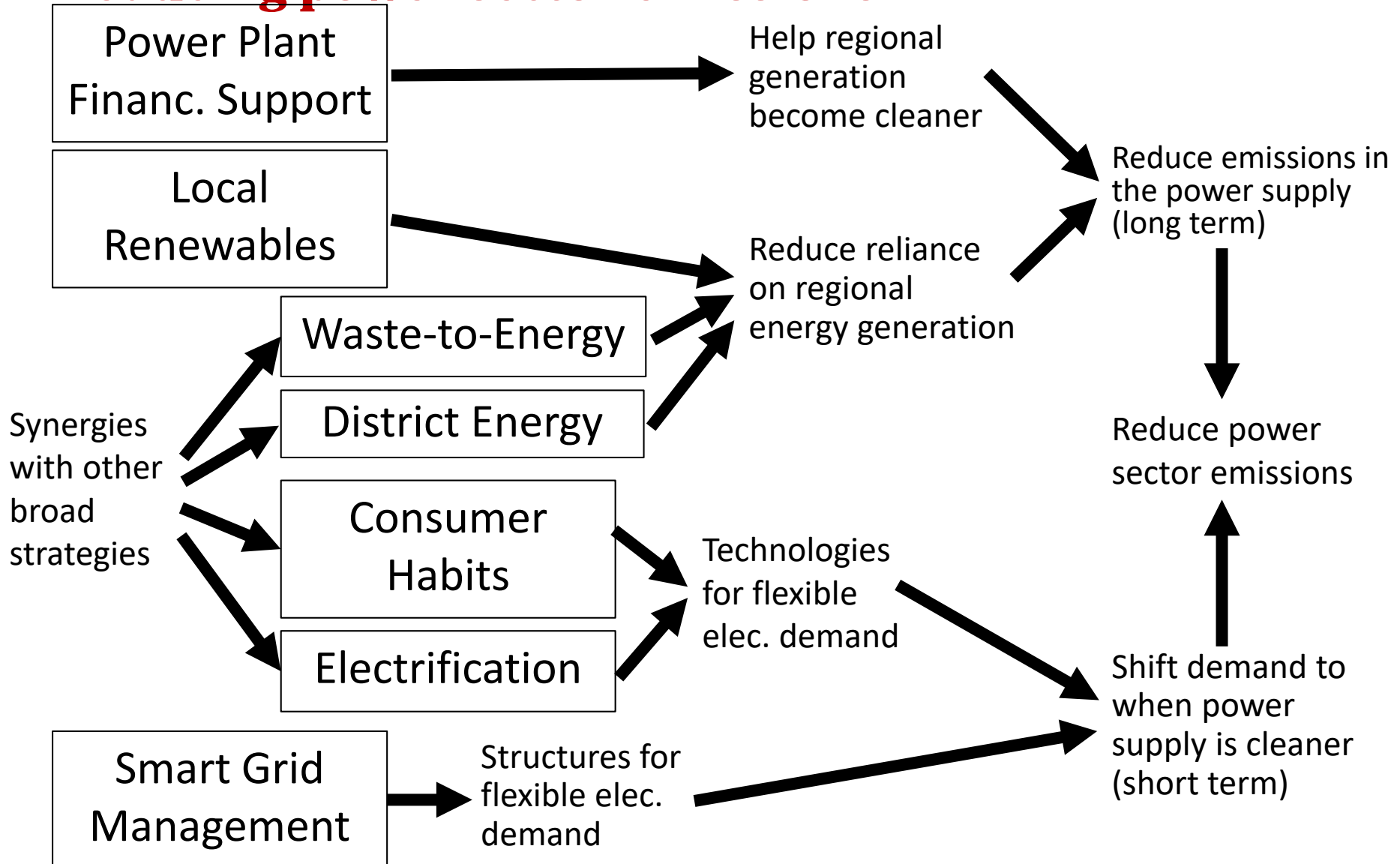
# Combined policies achieve a broader goal of reducing building energy consumption



# Emissions intensity can vary substantially between different power plants



# Combined policies achieve a broader goal of reducing power sector emissions



# Course Summary

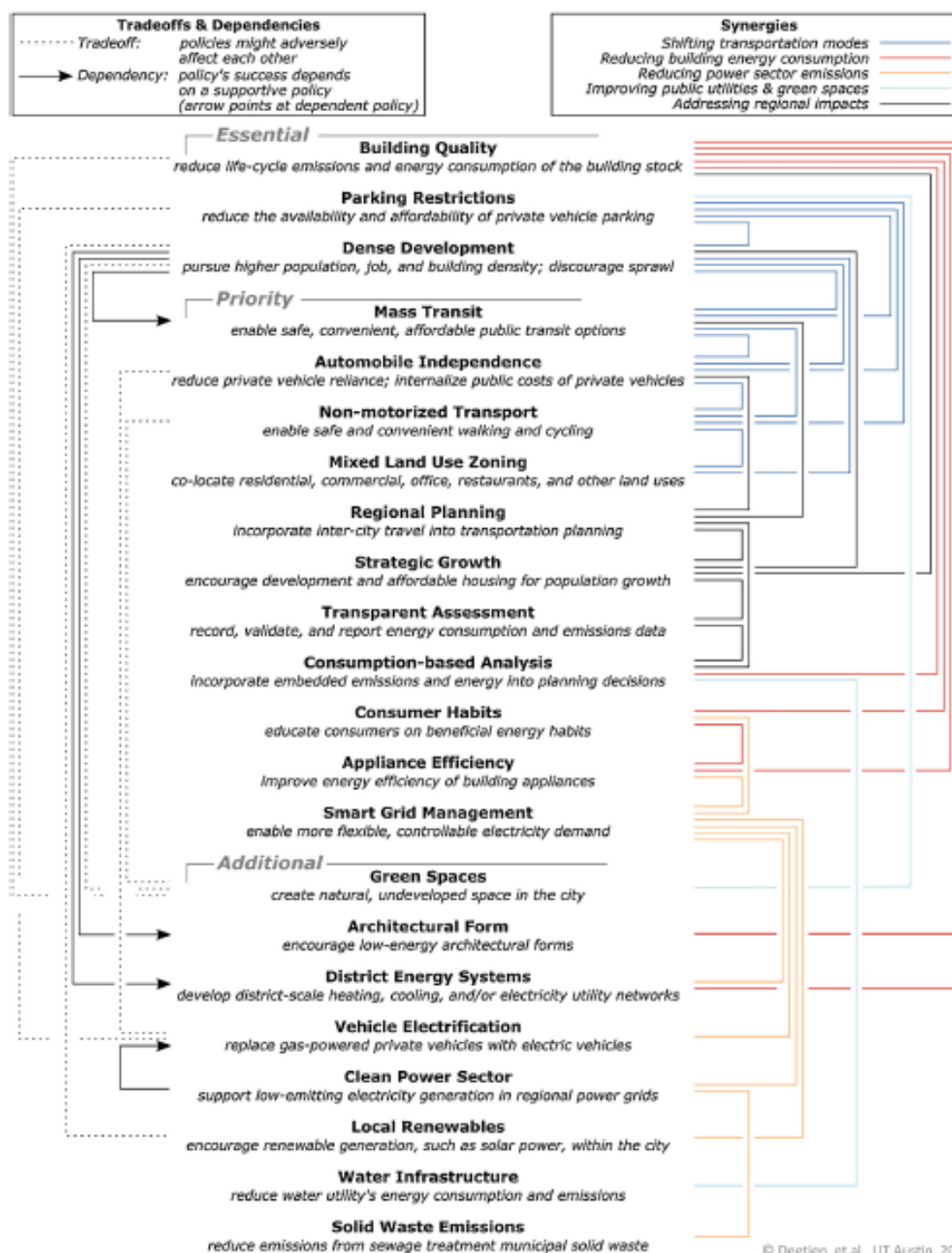
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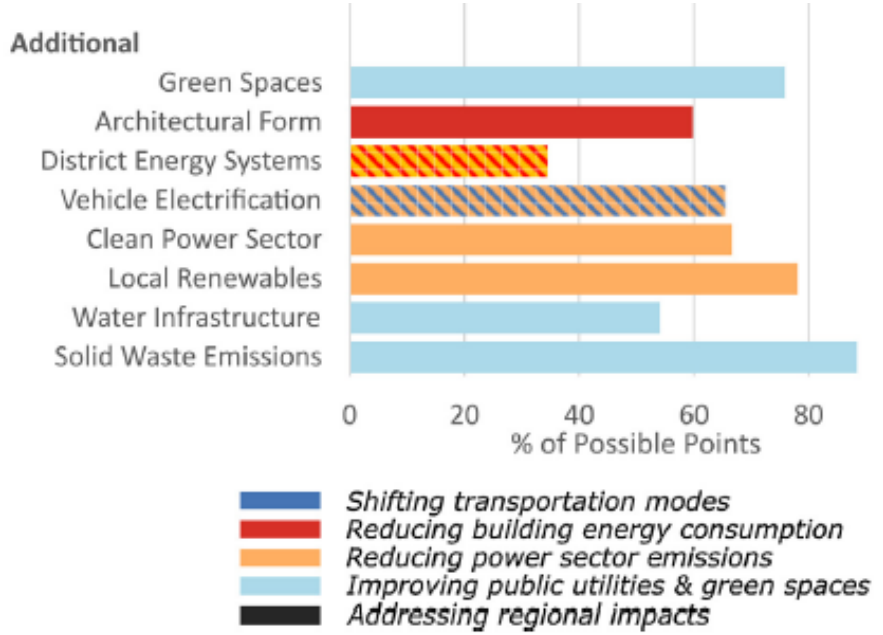
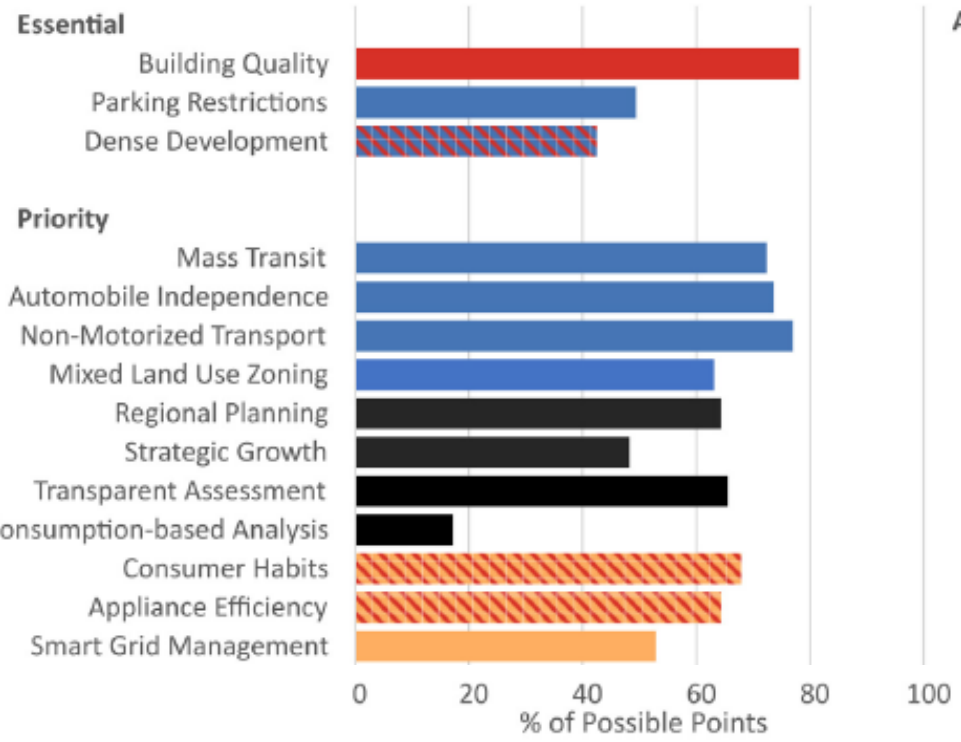




# Scoring rubric for climate action plans – see more in the publication

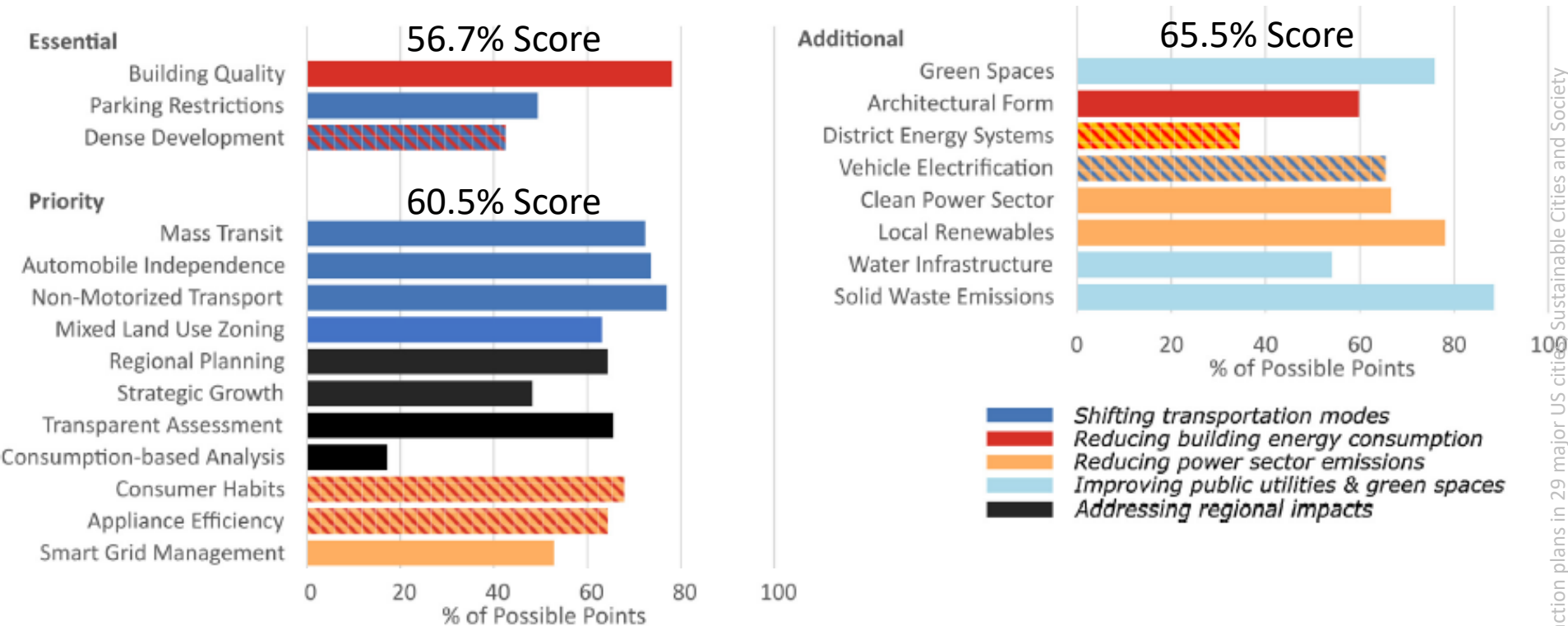
Policy type	Points awarded
<b>Essential policies</b>	
Building quality	<p>3 – communicates intentions to improve building quality, but mentions no specific policies or building code updates</p> <p>6 – plans to update building codes to promote higher efficiency new construction and retrofits</p> <p>9 – promotes urban regeneration, net zero energy, and/or embodied energy accounting for construction and demolition materials</p>
Parking restrictions	<p>3 – includes one of restructured zoning requirements (e.g. revised parking minimums/ratios), improved pricing (e.g. increased off-street parking rates and unbundled parking), or high-efficiency incentives (e.g. preferential parking for EVs or carpools)</p> <p>6 – contains two of restructured zoning requirements, improved pricing, or high-efficiency incentives</p> <p>9 – contains all three of restructured zoning requirements, improved pricing, and high-efficiency incentives</p>
Dense development	<p>3 – mentions goals to increase density without specific policies</p> <p>6 – develops specific policies for one of density bonuses, repurposing existing buildings, minimum floor area ratios or building heights, or urban growth boundaries</p> <p>9 – develops multiple urban containment and density promoting policies</p>
<b>Priority policies</b>	
Mass transit	<p>2 – mentions goals to expand transit network without specific policies or development plans</p> <p>4 – includes specific plans for transit-oriented development, increased bus lines, expansion of transit network, etc.</p> <p>6 – outlines a complete overhaul of the current transit system and/or expands the transit network to include rail</p>
Automobile independence	<p>2 – mentions need for congestion management and includes one specific policy including ride-sharing/carpool support, fuel taxes, higher parking prices, congestion charges, optimized traffic light timing, etc.</p>

# Applied the Scoring Rubric to the Climate Action Plans of 29 Major U.S. Cities

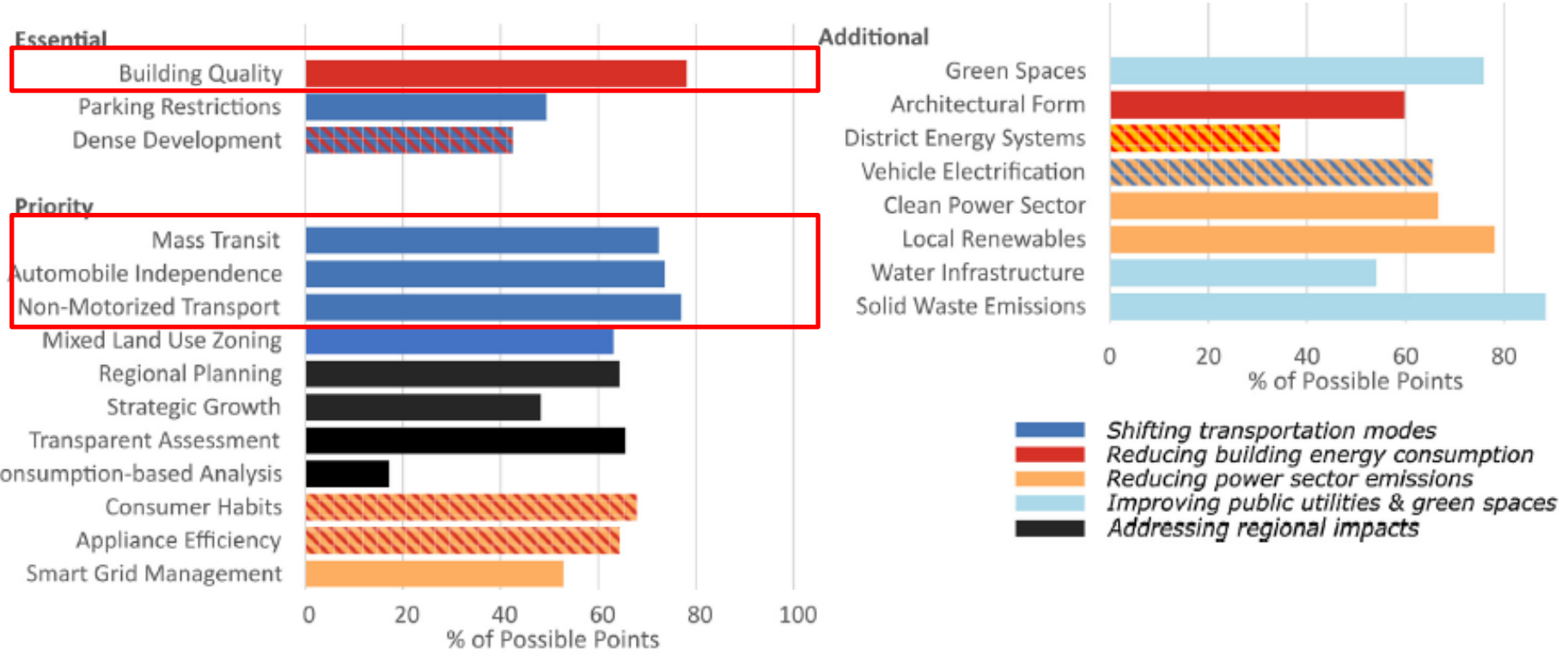


- *Shifting transportation modes*
- *Reducing building energy consumption*
- *Reducing power sector emissions*
- *Improving public utilities & green spaces*
- *Addressing regional impacts*

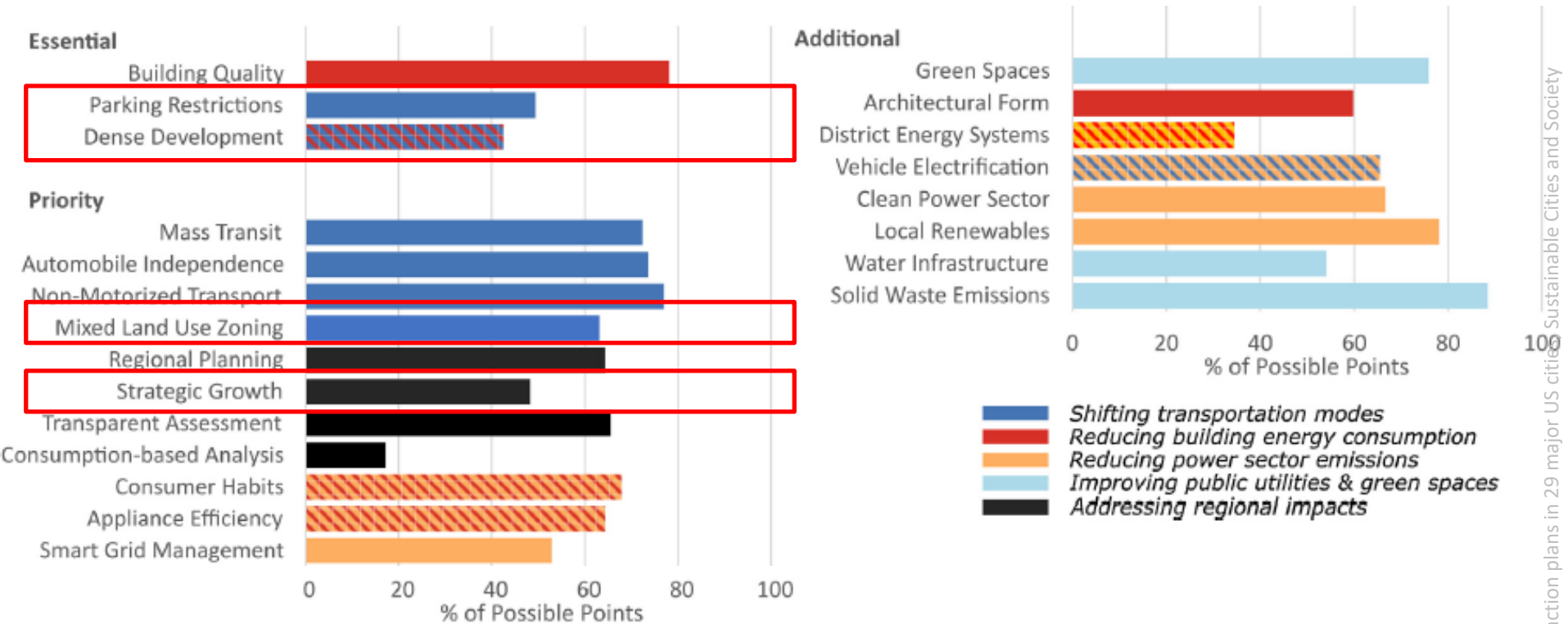
# Cities score worst in the essential policies and best in the least essential policies



# Cities do well in Building Quality & Transportation



# Cities do poorly in Strategic Growth & Urban Form



# Cities score from 38 to 79 with scores tending to cluster regionally

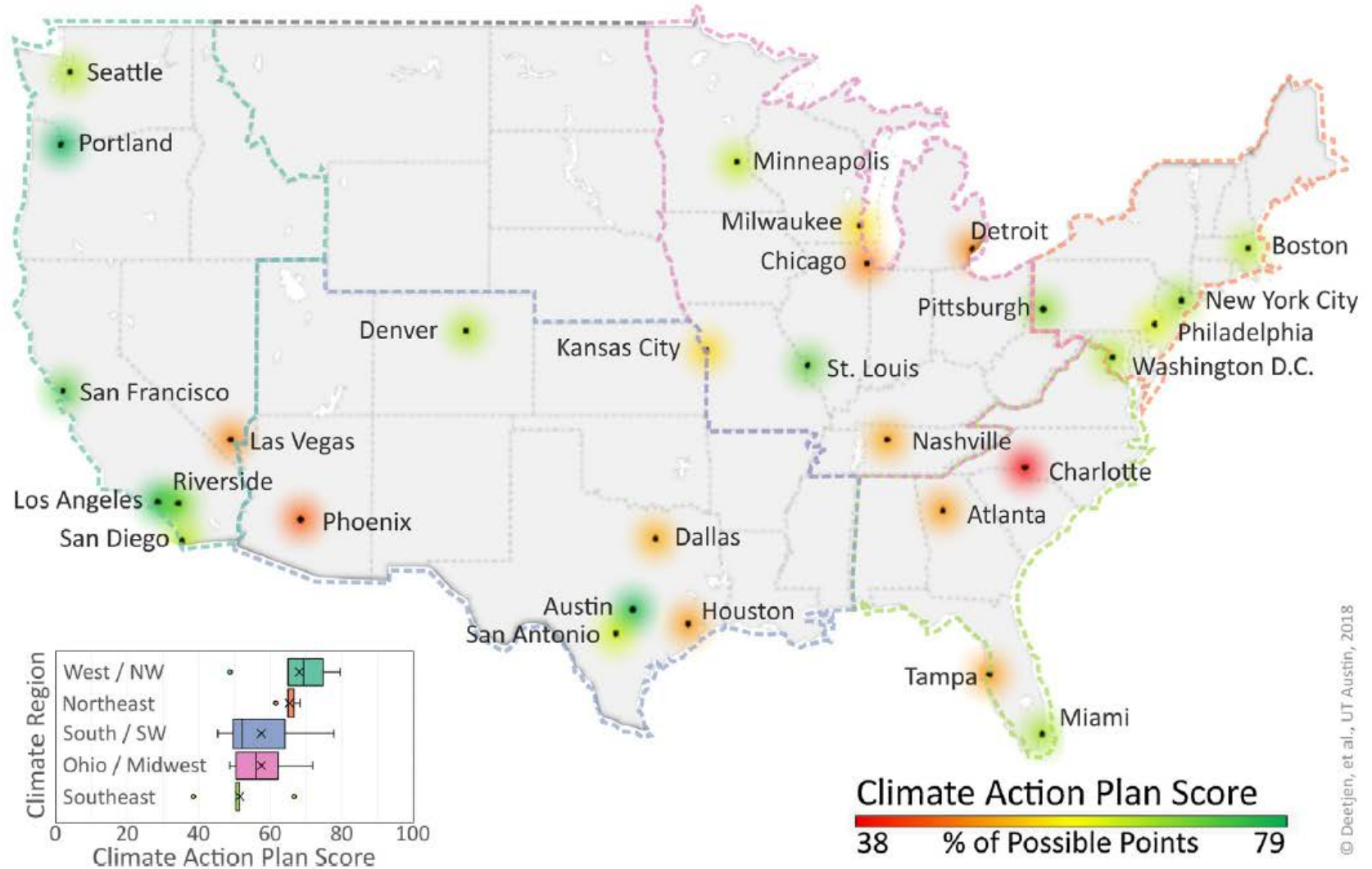
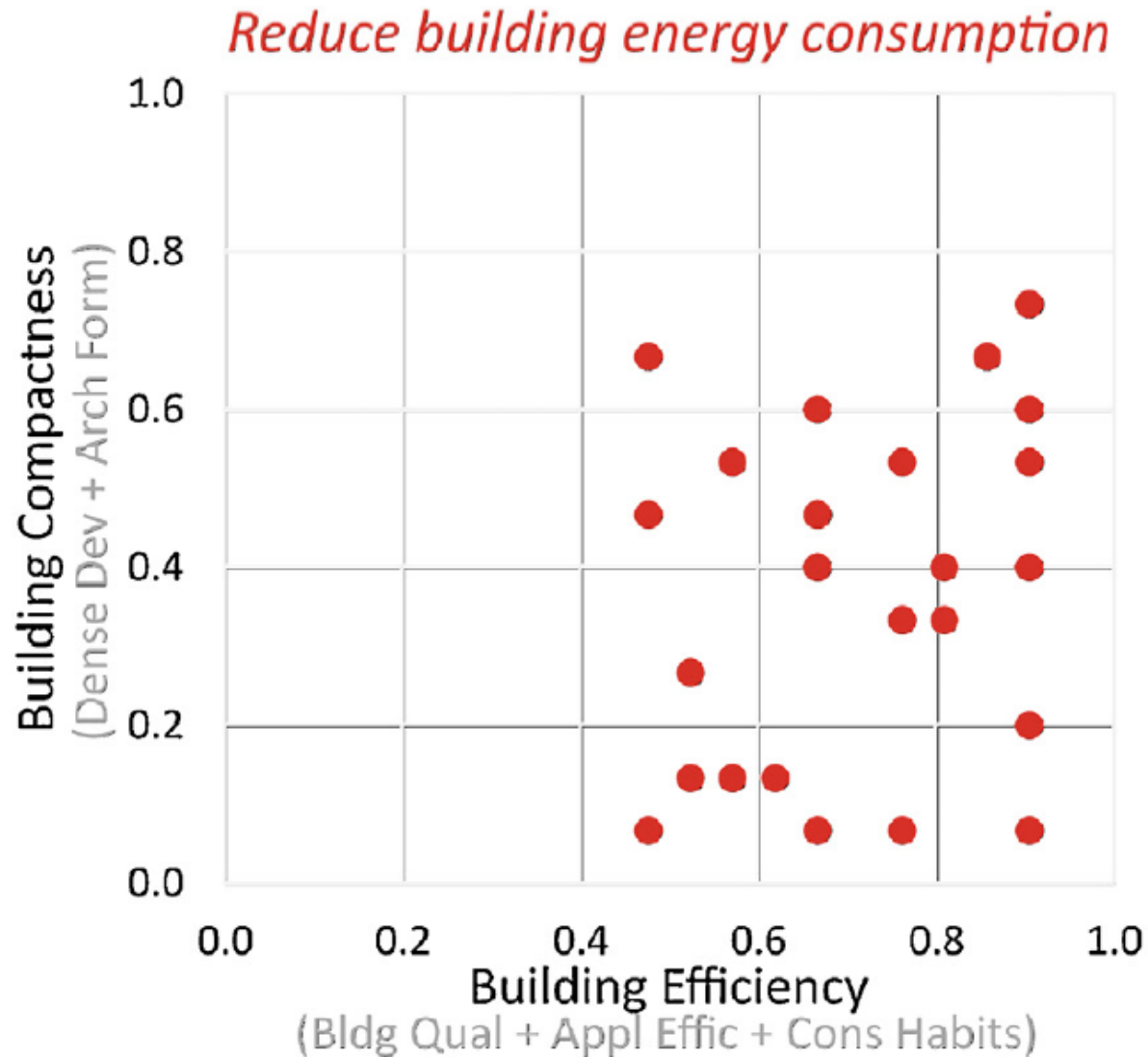


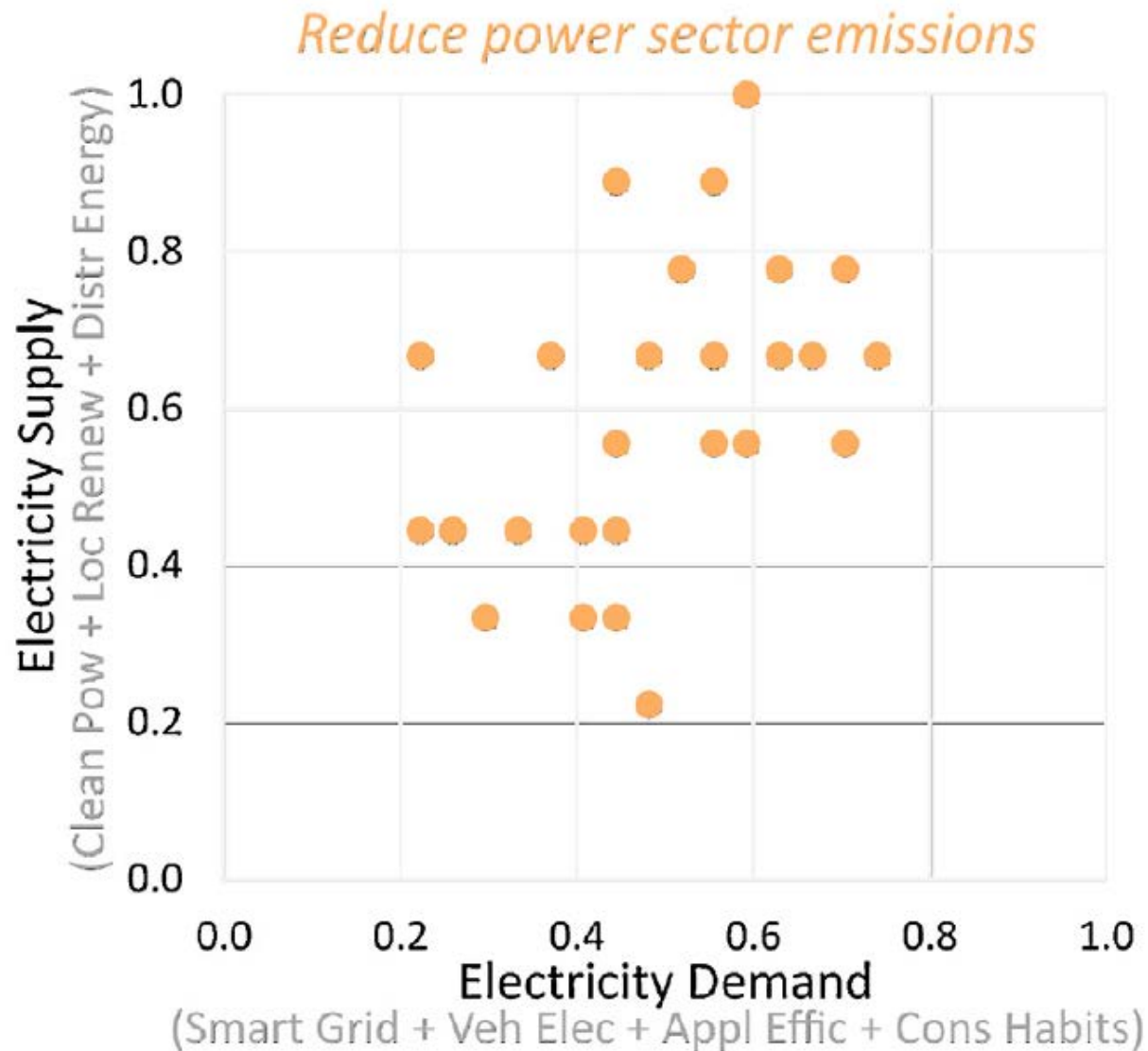
Fig. 6. The scores for each city's climate action plan are shown with their geographic location. The box and whisker plot uses NOAA climate regions (Karl & Koss, 1895–1983) to aggregate scores regionally.

# Building compactness and urban form often neglected regarding building energy reduction

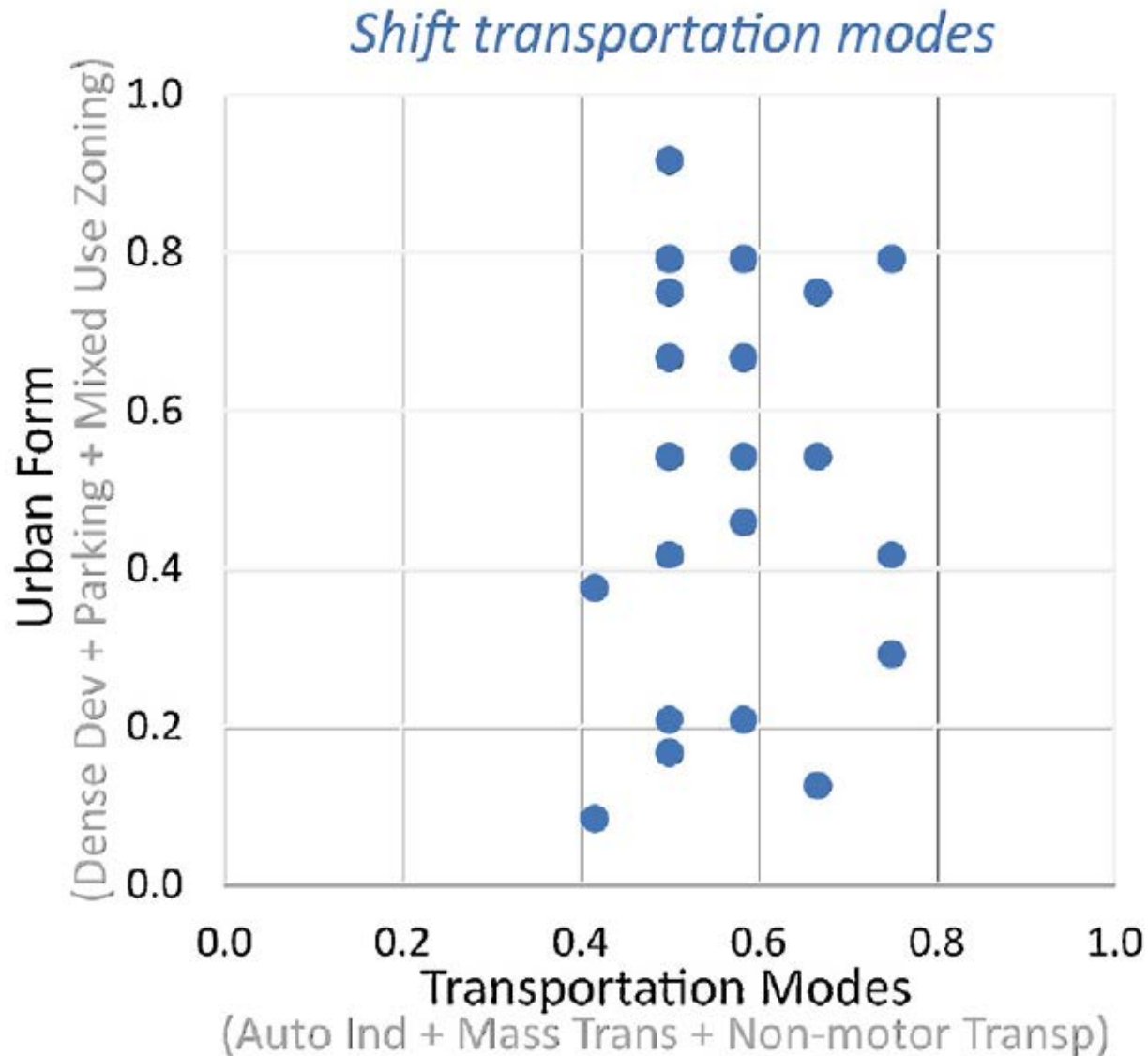




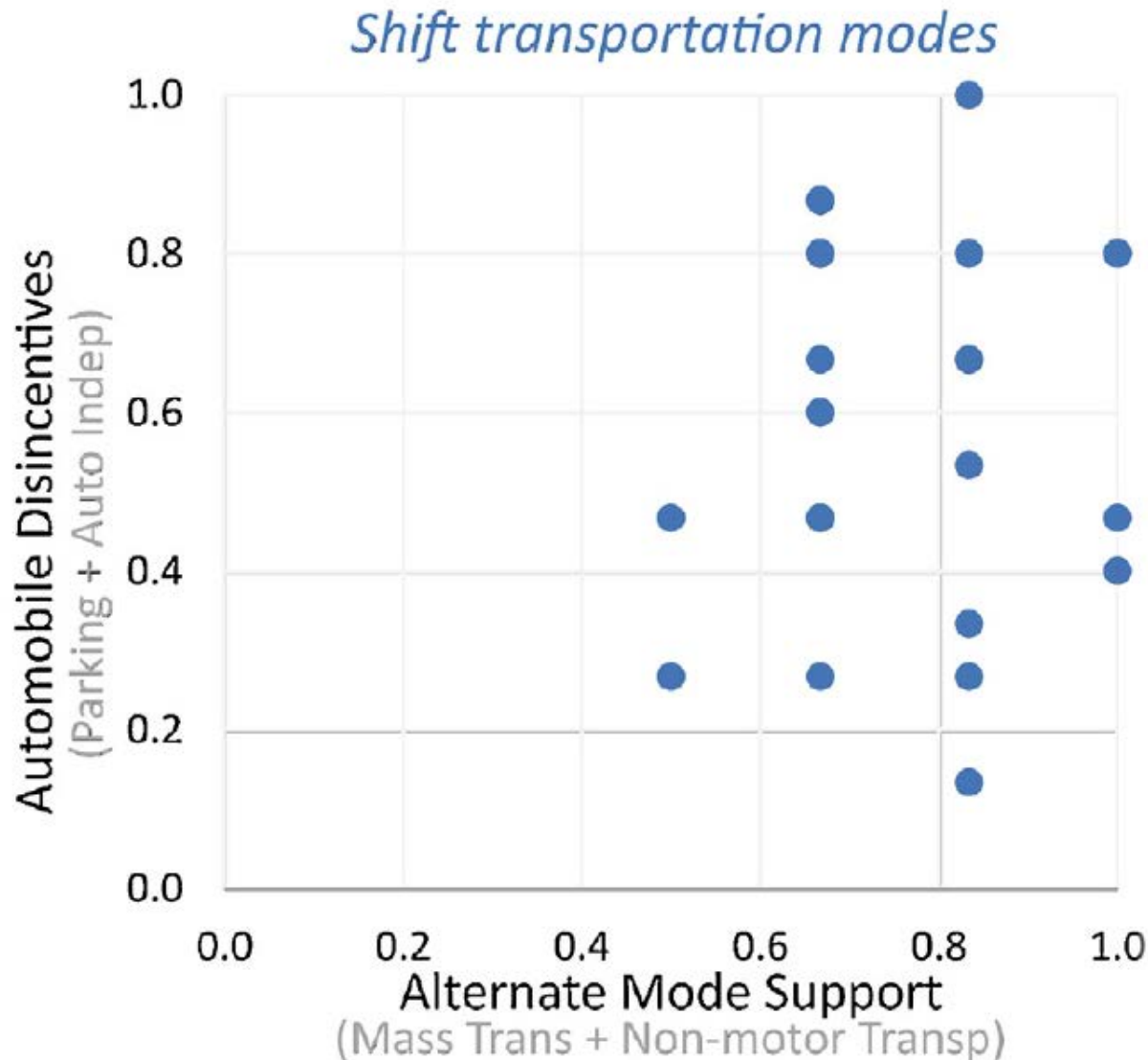
# Electricity supply receives more attention than electricity demand



# Transport policy not typically supported by urban form policy



# Transit support often poorly balanced with private vehicle disincentives



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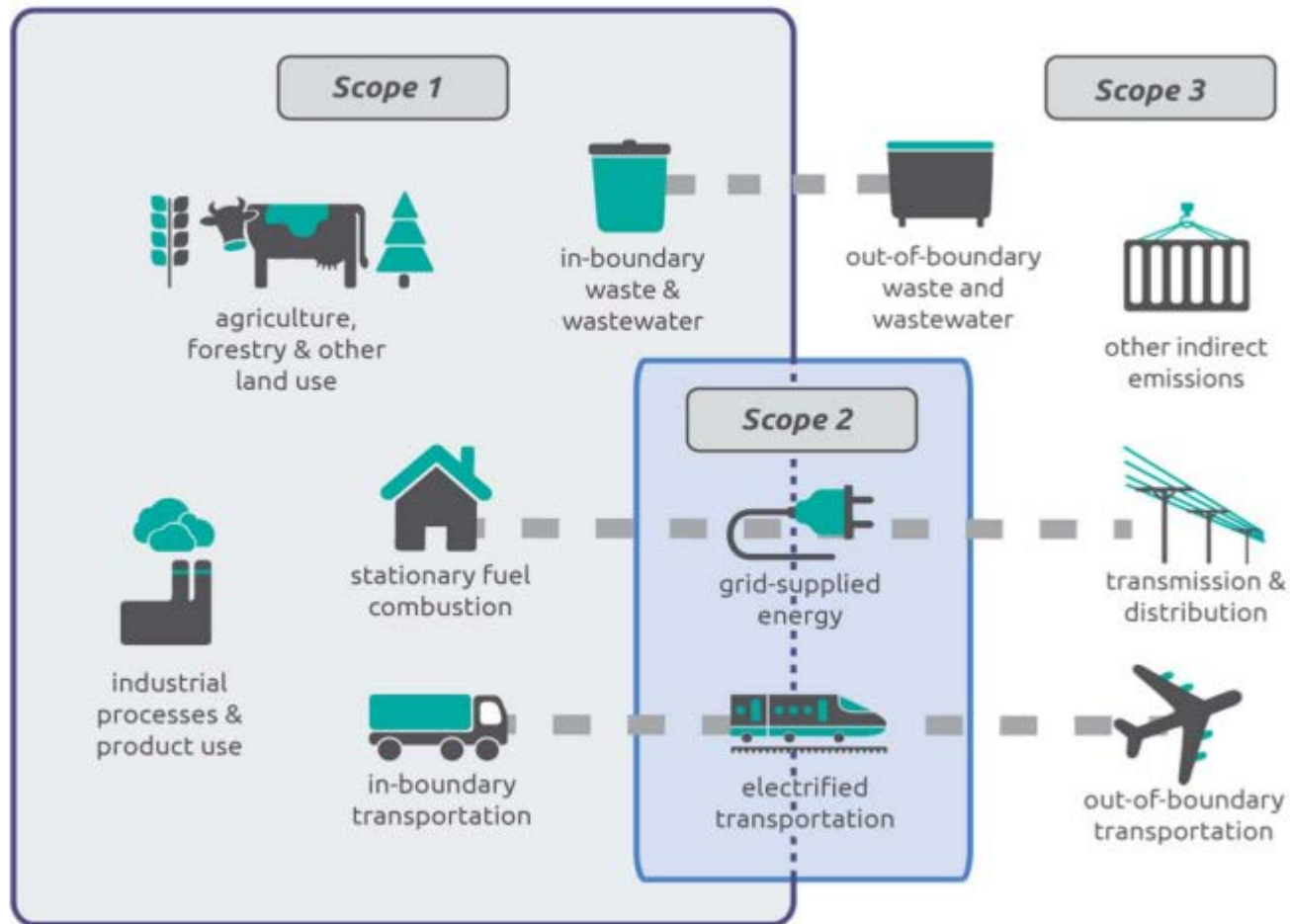
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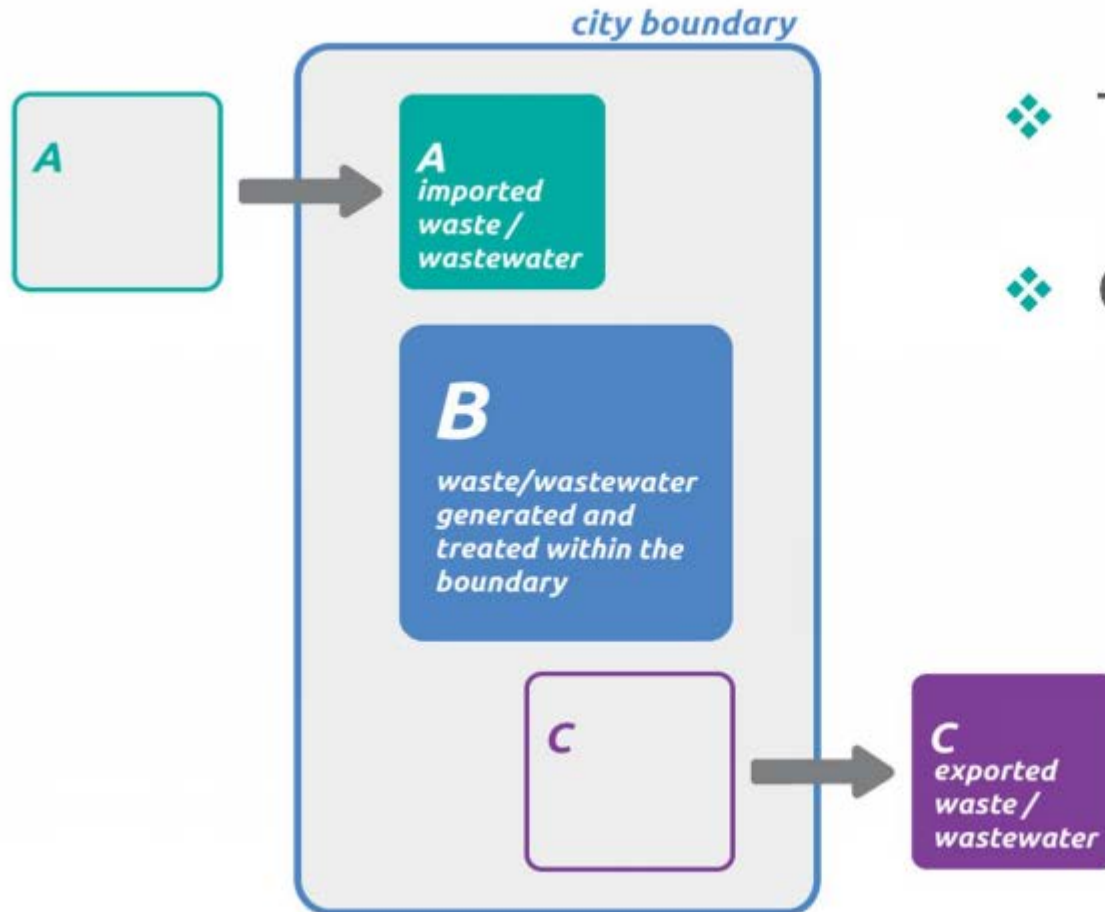
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Supplementary Topics

# CBA focuses on indirect and embodied emissions and can cover various scopes and scales



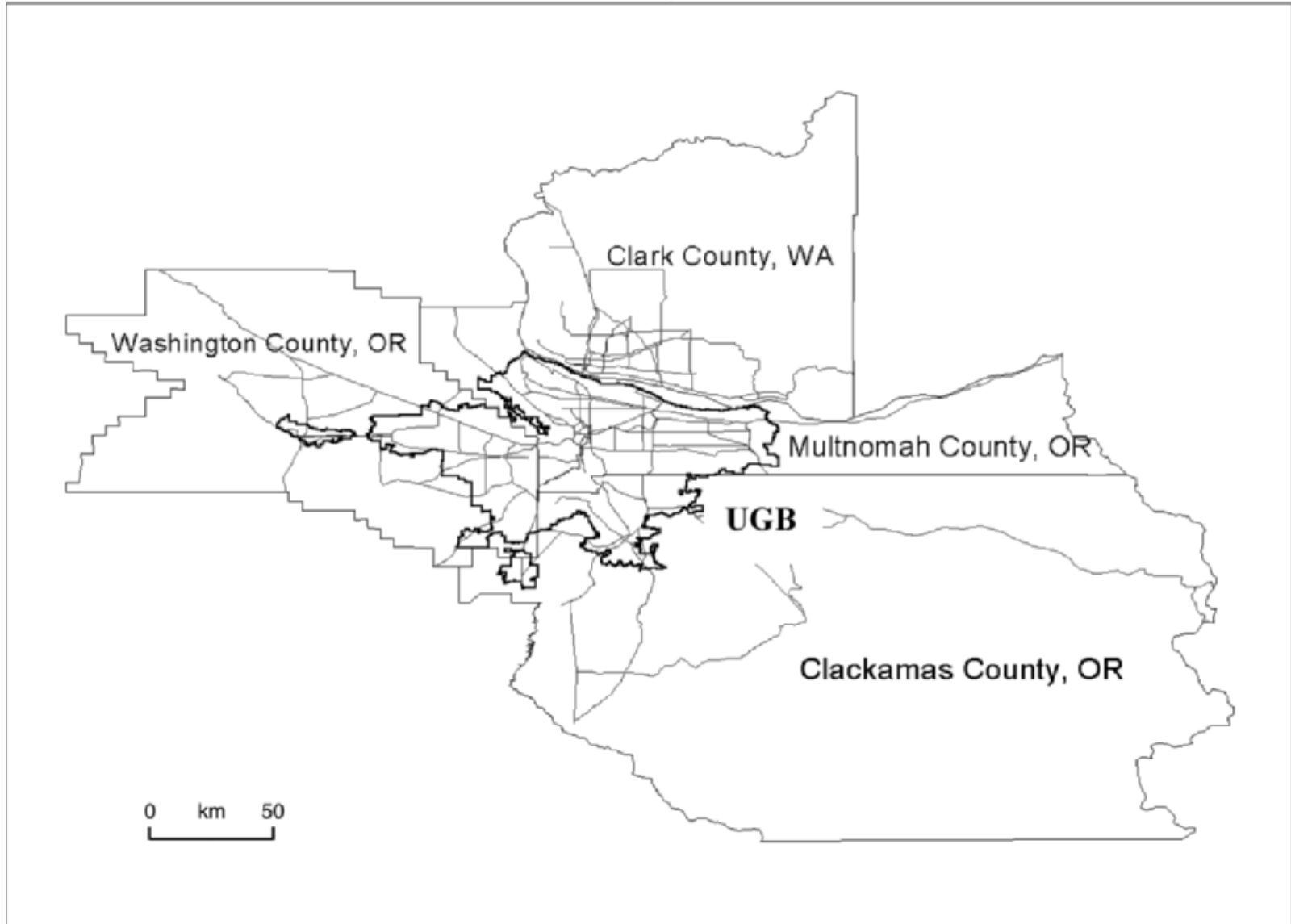
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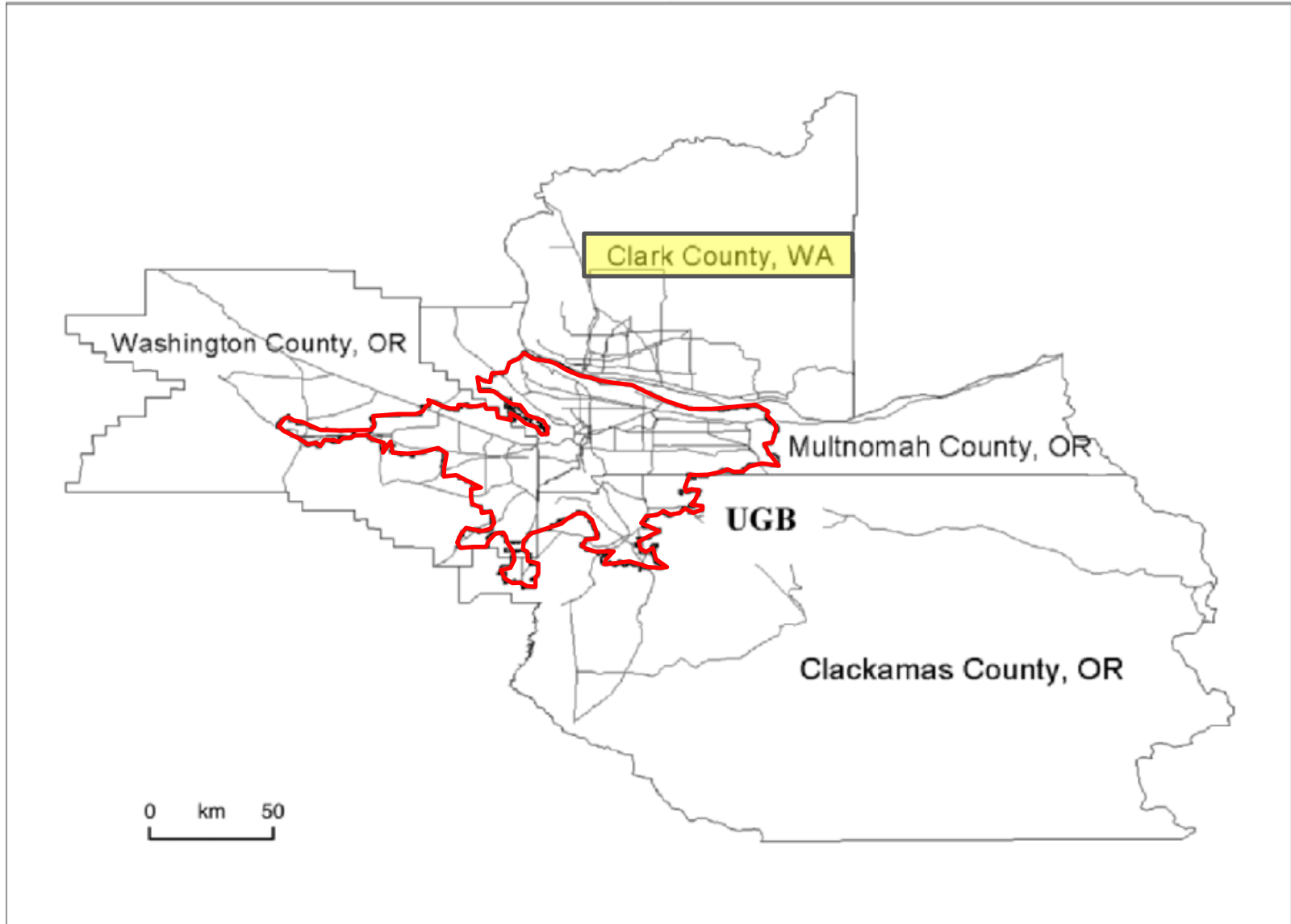
❖ Territorial = A+B

❖ GPC Basic = B+C

## Regional Impacts – for example, Portland growth boundary pushed development outside city

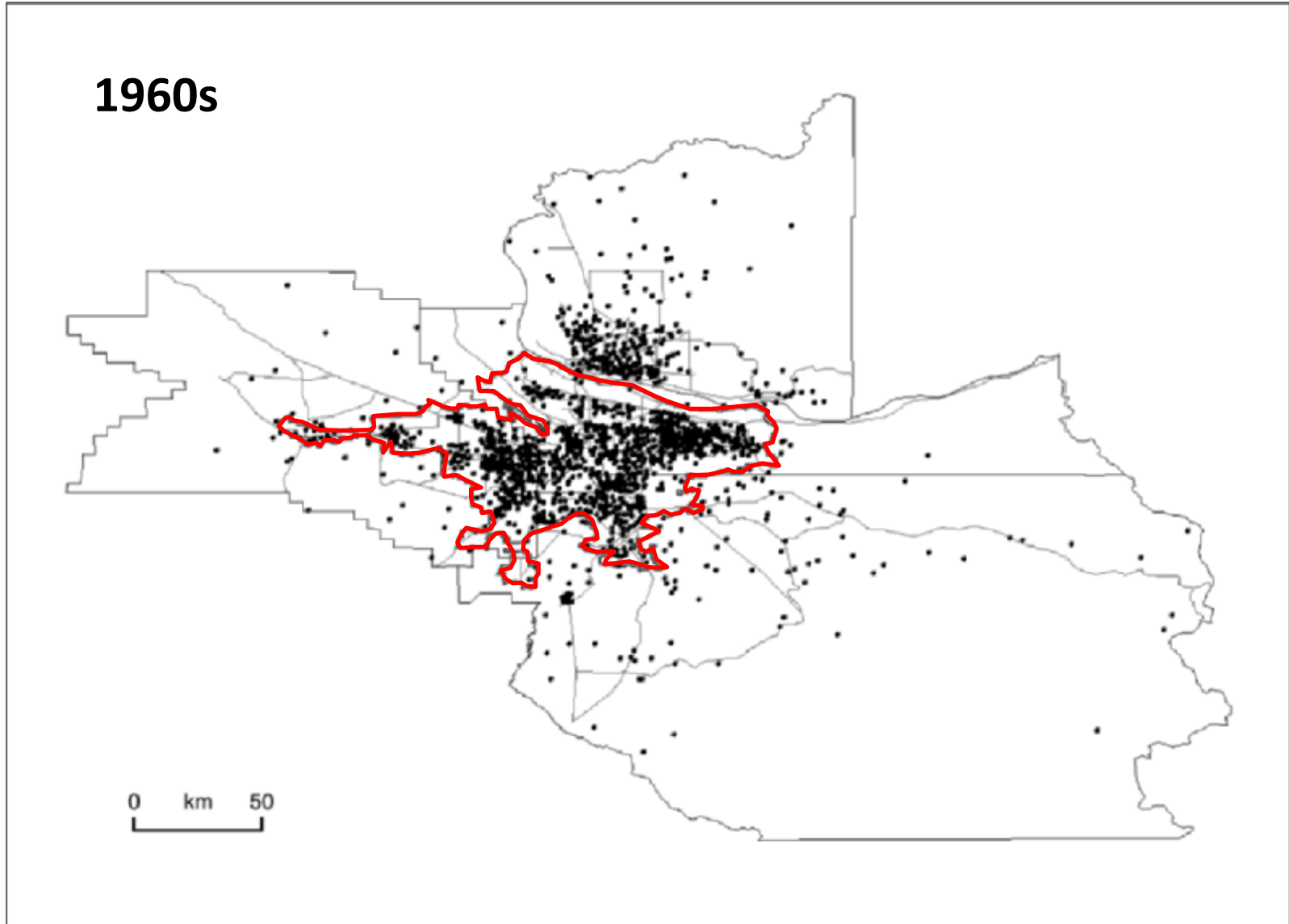


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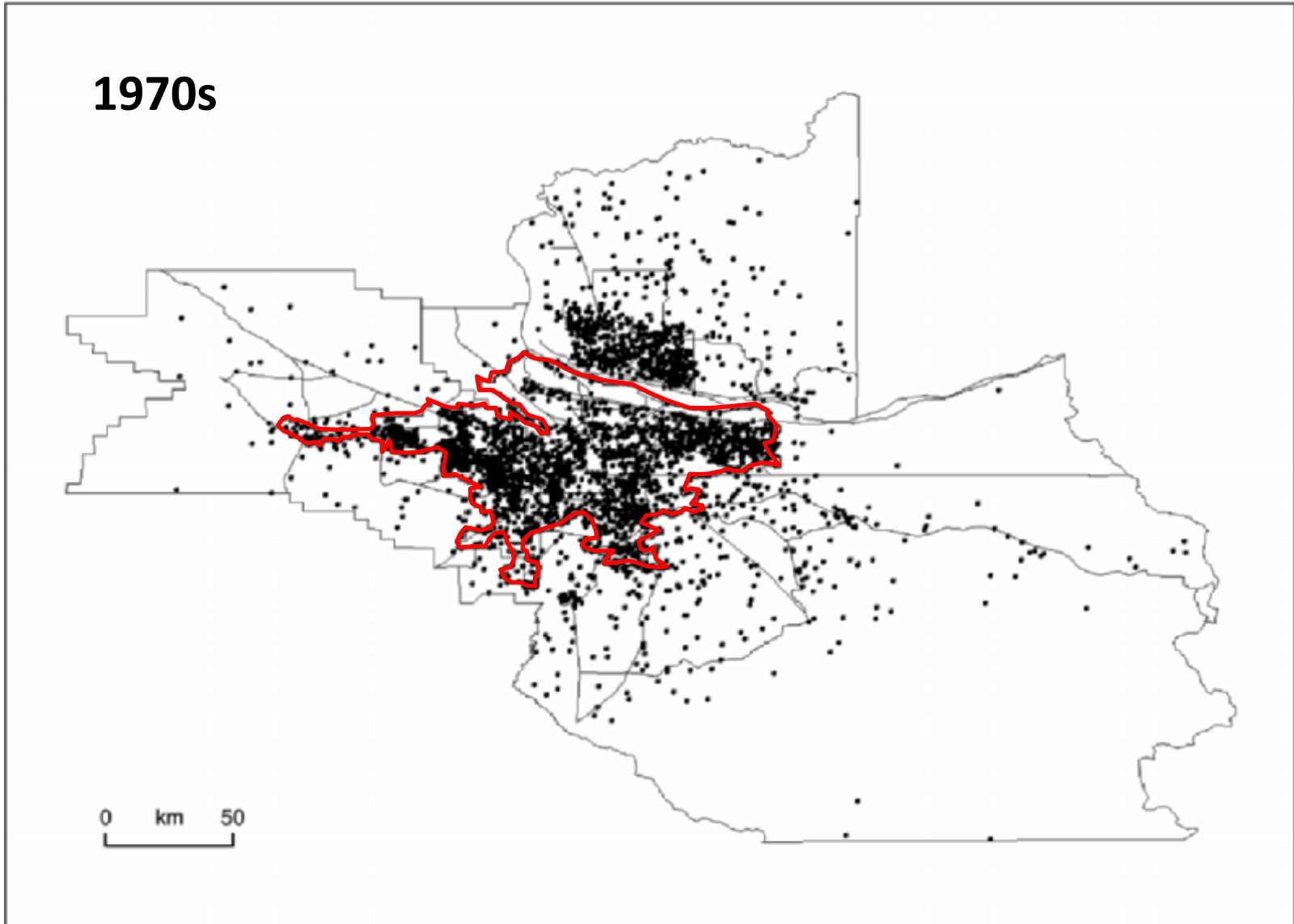




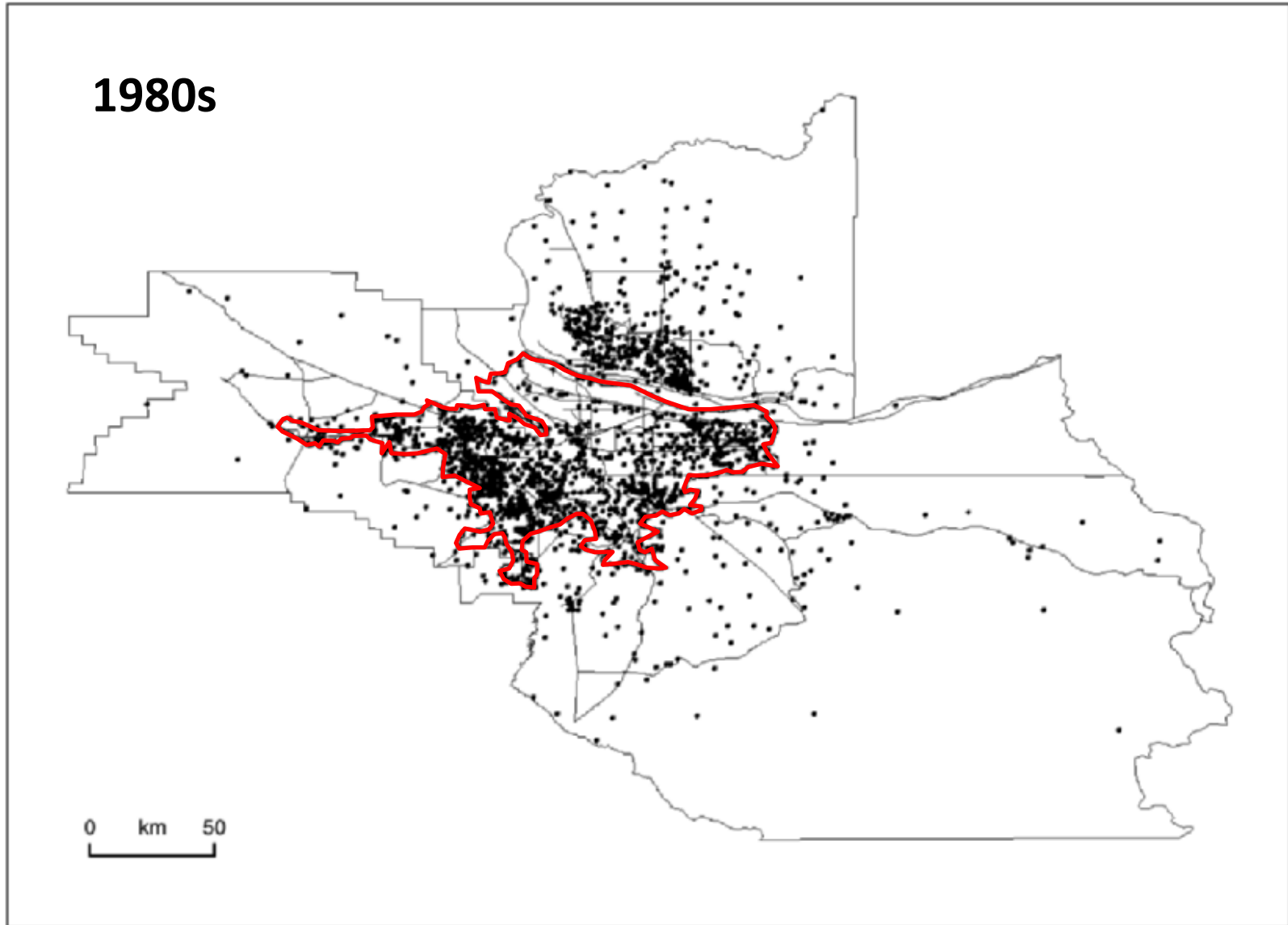
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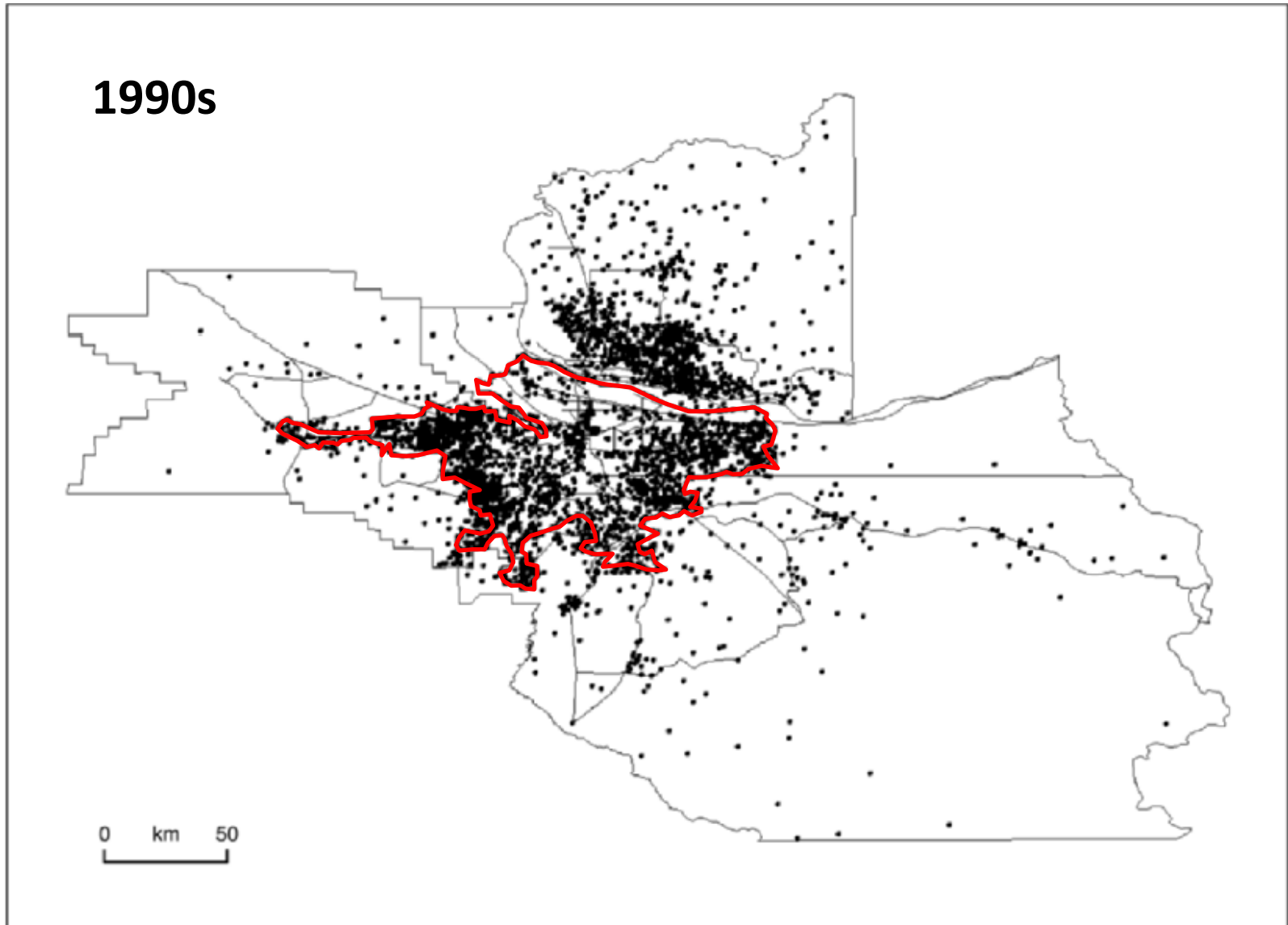
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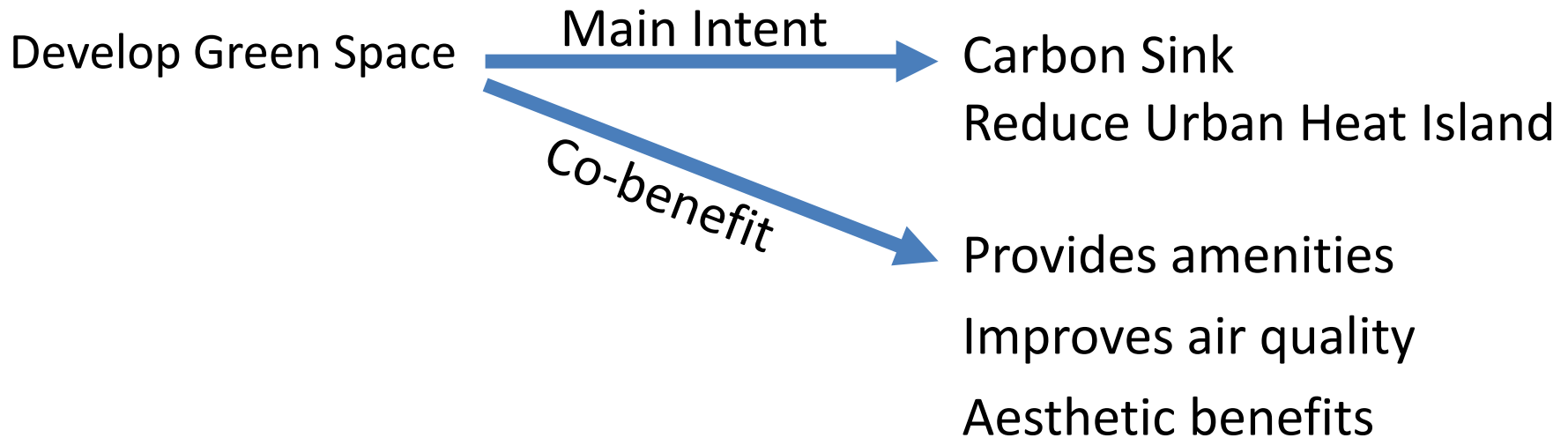
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## Green space provide numerous benefits, of which climate change might be relatively small

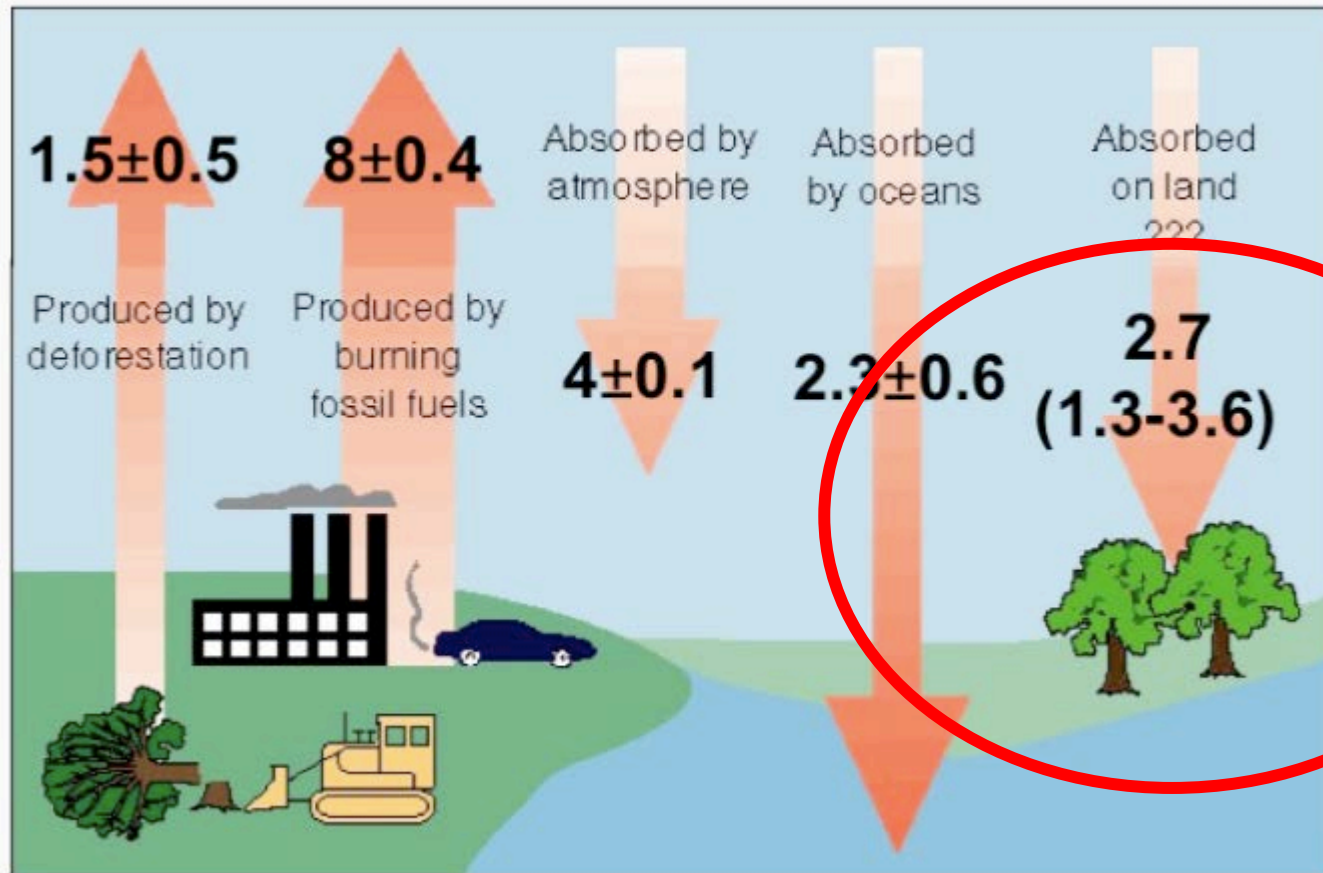


## **Green space provide numerous benefits, of which climate change might be relatively small**

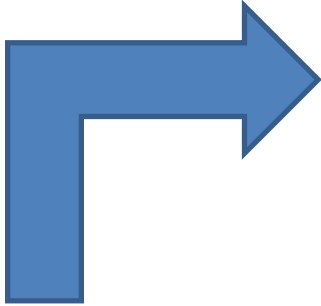


# Green space provide numerous benefits, of which climate change might be relatively small

Anthropogenic CO<sub>2</sub> sources and sinks in 2005 [PgC/y]

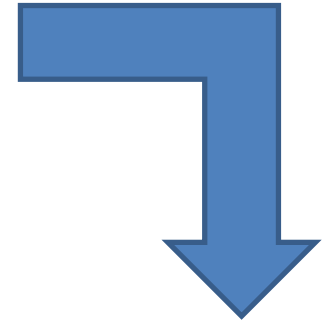


## Highway lock-in and path dependence

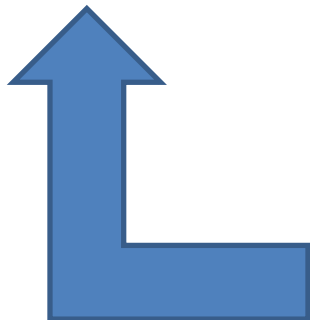


Highways last for decades.

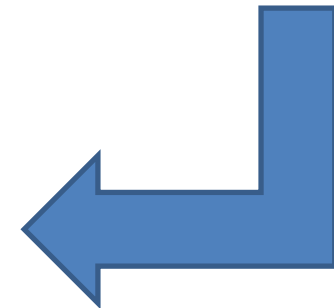
We want to use highways since they are there and available.



We build cars, freight, suburban communities relying on highways

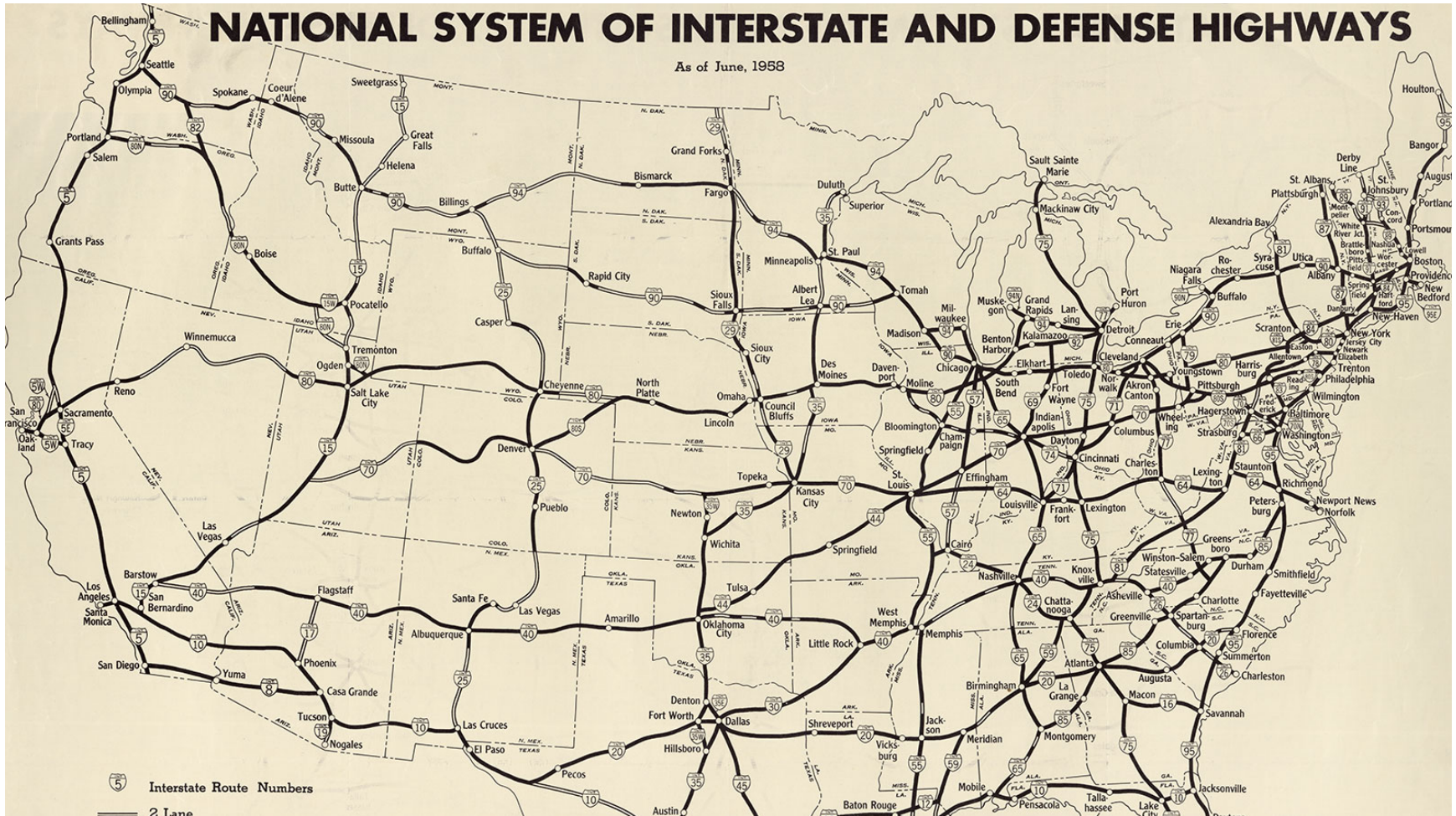


When demand increases or highways need replacement, we build more. Alternative transportation seems too difficult.





# U.S. highways built primarily in the 50s with the goal of national defense



# Changing an urban highway to expressway is a big project and only partially shifts transport modes



## Summary Slide

We used the academic literature to develop some theory about urban climate change mitigation and broad strategies for achieving that

We applied these theories to assess the climate action plans of Pittsburgh and provide recommendations

We explored supplementary topics that add additional layers to discussing urban climate change mitigation strategies

**Has this class changed the way you interact and view Pittsburgh and other cities?**

**If so, how?**

**What surprised you about the material?**