# ASSESSING CITIES: APPLYING GIS-BASED METHODS FOR MAPPING CROSS-SCALE SPATIAL INDICATORS

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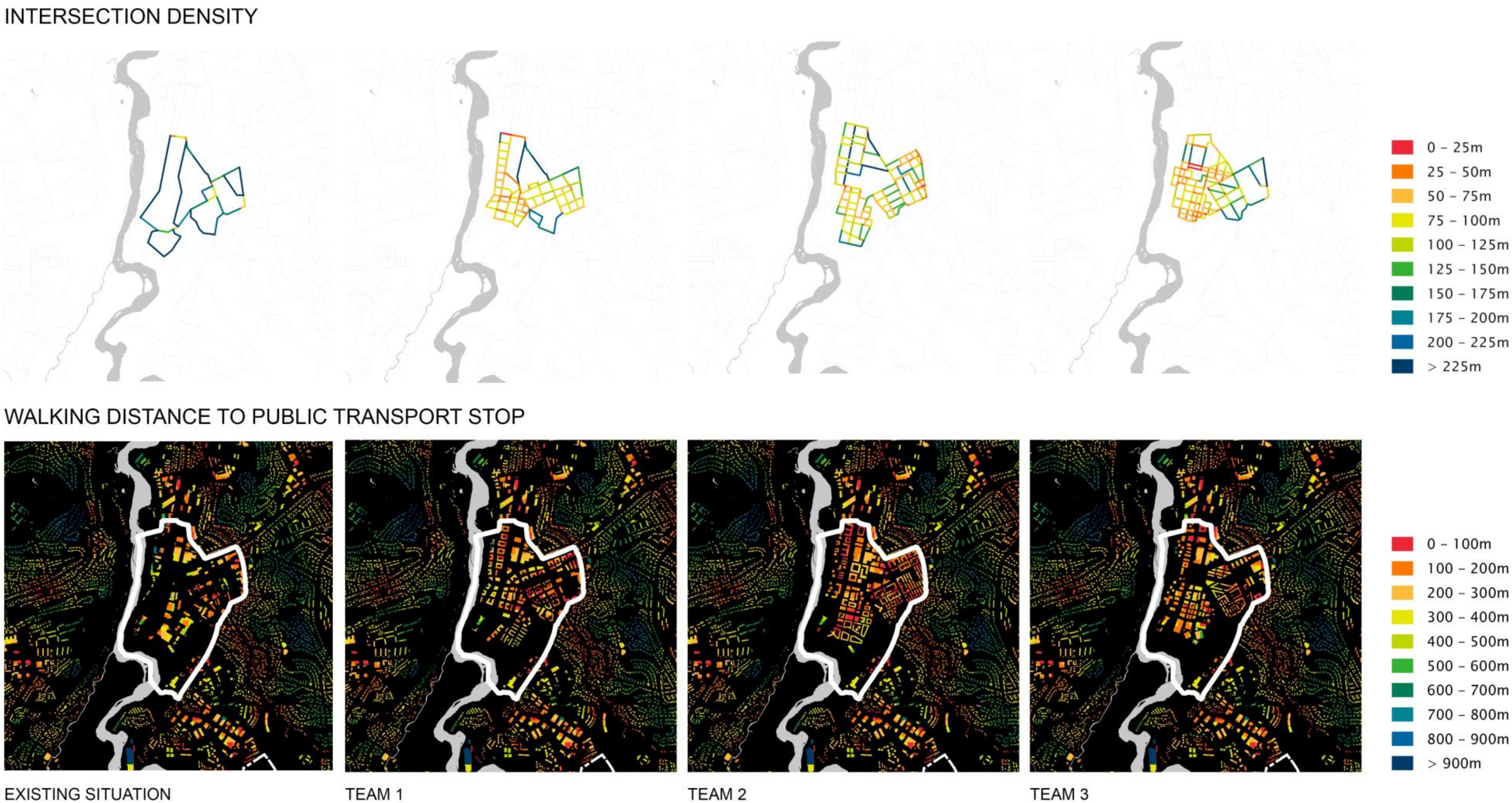
# BACKGROUND

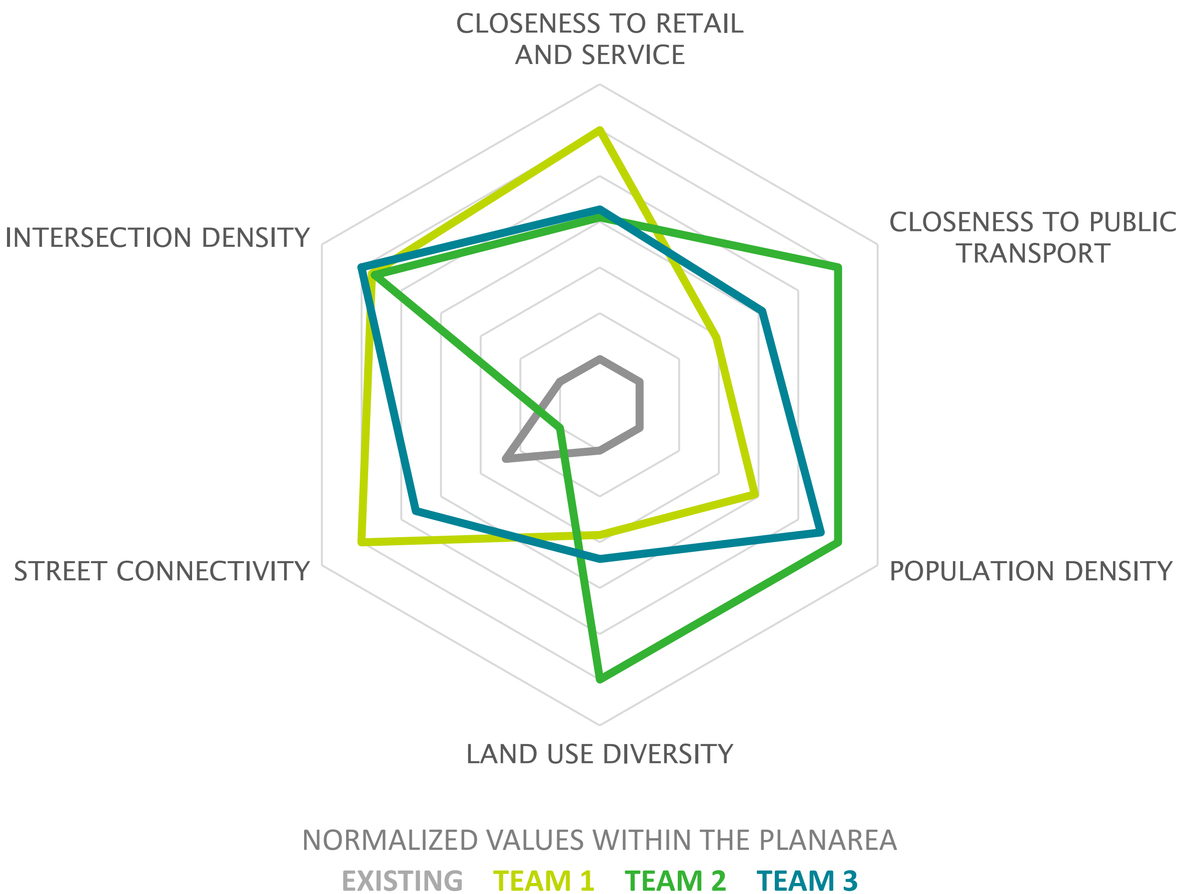
Sluppen, Trondheim: Comparative study of three design options focussing on the potential for attractivity and sustainable transport modal choices




Source: Rokseth, Manum & Nordström (2019)

# BACKGROUND

Sluppen, Trondheim: Revealed significant differences between the design options
Further research needed on selection of indicators/measures

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# URBAN MORPHOLOGY INSTITUTE (UMI) – 60 INDICATORS

| Theme | Concepts of triptych | Indicator type | Name | Scale |
|---|---|---|---|---|
| Land use | Urban form | Intensity | Human density | D/N |
| | | | Building density | D/N |
| | | | Housing density | D/N |
| | | | Density of legal entities | D/N |
| | | | Job density | D/N |
| | | | Coefficient of land occupancy | D/N |
| | | | Subdivision intensity | D/N |
| | | Diversity | Diversity of subdivisions size | D/N |
| | | | Diversity of land use (road network, built environment, courtyards, green spaces) | D/N |
| | | | Diversity of subdivision use (housing, offices, shops, public facilities, etc.) | D/N |
| Mobility | Urban form | Intensity | Surface occupied by pedestrian and bicycle paths | D/N |
| | | | Surface occupied by the road network | City/D |
| | | | Proportion of the road network dedicated to public transport | D |
| | | Connectivity | Connectivity of the pedestrian/bike grid | D/N |
| | | | Connectivity of the car grid | D |
| | | | Cyclomatic complexity of the car grid | D |
| | | | Cyclomatic complexity of the pedestrian/bike grid | N |
| | | | Average distance between intersections (bike/pedestrian grid) | D/N |
| | | | Average distance between intersections (car grid) | D |
| | | Proximity | Percentage of the population more than 300 m away from a public transport stop | City/D |
| | | Diversity | Number of public transport modes accessible within of 300 m | D |
| | | Complexity | Scale hierarchy of the street network | City/D |
| Water | Environmental | Intensity | Hydrological intensity | D |
| | | | Impermeability of land | D |
| | | | Intensity of water treatment: rate of wastewater collection and treatment | City/D |
| | | | Efficiency of water use | City |
| | | | Accessibility of drinking water | City/D |
| Biodiversity | Environmental/ urban form | Intensity | Proportion of agricultural surfaces | City/D |
| | | | Proportion of green fabric | D |
| | | Connectivity | Connectivity of green habitats | D |
| | | Distribution | Distribution of green spaces (distance from an even distribution) | City/D |
| Equity | Socio-economic | Intensity | Proportion of jobs in relation to housing | D/N |
| | | | Proportion of social housing | D/N |
| | | Diversity | Diversity of ages (structural distribution) | D/N/bl |
| | | | Diversity of incomes (structural diversity) | D/N/bl |

Source: Bourdic, L., Salat, S., & Nowacki, C. (2012)

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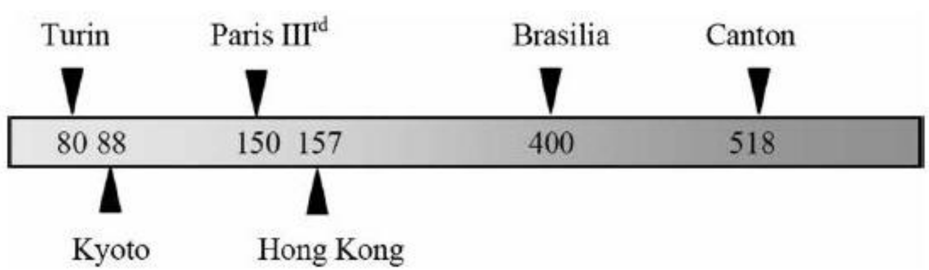
| | | | Average distance between intersections (bike/pedestrian grid) | D/N |
| | | | Average distance between intersections (car grid) | D |
| | | Proximity | Percentage of the population more than 300 m away from a public transport stop | City/D |

Algorithms return a number as result for each indicator:



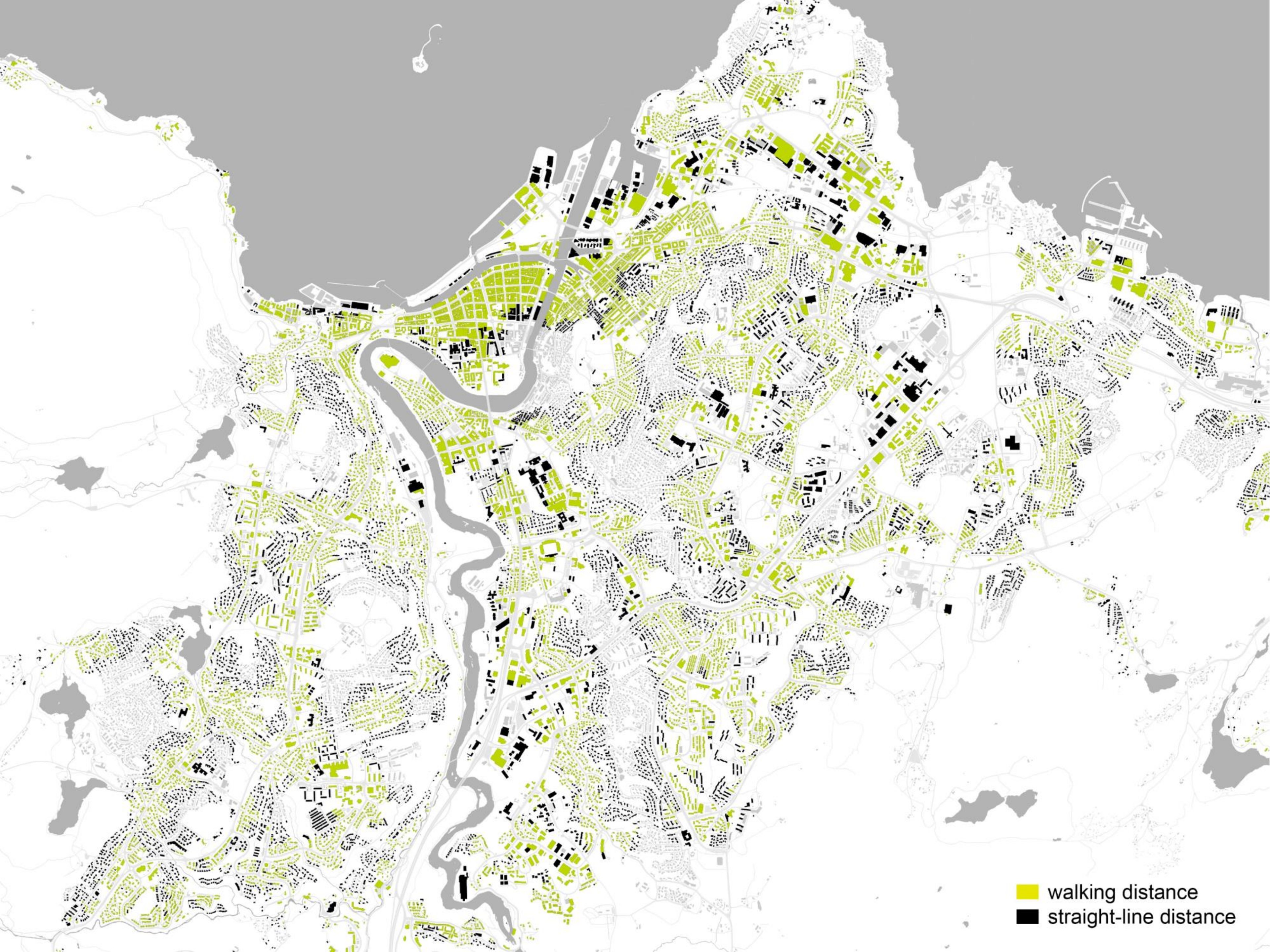

Example: Average distance (m) between intersections for several cities

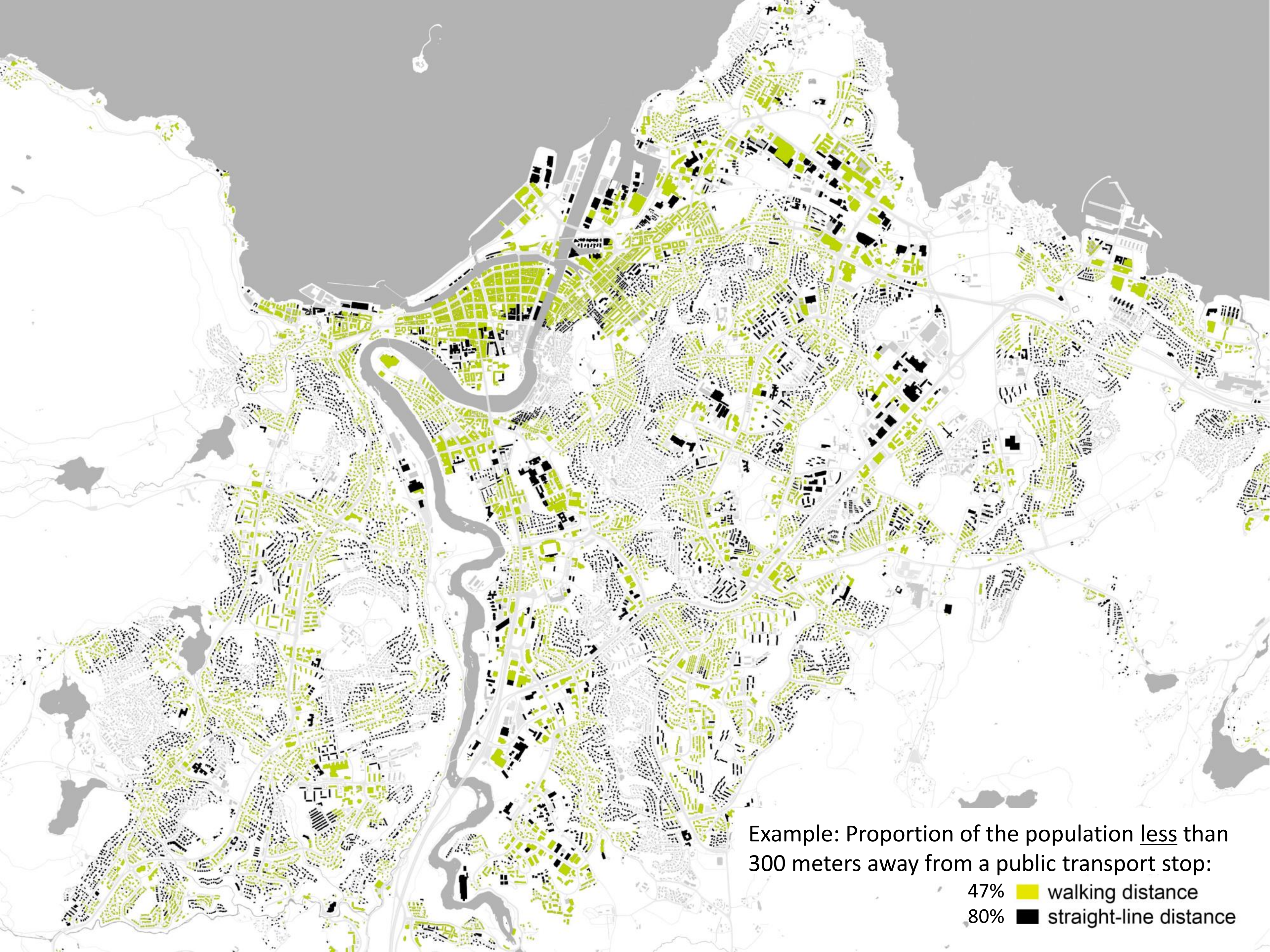
Source: Bourdic, L., Salat, S., & Nowacki, C. (2012)

# GIS-BASED PROXIMITY MEASURES

| Theme | UMI indicator | GIS-based proximity measure |
|---|---|---|
| Land Use | Human density | Residents and employees within a certain walking distance (typically 1 km) |
| Mobility | Proportion of the population more than 300 meters away from a public transport stop | Walking distance to public transport stop. Share of the population within specific walking distances can be extracted from the GIS model |
| Biodiversity | Proportion of green fabric | Share of green fabric of total area within a certain straight-line distance |
| Biodiversity | Distribution of green spaces | Walking distance to green space |
| Economy | % of residents living less than X from a convenience store | Walking distance to convenience store. Share of the population within specific walking distances can be extracted from the GIS model |
| Culture/Wellbeing | Proximity of leisure facilities | Walking distance to leisure facilities. Share of the population within specific walking distances can be extracted from the GIS model |

Adapted from Bourdic, L., Salat, S., & Nowacki, C. (2012)


walking distance
straight-line distance


Example: Proportion of the population less than 300 meters away from a public transport stop:
47% walking distance
80% straight-line distance

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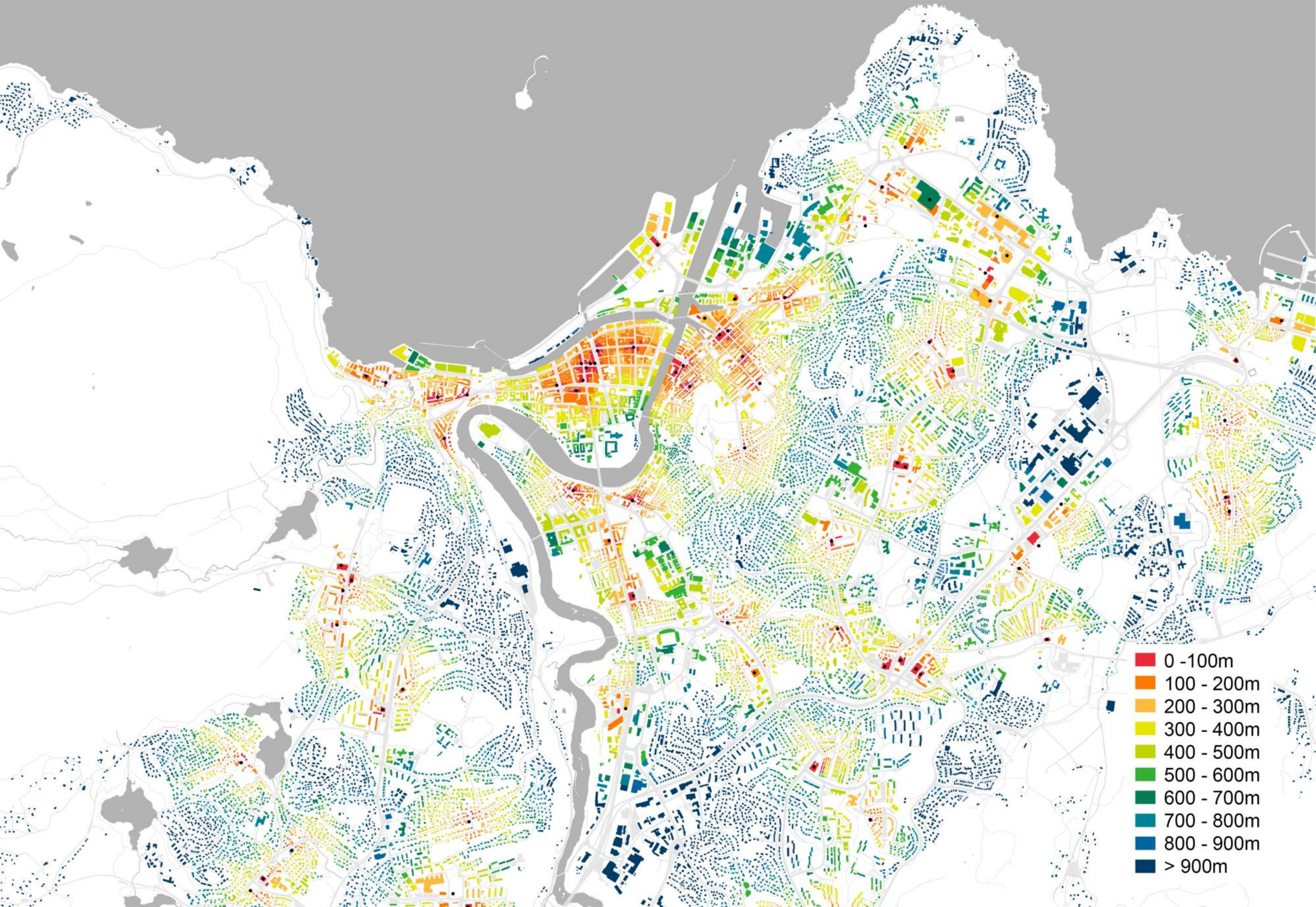
Adapted from Bourdic, L., Salat, S., & Nowacki, C. (2012)

# METHOD

Mapping in QGIS
Disaggregation of population data to building level
Analyses run in Place Syntax Tool (MapInfo/QGIS plugin)

QGIS Development Team. (2019). *QGIS Geographic Information System*.
Ståhle, A. (2012). Place Syntax Tool (PST). In A. Hull, C. Silva, & L. Bertolini (Eds.) *Accessibility Instruments for Planning Practice* (pp. 173-178).

# WALKING DISTANCE TO CONVENIENCE STORE



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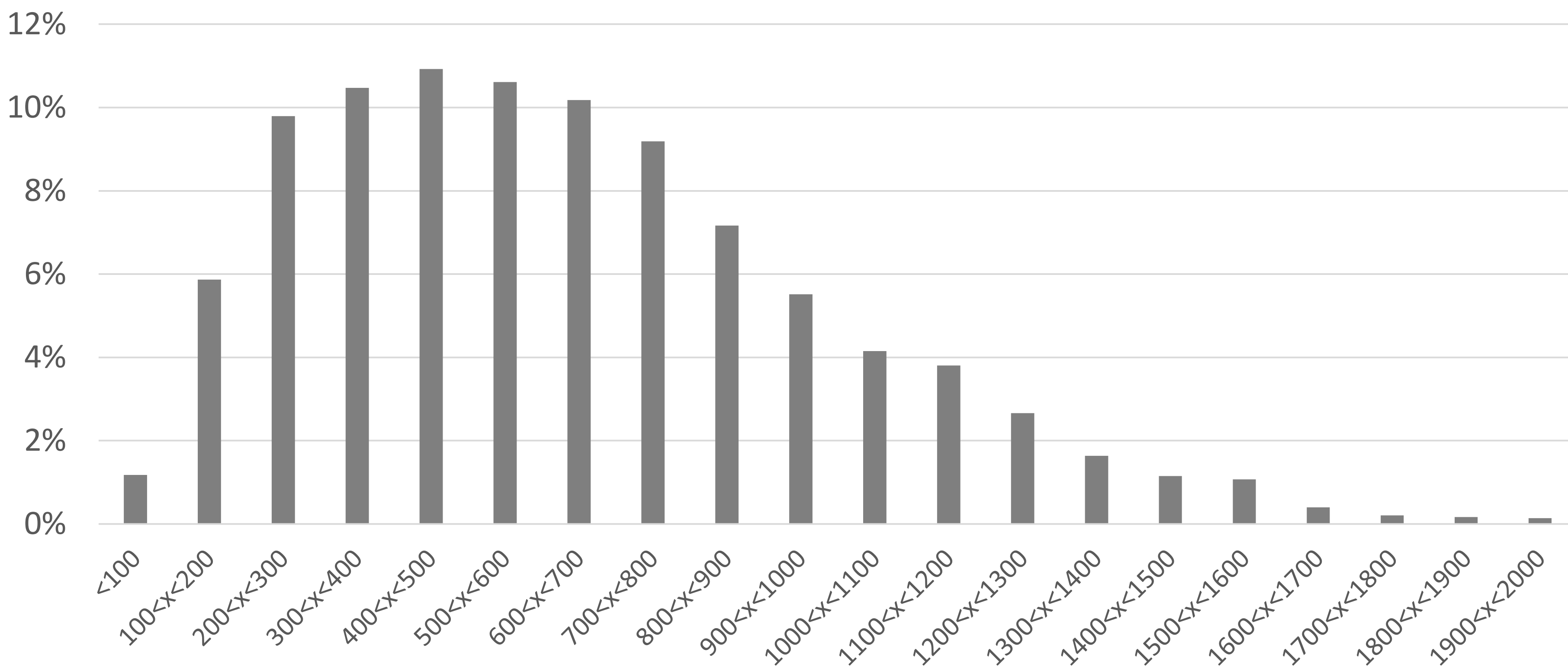
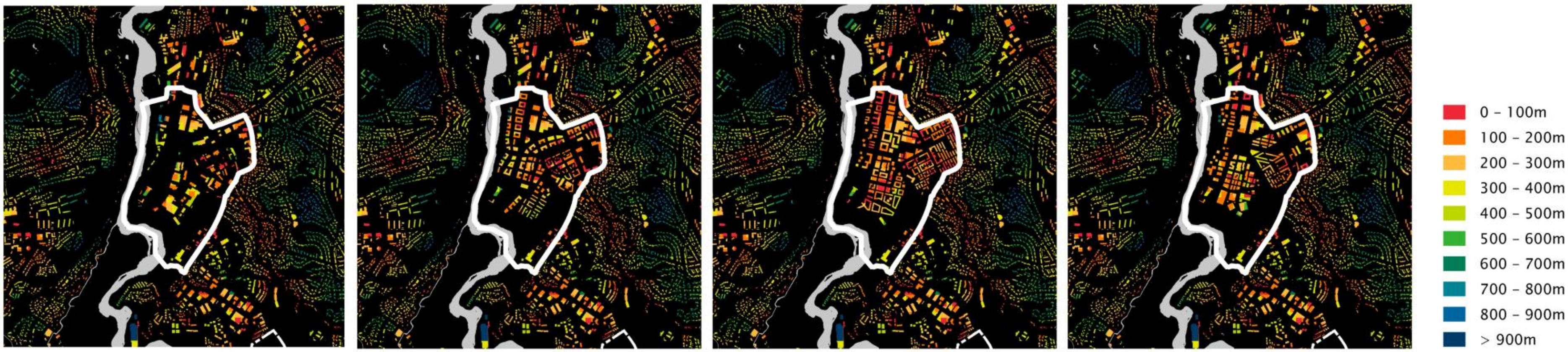



Share of the population within specific walking distances to convenience store

WALKING DISTANCE TO PUBLIC TRANSPORT STOP

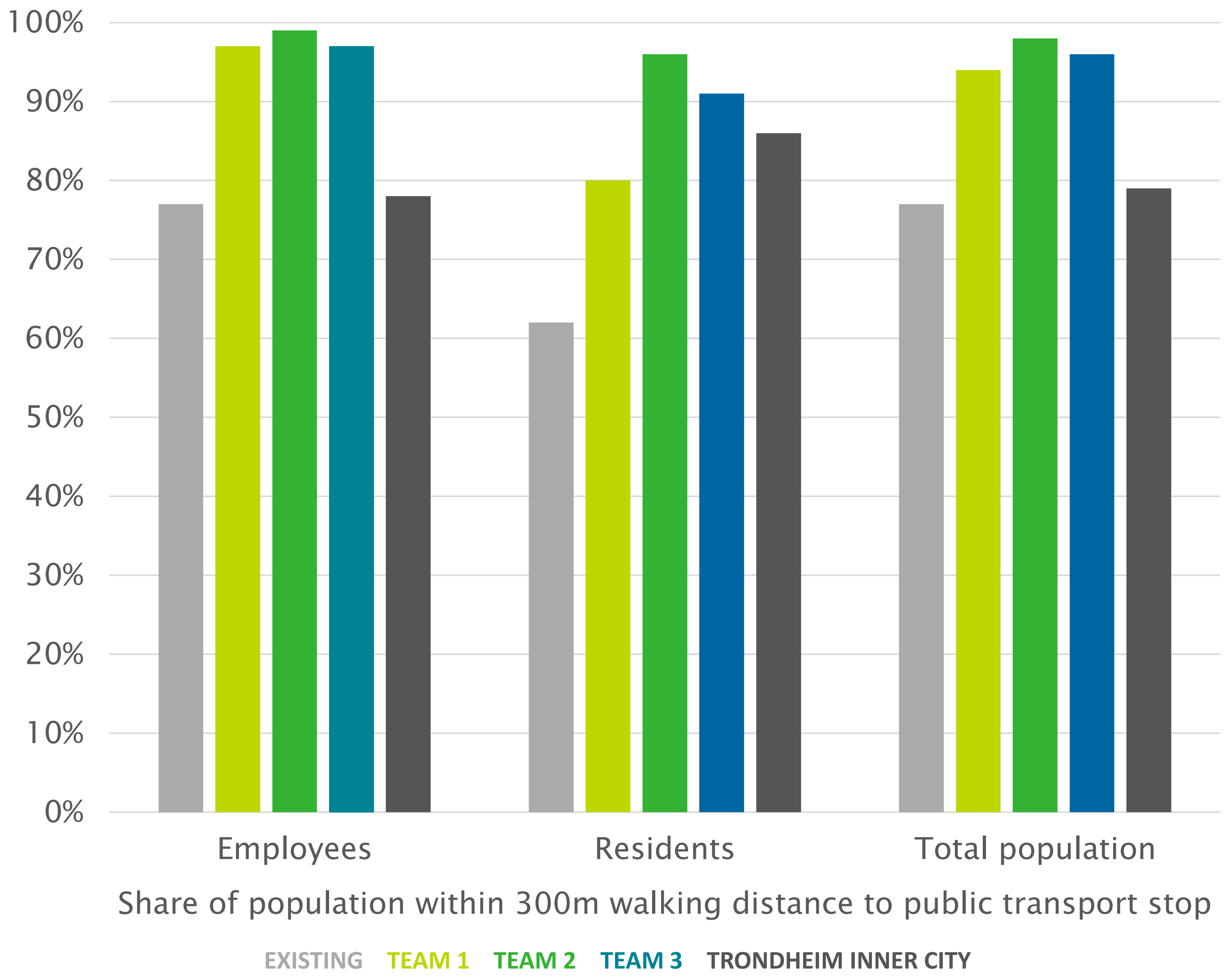



EXISTING SITUATION

TEAM 1

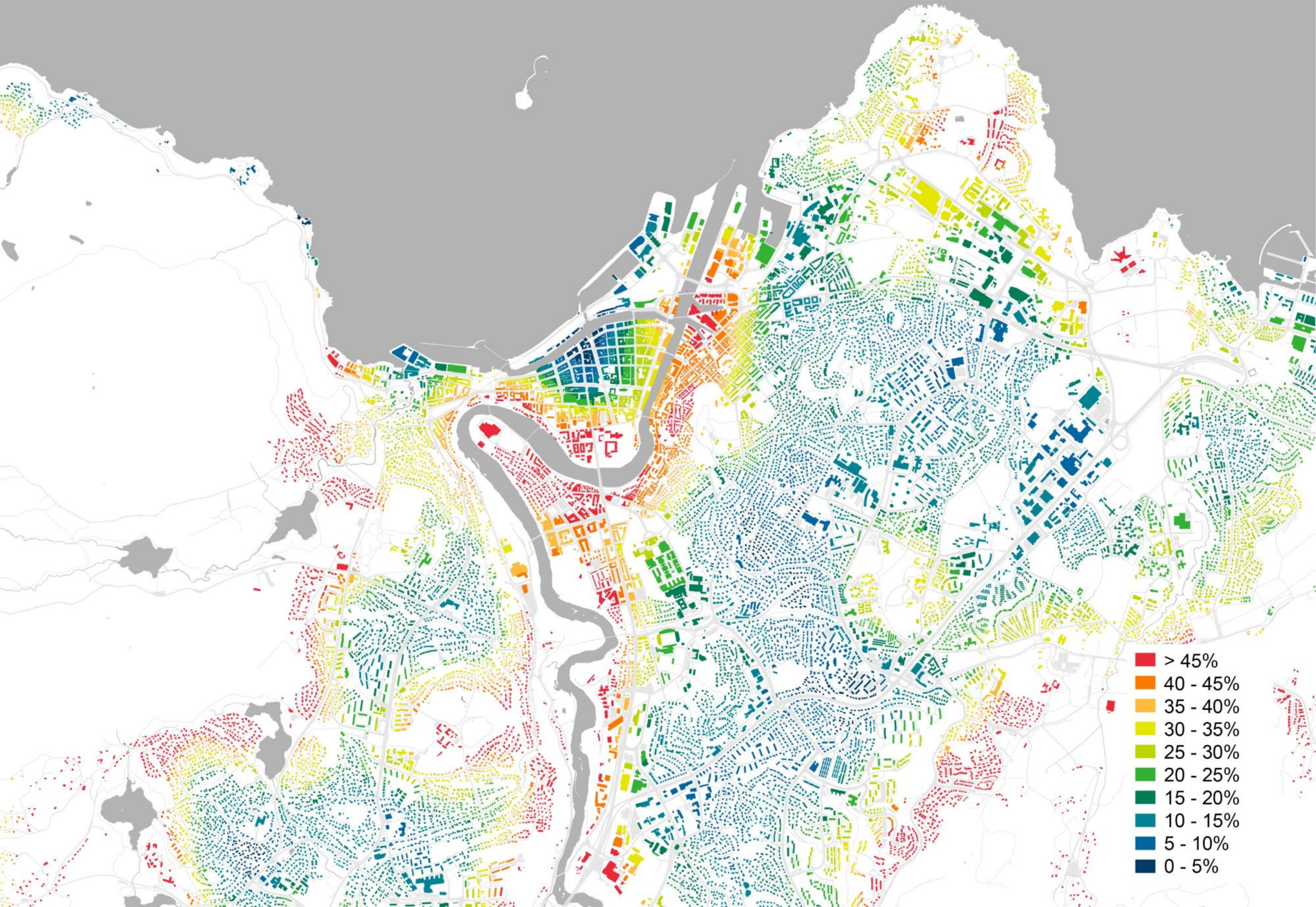
TEAM 2

TEAM 3



100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Employees
Residents
Total population
Share of population within 300m walking distance to public transport stop
EXISTING
TEAM 1
TEAM 2
TEAM 3
TRONDHEIM INNER CITY

# SHARE OF GREEN FABRIC OF TOTAL AREA WITHIN STRAIGHT-LINE DISTANCE



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- GISs methods currently being developed holds a potential to support assessment systems for urban sustainability in terms of providing informative thematic maps for visualizations in different scales.

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- The GIS model will also provide data in various scales and units, allowing for several alternatives of comparing data between cities or between planning options and for a richer ground for discussions about the meaning and importance of examined topics and indicators.

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- GISs methods currently being developed holds a potential to support assessment systems for urban sustainability in terms of providing informative thematic maps for visualizations in different scales.
- In addition, GIS-based methods can be implemented to further specify which measures to apply.
- The GIS model will also provide data in various scales and units, allowing for several alternatives of comparing data between cities or between planning options and for a richer ground for discussions about the meaning and importance of examined topics and indicators.
- The potential of applicability of urban assessment system in planning as well as design processes will increase when linked to tools that to some extent are already implemented.